Configuring SNMP

This chapter describes how to configure the Simple Network Management Protocol (SNMP) on the Catalyst 2960, 2960-S, or 2960-C switch. Unless otherwise noted, the term switch refers to a standalone switch and a switch stack.

Note
Stacking is supported only on Catalyst 2960-S switches running the LAN base image.

Note

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- Configuring SNMP, page 32-6
- Displaying SNMP Status, page 32-19

Understanding SNMP

SNMP is an application-layer protocol that provides a message format for communication between managers and agents. The SNMP system consists of an SNMP manager, an SNMP agent, and a MIB. The SNMP manager can be part of a network management system (NMS) such as CiscoWorks. The agent and MIB reside on the switch. To configure SNMP on the switch, you define the relationship between the manager and the agent.

The SNMP agent contains MIB variables whose values the SNMP manager can request or change. A manager can get a value from an agent or store a value into the agent. The agent gathers data from the MIB, the repository for information about device parameters and network data. The agent can also respond to a manager’s requests to get or set data.

An agent can send unsolicited traps to the manager. Traps are messages alerting the SNMP manager to a condition on the network. Traps can mean improper user authentication, restarts, link status (up or down), MAC address tracking, closing of a TCP connection, loss of connection to a neighbor, or other significant events.
The stack master handles the SNMP requests and traps for the whole switch stack. The stack master transparently manages any requests or traps that are related to all stack members. When a new stack master is elected, the new master continues to handle SNMP requests and traps as configured on the previous stack master, assuming that IP connectivity to the SNMP management stations is still in place after the new master has taken control.

For more information about switch stacks, see Chapter 9, “Managing Switch Stacks.”

These sections contain this conceptual information:
- SNMP Versions, page 32-2
- SNMP Manager Functions, page 32-3
- SNMP Agent Functions, page 32-4
- SNMP Community Strings, page 32-4
- Using SNMP to Access MIB Variables, page 32-5
- SNMP Notifications, page 32-5
- SNMP ifIndex MIB Object Values, page 32-6

**SNMP Versions**

This software release supports these SNMP versions:
- SNMPv1—The Simple Network Management Protocol, a Full Internet Standard, defined in RFC 1157.
- SNMPv2C replaces the Party-based Administrative and Security Framework of SNMPv2Classic with the community-string-based Administrative Framework of SNMPv2C while retaining the bulk retrieval and improved error handling of SNMPv2Classic. It has these features:
  - SNMPv2C—The community-string-based Administrative Framework for SNMPv2, an Experimental Internet Protocol defined in RFC 1901.
- SNMPv3—Version 3 of the SNMP is an interoperable standards-based protocol defined in RFCs 2273 to 2275. SNMPv3 provides secure access to devices by authenticating and encrypting packets over the network and includes these security features:
  - Message integrity—ensuring that a packet was not tampered with in transit
  - Authentication—determining that the message is from a valid source
  - Encryption—mixing the contents of a package to prevent it from being read by an unauthorized source.

\[\text{Note} \] To select encryption, enter the `priv` keyword. This keyword is available only when the cryptographic (encrypted) software image is installed.

Both SNMPv1 and SNMPv2C use a community-based form of security. The community of managers able to access the agent’s MIB is defined by an IP address access control list and password.
SNMPv2C includes a bulk retrieval mechanism and more detailed error message reporting to management stations. The bulk retrieval mechanism retrieves tables and large quantities of information, minimizing the number of round-trips required. The SNMPv2C improved error-handling includes expanded error codes that distinguish different kinds of error conditions; these conditions are reported through a single error code in SNMPv1. Error return codes in SNMPv2C report the error type.

SNMPv3 provides for both security models and security levels. A security model is an authentication strategy set up for a user and the group within which the user resides. A security level is the permitted level of security within a security model. A combination of the security level and the security model determine which security mechanism is used when handling an SNMP packet. Available security models are SNMPv1, SNMPv2C, and SNMPv3.

Table 32-1 identifies the characteristics of the different combinations of security models and levels.

