



Administering the Switch

This chapter describes how to perform one-time operations to administer your switch. This chapter consists of these sections:

- [Preventing Unauthorized Access to Your Switch, page 6-1](#)
- [Protecting Access to Privileged EXEC Commands, page 6-2](#)
- [Controlling Switch Access with TACACS+, page 6-9](#)
- [Managing the System Time and Date, page 6-17](#)
- [Configuring a System Name and Prompt, page 6-32](#)
- [Creating a Banner, page 6-35](#)
- [Managing the MAC Address Table, page 6-37](#)
- [Optimizing System Resources for User-Selected Features, page 6-41](#)

Preventing Unauthorized Access to Your Switch

You can prevent unauthorized users from reconfiguring your switch and viewing configuration information. Typically, you want network administrators to have access to your switch while you restrict access to users who dial from outside the network through an asynchronous port, connect from outside the network through a serial port, or connect through a terminal or workstation from within the local network.

To prevent unauthorized access into your switch, you should configure one or more of these security features:

- At a minimum, you should configure passwords and privileges at each switch port. These passwords are locally stored on the switch. When users attempt to access the switch through a port or line, they must enter the password specified for the port or line before they can access the switch. For more information, see the [“Protecting Access to Privileged EXEC Commands” section on page 6-2](#).
- For an additional layer of security, you can also configure username and password pairs, which are locally stored on the switch. These pairs are assigned to lines or interfaces 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. For more information, see the [“Configuring Username and Password Pairs” section on page 6-6](#).
- If you want to use username and password pairs, but you want to store them centrally on a server instead of locally, you can store them in a database on a security server. Multiple networking devices can then use the same database to obtain user authentication (and, if necessary, authorization) information. For more information, see the [“Controlling Switch Access with TACACS+” section on page 6-9](#).

Protecting Access to Privileged EXEC Commands

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 issue after they have logged into a network device.

**Note**

For complete syntax and usage information for the commands used in this section, refer to the *Cisco IOS Security Command Reference for Release 12.1*.

This section describes how to control access to the configuration file and privileged EXEC commands. It contains this configuration information:

- [Default Password and Privilege Level Configuration, page 6-3](#)
- [Setting or Changing a Static Enable Password, page 6-3](#)
- [Protecting Enable and Enable Secret Passwords with Encryption, page 6-4](#)
- [Setting a Telnet Password for a Terminal Line, page 6-5](#)
- [Configuring Username and Password Pairs, page 6-6](#)
- [Configuring Multiple Privilege Levels, page 6-7](#)

Default Password and Privilege Level Configuration

Table 6-1 shows the default password and privilege level configuration.

Table 6-1 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.

Setting or Changing a Static Enable Password

The enable password controls access to the privileged EXEC mode. Beginning in privileged EXEC mode, follow these steps to set or change a static enable password:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	enable password <i>password</i>	Define a new password or change an existing password for access to privileged EXEC mode. By default, no password is defined. For <i>password</i> , 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 Ctrl-v when you create the password; for example, to create the password abc?123, do this: Enter abc . Enter Ctrl-v . 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 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file. The enable password is not encrypted and can be read in the switch configuration file.

To remove the password, use the **no enable password** global configuration command.

This example shows how to change the enable password to 11u2c3k4y5. The password is not encrypted and provides access to level 15 (traditional privileged EXEC mode access):

```
Switch(config)# enable password 11u2c3k4y5
```

Protecting Enable and Enable Secret Passwords with Encryption

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** 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.

Beginning in privileged EXEC mode, follow these steps to configure encryption for enable and enable secret passwords:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	enable password [level <i>level</i>] { <i>password</i> <i>encryption-type encrypted-password</i> } or enable secret [level <i>level</i>] { <i>password</i> <i>encryption-type encrypted-password</i> }	Define a new password or change an existing password for access to privileged EXEC mode. or Define a secret password, which is saved using a nonreversible encryption method. (Optional) For <i>level</i> , 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 <i>password</i> , 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 <i>encryption-type</i> , only type 5, a Cisco proprietary encryption algorithm, is available. If you specify an encryption type, you must provide an encrypted password—an encrypted password you copy from another Catalyst 3550 multilayer 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 3	service password-encryption	(Optional) Encrypt the password when the password is defined or when the current configuration is written. Encryption prevents the password from being readable in the configuration file.

	Command	Purpose
Step 4	end	Return to privileged EXEC mode.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

If both the enable and enable secret passwords are defined, users must enter the enable secret password.

Use the **level** keyword to define a password for a specific privilege level. After you specify the level and set a password, give the password only to users who need to have access at this level. Use the **privilege level** global configuration command to specify commands accessible at various levels. For more information, see the “[Configuring Multiple Privilege Levels](#)” section on page 6-7.

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.

To remove a password and level, use the **no enable password [level level]** or **no enable secret [level level]** global configuration command. To disable password encryption, use the **no service password-encryption** global configuration command.

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

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

Setting a Telnet Password for a Terminal Line

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 neglected to configure this password during the setup program, you can configure it now through the command-line interface (CLI).

Beginning in privileged EXEC mode, follow these steps to configure your switch for Telnet access:

	Command	Purpose
Step 1		Attach a PC or workstation with emulation software to the switch console 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.
Step 2	enable password <i>password</i>	Enter privileged EXEC mode.
Step 3	configure terminal	Enter global configuration mode.
Step 4	line vty 0 15	Configure the number of Telnet sessions (lines). There are 16 possible sessions on a command-capable switch. The 0 and 15 mean that you are configuring all 16 possible Telnet sessions.
Step 5	password <i>password</i>	Enter a Telnet password for the line or lines. For <i>password</i> , 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 6	end	Return to privileged EXEC mode.

	Command	Purpose
Step 7	show running-config	Verify your entries. The password is listed under the command line vty 0 15 .
Step 8	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To remove the password, use the **no password** global configuration command.

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

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

Configuring 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 interfaces 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.

Beginning in privileged EXEC mode, follow these steps to establish a username-based authentication system that requests a username and password during switch login operations:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	username name [privilege level] {password encryption-type password}	Enter the username, privilege level, and password for each user. For <i>name</i> , specify the user ID as one word. Spaces and quotation marks are not allowed. (Optional) For <i>level</i> , 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 <i>encryption-type</i> , enter 0 to specify that an unencrypted password will follow. Enter 7 to specify that a hidden password will follow. For <i>password</i> , specify the password the user must enter to gain access to the switch. 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 3	line console 0 or line vty 0 15	Enter line configuration mode, and configure the console port (line 0) or the VTY lines (line 0 to 15).
Step 4	login local	Enable local password checking at login time. Authentication is based on the username specified in Step 2.
Step 5	end	Return to privileged EXEC mode.
Step 6	show running-config	Verify your entries.
Step 7	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable username authentication for a specific user, use the **no username *name*** global configuration command. To disable password checking and allow connections without a password, use the **no login** line configuration command.

Configuring Multiple Privilege Levels

By default, the IOS software has two modes of password security: user EXEC and privileged EXEC. 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.

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.

This section includes this configuration information:

- [Setting the Privilege Level for a Command, page 6-7](#)
- [Changing the Default Privilege Level for Lines, page 6-8](#)
- [Logging into and Exiting a Privilege Level, page 6-9](#)

Setting the Privilege Level for a Command

Beginning in privileged EXEC mode, follow these steps to set the privilege level for a command mode:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	privilege mode level level command	Set the privilege level for a command. For <i>mode</i> , enter configure for global configuration mode, exec for EXEC mode, interface for interface configuration mode, or line for line configuration mode. For <i>level</i> , 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 <i>command</i> , specify the command to which you want to restrict access.
Step 3	enable password level level password	Specify the enable password for the privilege level. For <i>level</i> , the range is from 0 to 15. Level 1 is for normal user EXEC mode privileges. For <i>password</i> , 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 4	end	Return to privileged EXEC mode.
Step 5	show running-config or show privilege	Verify your entries. The first command displays the password and access level configuration. The second command displays the privilege level configuration.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

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 route** 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.

To return to the default privilege for a given command, use the **no privilege mode level level command** global configuration 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:

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

Changing the Default Privilege Level for Lines

Beginning in privileged EXEC mode, follow these steps to change the default privilege level for a line:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	line vty line	Select the virtual terminal line on which to restrict access.
Step 3	privilege level level	Change the default privilege level for the line. For <i>level</i> , 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 4	end	Return to privileged EXEC mode.
Step 5	show running-config or show privilege	Verify your entries. The first command displays the password and access level configuration. The second command displays the privilege level configuration.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

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.

To return to the default line privilege level, use the **no privilege level** line configuration command.

Logging into and Exiting a Privilege Level

Beginning in privileged EXEC mode, follow these steps to log in to a specified privilege level and to exit to a specified privilege level:

	Command	Purpose
Step 1	<code>enable level</code>	Log in to a specified privilege level. For <i>level</i> , the range is 0 to 15.
Step 2	<code>disable level</code>	Exit to a specified privilege level. For <i>level</i> , the range is 0 to 15.

