C H A P T E R

5

Administering the Switch

This chapter describes how to perform one-time operations to administer the Catalyst 3750 Metro switch.

This chapter consists of these sections:

- Managing the System Time and Date, page 5-1
- Configuring a System Name and Prompt, page 5-15
- Creating a Banner, page 5-18
- Managing the MAC Address Table, page 5-20
- Managing the ARP Table, page 5-26

Managing the System Time and Date

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

![note icon]

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 5-2
- Understanding Network Time Protocol, page 5-2
- Configuring NTP, page 5-4
- Configuring Time and Date Manually, page 5-11

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5-1

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 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 5-11.

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 5-1 shows a typical network example using NTP. Switch A is the NTP master, with Switches B, C, and D configured in NTP server mode, in server association with Switch A. Switch E is configured as an NTP peer to the upstream and downstream switches, Switch B and Switch F.

Figure 5-1   Typical NTP Network Configuration
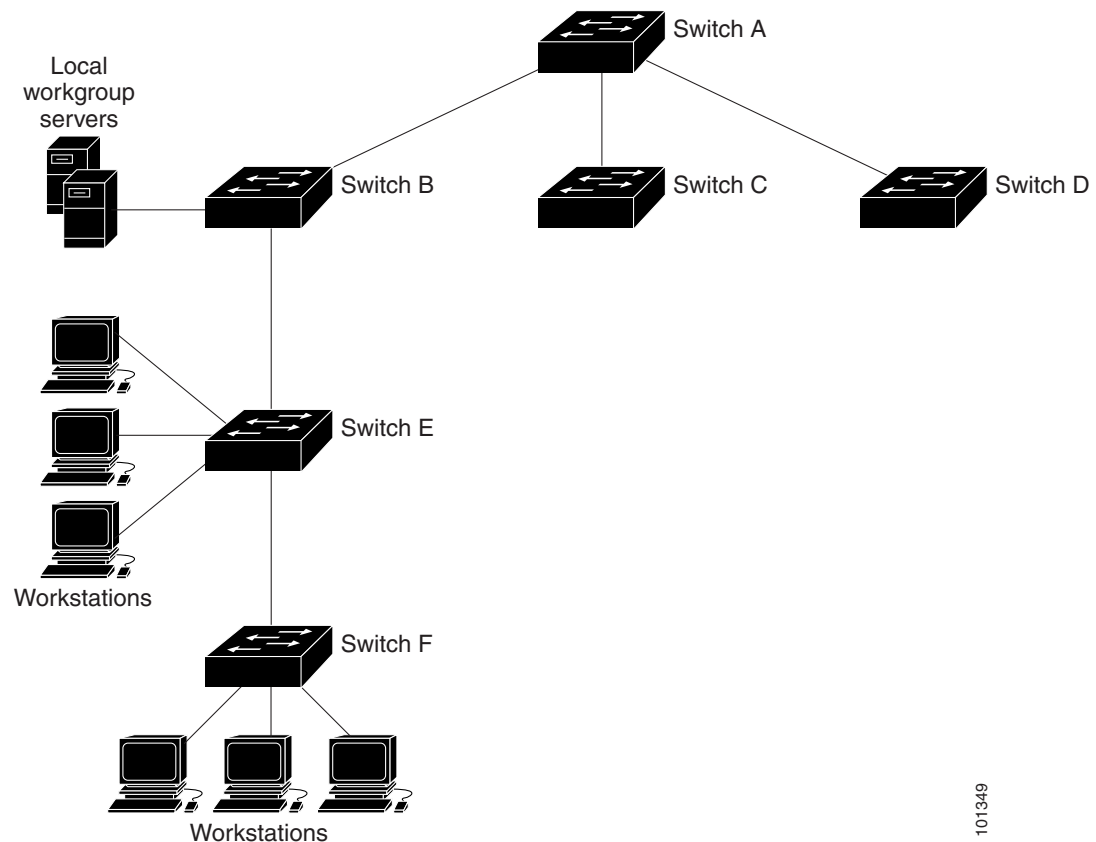
If the network is isolated from the Internet, Cisco's implementation of NTP allows a device to act as though it is synchronized through NTP, when in fact it has determined the time by using other means. Other devices then synchronize to that device through NTP.

