Administering the Switch

This chapter describes how to perform one-time operations to administer the Cisco Industrial Ethernet 2000U Series (IE 2000U) and Connected Grid Switches, hereafter referred to as *switch*.

This chapter includes the following sections:

- Information About Administering the Switch, page 4-1
- Prerequisites, page 4-5
- Guidelines and Limitations, page 4-6
- Default Settings, page 4-6
- Configuring NTP, page 4-7
- Configuring Time and Date Manually, page 4-15
- Configuring a System Name and Prompt, page 4-19
- Configuring DNS, page 4-20
- Creating a Banner, page 4-21
- Managing the MAC Address Table, page 4-23
- Verifying Configuration, page 4-35
- Configuration Example, page 4-35
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- Feature History, page 4-38

Note For complete syntax and usage information for the commands used in this chapter, see the documents listed in the "Related Documents" section on page 4-38.

Information About Administering the Switch

This section includes the following topics about administering the switch:

- System Clock, page 4-2
- Network Time Protocol, page 4-2
- DNS, page 4-4
- MAC Address Table, page 4-4

- ARP Table, page 4-5

System Clock

The system 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:

- NTP
- 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 set the time zone and adjust for Daylight Saving Time (DST), also known as summer time.

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 4-15.

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.

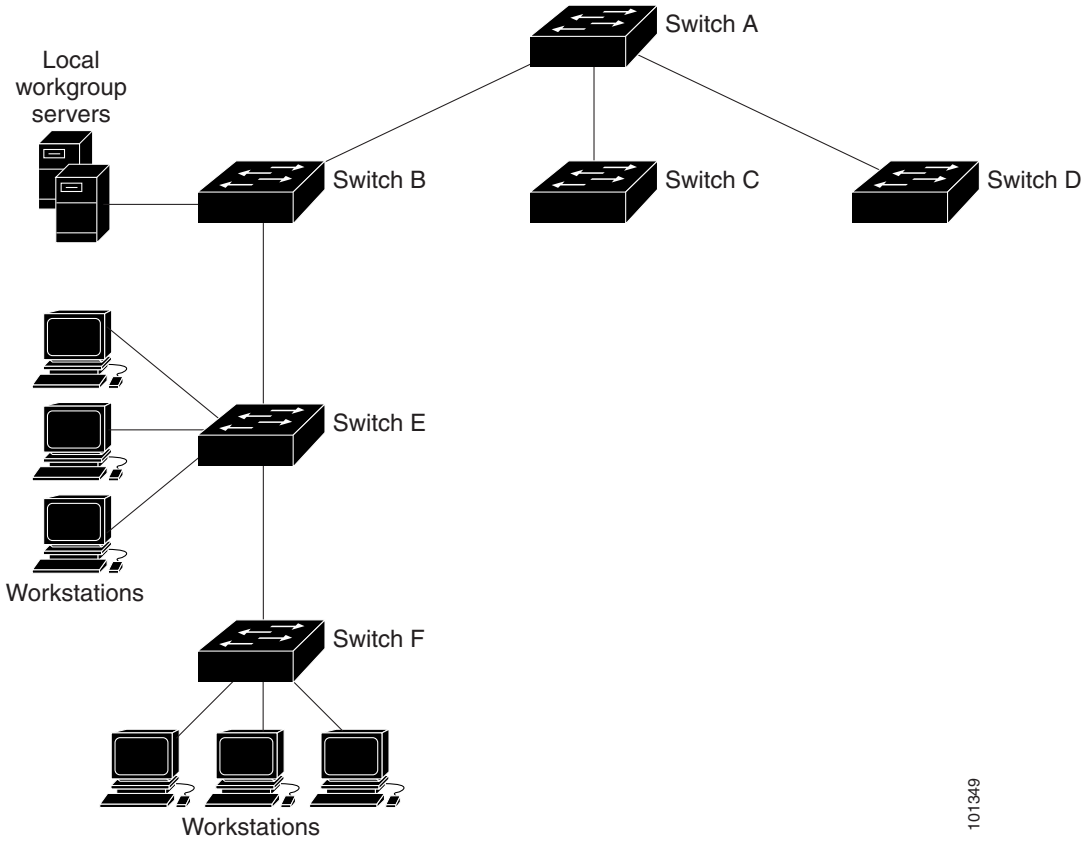
The communications between devices running NTP (known as *associations*) are usually statically configured; each device is given the IP address of all devices with which it should form associations. Accurate timekeeping is possible by exchanging NTP messages between each pair of devices with an association. 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 4-1 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 4-1 Typical NTP Network Configuration



If the network is isolated from the Internet, Cisco's implementation of NTP allows a device to act as if it is synchronized through NTP, when in fact it has learned the time by 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 also allows host systems to be time-synchronized.