<table>
<thead>
<tr>
<th>Model</th>
<th>Level</th>
<th>Authentication</th>
<th>Encryption</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNMPv1</td>
<td>noAuthNoPriv</td>
<td>Community string</td>
<td>No</td>
<td>Uses a community string match for authentication.</td>
</tr>
<tr>
<td>SNMPv2C</td>
<td>noAuthNoPriv</td>
<td>Community string</td>
<td>No</td>
<td>Uses a community string match for authentication.</td>
</tr>
<tr>
<td>SNMPv3</td>
<td>noAuthNoPriv</td>
<td>Username</td>
<td>No</td>
<td>Uses a username match for authentication.</td>
</tr>
<tr>
<td>SNMPv3</td>
<td>authNoPriv</td>
<td>Message Digest 5 (MD5) or Secure Hash Algorithm (SHA)</td>
<td>No</td>
<td>Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms.</td>
</tr>
</tbody>
</table>
| SNMPv3  | authPriv (requires the cryptographic software image) | MD5 or SHA | Data Encryption Standard (DES) or Advanced Encryption Standard (AES) | Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms. Allows specifying the User-based Security Model (USM) with these encryption algorithms:  
  - DES 56-bit encryption in addition to authentication based on the CBC-DES (DES-56) standard.  
  - 3DES 168-bit encryption  
  - AES 128-bit, 192-bit, or 256-bit encryption |

You must configure the SNMP agent to use the SNMP version supported by the management station. Because an agent can communicate with multiple managers, you can configure the software to support communications using SNMPv1, SNMPv2C, or SNMPv3.

**SNMP Manager Functions**

The SNMP manager uses information in the MIB to perform the operations described in Table 32-2.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>get-request</td>
<td>Retrieves a value from a specific variable.</td>
</tr>
<tr>
<td>get-next-request</td>
<td>Retrieves a value from a variable within a table.</td>
</tr>
</tbody>
</table>

1. SNMPv2C
Table 32-2  SNMP Operations (continued)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>get-bulk-request</td>
<td>Retrieves large blocks of data, such as multiple rows in a table, that would otherwise require the transmission of many small blocks of data.</td>
</tr>
<tr>
<td>get-response</td>
<td>Replies to a get-request, get-next-request, and set-request sent by an NMS.</td>
</tr>
<tr>
<td>set-request</td>
<td>Stores a value in a specific variable.</td>
</tr>
<tr>
<td>trap</td>
<td>An unsolicited message sent by an SNMP agent to an SNMP manager when some event has occurred.</td>
</tr>
</tbody>
</table>

1. With this operation, an SNMP manager does not need to know the exact variable name. A sequential search is performed to find the needed variable from within a table.

2. The get-bulk command only works with SNMPv2 or later.

SNMP Agent Functions

The SNMP agent responds to SNMP manager requests as follows:

- Get a MIB variable—The SNMP agent begins this function in response to a request from the NMS. The agent retrieves the value of the requested MIB variable and responds to the NMS with that value.
- Set a MIB variable—The SNMP agent begins this function in response to a message from the NMS. The SNMP agent changes the value of the MIB variable to the value requested by the NMS.

The SNMP agent also sends unsolicited trap messages to notify an NMS that a significant event has occurred on the agent. Examples of trap conditions include, but are not limited to, when a port or module goes up or down, when spanning-tree topology changes occur, and when authentication failures occur.

SNMP Community Strings

SNMP community strings authenticate access to MIB objects and function as embedded passwords. In order for the NMS to access the switch, the community string definitions on the NMS must match at least one of the three community string definitions on the switch.

A community string can have one of these attributes:

- Read-only (RO)—Gives read access to authorized management stations to all objects in the MIB except the community strings, but does not allow write access
- Read-write (RW)—Gives read and write access to authorized management stations to all objects in the MIB, but does not allow access to the community strings
- When a cluster is created, the command switch manages the exchange of messages among member switches and the SNMP application. The Network Assistant software appends the member switch number (@esN, where N is the switch number) to the first configured RW and RO community strings on the command switch and propagates them to the member switches. For more information, see Chapter 8, “Clustering Switches” and see Getting Started with Cisco Network Assistant, available on Cisco.com.
Understanding SNMP

Using SNMP to Access MIB Variables

An example of an NMS is the CiscoWorks network management software. CiscoWorks 2000 software uses the switch MIB variables to set device variables and to poll devices on the network for specific information. The results of a poll can be displayed as a graph and analyzed to troubleshoot internetworking problems, increase network performance, verify the configuration of devices, monitor traffic loads, and more.