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.

Several 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.

Configuring NTP

The 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

Table 5-1 shows the default NTP configuration.

Table 5-1   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** *number* **md5** *value*	Define the authentication keys. By default, none are defined. • For *number*, 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 *value*, 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** *key-number* command.
Step 4	**ntp trusted-key** *key-number*	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 *key-number*, 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** *ip-address* [**version** *number*] [**key** *keyid*] [**source** *interface*] [**prefer**]	Configure the switch system clock to synchronize a peer or to be synchronized by a peer (peer association).
	or	or
	ntp server *ip-address* [**version** *number*] [**key** *keyid*] [**source** *interface*] [**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 *ip-address* 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 *number*, specify the NTP version number. The range is 1 to 3. By default, version 3 is selected.
		• (Optional) For *keyid*, enter the authentication key defined with the **ntp authentication-key** global configuration command.
		• (Optional) For *interface*, 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 need to configure only 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** *interface-id*	Specify the interface to send NTP broadcast packets, and enter interface configuration mode.
Step 3	**ntp broadcast** [**version** *number*] [**key** *keyid*] [*destination-address*]	Enable the interface to send NTP broadcast packets to a peer. By default, this feature is disabled on all interfaces. • (Optional) For *number*, specify the NTP version number. The range is 1 to 3. If you do not specify a version, version 3 is used. • (Optional) For *keyid*, specify the authentication key to use when sending packets to the peer. • (Optional) For *destination-address*, 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 a port to send NTP version 2 packets:

```
Switch(config)# interface gigabitethernet1/0/1
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** *interface-id*	Specify the interface to receive NTP broadcast packets, and enter interface configuration mode.
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** *microseconds*	(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 a port 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 a port to receive NTP broadcast packets:

```
Switch(config)# interface gigabitethernet1/0/1
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 5-9
- Disabling NTP Services on a Specific Interface, page 5-10

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**} *access-list-number*	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 *access-list-number*, enter a standard IP access list number from 1 to 99.
Step 3	**access-list** *access-list-number* **permit** *source* [*source-wildcard*]	Create the access list. • For *access-list-number*, enter the number specified in Step 2. • Enter the **permit** keyword to permit access if the conditions are matched. • For *source*, enter the IP address of the device that is permitted access to the switch. • (Optional) For *source-wildcard*, 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** *interface-id*	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** *type number*	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 5-6.

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 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