DNS

The DNS protocol controls the Domain Name System (DNS), which is a distributed database for mapping hostnames to IP addresses. When you configure DNS on your switch, you can substitute the hostname 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 use period delimiters. 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 track 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 hostnames, specify the name server that is present on your network, and enable the DNS.

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).

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 be forwarded to port 1 in VLAN 1 and ports 1, 9, and 10 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.

When private VLANs are configured, address learning depends on the type of MAC address:

- Dynamic MAC addresses learned in one VLAN of a private VLAN are replicated in the associated VLANs. For example, a MAC address learned in a private-VLAN secondary VLAN is replicated in the primary VLAN.
- Static MAC addresses configured in a primary or secondary VLAN are not replicated in the associated VLANs. When you configure a static MAC address in a private VLAN primary or secondary VLAN, you should also configure the same static MAC address in all associated VLANs.

For more information about private VLANs, see the "Configuring Private VLANs" chapter in the *Layer 2 Switching Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*.

You can disable MAC address learning on a per-VLAN basis. Customers in a service provider network can tunnel a large number of MAC addresses through the network and fill up the available MAC address table space. You can control MAC address learning on a VLAN and manage the MAC address table space that is available on the switch by controlling which VLANs, and therefore which ports, can learn MAC addresses. See the "Disabling MAC Address Learning on a VLAN" section on page 4-33 for more information.

ARP Table

To communicate with a device (over Ethernet, for example), the software first must learn the 48-bit MAC address or the local data link address of that device. The process of learning 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. Using an IP address, ARP finds the associated MAC address. When a MAC address is found, 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 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 CLI procedures, see the *IP Addressing: ARP Configuration Guide, Cisco IOS Release 15M&T*.

Prerequisites

You should have at least a basic familiarity with the Cisco IOS environment and the command-line interface.

Guidelines and Limitations

NTP

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

MAC Address Table

See the "Configuring Unicast MAC Address Filtering" section on page 4-32 and "Disabling MAC Address Learning on a VLAN" section on page 4-33.

Default Settings

Feature	Default Setting
NTP	
NTP	Enabled on all interfaces. All interfaces receive NTP packets.
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 set by the outgoing interface.
System Name	
System name and prompt	The default switch system name and prompt is *Switch*.
DNS	
DNS enable state	Enabled.
DNS default domain name	None configured.
DNS servers	No name server addresses are configured.
Banners	
Message-of-the-day (MOTD) and login banners	No banners are configured.
MAC Address Table	
Aging time	300 seconds.
Dynamic addresses	Automatically learned.
Static addresses	None configured.

Configuring NTP

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. For manual configuration, see the "Configuring Time and Date Manually" section on page 4-15.

This section includes the following topics:

- Configuring NTP Authentication, page 4-7
- Configuring NTP Associations, page 4-8
- Configuring NTP Broadcast Service, page 4-10
- Configuring NTP Access Restrictions, page 4-11
- Configuring the Source IP Address for NTP Packets, page 4-14

Configuring NTP Authentication

Follow this procedure to authenticate the associations (communications between devices running NTP that provide for accurate timekeeping) with other devices for security purposes.

BEFORE YOU BEGIN

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.

DETAILED STEPS

	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.

	Command	Purpose
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.

EXAMPLE

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).

BEFORE YOU BEGIN

Review the "Network Time Protocol" section on page 4-2.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ntp peer** *ip-address* [**version** *number*] [**key** *keyid*] [**source** *interface*] [**prefer**] or **ntp server** *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 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.

EXAMPLE

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.

Configuring the Switch to Send NTP Broadcast Packets

BEFORE YOU BEGIN

Review the "Network Time Protocol" section on page 4-2.

DETAILED STEPS

	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	**no shutdown**	Enable the port, if necessary. By default, user network interfaces (UNIs) and enhanced network interfaces (ENIs) are disabled, and network node interfaces (NNIs) are enabled.
Step 4	**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 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.
Step 8		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.