As shown in Figure 32-1, the SNMP agent gathers data from the MIB. The agent can send traps, or notification of certain events, to the SNMP manager, which receives and processes the traps. Traps alert the SNMP manager to a condition on the network such as improper user authentication, restarts, link status (up or down), MAC address tracking, and so forth. The SNMP agent also responds to MIB-related queries sent by the SNMP manager in \textit{get-request}, \textit{get-next-request}, and \textit{set-request} format.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{snmp_network.png}
\caption{SNMP Network}
\end{figure}

SNMP Notifications

SNMP allows the switch to send notifications to SNMP managers when particular events occur. SNMP notifications can be sent as traps or inform requests. In command syntax, unless there is an option in the command to select either traps or informs, the keyword \textit{traps} refers to either traps or informs, or both. Use the \texttt{snmp-server host} command to specify whether to send SNMP notifications as traps or informs.

\begin{note}
SNMPv1 does not support informs.
\end{note}

Traps are unreliable because the receiver does not send an acknowledgment when it receives a trap, and the sender cannot determine if the trap was received. When an SNMP manager receives an inform request, it acknowledges the message with an SNMP response protocol data unit (PDU). If the sender does not receive a response, the inform request can be sent again. Because they can be re-sent, informs are more likely than traps to reach their intended destination.

The characteristics that make informs more reliable than traps also consume more resources in the switch and in the network. Unlike a trap, which is discarded as soon as it is sent, an inform request is held in memory until a response is received or the request times out. Traps are sent only once, but an inform might be re-sent or retried several times. The retries increase traffic and contribute to a higher overhead on the network. Therefore, traps and informs require a trade-off between reliability and resources. If it is important that the SNMP manager receive every notification, use inform requests. If traffic on the network or memory in the switch is a concern and notification is not required, use traps.
SNMP ifIndex MIB Object Values

In an NMS, the IF-MIB generates and assigns an interface index (ifIndex) object value that is a unique number greater than zero to identify a physical or a logical interface. When the switch reboots or the switch software is upgraded, the switch uses this same value for the interface. For example, if the switch assigns a port 2 an ifIndex value of 10003, this value is the same after the switch reboots.

The switch uses one of the values in Table 32-3 to assign an ifIndex value to an interface:

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>ifIndex Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVI</td>
<td>1–4999</td>
</tr>
<tr>
<td>EtherChannel</td>
<td>5001–5048</td>
</tr>
<tr>
<td>Physical (such as Gigabit Ethernet or SFP^2-module interfaces) based on type and port numbers</td>
<td>10000–14500</td>
</tr>
<tr>
<td>Null</td>
<td>10501 (nonstackable switches) 14501 (stackable switches)</td>
</tr>
<tr>
<td>Loopback and Tunnel</td>
<td>24567 +</td>
</tr>
</tbody>
</table>

^1 SVI = switch virtual interface
^2 SFP = small form-factor pluggable

Note

The switch might not use sequential values within a range.

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- Disabling the SNMP Agent, page 32-8
- Configuring Community Strings, page 32-8
- Configuring SNMP Groups and Users, page 32-10
- Configuring SNMP Notifications, page 32-13
- Setting the CPU Threshold Notification Types and Values, page 32-16
- Setting the Agent Contact and Location Information, page 32-17
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- SNMP Examples, page 32-18
Default SNMP Configuration

Table 32-4 shows the default SNMP configuration.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNMP agent</td>
<td>Disabled (^1).</td>
</tr>
<tr>
<td>SNMP trap receiver</td>
<td>None configured.</td>
</tr>
<tr>
<td>SNMP traps</td>
<td>None enabled except the trap for TCP connections (tty).</td>
</tr>
<tr>
<td>SNMP version</td>
<td>If no <strong>version</strong> keyword is present, the default is Version 1.</td>
</tr>
<tr>
<td>SNMPv3 authentication</td>
<td>If no keyword is entered, the default is the <strong>noauth</strong> (noAuthNoPriv) security level.</td>
</tr>
<tr>
<td>SNMP notification type</td>
<td>If no type is specified, all notifications are sent.</td>
</tr>
</tbody>
</table>

\(^1\) This is the default when the switch starts and the startup configuration does not have any **snmp-server** global configuration commands.

SNMP Configuration Guidelines

If the switch starts and the switch startup configuration has at least one **snmp-server** global configuration command, the SNMP agent is enabled.

An SNMP group is a table that maps SNMP users to SNMP views. An SNMP user is a member of an SNMP group. An SNMP host is the recipient of an SNMP trap operation. An SNMP engine ID is a name for the local or remote SNMP engine.