Controlling Switch Access with TACACS+

This section describes how to enable and configure Terminal Access Controller Access Control System Plus (TACACS+), which provides detailed accounting information and flexible administrative control over authentication and authorization processes. TACACS+ is facilitated through (authentication, authorization, accounting (AAA)) and can be enabled only through AAA commands.



Note

For complete syntax and usage information for the commands used in this section, refer to the *Cisco IOS Security Command Reference for Release 12.1*.

This section contains this configuration information:

- [Understanding TACACS+, page 6-9](#)
- [TACACS+ Operation, page 6-11](#)
- [Configuring TACACS+, page 6-12](#)
- [Displaying the TACACS+ Configuration, page 6-17](#)

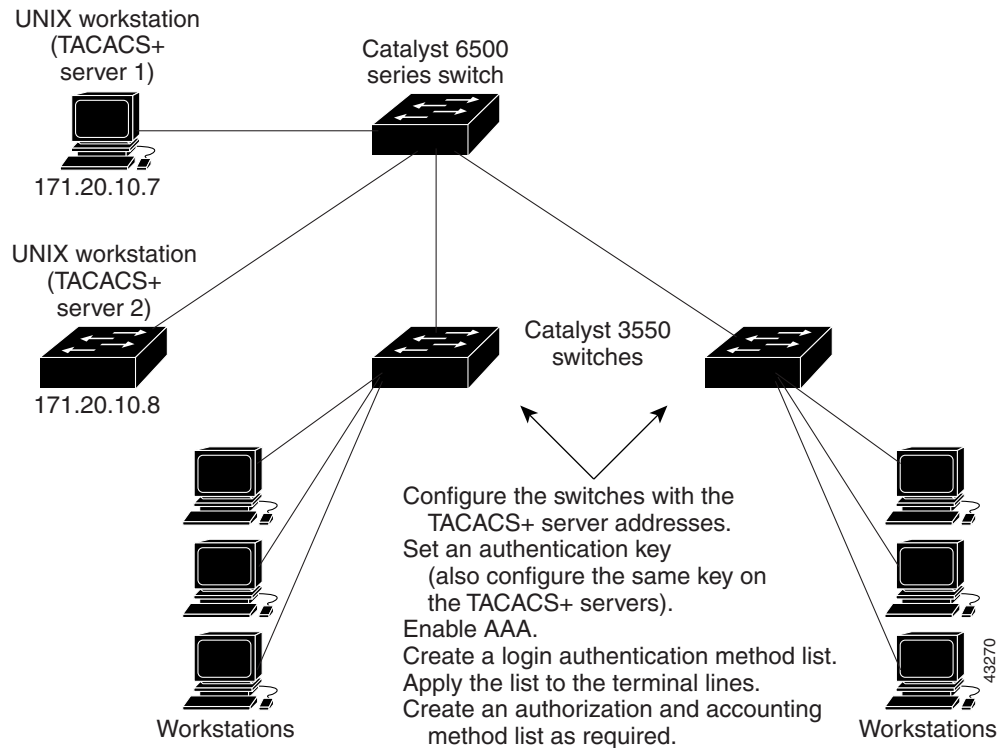
Understanding TACACS+

TACACS+ is a security application that provides centralized validation of users attempting to gain access to your switch. TACACS+ services are maintained in a database on a TACACS+ daemon typically running on a UNIX or Windows NT workstation. You should have access to and should configure a TACACS+ server before the configuring TACACS+ features on your switch.

TACACS+ provides for separate and modular authentication, authorization, and accounting facilities. TACACS+ allows for a single access control server (the TACACS+ daemon) to provide each service—authentication, authorization, and accounting—independently. Each service can be tied into its own database to take advantage of other services available on that server or on the network, depending on the capabilities of the daemon.

The goal of TACACS+ is to provide a method for managing multiple network access points from a single management service. Your switch can be a network access server along with other Cisco routers and access servers. A network access server provides connections to a single user, to a network or subnetwork, and to interconnected networks as shown in Figure 6-1.

Figure 6-1 Typical TACACS+ Network Configuration



TACACS+, administered through the AAA security services, can provide these services:

- **Authentication**—Provides complete control of authentication through login and password dialog, challenge and response, and messaging support.

The authentication facility can conduct a dialog with the user (for example, after a username and password are provided, to challenge a user with a number of questions, such as home address, mother's maiden name, service type, and social security number). In addition, the TACACS+ authentication service can also send messages to user screens. For example, a message could notify users that their passwords must be changed because of the company's password aging policy.
- **Authorization**—Provides fine-grained control over user capabilities for the duration of the user's session, including but not limited to setting autocommands, access control, session duration, or protocol support. You can also enforce restrictions on what commands a user can execute with the TACACS+ authorization feature.
- **Accounting**—Collects and sends information used for billing, auditing, and reporting to the TACACS+ daemon. Network managers can use the accounting facility to track user activity for a security audit or to provide information for user billing. Accounting records include user identities, start and stop times, executed commands (such as PPP), number of packets, and number of bytes.

The TACACS+ protocol provides authentication between the switch and the TACACS+ daemon, and it ensures confidentiality because all protocol exchanges between the switch and the TACACS+ daemon are encrypted.

You need a system running the TACACS+ daemon software to use TACACS+ on your switch.

TACACS+ Operation

When a user attempts a simple ASCII login by authenticating to a switch using TACACS+, this process occurs:

1. When the connection is established, the switch contacts the TACACS+ daemon to obtain a username prompt, which is then displayed to the user. The user enters a username, and the switch then contacts the TACACS+ daemon to obtain a password prompt. The switch displays the password prompt to the user, the user enters a password, and the password is then sent to the TACACS+ daemon.

TACACS+ allows a conversation to be held between the daemon and the user until the daemon receives enough information to authenticate the user. The daemon prompts for a username and password combination, but can include other items, such as the user's mother's maiden name.

2. The switch eventually receives one of these responses from the TACACS+ daemon:
 - ACCEPT—The user is authenticated and service can begin. If the switch is configured to require authorization, authorization begins at this time.
 - REJECT—The user has failed to authenticate. The user can be denied further access or is prompted to retry the login sequence, depending on the TACACS+ daemon.
 - ERROR—An error occurred at some time during authentication with the daemon or in the network connection between the daemon and the switch. If an ERROR response is received, the switch typically tries to use an alternative method for authenticating the user.
 - CONTINUE—The user is prompted for additional authentication information.

Following authentication, the user undergoes an additional authorization phase if authorization has been enabled on the switch. Users must first successfully complete TACACS+ authentication before proceeding to TACACS+ authorization.

3. If TACACS+ authorization is required, the TACACS+ daemon is again contacted, and it returns an ACCEPT or REJECT authorization response. If an ACCEPT response is returned, the response contains data in the form of attributes that direct the EXEC or NETWORK session for that user, determining the services that the user can access:
 - Telnet, rlogin, or EXEC services
 - Connection parameters, including the host or client IP address, access list, and user timeouts

Configuring TACACS+

This section describes how to configure your switch to support TACACS+. At a minimum, you must identify the host or hosts maintaining the TACACS+ daemon and define the method lists for TACACS+ authentication. You can optionally define method lists for TACACS+ authorization and accounting. A method list defines the sequence and methods to be used to authenticate, to authorize, or to keep accounts on a user. You can use method lists to designate one or more security protocols to be used, thus ensuring a backup system if the initial method fails. The software uses the first method listed to authenticate, to authorize, or to keep accounts on users; if that method does not respond, the software selects the next method in the list. This process continues until there is successful communication with a listed method or the method list is exhausted.

This section contains this configuration information:

- [Default TACACS+ Configuration, page 6-12](#)
- [Identifying the TACACS+ Server Host and Setting the Authentication Key, page 6-13](#)
- [Configuring Login Authentication, page 6-13](#)
- [Configuring TACACS+ Authorization for EXEC Access and Network Services, page 6-15](#)
- [Starting TACACS+ Accounting, page 6-15](#)
- [Configuring the Switch for Local Authentication and Authorization, page 6-16](#)

Default TACACS+ Configuration

TACACS+ and AAA are disabled by default.

To prevent a lapse in security, you cannot configure TACACS+ through a network management application. When enabled, TACACS+ can authenticate users accessing the switch through the CLI.

**Note**

Although TACACS+ configuration is performed through the CLI, the TACACS+ server authenticates HTTP connections that have been configured with a privilege level of 15.

Identifying the TACACS+ Server Host and Setting the Authentication Key

You can configure the switch to use a single server or AAA server groups to group existing server hosts for authentication. You can group servers to select a subset of the configured server hosts and use them for a particular service. The server group is used with a global server-host list and contains the list of IP addresses of the selected server hosts.