EXAMPLE

This example shows how to configure a port to send NTP Version 2 packets:

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

Configuring the Switch to Receive NTP Broadcast Packets

DETAILED STEPS

	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	**no shutdown**	Enable the port, if necessary. By default, UNIs and enhanced network interfaces (ENIs) are disabled, and NNIs are enabled.
Step 4	**ntp broadcast client**	Enable the interface to receive NTP broadcast packets. By default, no interfaces receive NTP broadcast packets.
Step 5	**exit**	Return to global configuration mode.
Step 6	**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 7	**end**	Return to privileged EXEC mode.
Step 8	**show running-config**	Verify your entries.
Step 9	**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.

EXAMPLE

This example shows how to configure a port 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 4-12

- Disabling NTP Services on a Specific Interface, page 4-13

Creating an Access Group and Assigning a Basic IP Access List

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.

BEFORE YOU BEGIN

Review the "Network Time Protocol" section on page 4-2.

DETAILED STEPS

	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.

	Command	Purpose
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.

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

EXAMPLE

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.

BEFORE YOU BEGIN

Review the "Network Time Protocol" section on page 4-2.

DETAILED STEPS

	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.

	Command	Purpose
Step 3	**no shutdown**	Enable the port, if necessary. By default, UNIs and enhanced network interfaces (ENIs) are disabled, and NNIs are enabled.
Step 4	**ntp disable**	Disable NTP packets from being received on the interface. By default, all interfaces receive NTP packets.
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 re-enable receipt of NTP packets on an interface, use the **no ntp disable** interface configuration command.

EXAMPLE

```
Switch(config)# interface ethernet 0
Switch(config-if)# ntp disable
Switch(config-if)# end
```

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.

BEFORE YOU BEGIN

Review the "Network Time Protocol" section on page 4-2.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**ntp source** *interface type interface number*	Specify the interface type and number from which the IP source address is taken. By default, the source address is set 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 4-8.

EXAMPLE

The following example shows how to configure a switch to use the IPv4 or IPv6 address of Ethernet interface 0 as the source address of all outgoing NTP packets:

```
Switch(config)# ntp source ethernet 0
```

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 includes the following topics:

- Setting the System Clock, page 4-15
- Displaying the Time and Date Configuration, page 4-16
- Configuring the Time Zone, page 4-16
- Configuring Daylight Saving Time (Summer Time), page 4-17

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.

BEFORE YOU BEGIN

Review the "System Clock" section on page 4-2.

DETAILED STEPS

	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).

EXAMPLE

This example shows how to manually set the system clock to 1:32 p.m. on July 23, 2014:

```
Switch# clock set 13:32:00 23 July 2014
```

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

BEFORE YOU BEGIN

Obtain your time zone information.

DETAILED STEPS

	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.

EXAMPLE

The following example sets the time zone to Pacific Standard Time (PST), which is 8 hours behind UTC:

```
Switch(config)# clock timezone PST -8
```

Configuring Daylight Saving Time (Summer Time)

Recurring Daylight Saving Time

Follow this procedure to configure daylight saving time (summer time) in areas where it starts and ends on a particular day of the week each year.

The first part of the **clock summer-time** global configuration command specifies when DST 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 DST. If the starting month is after the ending month, the system assumes that you are in the southern hemisphere.

BEFORE YOU BEGIN

Obtain the DST information for your time zone.

DETAILED STEPS

	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 DST to start and end on the specified days every year. DST 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 DST 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 DST. 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.

EXAMPLE

This example shows how to specify that DST 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
```

Specific Dates for Daylight Saving Time

Follow this procedure if summer time in your area does not follow a recurring pattern (configure the exact date and time of the next summer time events):

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.

BEFORE YOU BEGIN

Obtain the daylight saving time information for your time zone.

DETAILED STEPS

	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 DST to start on the first date and end on the second date. DST is disabled by default. • For *zone*, specify the name of the time zone (for example, PDT) to be displayed when DST 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.

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

EXAMPLE

This example shows how to set summer time to start on October 12, 2014, at 02:00, and end on April 26, 2015, at 02:00:

```
Switch(config)# clock summer-time pdt date 12 October 2014 2:00 26 April 2015 2:00
```

Configuring a System Name and Prompt

You configure the system name on the switch to identify it. When you set the system name, it is also used as the system prompt. 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.

BEFORE YOU BEGIN

Follow these guidelines when configuring the system name:

- Conventions dictate that computer names appear all lowercase.

- The name must follow the rules for ARPANET hostnames. They must start with a letter, end with a letter or digit, and contain only letters, digits, and hyphens. Names must be 63 characters or fewer. Creating an all numeric hostname is not recommended but the name will be accepted after an error is returned.
- A hostname of less than 10 characters is recommended.
- On most systems, a field of 30 characters is used for the hostname and the prompt in the CLI. Note that the length of your hostname may cause longer configuration mode prompts to be truncated.

DETAILED STEPS

	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 hostnames. They must start with a letter, end with a letter or digit, and contain 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.

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

EXAMPLE

```
Switch(config)# hostname ie2000u-1
```

Configuring DNS

If you use the switch IP address as its hostname, no DNS query occurs. If you configure a hostname that contains no periods (.), the system appends a period followed by the default domain name 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.

BEFORE YOU BEGIN

Obtain the DNS server IP address(es).

DETAILED STEPS

	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 hostnames (names without a dotted-decimal domain name). **Note** Do not include the initial period that separates an unqualified name from the domain name. At system boot up, 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** *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 hostname-to-address translation on your switch. This feature is enabled by default. If your network devices require connectivity with devices in networks where 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.

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.

EXAMPLE

```
Switch(config)# ip domain-name cisco.com
Switch(config)# ip name-server 172.16.1.111 172.16.1.2
Switch(config)# end
```

Creating a Banner

You can configure a message-of-the-day (MOTD) and a login banner. The MOTD banner is displayed 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 is also displayed on all connected terminals. It appears after the MOTD banner and before the login prompts.

This section includes the following topics:

- Configuring a Message-of-the-Day Login Banner, page 4-22
- Configuring a Login Banner, page 4-23

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.

DETAILED STEPS

	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.

EXAMPLE

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 that appears 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 that appears on all connected terminals. This banner appears after the MOTD banner and before the login prompt.

DETAILED STEPS

	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.

EXAMPLE

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).

This section includes the following topics:

- Changing the Address Aging Time, page 4-24
- Removing Dynamic Address Entries, page 4-25
- Configuring MAC Address Change Notification Traps, page 4-25
- Configuring MAC Address Move Notification Traps, page 4-27
- Configuring MAC Threshold Notification Traps, page 4-29
- Adding and Removing Static Address Entries, page 4-30
- Configuring Unicast MAC Address Filtering, page 4-32
- Disabling MAC Address Learning on a VLAN, page 4-33
- Displaying Address Table Entries, page 4-34

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.

BEFORE YOU BEGIN

Review the "MAC Address Table" section on page 4-4.

DETAILED STEPS

	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*, valid IDs are 1 to 4094. Do not enter leading zeros.
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.

EXAMPLE

The following example shows how to configure aging time to 300 seconds:

```
Switch(config)# mac-address-table aging-time 300
```

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 Change Notification Traps

MAC address change notification tracks users on a network by storing the MAC address change activity. When the switch learns or removes a MAC address, an SNMP notification trap can be 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 to reduce network traffic. The MAC notification history table stores MAC address activity for each port for which the trap is set. MAC address change notifications are generated for dynamic and secure MAC addresses. Notifications are not generated for self addresses, multicast addresses, or other static addresses.

BEFORE YOU BEGIN

Obtain the NMS name or address and the community string.

DETAILED STEPS

	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 change**	Enable the switch to send MAC address change notification traps to the NMS.
Step 4	**mac address-table notification change**	Enable the MAC address change notification feature.
Step 5	**mac address-table notification change** [**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.
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.

	Command	Purpose
Step 7	**snmp trap mac-notification change** {**added** | **removed**}	Enable the MAC address change notification trap on the interface. • Enable the trap when a MAC address is **added** on this interface. • Enable the trap when a MAC address is **removed** from this interface.
Step 8	**end**	Return to privileged EXEC mode.
Step 9	**show mac address-table notification change interface** **show running-config**	Verify your entries.
Step 10	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

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

EXAMPLE

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-change notification feature, set the interval time to 123 seconds, set the history-size to 100 entries, and enable traps whenever a MAC address is added on the specified port:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification change
Switch(config)# mac address-table notification change
Switch(config)# mac address-table notification change interval 123
Switch(config)# mac address-table notification change history-size 100
Switch(config)# interface gigabitethernet0/2
Switch(config-if)# snmp trap mac-notification change added
```

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

Configuring MAC Address Move Notification Traps

When you configure MAC-move notification, an SNMP notification is generated and sent to the network management system whenever a MAC address moves from one port to another within the same VLAN.