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	**clock set** *hh*:*mm*:*ss day month year* or **clock set** *hh*:*mm*:*ss month day year*	Manually set the system clock using one of these formats. • For *hh*:*mm*:*ss*, specify the time in hours (24-hour format), minutes, and seconds. The time specified is relative to the configured time zone. • For *day*, specify the day by date in the month. • For *month*, specify the month by name. • For *year*, specify the year (no abbreviation).
Step 2	**show running-config**	Verify your entries.
Step 3	**copy running-config startup-config**	(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** *zone hours-offset* [*minutes-offset*]	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 *zone*, enter the name of the time zone to be displayed when standard time is in effect. The default is UTC. • For *hours-offset*, enter the hours offset from UTC. • (Optional) For *minutes-offset*, 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** global configuration command is available for those cases where a local time zone is a percentage of an hour different from UTC. For example, the time zone 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** global configuration 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** [*week day month hh***:***mm week day month hh***:***mm* [*offset*]]	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 *zone*, specify the name of the time zone (for example, PDT) to be displayed when summer time is in effect.
		• (Optional) For *week*, specify the week of the month (1 to 5 or **last**).
		• (Optional) For *day*, specify the day of the week (Sunday, Monday...).
		• (Optional) For *month*, specify the month (January, February...).
		• (Optional) For *hh***:***mm*, specify the time (24-hour format) in hours and minutes.
		• (Optional) For *offset*, 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** global configuration 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** [*month date year hh***:***mm month date year hh***:***mm* [*offset*]] or **clock summer-time** *zone* **date** [*date month year hh***:***mm date month year hh***:***mm* [*offset*]]	Configure summer time to start on the first date and end on the second date. Summer time is disabled by default. • For *zone*, specify the name of the time zone (for example, PDT) to be displayed when summer time is in effect. • (Optional) For *week*, specify the week of the month (1 to 5 or **last**). • (Optional) For *day*, specify the day of the week (Sunday, Monday...). • (Optional) For *month*, specify the month (January, February...). • (Optional) For *hh***:***mm*, specify the time (24-hour format) in hours and minutes. • (Optional) For *offset*, 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** global configuration 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, 2003, at 02:00, and end on April 26, 2004, at 02:00:

```
Switch(config)# clock summer-time pdt date 12 October 2003 2:00 26 April 2004 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 5-15
- Configuring a System Name, page 5-15
- Configuring a System Prompt, page 5-16
- Understanding DNS, page 5-16

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 *switch*. 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** *string*	Configure the command-line prompt to override the setting from the **hostname** command.
		The default prompt is either *switch* 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 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

Table 5-2 shows the default DNS configuration.

Table 5-2   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** *name*	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 DHCPserver, 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** *server-address1* [*server-address2 ... server-address6*]	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 Cisco 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 5-18
- Configuring a Message-of-the-Day Login Banner, page 5-19
- Configuring a Login Banner, page 5-20

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	**configure terminal**	Enter global configuration mode.
Step 2	**banner motd** *c message c*	Specify the message of the day.
		For *c*, 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 after the ending delimiter are discarded.
		For *message*, enter a banner message up to 255 characters. You cannot use the delimiting character in the message.
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 delete the MOTD banner, use the **no banner motd** global configuration command.

This example shows how to configure a MOTD banner for the switch by 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 appears 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	**configure terminal**	Enter global configuration mode.
Step 2	**banner login** *c message c*	Specify the login message.
		For *c*, 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 after the ending delimiter are discarded.
		For *message*, enter a login message up to 255 characters. You cannot use the delimiting character in the message.
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 delete the login banner, use the **no banner login** global configuration command.

This example shows how to configure a login banner for the switch by 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 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 and the type (static or dynamic).

Note For complete syntax and usage information for the commands used in this section, refer to the command reference for this release.

This section contains this configuration information:

Building the Address Table

With multiple MAC addresses 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 not in use.

The aging interval is globally configured. 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 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. Unicast addresses, for example, could forward to port 1 in VLAN 1 and ports 9, 10, and 1 in VLAN 5.

Note   Multiport static addresses are not supported.

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.

Default MAC Address Table Configuration

Table 5-3 shows the default MAC address table configuration.

Table 5-3   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** *vlan-id*]	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 *vlan-id*, the range is 1 to 4094.
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.

Configuring MAC Address Notification Traps

MAC address notification enables you to track users on a network by storing the MAC address activity on the switch. Whenever the switch learns or removes a MAC address, an SNMP notification can be generated and sent to the NMS. If you have many users coming and going from the network, you can set a trap interval time to bundle the notification traps and reduce network traffic. The MAC notification history table stores the MAC address activity for each hardware port for which the trap is enabled. MAC address notifications are generated for dynamic and secure MAC addresses; events are not generated for self addresses, multicast addresses, or other static addresses.

Beginning in privileged EXEC mode, follow these steps to configure the switch to send MAC address notification traps to an NMS host:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**snmp-server host** *host-addr* {**traps** | **informs**} {**version** {**1** | **2c** | **3**}} *community-string notification-type*	Specify the recipient of the trap message. • For *host-addr*, specify the name or address of the NMS. • Specify **traps** (the default) to send SNMP traps to the host. Specify **informs** to send SNMP informs to the host. • Specify the SNMP version to support. Version 1, the default, is not available with informs. • For *community-string,* specify the string to send with the notification operation. Though you can set this string by using the **snmp-server host** command, we recommend that you define this string by using the **snmp-server community** command before using the **snmp-server host** command. • For *notification-type*, use the **mac-notification** keyword.
Step 3	**snmp-server enable traps mac-notification**	Enable the switch to send MAC address traps to the NMS.
Step 4	**mac address-table notification**	Enable the MAC address notification feature.
Step 5	**mac address-table notification** [**interval** *value*] | [**history-size** *value*]	Enter the trap interval time and the history table size. • (Optional) For **interval** *value,* specify the notification trap interval in seconds between each set of traps that are generated to the NMS. The range is 0 to 2147483647 seconds; the default is 1 second. • (Optional) For **history-size** *value*, specify the maximum number of entries in the MAC notification history table. The range is 0 to 500; the default is 1.

	Command	Purpose
Step 6	**interface** *interface-id*	Enter interface configuration mode, and specify the Layer 2 interface on which to enable the SNMP MAC address notification trap.
Step 7	**snmp trap mac-notification** {**added** | **removed**}	Enable the MAC address notification trap. • Enable the MAC notification trap whenever a MAC address is **added** on this interface. • Enable the MAC notification trap whenever a MAC address is **removed** from this interface.
Step 8	**end**	Return to privileged EXEC mode.
Step 9	**show mac address-table notification interface** **show running-config**	Verify your entries.
Step 10	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable the switch from sending MAC address notification traps, use the **no snmp-server enable traps mac-notification** global configuration command. To disable the MAC address notification traps on a specific interface, use the **no snmp trap mac-notification** {**added** | **removed**} interface configuration command. To disable the MAC address notification feature, use the **no mac address-table notification** global configuration command.

This example shows how to specify 172.20.10.10 as the NMS, enable the switch to send MAC address notification traps to the NMS, enable the MAC address notification feature, set the interval time to 60 seconds, set the history-size to 100 entries, and enable traps whenever a MAC address is added on a port.