Beginning in privileged EXEC mode, follow these steps to identify the IP host or host maintaining TACACS+ server and optionally set the encryption key:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	tacacs-server host <i>hostname</i> [port <i>integer</i>] [timeout <i>integer</i>] [key <i>string</i>]	Identify the IP host or hosts maintaining a TACACS+ server. Enter this command multiple times to create a list of preferred hosts. The software searches for hosts in the order in which you specify them. For <i>hostname</i> , specify the name or IP address of the host. (Optional) For port <i>integer</i> , specify a server port number. The default is port 49. The range is 1 to 65535. (Optional) For timeout <i>integer</i> , specify a time in seconds the switch waits for a response from the daemon before it times out and declares an error. The default is 5 seconds. The range is 1 to 1000 seconds. (Optional) For key <i>string</i> , specify the encryption key for encrypting and decrypting all traffic between the switch and the TACACS+ daemon. You must configure the same key on the TACACS+ daemon for encryption to be successful.
Step 3	aaa group server tacacs+ <i>group-name</i>	(Optional) Define the AAA server-group with a group name. This command puts the switch in a server group subconfiguration mode.
Step 4	server <i>ip-address</i>	(Optional) Associate a particular TACACS+ server with the defined server group. Repeat this step for each TACACS+ server in the AAA server group. Each server in the group must be previously defined in Step 2.
Step 5	end	Return to privileged EXEC mode.
Step 6	show tacacs	Verify your entries.
Step 7	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To remove the specified TACACS+ server name or address, use the **no tacacs-server host** *hostname* global configuration command. To remove a server group from the configuration list, use the **no aaa group server tacacs+** *group-name* global configuration command. To remove the IP address of a TACACS+ server, use the **no server ip-address** server group subconfiguration command.

Configuring Login Authentication

To configure AAA authentication, you define a named list of authentication methods and then apply that list to various interfaces. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific interface before any of the defined authentication methods are performed. The only exception is the default method list (which, by

coincidence, is named *default*). The default method list is automatically applied to all interfaces except those that have a named method list explicitly defined. A defined method list overrides the default method list.

A method list describes the sequence and authentication methods to be queried to authenticate a user. You can designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method listed to authenticate users; if that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—meaning that the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

Beginning in privileged EXEC mode, follow these steps to configure login authentication:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	aaa new-model	Enable AAA.
Step 3	aaa authentication login { default <i>list-name</i> } <i>method1</i> [<i>method2</i> ...]	<p>Create a login authentication method list.</p> <p>To create a default list that is used when a named list is <i>not</i> specified in the login authentication command, use the default keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all interfaces.</p> <p>For <i>list-name</i>, specify a character string to name the list you are creating.</p> <p>For <i>method1</i>..., specify the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails.</p> <p>Select one of these methods:</p> <p>line—Use the line password for authentication. You must define a line password before you can use this authentication method. Use the password <i>password</i> line configuration command.</p> <p>local—Use the local username database for authentication. You must enter username information into the database. Use the username <i>password</i> global configuration command.</p> <p>tacacs+—Uses TACACS+ authentication. You must configure the TACACS+ server before you can use this authentication method.</p>
Step 4	line [console tty vty] <i>line-number</i> [<i>ending-line-number</i>]	Enter line configuration mode, and configure the lines to which you want to apply the authentication list.
Step 5	login authentication { default <i>list-name</i> }	<p>Apply the authentication list to a line or set of lines.</p> <p>If you specify default, use the default list created with the aaa authentication login command.</p> <p>For <i>list-name</i>, specify the list created with the aaa authentication login command.</p>
Step 6	end	Return to privileged EXEC mode.
Step 7	show running-config	Verify your entries.
Step 8	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable AAA, use the **no aaa new-model** global configuration command. To disable AAA authentication, use the **no aaa authentication login {default | list-name} method1 [method2...]** global configuration command. To either disable TACACS+ authentication for logins or to return to the default value, use the **no login authentication {default | list-name}** line configuration command.

Configuring TACACS+ Authorization for EXEC Access and Network Services

AAA authorization limits the services available to a user. When AAA authorization is enabled, the switch uses information retrieved from the user's profile, which is located either in the local user database or on the security server, to configure the user's session. The user is granted access to a requested service only if the information in the user profile allows it.

You can use the **aaa authorization** command with the **tacacs+** keyword to set parameters that restrict a user's network access to privileged EXEC mode (EXEC access).

The **aaa authorization exec tacacs+ local** command sets these authorization parameters:

- Use TACACS+ for EXEC access authorization if authentication was performed by using TACACS+.
- Use the local database if authentication was not performed by using TACACS+.



Note

Authorization is bypassed for authenticated users who log in through the CLI even if authorization has been configured.

Beginning in privileged EXEC mode, follow these steps to specify TACACS+ authorization for EXEC access and network services:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	aaa authorization network tacacs+	Configure the switch for user TACACS+ authorization for all network-related service requests.
Step 3	aaa authorization exec tacacs+	Configure the switch for user TACACS+ authorization to determine if the user has EXEC access. The exec keyword might return user profile information (such as autocommand information).
Step 4	end	Return to privileged EXEC mode.
Step 5	show running-config	Verify your entries.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable authorization, use the **no aaa authorization {network | exec} method1** global configuration command.

Starting TACACS+ Accounting

The AAA accounting feature tracks the services that users are accessing as well as the amount of network resources they are consuming. When AAA accounting is enabled, the switch reports user activity to the TACACS+ security server in the form of accounting records. Each accounting record contains accounting attribute-value (AV) pairs and is stored on the security server. This data can then be analyzed for network management, client billing, or auditing.

Beginning in privileged EXEC mode, follow these steps to enable TACACS+ accounting for each Cisco IOS privilege level and for network services:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	aaa accounting network start-stop tacacs+	Enable TACACS+ accounting for all network-related service requests.
Step 3	aaa accounting exec start-stop tacacs+	Enable TACACS+ accounting to send a start-record accounting notice at the beginning of an EXEC process and a stop-record at the end.
Step 4	end	Return to privileged EXEC mode.
Step 5	show running-config	Verify your entries.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable accounting, use the **no aaa accounting {network | exec}{start-stop} method1...** global configuration command.

Configuring the Switch for Local Authentication and Authorization

You can configure AAA to operate without a server by setting the switch to implement AAA in local mode. The switch then handles authentication and authorization. No accounting is available in this configuration.

Beginning in privileged EXEC mode, follow these steps to configure the switch for local AAA:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	aaa new-model	Enable AAA.
Step 3	aaa authentication login default local	Set the login authentication to use the local username database. The default keyword applies the local user database authentication to all interfaces.
Step 4	aaa authorization exec local	Configure user AAA authorization to determine if the user is allowed to run an EXEC shell by checking the local database.
Step 5	aaa authorization network local	Configure user AAA authorization for all network-related service requests.

	Command	Purpose
Step 6	<code>username name [privilege level] {password encryption-type password}</code>	<p>Enter the local database, and establish a username-based authentication system.</p> <p>Repeat this command for each user.</p> <p>For <i>name</i>, specify the user ID as one word. Spaces and quotation marks are not allowed.</p> <p>(Optional) For <i>level</i>, specify the privilege level the user has after gaining access. The range is 0 to 15. Level 15 gives privileged EXEC mode access. Level 0 gives user EXEC mode access.</p> <p>For <i>encryption-type</i>, enter 0 to specify that an unencrypted password follows. Enter 7 to specify that a hidden password follows.</p> <p>For <i>password</i>, specify the password the user must enter to gain access to the switch. The password must be from 1 to 25 characters, can contain embedded spaces, and must be the last option specified in the username command.</p>
Step 7	<code>end</code>	Return to privileged EXEC mode.
Step 8	<code>show running-config</code>	Verify your entries.
Step 9	<code>copy running-config startup-config</code>	(Optional) Save your entries in the configuration file.

To disable AAA, use the **no aaa new-model** global configuration command. To disable authorization, use the **no aaa authorization {network | exec} method1** global configuration command.

Displaying the TACACS+ Configuration

To display TACACS+ server statistics, use the **show tacacs** privileged EXEC command.

Managing the System Time and Date

You can manage the system time and date on your switch using automatic, such as the Network Time Protocol (NTP), or manual configuration methods.



Note

For complete syntax and usage information for the commands used in this section, refer to the *Cisco IOS Configuration Fundamentals Command Reference for Release 12.1*.

This section contains this configuration information:

- [Understanding the System Clock, page 6-18](#)
- [Understanding Network Time Protocol, page 6-18](#)
- [Configuring NTP, page 6-20](#)
- [Configuring Time and Date Manually, page 6-27](#)

Understanding the System Clock

The heart of the time service is the system clock. This clock runs from the moment the system starts up and keeps track of the current date and time.