BEFORE YOU BEGIN

Obtain the NMS name or address and the community string.

DETAILED STEPS

	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 move**	Enable the switch to send MAC address move notification traps to the NMS.
Step 4	**mac address-table notification mac-move**	Enable the MAC address move notification feature.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**show mac address-table notification mac-move** **show running-config**	Verify your entries.
Step 7	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable MAC address-move notification traps, use the **no snmp-server enable traps mac-notification move** global configuration command. To disable the MAC address-move notification feature, use the **no mac address-table notification mac-move** global configuration command.

EXAMPLE

This example shows how to specify 172.20.10.10 as the NMS, enable the switch to send MAC address move notification traps to the NMS, enable the MAC address move notification feature, and enable traps when a MAC address moves from one port to another:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification move
Switch(config)# mac address-table notification mac-move
```

You can verify your settings by entering the **show mac address-table notification mac-move** privileged EXEC commands.

Configuring MAC Threshold Notification Traps

When you configure MAC threshold notification, an SNMP notification is generated and sent to the network management system when a MAC address table threshold limit is reached or exceeded.

BEFORE YOU BEGIN

Obtain the NMS name or address and the community string.

DETAILED STEPS

	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 threshold**	Enable the switch to send MAC threshold notification traps to the NMS.
Step 4	**mac address-table notification threshold**	Enable the MAC address threshold notification feature.

	Command	Purpose
Step 5	**mac address-table notification threshold** [**limit** *percentage*] | [**interval** *time*]	Enter the threshold value for the MAC address threshold usage monitoring. • (Optional) For **limit** *percentage*, specify the percentage of the MAC address table use; valid values are from 1 to 100 percent. The default is 50 percent. • (Optional) For **interval** *time*, specify the time between notifications; valid values are greater than or equal to 120 seconds. The default is 120 seconds.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**show mac address-table notification threshold** **show running-config**	Verify your entries.
Step 8	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable MAC address-threshold notification traps, use the **no snmp-server enable traps mac-notification threshold** global configuration command. To disable the MAC address-threshold notification feature, use the **no mac address-table notification threshold** global configuration command.

EXAMPLE

This example shows how to specify 172.20.10.10 as the NMS, enable the MAC address threshold notification feature, set the interval time to 123 seconds, and set the limit to 78 percent:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification threshold
Switch(config)# mac address-table notification threshold
Switch(config)# mac address-table notification threshold interval 123
Switch(config)# mac address-table notification threshold limit 78
```

You can verify your settings by entering the **show mac address-table notification threshold** 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 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 defines 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 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.

When you configure a static MAC address in a private-VLAN primary or secondary VLAN, you should also configure the same static MAC address in all associated VLANs. Static MAC addresses configured in a private-VLAN primary or secondary VLAN are not replicated in the associated VLAN. For more information about private VLANs, see the "Configuring Private VLANs" chapter in the *Layer 2 Switching Software Configuration Guide for Cisco IE 2000U and Connected Grid Switches*.

BEFORE YOU BEGIN

Review the "MAC Address Table" section on page 4-4.

DETAILED STEPS

	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. Valid VLAN IDs are 1 to 4094; do not enter leading zeros. • For *interface-id*, specify the interface to which the received packet is forwarded. Valid interfaces include physical ports or port channels. For static multicast addresses, you can enter multiple interface IDs. For static unicast addresses, you can enter only one interface at a time, but you can enter the command multiple times with the same MAC address and VLAN ID.
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.

EXAMPLE

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 port:

```
Switch(config)# mac address-table static c2f3.220a.12f4 vlan 4 interface
gigabitethernet0/1
```

Configuring Unicast MAC Address Filtering

When unicast MAC address filtering is enabled, the switch drops packets with specific source or destination MAC addresses. This feature is disabled by default and only supports unicast static addresses.