```
Switch(config)# snmp-server host 172.20.10.10 traps private
Switch(config)# snmp-server enable traps mac-notification
Switch(config)# mac address-table notification
Switch(config)# mac address-table notification interval 60
Switch(config)# mac address-table notification history-size 100
Switch(config)# interface fastethernet1/0/4
Switch(config-if)# snmp trap mac-notification added
```

You can verify the previous commands by entering the **show mac address-table notification interface** and the **show mac address-table notification** privileged EXEC commands.

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 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.

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 unicast address 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** *mac-addr* **vlan** *vlan-id* **interface** *interface-id*	Add a static address to the MAC address table. • For *mac-addr*, specify the destination MAC unicast address to add to the address table. Packets with this destination address received in the specified VLAN are forwarded to the specified interface. • For *vlan-id*, specify the VLAN for which the packet with the specified MAC address is received. The range is 1 to 4094. • For *interface-id*, specify the interface to which the received packet is forwarded. Valid interfaces include physical ports.
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* 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 packet is forwarded to the specified interface:

```
Switch(config)# mac address-table static c2f3.220a.12f4 vlan 4 interface
gigabitethernet1/0/1
```

Displaying Address Table Entries

You can display the MAC address table by using one or more of the privileged EXEC commands described in Table 5-4:

Table 5-4   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 only dynamic MAC address table entries.
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 notification	Displays the MAC notification parameters and history table.

Table 5-4   Commands for Displaying the MAC Address Table (continued)

Command	Description
show mac address-table static	Displays only static MAC address table entries.
show mac address-table vlan	Displays the MAC address table information for the specified VLAN.

Managing the ARP Table

To communicate with a device (over Ethernet, for example), the software first must determine the 48-bit MAC or the local data link address of that device. The process of determining the local data link address from an IP address is called *address resolution*.

The Address Resolution Protocol (ARP) associates a host IP address with the corresponding media or MAC addresses and the VLAN ID. Taking an IP address as input, ARP determines the associated MAC address. Once a MAC address is determined, the IP-MAC address association is stored in an ARP cache for rapid retrieval. Then the IP datagram is encapsulated in a link-layer frame and sent over the network. Encapsulation of IP datagrams and ARP requests and replies on IEEE 802 networks other than Ethernet is specified by the Subnetwork Access Protocol (SNAP). By default, standard Ethernet-style ARP encapsulation (represented by the **arpa** keyword) is enabled on the IP interface.

ARP entries added manually to the table do not age and must be manually removed.

For more information, refer to the Cisco IOS Release 12.1 documentation on Cisco.com.