The system clock can then be set from these sources:

- Network Time Protocol
- Manual configuration

The system clock can provide time to these services:

- User **show** commands
- Logging and debugging messages

The system clock keeps track of time internally based on Universal Time Coordinated (UTC), also known as Greenwich Mean Time (GMT). You can configure information about the local time zone and summer time (daylight saving time) so that the time is correctly displayed for the local time zone.

The system clock keeps track of whether the time is *authoritative* or not (that is, whether it has been set by a time source considered to be authoritative). If it is not authoritative, the time is available only for display purposes and is not redistributed. For configuration information, see the “[Configuring Time and Date Manually](#)” section on page 6-27.

Understanding Network Time Protocol

The NTP is designed to time-synchronize a network of devices. NTP runs over User Datagram Protocol (UDP), which runs over IP. NTP is documented in RFC 1305.

An NTP network usually gets its time from an authoritative time source, such as a radio clock or an atomic clock attached to a time server. NTP then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two devices to within a millisecond of one another.

NTP uses the concept of a *stratum* to describe how many NTP hops away a device is from an authoritative time source. A stratum 1 time server has a radio or atomic clock directly attached, a stratum 2 time server receives its time through NTP from a stratum 1 time server, and so on. A device running NTP automatically chooses as its time source the device with the lowest stratum number with which it communicates through NTP. This strategy effectively builds a self-organizing tree of NTP speakers.

NTP avoids synchronizing to a device whose time might not be accurate by never synchronizing to a device that is not synchronized. NTP also compares the time reported by several devices and does not synchronize to a device whose time is significantly different than the others, even if its stratum is lower.

The communications between devices running NTP (known as *associations*) are usually statically configured; each device is given the IP address of all devices with which it should form associations. Accurate timekeeping is possible by exchanging NTP messages between each pair of devices with an association. However, in a LAN environment, NTP can be configured to use IP broadcast messages instead. This alternative reduces configuration complexity because each device can simply be configured to send or receive broadcast messages. However, in that case, information flow is one-way only.

The time kept on a device is a critical resource; you should use the security features of NTP to avoid the accidental or malicious setting of an incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

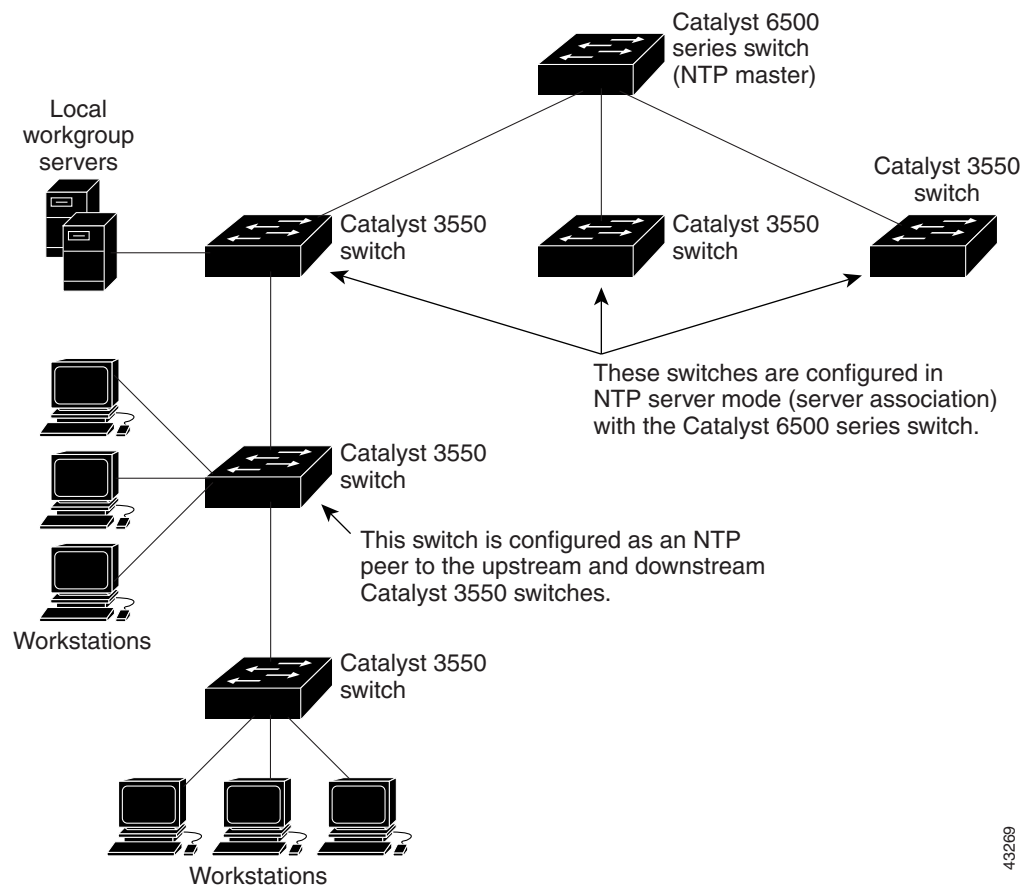
Cisco's implementation of NTP does not support stratum 1 service; it is not possible to connect to a radio or atomic clock. We recommend that the time service for your network be derived from the public NTP servers available on the IP Internet. Figure 6-2 show a typical network example using NTP.

If the network is isolated from the Internet, Cisco's implementation of NTP allows a device to act as though it is synchronized through NTP, when in fact it has determined the time by using other means. Other devices then synchronize to that device through NTP.

When multiple sources of time are available, NTP is always considered to be more authoritative. NTP time overrides the time set by any other method.

A number of manufacturers include NTP software for their host systems, and a publicly available version for systems running UNIX and its various derivatives is also available. This software allows host systems to be time-synchronized as well.

Figure 6-2 Typical NTP Network Configuration



43269

Configuring NTP

The Catalyst 3550 switches do not have a hardware-supported clock, and they cannot function as an NTP master clock to which peers synchronize themselves when an external NTP source is not available. These switches also have no hardware support for a calendar. As a result, the **ntp update-calendar** and the **ntp master** global configuration commands are not available.

This section contains this configuration information:

- [Default NTP Configuration, page 6-20](#)
- [Configuring NTP Authentication, page 6-21](#)
- [Configuring NTP Associations, page 6-22](#)
- [Configuring NTP Broadcast Service, page 6-23](#)
- [Configuring NTP Access Restrictions, page 6-24](#)
- [Configuring the Source IP Address for NTP Packets, page 6-27](#)
- [Displaying the NTP Configuration, page 6-27](#)

Default NTP Configuration

[Table 6-2](#) shows the default NTP configuration.

Table 6-2 *Default NTP Configuration*

Feature	Default Setting
NTP authentication	Disabled. No authentication key is specified.
NTP peer or server associations	None configured.
NTP broadcast service	Disabled; no interface sends or receives NTP broadcast packets.
NTP access restrictions	No access control is specified.
NTP packet source IP address	The source address is determined by the outgoing interface.

NTP is enabled on all interfaces by default. All interfaces receive NTP packets.

Configuring NTP Authentication

This procedure must be coordinated with the administrator of the NTP server; the information you configure in this procedure must be matched by the servers used by the switch to synchronize its time to the NTP server.

Beginning in privileged EXEC mode, follow these steps to authenticate the associations (communications between devices running NTP that provide for accurate timekeeping) with other devices for security purposes:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ntp authenticate	Enable the NTP authentication feature, which is disabled by default.
Step 3	ntp authentication-key <i>number</i> md5 <i>value</i>	Define the authentication keys. By default, none are defined. For <i>number</i> , specify a key number. The range is 1 to 4294967295. md5 specifies that message authentication support is provided by using the message digest algorithm 5 (MD5). For <i>value</i> , enter an arbitrary string of up to eight characters for the key. The switch does not synchronize to a device unless both have one of these authentication keys, and the key number is specified by the ntp trusted-key <i>key-number</i> command.
Step 4	ntp trusted-key <i>key-number</i>	Specify one or more key numbers (defined in Step 3) that a peer NTP device must provide in its NTP packets for this switch to synchronize to it. By default, no trusted keys are defined. For <i>key-number</i> , specify the key defined in Step 3. This command provides protection against accidentally synchronizing the switch to a device that is not trusted.
Step 5	end	Return to privileged EXEC mode.
Step 6	show running-config	Verify your entries.
Step 7	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable NTP authentication, use the **no ntp authenticate** global configuration command. To remove an authentication key, use the **no ntp authentication-key *number*** global configuration command. To disable authentication of the identity of a device, use the **no ntp trusted-key *key-number*** global configuration command.

This example shows how to configure the switch to synchronize only to devices providing authentication key 42 in the device's NTP packets:

```
Switch(config)# ntp authenticate
Switch(config)# ntp authentication-key 42 md5 aNiceKey
Switch(config)# ntp trusted-key 42
```

Configuring NTP Associations

An NTP association can be a peer association (this switch can either synchronize to the other device or allow the other device to synchronize to it), or it can be a server association (meaning that only this switch synchronizes to the other device, and not the other way around).