You enable unicast MAC address filtering and configure the switch to drop packets with a specific address by specifying the source or destination unicast MAC address and the VLAN from which it is received.

BEFORE YOU BEGIN

Follow these guidelines when using this feature:

- Multicast MAC addresses, broadcast MAC addresses, and router MAC addresses are not supported. If you specify one of these addresses when entering the **mac address-table static** *mac-addr* **vlan** *vlan-id* **drop** global configuration command, one of these messages appears:

```
% Only unicast addresses can be configured to be dropped

% CPU destined address cannot be configured as drop address
```

- Packets that are forwarded to the CPU are also not supported.
- If you add a unicast MAC address as a static address and configure unicast MAC address filtering, the switch either adds the MAC address as a static address or drops packets with that MAC address, depending on which command was entered last. The second command that you entered overrides the first command.

  For example, if you enter the **mac address-table static** *mac-addr* **vlan** *vlan-id* **interface** *interface-id* global configuration command followed by the **mac address-table static** *mac-addr* **vlan** *vlan-id* **drop** command, the switch drops packets with the specified MAC address as a source or destination.

  If you enter the **mac address-table static** *mac-addr* **vlan** *vlan-id* **drop** global configuration command followed by the **mac address-table static** *mac-addr* **vlan** *vlan-id* **interface** *interface-id* command, the switch adds the MAC address as a static address.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**mac address-table static** *mac-addr* **vlan** *vlan-id* **drop**	Enable unicast MAC address filtering and configure the switch to drop a packet with the specified source or destination unicast static address. • For *mac-addr*, specify a source or destination unicast MAC address. Packets with this MAC address are dropped. • For *vlan-id*, specify the VLAN for which the packet with the specified MAC address is received. Valid VLAN IDs are 1 to 4094.
Step 3	**end**	Return to privileged EXEC mode.

	Command	Purpose
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 disable unicast MAC address filtering, use the **no mac address-table static** *mac-addr* **vlan** *vlan-id* global configuration command.

EXAMPLE

This example shows how to enable unicast MAC address filtering and to configure the switch to drop packets that have a source or destination address of c2f3.220a.12f4. When a packet is received in VLAN 4 with this MAC address as its source or destination, the packet is dropped:

```
Switch(config)# mac address-table static c2f3.220a.12f4 vlan 4 drop
```

Disabling MAC Address Learning on a VLAN

By default, MAC address learning is enabled on all VLANs on the switch. You can control MAC address learning on a VLAN to manage the available MAC address table space by controlling which VLANs, and therefore which ports, can learn MAC addresses.

BEFORE YOU BEGIN

Follow these guidelines when disabling MAC address learning on a VLAN:

- Before you disable MAC address learning, be sure that you are familiar with the network topology and the switch system configuration. Disabling MAC address learning on a VLAN could cause flooding in the network.
- Use caution before disabling MAC address learning on a VLAN with a configured switch virtual interface (SVI). The switch then floods all IP packets in the Layer 2 domain.
- You can disable MAC address learning on a single VLAN ID from 1 to 4094 (for example, **no mac address-table learning vlan 223**) or a range of VLAN IDs, separated by a hyphen or comma (for example, **no mac address-table learning vlan 1-10, 15**).
- We recommend that you disable MAC address learning only in VLANs with two ports. If you disable MAC address learning on a VLAN with more than two ports, every packet entering the switch is flooded in that VLAN domain.
- You cannot disable MAC address learning on a VLAN that is used internally by the switch. If the VLAN ID that you enter is an internal VLAN, the switch generates an error message and rejects the command. To view internal VLANs in use, enter the **show vlan internal usage** privileged EXEC command.
- If you disable MAC address learning on a VLAN configured as a private-VLAN primary VLAN, MAC addresses are still learned on the secondary VLAN that belongs to the private VLAN and are then replicated on the primary VLAN. If you disable MAC address learning on the secondary VLAN, but not the primary VLAN of a private VLAN, MAC address learning occurs on the primary VLAN and is replicated on the secondary VLAN.
- You cannot disable MAC address learning on an RSPAN VLAN. The configuration is not allowed.

- If you disable MAC address learning on a VLAN that includes a secure port, MAC address learning is not disabled on that port. If you disable port security, the configured MAC address learning state is enabled.