When configuring SNMP, follow these guidelines:

- When configuring an SNMP group, do not specify a notify view. The **snmp-server host** global configuration command autogenerates a notify view for the user and then adds it to the group associated with that user. Modifying the group’s notify view affects all users associated with that group. See the Cisco IOS Network Management Command Reference for information about when you should configure notify views.
- To configure a remote user, specify the IP address or port number for the remote SNMP agent of the device where the user resides.
- Before you configure remote users for a particular agent, configure the SNMP engine ID, using the **snmp-server engineID** global configuration with the **remote** option. The remote agent’s SNMP engine ID and user password are used to compute the authentication and privacy digests. If you do not configure the remote engine ID first, the configuration command fails.
- When configuring SNMP informs, you need to configure the SNMP engine ID for the remote agent in the SNMP database before you can send proxy requests or informs to it.
- If a local user is not associated with a remote host, the switch does not send informs for the **auth** (authNoPriv) and the **priv** (authPriv) authentication levels.
- Changing the value of the SNMP engine ID has important side effects. A user’s password (entered on the command line) is converted to an MD5 or SHA security digest based on the password and the local engine ID. The command-line password is then destroyed, as required by RFC 2274. Because of this deletion, if the value of the engine ID changes, the security digests of SNMPv3 users become
invalid, and you need to reconfigure SNMP users by using the `snmp-server user username` global configuration command. Similar restrictions require the reconfiguration of community strings when the engine ID changes.

- The `snmp-server inform retries number timeout seconds pending number` global configuration command is used to specify the retry options for the SNMP server. The retry interval is exponential, and is calculated as $2^{\text{retry number}} \times \text{retry timer}$.

### Disabling the SNMP Agent

Beginning in privileged EXEC mode, follow these steps to disable the SNMP agent:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> configure terminal</td>
<td>Enter global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 2</strong> no snmp-server</td>
<td>Disable the SNMP agent operation.</td>
</tr>
<tr>
<td><strong>Step 3</strong> end</td>
<td>Return to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 4</strong> show running-config</td>
<td>Verify your entries.</td>
</tr>
<tr>
<td><strong>Step 5</strong> copy running-config startup-config</td>
<td>(Optional) Save your entries in the configuration file.</td>
</tr>
</tbody>
</table>

The `no snmp-server` global configuration command disables all running versions (Version 1, Version 2C, and Version 3) on the device. No specific Cisco IOS command exists to enable SNMP. The first `snmp-server` global configuration command that you enter enables all versions of SNMP.

### Configuring Community Strings

You use the SNMP community string to define the relationship between the SNMP manager and the agent. The community string acts like a password to permit access to the agent on the switch. Optionally, you can specify one or more of these characteristics associated with the string:

- An access list of IP addresses of the SNMP managers that are permitted to use the community string to gain access to the agent
- A MIB view, which defines the subset of all MIB objects accessible to the given community
- Read and write or read-only permission for the MIB objects accessible to the community
Beginning in privileged EXEC mode, follow these steps to configure a community string on the switch:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>configure terminal</td>
<td>Enter global configuration mode.</td>
</tr>
<tr>
<td>snmp-server community string [view view-name] [ro</td>
<td>rw] [access-list-number]</td>
</tr>
<tr>
<td>access-list access-list-number {deny</td>
<td>permit} source [source-wildcard]</td>
</tr>
<tr>
<td>end</td>
<td>Return to privileged EXEC mode.</td>
</tr>
<tr>
<td>show running-config</td>
<td>Verify your entries.</td>
</tr>
<tr>
<td>copy running-config startup-config</td>
<td>(Optional) Save your entries in the configuration file.</td>
</tr>
</tbody>
</table>

**Note** To disable access for an SNMP community, set the community string for that community to the null string (do not enter a value for the community string).

To remove a specific community string, use the `no snmp-server community string` global configuration command.
This example shows how to assign the string `comaccess` to SNMP, to allow read-only access, and to specify that IP access list 4 can use the community string to gain access to the switch SNMP agent:

```
Switch(config)# snmp-server community comaccess ro 4
```

### Configuring SNMP Groups and Users

You can specify an identification name (engine ID) for the local or remote SNMP server engine on the switch. You can configure an SNMP server group that maps SNMP users to SNMP views, and you can add new users to the SNMP group.

Beginning in privileged EXEC mode, follow these steps to configure SNMP on the switch:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>`snmp-server engineID [local engineid-string</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| | | • If you select `remote`, specify the `ip-address` of the device that contains the remote copy of SNMP and the optional User Datagram Protocol (UDP) port on the remote device. The default is 162.
Step 3

`snmp-server group groupname {v1 | v2c | v3 {auth | noauth | priv} [read readview] [write writeview] [notify notifyview] [access access-list]}

Configure a new SNMP group on the remote device.