Beginning in privileged EXEC mode, follow these steps to form an NTP association with another device:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ntp peer <i>ip-address</i> [version <i>number</i>] [key <i>keyid</i>] [source <i>interface</i>] [prefer]	Configure the switch system clock to synchronize a peer or to be synchronized by a peer (peer association).
	or	or
	ntp server <i>ip-address</i> [version <i>number</i>] [key <i>keyid</i>] [source <i>interface</i>] [prefer]	Configure the switch system clock to be synchronized by a time server (server association).
		No peer or server associations are defined by default.
		For <i>ip-address</i> in a peer association, specify either the IP address of the peer providing, or being provided, the clock synchronization. For a server association, specify the IP address of the time server providing the clock synchronization.
		(Optional) For <i>number</i> , specify the NTP version number. The range is 1 to 3. By default, version 3 is selected.
		(Optional) For <i>keyid</i> , enter the authentication key defined with the ntp authentication-key global configuration command.
		(Optional) For <i>interface</i> , specify the interface from which to pick the IP source address. By default, the source IP address is taken from the outgoing interface.
		(Optional) Enter the prefer keyword to make this peer or server the preferred one that provides synchronization. This keyword reduces switching back and forth between peers and servers.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

You only need to configure one end of an association; the other device can automatically establish the association. If you are using the default NTP version (version 3) and NTP synchronization does not occur, try using NTP version 2. Many NTP servers on the Internet run version 2.

To remove a peer or server association, use the **no ntp peer** *ip-address* or the **no ntp server** *ip-address* global configuration command.

This example shows how to configure the switch to synchronize its system clock with the clock of the peer at IP address 172.16.22.44 using NTP version 2:

```
Switch(config)# ntp server 172.16.22.44 version 2
```

Configuring NTP Broadcast Service

The communications between devices running NTP (known as *associations*) are usually statically configured; each device is given the IP addresses of all devices with which it should form associations. Accurate timekeeping is possible by exchanging NTP messages between each pair of devices with an association. However, in a LAN environment, NTP can be configured to use IP broadcast messages instead. This alternative reduces configuration complexity because each device can simply be configured to send or receive broadcast messages. However, the information flow is one-way only.

The switch can send or receive NTP broadcast packets on an interface-by-interface basis if there is an NTP broadcast server, such as a router, broadcasting time information on the network. The switch can send NTP broadcast packets to a peer so that the peer can synchronize to it. The switch can also receive NTP broadcast packets to synchronize its own clock. This section provides procedures for both sending and receiving NTP broadcast packets.

Beginning in privileged EXEC mode, follow these steps to configure the switch to send NTP broadcast packets to peers so that they can synchronize their clock to the switch:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	interface <i>interface-id</i>	Enter interface configuration mode, and specify the interface to send NTP broadcast packets.
Step 3	ntp broadcast [<i>version number</i>] [<i>key keyid</i>] [<i>destination-address</i>]	Enable the interface to send NTP broadcast packets to a peer. By default, this feature is disabled on all interfaces. (Optional) For <i>number</i> , specify the NTP version number. The range is 1 to 3. If you do not specify a version, version 3 is used. (Optional) For <i>keyid</i> , specify the authentication key to use when sending packets to the peer. (Optional) For <i>destination-address</i> , specify the IP address of the peer that is synchronizing its clock to this switch.
Step 4	end	Return to privileged EXEC mode.
Step 5	show running-config	Verify your entries.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.
Step 7		Configure the connected peers to receive NTP broadcast packets as described in the next procedure.

To disable the interface from sending NTP broadcast packets, use the **no ntp broadcast** interface configuration command.

This example shows how to configure an interface to send NTP version 2 packets:

```
Switch(config)# interface gigabitethernet0/1
Switch(config-if)# ntp broadcast version 2
```

Beginning in privileged EXEC mode, follow these steps to configure the switch to receive NTP broadcast packets from connected peers:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	interface <i>interface-id</i>	Enter interface configuration mode, and specify the interface to receive NTP broadcast packets.
Step 3	ntp broadcast client	Enable the interface to receive NTP broadcast packets. By default, no interfaces receive NTP broadcast packets.
Step 4	exit	Return to global configuration mode.
Step 5	ntp broadcastdelay <i>microseconds</i>	(Optional) Change the estimated round-trip delay between the switch and the NTP broadcast server. The default is 3000 microseconds; the range is 1 to 999999.
Step 6	end	Return to privileged EXEC mode.
Step 7	show running-config	Verify your entries.
Step 8	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To disable an interface from receiving NTP broadcast packets, use the **no ntp broadcast client** interface configuration command. To change the estimated round-trip delay to the default, use the **no ntp broadcastdelay** global configuration command.

This example shows how to configure an interface to receive NTP broadcast packets:

```
Switch(config)# interface gigabitethernet0/1
Switch(config-if)# ntp broadcast client
```

Configuring NTP Access Restrictions

You can control NTP access on two levels as described in these sections:

- [Creating an Access Group and Assigning a Basic IP Access List, page 6-25](#)
- [Disabling NTP Services on a Specific Interface, page 6-26](#)

Creating an Access Group and Assigning a Basic IP Access List

Beginning in privileged EXEC mode, follow these steps to control access to NTP services by using access lists:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ntp access-group { query-only serve-only serve peer } <i>access-list-number</i>	Create an access group, and apply a basic IP access list. The keywords have these meanings: query-only : Allows only NTP control queries. serve-only : Allows only time requests. serve : Allows time requests and NTP control queries, but does not allow the switch to synchronize to the remote device. peer : Allows time requests and NTP control queries and allows the switch to synchronize to the remote device. For <i>access-list-number</i> , enter a standard IP access list number from 1 to 99.
Step 3	access-list <i>access-list-number</i> permit <i>source</i> [<i>source-wildcard</i>]	Create the access list. For <i>access-list-number</i> , enter the number specified in Step 2. Enter the permit keyword to permit access if the conditions are matched. For <i>source</i> , enter the IP address of the device that is permitted access to the switch. (Optional) For <i>source-wildcard</i> , enter the wildcard bits to be applied to the source. Note When creating an access list, remember that, by default, the end of the access list contains an implicit deny statement for everything if it did not find a match before reaching the end.
Step 4	end	Return to privileged EXEC mode.
Step 5	show running-config	Verify your entries.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

The access group keywords are scanned in this order, from least restrictive to most restrictive:

1. **peer**—Allows time requests and NTP control queries and allows the switch to synchronize itself to a device whose address passes the access list criteria.
2. **serve**—Allows time requests and NTP control queries, but does not allow the switch to synchronize itself to a device whose address passes the access list criteria.
3. **serve-only**—Allows only time requests from a device whose address passes the access list criteria.
4. **query-only**—Allows only NTP control queries from a device whose address passes the access list criteria.

If the source IP address matches the access lists for more than one access type, the first type is granted. If no access groups are specified, all access types are granted to all devices. If any access groups are specified, only the specified access types are granted.

To remove access control to the switch NTP services, use the **no ntp access-group {query-only | serve-only | serve | peer}** global configuration command.

This example shows how to configure the switch to allow itself to synchronize to a peer from access list 99. However, the switch restricts access to allow only time requests from access list 42:

```
Switch# configure terminal
Switch(config)# ntp access-group peer 99
Switch(config)# ntp access-group serve-only 42
Switch(config)# access-list 99 permit 172.20.130.5
Switch(config)# access list 42 permit 172.20.130.6
```

Disabling NTP Services on a Specific Interface

NTP services are enabled on all interfaces by default.

Beginning in privileged EXEC mode, follow these steps to disable NTP packets from being received on an interface:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	interface <i>interface-id</i>	Enter interface configuration mode, and specify the interface to disable.
Step 3	ntp disable	Disable NTP packets from being received on the interface. By default, all interfaces receive NTP packets.
Step 4	end	Return to privileged EXEC mode.
Step 5	show running-config	Verify your entries.
Step 6	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To re-enable receipt of NTP packets on an interface, use the **no ntp disable** interface configuration command.

Configuring the Source IP Address for NTP Packets

When the switch sends an NTP packet, the source IP address is normally set to the address of the interface through which the NTP packet is sent. Use the **ntp source** global configuration command when you want to use a particular source IP address for all NTP packets. The address is taken from the specified interface. This command is useful if the address on an interface cannot be used as the destination for reply packets.

Beginning in privileged EXEC mode, follow these steps to configure a specific interface from which the IP source address is to be taken:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ntp source <i>type number</i>	Specify the interface type and number from which the IP source address is taken. By default, the source address is determined by the outgoing interface.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

The specified interface is used for the source address for all packets sent to all destinations. If a source address is to be used for a specific association, use the **source** keyword in the **ntp peer** or **ntp server** global configuration command as described in the “[Configuring NTP Associations](#)” section on page 6-22.