DETAILED STEPS

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**no mac address-table learning vlan** *vlan-id*	Disable MAC address learning on the specified VLAN or VLANs. You can specify a single VLAN ID or a range of VLAN IDs separated by a hyphen or comma. Valid VLAN IDs 1 to 4094. It cannot be an internal VLAN.
Step 3	**end**	Return to privileged EXEC mode.
Step 4	**show mac address-table learning** [**vlan** *vlan-id*]	Verify the configuration.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To reenable MAC address learning on a VLAN, use the **default mac address-table learning vlan** *vlan-id* global configuration command. You can also reenable MAC address learning on a VLAN by entering the **mac address-table learning vlan** *vlan-id* global configuration command. The first (**default**) command returns to a default condition and therefore does not appear in the output from the **show running-config** command. The second command causes the configuration to appear in the **show running-config** privileged EXEC command display.

EXAMPLE

This example shows how to disable MAC address learning on VLAN 200:

```
Switch(config)# no mac address-table learning vlan 200
```

You can display the MAC address learning status of all VLANs or a specified VLAN by entering the **show mac-address-table learning** [**vlan** *vlan-id*] privileged EXEC command.

Displaying Address Table Entries

Command	Description
show ip igmp snooping groups	Displays the Layer 2 multicast entries for all VLANs or the specified VLAN.
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.

Command	Description
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 notification	Displays the MAC notification parameters and history table.
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.

Verifying Configuration

Command	Purpose
show ntp associations [**detail**]	Display NTP information.
show ntp status	Display NTP information.
show clock [**detail**]	Display the time and date configuration.
show running-config	Display the DNS configuration.

Configuration Example

System Time and Date

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
```

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
```

This example shows how to configure a port to send NTP Version 2 packets:

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

This example shows how to configure a port to receive NTP broadcast packets:

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

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
```

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
```

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
```

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
```

MOTD Banner

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 that appears 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:
```

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)#
```

MAC Address Table

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-change notification feature, set the interval time to 123 seconds, set the history-size to 100 entries, and enable traps whenever a MAC address is added on the specified port:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification change
Switch(config)# mac address-table notification change
Switch(config)# mac address-table notification change interval 123
Switch(config)# mac address-table notification change history-size 100
```

```
Switch(config)# interface gigabitethernet0/2
Switch(config-if)# snmp trap mac-notification change added
```

This example shows how to specify 172.20.10.10 as the NMS, enable the switch to send MAC address move notification traps to the NMS, enable the MAC address move notification feature, and enable traps when a MAC address moves from one port to another:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification move
Switch(config)# mac address-table notification mac-move
```

This example shows how to specify 172.20.10.10 as the NMS, enable the MAC address threshold notification feature, set the interval time to 123 seconds, and set the limit to 78 percent:

```
Switch(config)# snmp-server host 172.20.10.10 traps private mac-notification
Switch(config)# snmp-server enable traps mac-notification threshold
Switch(config)# mac address-table notification threshold
Switch(config)# mac address-table notification threshold interval 123
Switch(config)# mac address-table notification threshold limit 78
```

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 port:

```
Switch(config)# mac address-table static c2f3.220a.12f4 vlan 4 interface
gigabitethernet0/1
```

This example shows how to enable unicast MAC address filtering and configure the switch to drop packets that have a source or destination address of c2f3.220a.12f4. When a packet is received in VLAN 4 with this MAC address as its source or destination, the packet is dropped:

```
Switch(config)# mac address-table static c2f3.220a.12f4 vlan 4 drop
```

This example shows how to disable MAC address learning on VLAN 200:

```
Switch(config)# no mac address-table learning vlan 200
```

Related Documents

- Cisco IOS Configuration Fundamentals Command Reference, Release 15.2M&T
- Cisco IOS Basic System Management Command Reference
- Cisco IOS IP Addressing Services Command Reference, Release 15.2M&T
- Cisco IOS Carrier Ethernet Command Reference
- IP Addressing: ARP Configuration Guide, Cisco IOS Release 15M&T
- Cisco IOS LAN Switching Command Reference
- Layer 2 Switching Software Configuration Guide for IE 2000U and Connected Grid Switches

Feature History

Platform	First Supported Release
IE 2000U	Cisco IOS Release 15.0(2)EH
CGS 2520	Cisco IOS Release 12.2(53)EX
Ethernet Switch Module (ESM) for CGR 2010	Cisco IOS Release 12.2(53)EX