- For `groupname`, specify the name of the group.
- Specify a security model:
  - `v1` is the least secure of the possible security models.
  - `v2c` is the second least secure model. It allows transmission of informs and integers twice the normal width.
  - `v3`, the most secure, requires you to select an authentication level:
    - `auth`—Enables the Message Digest 5 (MD5) and the Secure Hash Algorithm (SHA) packet authentication.
    - `noauth`—Enables the noAuthNoPriv security level. This is the default if no keyword is specified.
    - `priv`—Enables Data Encryption Standard (DES) packet encryption (also called privacy).

Note: The `priv` keyword is available only when the cryptographic software image is installed.

- (Optional) Enter `read readview` with a string (not to exceed 64 characters) that is the name of the view in which you can only view the contents of the agent.
- (Optional) Enter `write writeview` with a string (not to exceed 64 characters) that is the name of the view in which you enter data and configure the contents of the agent.
- (Optional) Enter `notify notifyview` with a string (not to exceed 64 characters) that is the name of the view in which you specify a notify, inform, or trap.
- (Optional) Enter `access access-list` with a string (not to exceed 64 characters) that is the name of the access list.
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Step 4

```
snmp-server user username groupname
  [remote host [udp-port port]] [v1 [access access-list] | v2c [access access-list] | v3 [encrypted] [access access-list] [auth {md5 [sha] auth-password}] [priv {des | 3des | aes {128 | 192 | 256}}] priv-password]
```

Command Purpose

Add a new user for an SNMP group.

- The `username` is the name of the user on the host that connects to the agent.
- The `groupname` is the name of the group to which the user is associated.
- Enter `remote` to specify a remote SNMP entity to which the user belongs and the hostname or IP address of that entity with the optional UDP port number. The default is 162.
- Enter the SNMP version number (`v1`, `v2c`, or `v3`). If you enter `v3`, you have these additional options:
  - `encrypted` specifies that the password appears in encrypted format. This keyword is available only when the `v3` keyword is specified.
  - `auth` is an authentication level setting session that can be either the HMAC-MD5-96 (`md5`) or the HMAC-SHA-96 (`sha`) authentication level and requires a password string `auth-password` (not to exceed 64 characters).
  - If you enter `v3` and the switch is running the cryptographic software image, you can also configure a private (`priv`) encryption algorithm and password string `priv-password` (not to exceed 64 characters).
    - `priv` specifies the User-based Security Model (USM).
    - `des` specifies the use of the 56-bit DES algorithm.
    - `3des` specifies the use of the 168-bit DES algorithm.
    - `aes` specifies the use of the DES algorithm. You must select either 128-bit, 192-bit, or 256-bit encryption.
  - (Optional) Enter `access access-list` with a string (not to exceed 64 characters) that is the name of the access list.

Step 5

```
end
```

Return to privileged EXEC mode.

Step 6

```
show running-config
```

Verify your entries.

Note To display SNMPv3 information about `auth` | `noauth` | `priv` mode configuration, you must enter the `show snmp user` privileged EXEC command.

Step 7

```
copy running-config startup-config
```

(Optional) Save your entries in the configuration file.
Configuring SNMP Notifications

A trap manager is a management station that receives and processes traps. Traps are system alerts that the switch generates when certain events occur. By default, no trap manager is defined, and no traps are sent. Switches running this Cisco IOS release can have an unlimited number of trap managers.

Note

Many commands use the word traps in the command syntax. Unless there is an option in the command to select either traps or informs, the keyword traps refers to traps, informs, or both. Use the snmp-server host global configuration command to specify whether to send SNMP notifications as traps or informs.

Table 32-5 describes the supported switch traps (notification types). You can enable any or all of these traps and configure a trap manager to receive them. To enable the sending of SNMP inform notifications, use the snmp-server enable traps global configuration command combined with the snmp-server host host-addr informs global configuration command.