Displaying the NTP Configuration

You can use two privileged EXEC commands to display NTP information:

- **show ntp associations [detail]**
- **show ntp status**

For detailed information about the fields in these displays, refer to the *Cisco IOS Configuration Fundamentals Command Reference for Release 12.1*.

Configuring Time and Date Manually

If no other source of time is available, you can manually configure the current time and date after the system is restarted. The time remains accurate until the next system restart. We recommend that you use manual configuration only as a last resort. If you have an outside source to which the switch can synchronize, you do not need to manually set the system clock.

This section contains this configuration information:

- [Setting the System Clock, page 6-28](#)
- [Displaying the Time and Date Configuration, page 6-28](#)
- [Configuring the Time Zone, page 6-29](#)
- [Configuring Summer Time \(Daylight Saving Time\), page 6-30](#)

Setting the System Clock

If you have an outside source on the network that provides time services, such as an NTP server, you do not need to manually set the system clock.

Beginning in privileged EXEC mode, follow these steps to set the system clock:

	Command	Purpose
Step 1	<code>clock set hh:mm:ss day month year</code> or <code>clock set hh:mm:ss month day year</code>	Manually set the system clock using one of these formats. For <i>hh:mm:ss</i> , specify the current time in hours (24-hour format), minutes, and seconds. The time specified is relative to the configured time zone. For <i>day</i> , specify the day by date in the month. For <i>month</i> , specify the month by name. For <i>year</i> , specify the year (no abbreviation).
Step 2	<code>show running-config</code>	Verify your entries.
Step 3	<code>copy running-config startup-config</code>	(Optional) Save your entries in the configuration file.

This example shows how to manually set the system clock to 1:32 p.m. on July 23, 2001:

```
Switch# clock set 13:32:00 23 July 2001
```

Displaying the Time and Date Configuration

To display the time and date configuration, use the **show clock [detail]** privileged EXEC command.

The system clock keeps an *authoritative* flag that shows whether the time is authoritative (believed to be accurate). If the system clock has been set by a timing source such as NTP, the flag is set. If the time is not authoritative, it is used only for display purposes. Until the clock is authoritative and the *authoritative* flag is set, the flag prevents peers from synchronizing to the clock when the peers' time is invalid.

The symbol that precedes the **show clock** display has this meaning:

- *—Time is not authoritative.
- (blank)—Time is authoritative.
- .—Time is authoritative, but NTP is not synchronized.

Configuring the Time Zone

Beginning in privileged EXEC mode, follow these steps to manually configure the time zone:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	clock timezone <i>zone hours-offset</i> [<i>minutes-offset</i>]	Set the time zone. The switch keeps internal time in universal time coordinated (UTC), so this command is used only for display purposes and when the time is manually set. For <i>zone</i> , enter the name of the time zone to be displayed when standard time is in effect. The default is UTC. For <i>hours-offset</i> , enter the hours offset from UTC. (Optional) For <i>minutes-offset</i> , enter the minutes offset from UTC.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

The *minutes-offset* variable in the **clock timezone** command is available for those cases where a local time zone is a percentage of an hour different from UTC. For example, the timezone for some sections of Atlantic Canada (AST) is UTC -3.5, where the 3 means 3 hours and .5 means 50 percent. In this case, the necessary command is **clock timezone AST -3 30**.

To set the time to UTC, use the **no clock timezone** command.

Configuring Summer Time (Daylight Saving Time)

Beginning in privileged EXEC mode, follow these steps to configure summer time (daylight saving time) in areas where it starts and ends on a particular day of the week each year:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	clock summer-time zone recurring [<i>week day month hh:mm week day month</i> <i>hh:mm [offset]</i>]	Configure summer time to start and end on the specified days every year. Summer time is disabled by default. If you specify clock summer-time zone recurring without parameters, the summer time rules default to the United States rules. For <i>zone</i> , specify the name of the time zone (for example, PDT) to be displayed when summer time is in effect. (Optional) For <i>week</i> , specify the week of the month (1 to 5 or last). (Optional) For <i>day</i> , specify the day of the week (Sunday, Monday...). (Optional) For <i>month</i> , specify the month (January, February...). (Optional) For <i>hh:mm</i> , specify the time (24-hour format) in hours and minutes. (Optional) For <i>offset</i> , specify the number of minutes to add during summer time. The default is 60.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

The first part of the **clock summer-time** command specifies when summer time begins, and the second part specifies when it ends. All times are relative to the local time zone. The start time is relative to standard time. The end time is relative to summer time. If the starting month is after the ending month, the system assumes that you are in the Southern Hemisphere.

This example shows how to specify that summer time starts on the first Sunday in April at 02:00 and ends on the last Sunday in October at 02:00:

```
Switch(config)# clock summer-time PDT recurring 1 Sunday April 2:00 last Sunday October 2:00
```

Beginning in privileged EXEC mode, follow these steps if summer time in your area does not follow a recurring pattern (configure the exact date and time of the next summer time events):

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	clock summer-time zone date [<i>month date year hh:mm month date year hh:mm [offset]</i>] or clock summer-time zone date [<i>date month year hh:mm date month year hh:mm [offset]</i>]	Configure summer time to start on the first date and end on the second date. Summer time is disabled by default. For <i>zone</i> , specify the name of the time zone (for example, PDT) to be displayed when summer time is in effect. (Optional) For <i>week</i> , specify the week of the month (1 to 5 or last). (Optional) For <i>day</i> , specify the day of the week (Sunday, Monday...). (Optional) For <i>month</i> , specify the month (January, February...). (Optional) For <i>hh:mm</i> , specify the time (24-hour format) in hours and minutes. (Optional) For <i>offset</i> , specify the number of minutes to add during summer time. The default is 60.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

The first part of the **clock summer-time** command specifies when summer time begins, and the second part specifies when it ends. All times are relative to the local time zone. The start time is relative to standard time. The end time is relative to summer time. If the starting month is after the ending month, the system assumes that you are in the Southern Hemisphere.

To disable summer time, use the **no clock summer-time** global configuration command.

This example shows how to set summer time to start on October 12, 2000, at 02:00 and end on April 26, 2001, at 02:00:

```
Switch(config)# clock summer-time pdt date 12 October 2000 2:00 26 April 2001 2:00
```

Configuring a System Name and Prompt

You configure the system name on the switch to identify it. By default, the system name and prompt are *Switch*.

If you have not configured a system prompt, the first 20 characters of the system name are used as the system prompt. A greater-than symbol [>] is appended. The prompt is updated whenever the system name changes, unless you manually configure the prompt by using the **prompt** global configuration command.



Note

For complete syntax and usage information for the commands used in this section, refer to the *Cisco IOS Configuration Fundamentals Command Reference* and the *Cisco IOS IP and IP Routing Command Reference for Release 12.1*.

This section contains this configuration information:

- [Default System Name and Prompt Configuration, page 6-32](#)
- [Configuring a System Name, page 6-32](#)
- [Configuring a System Prompt, page 6-33](#)
- [Understanding DNS, page 6-33](#)

Default System Name and Prompt Configuration

The default switch system name and prompt is *Switch*.

Configuring a System Name

Beginning in privileged EXEC mode, follow these steps to manually configure a system name:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	hostname name	Manually configure a system name. The default setting is <i>switch</i> . The name must follow the rules for ARPANET host names. They must start with a letter, end with a letter or digit, and have as interior characters only letters, digits, and hyphens. Names can be up to 63 characters.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

When you set the system name, it is also used as the system prompt. You can override the prompt setting by using the **prompt** global configuration command.

To return to the default hostname, use the **no hostname** global configuration command.

Configuring a System Prompt

Beginning in privileged EXEC mode, follow these steps to manually configure a system prompt:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	prompt <i>string</i>	Configure the command-line prompt to override the setting from the hostname command. The default prompt is either <i>switch</i> or the name defined with the hostname global configuration command, followed by an angle bracket (>) for user EXEC mode or a pound sign (#) for privileged EXEC mode. The prompt can consist of all printing characters and escape sequences.
Step 3	end	Return to privileged EXEC mode.
Step 4	show running-config	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To return to the default prompt, use the **no prompt [*string*]** global configuration command.

Understanding DNS

The DNS protocol controls the Domain Name System (DNS), a distributed database with which you can map host names to IP addresses. When you configure DNS on your switch, you can substitute the host name for the IP address with all IP commands, such as **ping**, **telnet**, **connect**, and related Telnet support operations.

IP defines a hierarchical naming scheme that allows a device to be identified by its location or domain. Domain names are pieced together with periods (.) as the delimiting characters. For example, Cisco Systems is a commercial organization that IP identifies by a *com* domain name, so its domain name is *cisco.com*. A specific device in this domain, for example, the File Transfer Protocol (FTP) system is identified as *ftp.cisco.com*.

To keep track of domain names, IP has defined the concept of a domain name server, which holds a cache (or database) of names mapped to IP addresses. To map domain names to IP addresses, you must first identify the host names, specify the name server that is present on your network, and enable the DNS.

This section contains this configuration information:

- [Default DNS Configuration, page 6-34](#)
- [Setting Up DNS, page 6-34](#)
- [Displaying the DNS Configuration, page 6-35](#)

Default DNS Configuration

Table 6-3 shows the default DNS configuration.

Table 6-3 Default DNS Configuration

Feature	Default Setting
DNS enable state	Enabled.
DNS default domain name	None configured.
DNS servers	No name server addresses are configured.

Setting Up DNS

Beginning in privileged EXEC mode, follow these steps to set up your switch to use the DNS:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	ip domain-name <i>name</i>	Define a default domain name that the software uses to complete unqualified host names (names without a dotted-decimal domain name). Do not include the initial period that separates an unqualified name from the domain name. At boot time, no domain name is configured; however, if the switch configuration comes from a BOOTP or Dynamic Host Configuration Protocol (DHCP) server, then the default domain name might be set by the BOOTP or DHCP server (if the servers were configured with this information).
Step 3	ip name-server <i>server-address1</i> [<i>server-address2</i> ... <i>server-address6</i>]	Specify the address of one or more name servers to use for name and address resolution. You can specify up to six name servers. Separate each server address with a space. The first server specified is the primary server. The switch sends DNS queries to the primary server first. If that query fails, the backup servers are queried.
Step 4	ip domain-lookup	(Optional) Enable DNS-based host name-to-address translation on your switch. This feature is enabled by default. If your network devices require connectivity with devices in networks for which you do not control name assignment, you can dynamically assign device names that uniquely identify your devices by using the global Internet naming scheme (DNS).
Step 5	end	Return to privileged EXEC mode.
Step 6	show running-config	Verify your entries.
Step 7	copy running-config startup-config	(Optional) Save your entries in the configuration file.

If you use the switch IP address as its hostname, the IP address is used and no DNS query occurs. If you configure a hostname that contains no periods (.), a period followed by the default domain name is appended to the hostname before the DNS query is made to map the name to an IP address. The default

domain name is the value set by the **ip domain-name** global configuration command. If there is a period (.) in the hostname, the IOS software looks up the IP address without appending any default domain name to the hostname.

To remove a domain name, use the **no ip domain-name** *name* global configuration command. To remove a name server address, use the **no ip name-server** *server-address* global configuration command. To disable DNS on the switch, use the **no ip domain-lookup** global configuration command.

Displaying the DNS Configuration

To display the DNS configuration information, use the **show running-config** privileged EXEC command.

Creating a Banner

You can configure a message-of-the-day (MOTD) and a login banner. The MOTD banner displays on all connected terminals at login and is useful for sending messages that affect all network users (such as impending system shutdowns).

The login banner also displays on all connected terminals. It is displayed after the MOTD banner and before the login prompts.



Note

For complete syntax and usage information for the commands used in this section, refer to the *Cisco IOS Configuration Fundamentals Command Reference for Release 12.1*.

This section contains this configuration information:

- [Default Banner Configuration, page 6-35](#)
- [Configuring a Message-of-the-Day Login Banner, page 6-36](#)
- [Configuring a Login Banner, page 6-37](#)

Default Banner Configuration

The MOTD and login banners are not configured.

Configuring a Message-of-the-Day Login Banner

You can create a single or multiline message banner that appears on the screen when someone logs in to the switch.

Beginning in privileged EXEC mode, follow these steps to configure a MOTD login banner:

	Command	Purpose
Step 1	<code>configure terminal</code>	Enter global configuration mode.
Step 2	<code>banner motd c message c</code>	Specify the message of the day. For <i>c</i> , enter the delimiting character of your choice, for example, a pound sign (#), and press the Return key. The delimiting character signifies the beginning and end of the banner text. Characters following the ending delimiter are discarded. For <i>message</i> , enter the banner message in 255 characters or less. You cannot use the delimiting character in the message.
Step 3	<code>end</code>	Return to privileged EXEC mode.
Step 4	<code>show running-config</code>	Verify your entries.
Step 5	<code>copy running-config startup-config</code>	(Optional) Save your entries in the configuration file.

To delete the MOTD banner, use the **no banner motd** global configuration command.

This example shows how to configure a MOTD banner for the switch using the pound sign (#) symbol as the beginning and ending delimiter:

```
Switch(config)# banner motd #
This is a secure site. Only authorized users are allowed.
For access, contact technical support.
#
Switch(config)#
```

This example shows the banner displayed from the previous configuration:

```
Unix> telnet 172.2.5.4
Trying 172.2.5.4...
Connected to 172.2.5.4.
Escape character is '^]'.

```

```
This is a secure site. Only authorized users are allowed.
For access, contact technical support.
```

```
User Access Verification
```

```
Password:
```

Configuring a Login Banner

You can configure a login banner to be displayed on all connected terminals. This banner is displayed after the MOTD banner and before the login prompt.

Beginning in privileged EXEC mode, follow these steps to configure a login banner:

	Command	Purpose
Step 1	<code>configure terminal</code>	Enter global configuration mode.
Step 2	<code>banner login c message c</code>	Specify the login message. For <i>c</i> , enter the delimiting character of your choice, for example, a pound sign (#), and press the Return key. The delimiting character signifies the beginning and end of the banner text. Characters following the ending delimiter are discarded. For <i>message</i> , enter the login message in 255 characters or less. You cannot use the delimiting character in the message.
Step 3	<code>end</code>	Return to privileged EXEC mode.
Step 4	<code>show running-config</code>	Verify your entries.
Step 5	<code>copy running-config startup-config</code>	(Optional) Save your entries in the configuration file.

To delete the login banner, use the **no banner login** global configuration command.

This example shows how to configure a login banner for the switch using the dollar sign (\$) symbol as the beginning and ending delimiter:

```
Switch(config)# banner login $
Access for authorized users only. Please enter your username and password.
$
Switch(config)#
```

Managing the MAC Address Table

The MAC address table contains address information that the switch uses to forward traffic between ports. All MAC addresses in the address table are associated with one or more ports. The address table includes these types of addresses:

- Dynamic address: a source MAC address that the switch learns and then ages when it is not in use.
- Static address: a manually entered unicast or multicast address that does not age and that is not lost when the switch resets.

The address table lists the destination MAC address, the associated VLAN ID, and port number associated with the address.



Note

For complete syntax and usage information for the commands used in this section, refer to the *Catalyst 3550 Multilayer Switch Command Reference* for this release.

This section contains this configuration information:

- [Building the Address Table, page 6-38](#)
- [MAC Addresses and VLANs, page 6-38](#)
- [Default MAC Address Table Configuration, page 6-39](#)
- [Changing the Address Aging Time, page 6-39](#)
- [Removing Dynamic Address Entries, page 6-40](#)
- [Adding and Removing Static Address Entries, page 6-40](#)
- [Displaying Address Table Entries, page 6-41](#)

Building the Address Table

With multiple MAC address supported on all ports, you can connect any port on the switch to individual workstations, repeaters, switches, routers, or other network devices. The switch provides dynamic addressing by learning the source address of packets it receives on each port and adding the address and its associated port number to the address table. As stations are added or removed from the network, the switch updates the address table, adding new dynamic addresses and aging out those that are currently not in use.

The aging interval is configured on a per-switch basis. However, the switch maintains an address table for each VLAN, and STP can accelerate the aging interval on a per-VLAN basis.

The switch sends packets between any combination of ports, based on the destination address of the received packet. Using the MAC address table, the switch forwards the packet only to the port or ports associated with the destination address. If the destination address is on the port that sent the packet, the packet is filtered and not forwarded. The switch always uses the store-and-forward method: complete packets are stored and checked for errors before transmission.

MAC Addresses and VLANs

All addresses are associated with a VLAN. An address can exist in more than one VLAN and have different destinations in each. Multicast addresses, for example, could be forwarded to port 1 in VLAN 1 and ports 9, 10, and 11 in VLAN 5.

Each VLAN maintains its own logical address table. A known address in one VLAN is unknown in another until it is learned or statically associated with a port in the other VLAN. Addresses that are statically entered in one VLAN must be configured as static addresses in all other VLANs or remain unlearned in the other VLANs.

Default MAC Address Table Configuration

Table 6-4 shows the default MAC address table configuration.

Table 6-4 Default MAC Address Table Configuration

Feature	Default Setting
Aging time	300 seconds
Dynamic addresses	Automatically learned
Static addresses	None configured

Changing the Address Aging Time

Dynamic addresses are source MAC addresses that the switch learns and then ages when they are not in use. You can change the aging time setting for all VLANs or for a specified VLAN.