<table>
<thead>
<tr>
<th>Notification Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bridge</td>
<td>Generates STP bridge MIB traps.</td>
</tr>
<tr>
<td>cluster</td>
<td>Generates a trap when the cluster configuration changes.</td>
</tr>
<tr>
<td>config</td>
<td>Generates a trap for SNMP configuration changes.</td>
</tr>
<tr>
<td>copy-config</td>
<td>Generates a trap for SNMP copy configuration changes.</td>
</tr>
<tr>
<td>entity</td>
<td>Generates a trap for SNMP entity changes.</td>
</tr>
<tr>
<td>cpu threshold</td>
<td>Allow CPU-related traps. This trap is supported only when the switch is running the LAN Base image.</td>
</tr>
<tr>
<td>envmon</td>
<td>Generates environmental monitor traps. You can enable any or all of these environmental traps: fan, shutdown, status, supply, temperature.</td>
</tr>
<tr>
<td>errdisable</td>
<td>Generates a trap for a port VLAN(errdisabled). You can also set a maximum trap rate per minute. The range is from 0 to 10000; the default is 0, which means there is no rate limit.</td>
</tr>
<tr>
<td>flash</td>
<td>Generates SNMP FLASH notifications. You can optionally enable notification for flash insertion or removal, which would cause a trap to be issued whenever a switch in the stack is removed or inserted (physical removal, power cycle, or reload).</td>
</tr>
<tr>
<td>fru-ctrl</td>
<td>Generates entity field-replaceable unit (FRU) control traps. In the switch stack, this trap refers to the insertion or removal of a switch in the stack.</td>
</tr>
<tr>
<td>ipmulticast</td>
<td>Generates a trap for IP multicast routing changes.</td>
</tr>
<tr>
<td>mac-notification</td>
<td>Generates a trap for MAC address notifications.</td>
</tr>
<tr>
<td>msdp</td>
<td>Generates a trap for Multicast Source Discovery Protocol (MSDP) changes.</td>
</tr>
<tr>
<td>ospf</td>
<td>Generates a trap for Open Shortest Path First (OSPF) changes. You can enable any or all of these traps: Cisco specific, errors, link-state advertisement, rate limit, retransmit, and state changes.</td>
</tr>
<tr>
<td>pim</td>
<td>Generates a trap for Protocol-Independent Multicast (PIM) changes. You can enable any or all of these traps: invalid PIM messages, neighbor changes, and rendezvous point (RP)-mapping changes.</td>
</tr>
</tbody>
</table>
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Configuring SNMP

Note Though visible in the command-line help strings, the insertion, and removal keywords are not supported.

You can use the **snmp-server host** global configuration command to a specific host to receive the notification types listed in Table 32-5.

Beginning in privileged EXEC mode, follow these steps to configure the switch to send traps or informs to a host:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> configure terminal</td>
<td>Enter global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 2</strong> snmp-server engineID remote ip-address engineid-string</td>
<td>Specify the engine ID for the remote host.</td>
</tr>
</tbody>
</table>
| **Step 3** snmp-server user username groupname [*remote host [udp-port port]] [v1 [access access-list] | v2c [access access-list] | v3 [encrypted] [access access-list] [auth {md5 | sha} auth-password]] | Configure an SNMP user to be associated with the remote host created in Step 2.  

**Note** You cannot configure a remote user for an address without first configuring the engine ID for the remote host. Otherwise, you receive an error message, and the command is not executed.
### Configuring SNMP

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 4**

```plaintext
snmp-server group groupname {v1 | v2c | v3 [auth | noauth | priv]} [read
readview] [write writeview] [notify
notifyview] [access access-list]
```  

Configure an SNMP group.

| **Step 5**

```plaintext
snmp-server host host-addr
[informs | traps] [version {1 | 2c | 3
[auth | noauth | priv}]]
community-string [notification-type]
```  

Specify the recipient of an SNMP trap operation.

- For `host-addr`, specify the name or Internet address of the host (the targeted recipient).
- (Optional) Enter `informs` to send SNMP informs to the host.
- (Optional) Enter `traps` (the default) to send SNMP traps to the host.
- (Optional) Specify the SNMP `version` (1, 2c, or 3). SNMPv1 does not support informs.
- (Optional) For Version 3, select authentication level `auth`, `noauth`, or `priv`.

**Note**  The `priv` keyword is available only when the cryptographic software image is installed.

- For `community-string`, when `version 1` or `version 2c` is specified, enter the password-like community string sent with the notification operation. When `version 3` is specified, enter the SNMPv3 username.

**Note**  The `@` symbol is used for delimiting the context information. Avoid using the `@` symbol as part of the SNMP community string when configuring this command.