Setting too short an aging time can cause addresses to be prematurely removed from the table. Then when the switch receives a packet for an unknown destination, it floods the packet to all ports in the same VLAN as the receiving port. This unnecessary flooding can impact performance. Setting too long an aging time can cause the address table to be filled with unused addresses, which prevents new addresses from being learned. Flooding results, which can impact switch performance.

Beginning in privileged EXEC mode, follow these steps to configure the dynamic address table aging time:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	mac-address-table aging-time [0 10-1000000] [vlan <i>vlan-id</i>]	Set the length of time that a dynamic entry remains in the MAC address table after the entry is used or updated. The range is 10 to 1000000 seconds. The default is 300. You can also enter 0, which disables aging. Static address entries are never aged or removed from the table. For <i>vlan-id</i> , valid IDs are 1 to 1005.
Step 3	end	Return to privileged EXEC mode.
Step 4	show mac-address-table aging-time	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To return to the default value, use the **no mac-address-table aging-time** global configuration command.

Removing Dynamic Address Entries

To remove all dynamic entries, use the **clear mac-address-table dynamic** command in privileged EXEC mode. You can also remove a specific MAC address (**clear mac-address-table dynamic address *mac-address***), remove all addresses on the specified physical port or port channel (**clear mac-address-table dynamic interface *interface-id***), or remove all addresses on a specified VLAN (**clear mac-address-table dynamic vlan *vlan-id***).

To verify that dynamic entries have been removed, use the **show mac-address-table dynamic** privileged EXEC command.

Adding and Removing Static Address Entries

A static address has these characteristics:

- It is manually entered in the address table and must be manually removed.
- It can be a unicast or multicast address.
- It does not age and is retained when the switch restarts.

You can add and remove static addresses and define the forwarding behavior for them. The forwarding behavior determines how a port that receives a packet forwards it to another port for transmission. Because all ports are associated with at least one VLAN, the switch acquires the VLAN ID for the address from the ports that you specify. You can specify a different list of destination ports for each source port.

A static address in one VLAN must be a static address in other VLANs. A packet with a static address that arrives on a VLAN where it has not been statically entered is flooded to all ports and not learned.

You add a static address to the address table by specifying the destination MAC address (unicast or multicast) and the VLAN from which it is received. Packets received with this destination address are forwarded to the interface specified with the *interface-id* option.

Beginning in privileged EXEC mode, follow these steps to add a static address:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	mac-address-table static <i>mac-addr</i> vlan <i>vlan-id</i> interface <i>interface-id</i> <i>interface-id</i>...	Add a static address to the MAC address table. For <i>mac-addr</i> , specify the destination MAC address (unicast or multicast) to add to the address table. Packets with this destination address received in the specified VLAN are forwarded to the specified interface. For <i>vlan-id</i> , specify the VLAN for which the packet with the specified MAC address is received. Valid VLAN IDs are 1 to 1005; do not enter leading zeroes. For <i>interface-id</i> ..., specify the interface to which the received packet is forwarded. Valid interfaces include physical ports and EtherChannel port-channels. Multiple interfaces can be specified for multicast addresses.
Step 3	end	Return to privileged EXEC mode.
Step 4	show mac-address-table static	Verify your entries.
Step 5	copy running-config startup-config	(Optional) Save your entries in the configuration file.

To remove static entries from the address table, use the **no mac-address-table static *mac-addr* vlan *vlan-id* interface *interface-id* *interface-id*...** global configuration command.

This example shows how to add the static address c2f3.220a.12f4 to the MAC address table. When a packet is received in VLAN 4 with this MAC address as its destination address, the packets is forwarded to the specified interfaces:

```
Switch(config)# mac-address-table static c2f3.220a.12f4 vlan 4 interface gi0/1 gi0/2
gi0/8
```

Displaying Address Table Entries

You can display the MAC address table by using one or more of the privileged EXEC commands described in [Table 6-5](#):

Table 6-5 Commands for Displaying the MAC Address Table

Command	Description
show mac-address-table address	Displays MAC address table information for the specified MAC address.
show mac-address-table aging-time	Displays the aging time in all VLANs or the specified VLAN.
show mac-address-table count	Displays the number of addresses present in all VLANs or the specified VLAN.
show mac-address-table dynamic	Displays dynamic MAC address table entries only.
show mac-address-table interface	Displays the MAC address table information for the specified interface.
show mac-address-table multicast	Displays the Layer 2 multicast entries for all VLANs or the specified VLAN.
show mac-address-table static	Displays static MAC address table entries only.
show mac-address-table vlan	Displays the MAC address table information for the specified VLAN.

Optimizing System Resources for User-Selected Features

You can configure memory resources in the switch to optimize support for specific features, depending on how the switch is used in your network, by using Switch Database Management (SDM) templates. You can select one of four templates to specify how system resources are allocated. You can then approximate the maximum number of unicast MAC addresses, IGMP groups, QoS ACLs, security ACLs, unicast routes, multicast routes, subnet VLANs (routed interfaces), and Layer 2 VLANs that can be configured on the switch.

The four templates prioritize system memory to optimize support for these types of features:

- QoS and security ACLs—The access template might typically be used in an access switch at the network edge where the route table sizes might not be substantial. Filtering and QoS might be more important because an access switch is the entry to the whole network.
- Routing—The routing template maximizes system resources for unicast routing, typically required for a router or aggregator in the center of a network.
- VLANs—The VLAN template disables routing and would typically be selected for a Catalyst 3550 used as a Layer 2 switch.
- Default—The default template gives balance to all functionalities (QoS, ACLs, unicast routing, multicast routing, VLANs and MAC addresses).

Table 6-6 lists the approximate number of each resource supported in each of the four templates. The first six rows in the table (unicast MAC addresses through multicast routes) represent approximate boundaries set in hardware when a template is selected. If a section of a hardware resource is used up, all processing overflow is sent to the CPU for processing, which would seriously impact switch performance.

The last two rows, the total number of routed ports and SVIs and the number of Layer 2 VLANs, are guidelines used to calculate hardware resource consumption related to the other resource parameters. If the number of subnet VLANs or active Layer 2 VLANs is greater than shown in Table 6-6, hardware resources might be used up before the limits shown here are reached. This would result in poor performance because overflows are always sent to the switch CPU.

Table 6-6 Approximate Number of Feature Resources Allowed by Each Template

Resource	Default Template	Access Template	Routing Template	VLAN Template
Unicast MAC addresses	6 K	2 K	6 K	12 K
IGMP groups (managed by Layer 2 multicast features such as MVR or IGMP snooping)	6 K	8 K	6 K	6 K
QoS classification ACLs	2 K	2 K	1 K	2 K
Security ACLs	2 K	4 K	1 K	2 K
Unicast routes	12 K	4 K	24 K	0
Multicast routes	6 K	8 K	6 K	0
Subnet VLANs (routed ports and SVIs)	16	16	16	16
Layer 2 VLANs	256	256	256	1 K



Note

The maximum number of resources allowed in each template is an approximation and depends upon the actual number of other features configured. For example, in the default template for the Catalyst 3550-12T, if your switch has more than 16 routed interfaces configured, the number of multicast or unicast routes that can be accommodated by hardware might be less than indicated.

This procedure shows how to change the SDM template from the default. The switch must reload before the configuration takes effect. If you use the **show sdm prefer** privileged EXEC command before the switch reloads, the previous configuration (in this case, the default) is displayed.

Beginning in privileged EXEC mode, follow these steps to use the SDM template to maximize feature usage:

	Command	Purpose
Step 1	configure terminal	Enter global configuration mode.
Step 2	sdm prefer { access default routing vlan }	Specify the SDM template to be used on the switch: The keywords have these meanings: <ul style="list-style-type: none"> • access—Maximizes the use of QoS classification ACLs and security ACLs on the switch. • default—Balance the use of unicast MAC addresses, IGMP groups, QoS ACLs, security ACLs, unicast and multicast routes, routed interfaces, and Layer 2 VLANs. • routing—Maximizes routing on the switch. • vlan—Maximizes VLAN configuration on the switch with no routing allowed.
Step 3	end	Return to privileged EXEC mode.
Step 4	copy running-config startup-config	(Optional) Save your entries in the configuration file.
Step 5	reload	Reload the operating system.

After the system reboots, you can use the **show sdm-prefer** privileged EXEC command to verify the new template configuration. If you use the **show sdm-prefer** command before the **reload** command, the previous template is displayed instead of the new one.

To return to the default template, use the **no sdm prefer** global configuration command.

This example shows how to configure a switch with the routing template and verify the configuration:

```
Switch(config)# sdm prefer routing
Switch(config)# end
Switch # reload
Proceed with reload? [confirm]

Switch# show sdm prefer
The current template is routing template.
The selected template optimizes the resources in
the switch to support this level of features for
16 routed interfaces and 256 VLANs.

number of unicast mac addresses: 6K
number of igmp groups:          6K
number of qos/acls:             1K
number of security acls:        1K
number of unicast routes:       24K
number of multicast routes:     6K
```