- (Optional) For `notification-type`, use the keywords listed in Table 32-5 on page 32-13. If no type is specified, all notifications are sent.

| **Step 6**

```plaintext
snmp-server enable traps
notification-types
```  

Enable the switch to send traps or informs and specify the type of notifications to be sent. For a list of notification types, see Table 32-5 on page 32-13, or enter `snmp-server enable traps ?`

To enable multiple types of traps, you must enter a separate `snmp-server enable traps` command for each trap type.

**Note**  When you configure a trap by using the notification type `port-security`, configure the port security trap first, and then configure the port security trap rate:

- `snmp-server enable traps port-security`
- `snmp-server enable traps port-security trap-rate rate`

| **Step 7**

```plaintext
snmp-server trap-source interface-id
```  

(Optional) Specify the source interface, which provides the IP address for the trap message. This command also sets the source IP address for informs.

| **Step 8**

```plaintext
snmp-server queue-length length
```  

(Optional) Establish the message queue length for each trap host. The range is 1 to 1000; the default is 10.

| **Step 9**

```plaintext
snmp-server trap-timeout seconds
```  

(Optional) Define how often to resend trap messages. The range is 1 to 1000; the default is 30 seconds.

| **Step 10**

```plaintext
end
```  

Return to privileged EXEC mode.
Chapter 32      Configuring SNMP

Configuring SNMP

The `snmp-server host` command specifies which hosts receive the notifications. The `snmp-server enable trap` command globally enables the mechanism for the specified notification (for traps and informs). To enable a host to receive an inform, you must configure an `snmp-server host informs` command for the host and globally enable informs by using the `snmp-server enable traps` command.

To remove the specified host from receiving traps, use the `no snmp-server host` global configuration command. The `no snmp-server host` command with no keywords disables traps, but not informs, to the host. To disable informs, use the `no snmp-server host informs` global configuration command. To disable a specific trap type, use the `no snmp-server enable traps notification-types` global configuration command.

Setting the CPU Threshold Notification Types and Values

Beginning in privileged EXEC mode, follow these steps to set the CPU threshold notification types and values:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>configure terminal</td>
</tr>
<tr>
<td>Step 2</td>
<td>process cpu threshold type {total</td>
</tr>
<tr>
<td></td>
<td>total</td>
</tr>
<tr>
<td></td>
<td>process</td>
</tr>
<tr>
<td></td>
<td>interrupt</td>
</tr>
<tr>
<td></td>
<td>rising percentage</td>
</tr>
<tr>
<td></td>
<td>interval seconds</td>
</tr>
<tr>
<td></td>
<td>falling fall-percentage interval seconds</td>
</tr>
<tr>
<td>Step 3</td>
<td>end</td>
</tr>
<tr>
<td>Step 4</td>
<td>show running-config</td>
</tr>
<tr>
<td>Step 5</td>
<td>copy running-config startup-config</td>
</tr>
</tbody>
</table>
Setting the Agent Contact and Location Information

Beginning in privileged EXEC mode, follow these steps to set the system contact and location of the SNMP agent so that these descriptions can be accessed through the configuration file:

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>configure terminal</td>
<td>Enter global configuration mode.</td>
</tr>
<tr>
<td>2</td>
<td>snmp-server contact text</td>
<td>Set the system contact string.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: snmp-server contact Dial System Operator at beeper 21555.</td>
</tr>
<tr>
<td>3</td>
<td>snmp-server location text</td>
<td>Set the system location string.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For example: snmp-server location Building 3/Room 222</td>
</tr>
<tr>
<td>4</td>
<td>end</td>
<td>Return to privileged EXEC mode.</td>
</tr>
<tr>
<td>5</td>
<td>show running-config</td>
<td>Verify your entries.</td>
</tr>
<tr>
<td>6</td>
<td>copy running-config startup-config</td>
<td>(Optional) Save your entries in the configuration file.</td>
</tr>
</tbody>
</table>

Limiting TFTP Servers Used Through SNMP

Beginning in privileged EXEC mode, follow these steps to limit the TFTP servers used for saving and loading configuration files through SNMP to the servers specified in an access list:

<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>configure terminal</td>
<td>Enter global configuration mode.</td>
</tr>
<tr>
<td>2</td>
<td>snmp-server tftp-server-list access-list-number</td>
<td>Limit TFTP servers used for configuration file copies through SNMP to the servers in the access list.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For access-list-number, enter an IP standard access list numbered from 1 to 99 and 1300 to 1999.</td>
</tr>
<tr>
<td>3</td>
<td>access-list access-list-number [deny</td>
<td>permit] source [source-wildcard]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• For access-list-number, enter the access list number specified in Step 2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The deny keyword denies access if the conditions are matched. The permit keyword permits access if the conditions are matched.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• For source, enter the IP address of the TFTP servers that can access the switch.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• (Optional) For source-wildcard, enter the wildcard bits, in dotted decimal notation, to be applied to the source. Place ones in the bit positions that you want to ignore.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recall that the access list is always terminated by an implicit deny statement for everything.</td>
</tr>
</tbody>
</table>
### SNMP Examples

This example shows how to enable all versions of SNMP. The configuration permits any SNMP manager to access all objects with read-only permissions using the community string `public`. This configuration does not cause the switch to send any traps.

```
Switch(config)# snmp-server community public
```

This example shows how to permit any SNMP manager to access all objects with read-only permission using the community string `public`. The switch also sends VTP traps to the hosts 192.180.1.111 and 192.180.1.33 using SNMPv1 and to the host 192.180.1.27 using SNMPv2C. The community string `public` is sent with the traps.

```
Switch(config)# snmp-server community public
Switch(config)# snmp-server enable traps vtp
Switch(config)# snmp-server host 192.180.1.27 version 2c public
Switch(config)# snmp-server host 192.180.1.111 version 1 public
Switch(config)# snmp-server host 192.180.1.33 public
```

This example shows how to allow read-only access for all objects to members of access list 4 that use the `comaccess` community string. No other SNMP managers have access to any objects. SNMP Authentication Failure traps are sent by SNMPv2C to the host `cisco.com` using the community string `public`.

```
Switch(config)# snmp-server community comaccess ro 4
Switch(config)# snmp-server enable traps snmp authentication
Switch(config)# snmp-server host cisco.com version 2c public
```

This example shows how to send Entity MIB traps to the host `cisco.com`. The community string is restricted. The first line enables the switch to send Entity MIB traps in addition to any traps previously enabled. The second line specifies the destination of these traps and overwrites any previous `snmp-server host` commands for the host `cisco.com`.

```
Switch(config)# snmp-server enable traps entity
Switch(config)# snmp-server host cisco.com restricted entity
```

This example shows how to enable the switch to send all traps to the host `myhost.cisco.com` using the community string `public`:

```
Switch(config)# snmp-server enable traps
Switch(config)# snmp-server host myhost.cisco.com public
```

This example shows how to associate a user with a remote host and to send `auth` (authNoPriv) authentication-level informs when the user enters global configuration mode:

```
Switch(config)# snmp-server engineID remote 192.180.1.27 00000063000100a1c0b4011b
Switch(config)# snmp-server group authgroup v3 auth
Switch(config)# snmp-server user authuser authgroup remote 192.180.1.27 v3 auth md5
Switch(config)# snmp-server user authuser authgroup v3 auth md5 mypassword
Switch(config)# snmp-server host 192.180.1.27 informs version 3 auth authuser config
Switch(config)# snmp-server enable traps
Switch(config)# snmp-server inform retries 0
```

---

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 4</strong></td>
<td>Return to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Verify your entries.</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>(Optional) Save your entries in the configuration file.</td>
</tr>
</tbody>
</table>
Displaying SNMP Status

To display SNMP input and output statistics, including the number of illegal community string entries, errors, and requested variables, use the `show snmp` privileged EXEC command. You also can use the other privileged EXEC commands in Table 32-6 to display SNMP information. For information about the fields in the displays, see the Cisco IOS Configuration Fundamentals Command Reference.

**Table 32-6 Commands for Displaying SNMP Information**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>show snmp</td>
<td>Displays SNMP statistics.</td>
</tr>
<tr>
<td>show snmp engineID</td>
<td>Displays information on the local SNMP engine and all remote engines that have been configured on the device.</td>
</tr>
<tr>
<td>show snmp group</td>
<td>Displays information on each SNMP group on the network.</td>
</tr>
<tr>
<td>show snmp pending</td>
<td>Displays information on pending SNMP requests.</td>
</tr>
<tr>
<td>show snmp sessions</td>
<td>Displays information on the current SNMP sessions.</td>
</tr>
<tr>
<td>show snmp user</td>
<td>Displays information on each SNMP user name in the SNMP users table.</td>
</tr>
</tbody>
</table>

**Note** You must use this command to display SNMPv3 configuration information for **auth | noauth | priv** mode. This information is not displayed in the `show running-config` output.