



Configuring System Security and AAA Services

Security can be independently configured for each of the following management paths:

- Command-line interface (CLI)—You can access the CLI using one of three connection options:
 - Console (serial connection)
 - Telnet
 - Secure Shell Protocol (SSH)
- Simple Network Management Protocol (SNMP)—The SNMP agent supports security features FOR versions 1, 2c, and 3. Normal SNMP security mechanisms apply to all applications that use SNMP (for example, Cisco MDS 9000 Fabric Manager).



Note

Refer to the *Cisco MDS 9000 Family Fabric Manager User Guide* for information on this management tool.

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Management Security Features

Table 14-1 shows the security features of the Cisco MDS 9000 Family switches.

Table 14-1 Management Security Features

Security Features	CLI (Console or Telnet/SSH Access)	SNMP (v1, v2c, and v3 access)
User authentication	Local and RADIUS	Local only
Role-based authorization	Local and RADIUS	Local only
Accounting	Local and RADIUS	Local and RADIUS (only logs configuration commands)
Encryption management access	SSH only (not applicable for console or Telnet access)	SNMPv3
Anti-replay attack and prevention of man-in-middle attack		



Note

Users and roles configured through the CLI are different from users and roles configured through SNMP. These configurations do not directly correspond with each other. However, you can configure both CLI and SNMP identically, if required.

User Authentication

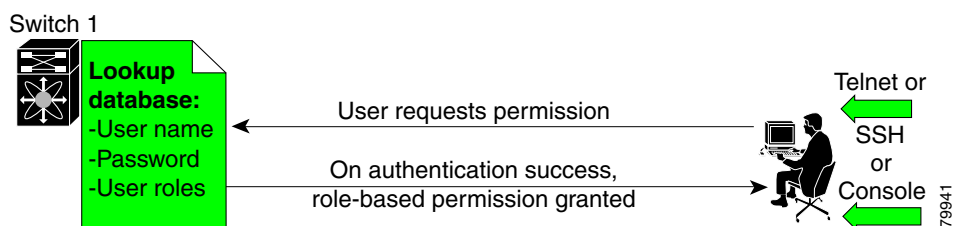
Authentication is the process of verifying the identity of the person managing the switch. This identity verification is based on the user ID and password combination provided by the person trying to manage the switch. Cisco MDS 9000 Family switches allow you to perform local authentication (using the lookup database) or remote authentication (using one or more RADIUS servers).

For each management path (console or Telnet and SSH), you can enable only one of three options—local, RADIUS, or none. The option can be different for each path.

Local Authentication

The system maintains the user name and password locally and stores the password information in encrypted form. You are authenticated based on the locally stored information (see [Figure 14-1](#)).

Figure 14-1 Local Authentication



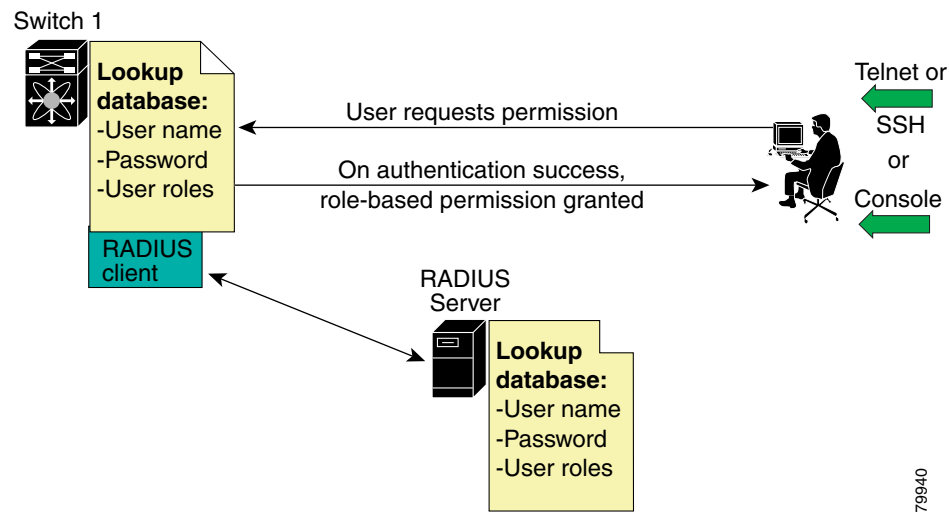
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RADIUS Authentication

Cisco MDS 9000 Family switches provide remote authentication through RADIUS servers. You can also configure multiple RADIUS servers, and each server is tried in the order specified.

RADIUS protocols support one-time password (OTP) schemes that all switches can make use of for authentication purposes (see [Figure 14-2](#)).

Figure 14-2 RADIUS Authentication



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Role-Based Authorization

By default, two roles exist in all switches:

- Network operator (**network-operator**)—Has permission to view the configuration only. The operator cannot make any configuration changes.
- Network administrator (**network-admin**)— Has permission to execute all commands and make configuration changes. The administrator can also create and customize up to 64 additional roles.

The two default roles cannot be changed or deleted. Vendor-specific attributes (VSAs) contain the user profile information used by the switch. To use this option, configure the VSAs on the RADIUS servers.

Accounting

Accounting refers to the log that is kept for each management session in a switch. This information may be used to generate reports for troubleshooting purposes and user accountability. Accounting can be implemented locally and remotely (using RADIUS).

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Authentication and Authorization Process

The following steps explain the authorization and authentication process. Figure 14-3 shows a flow chart of the process.

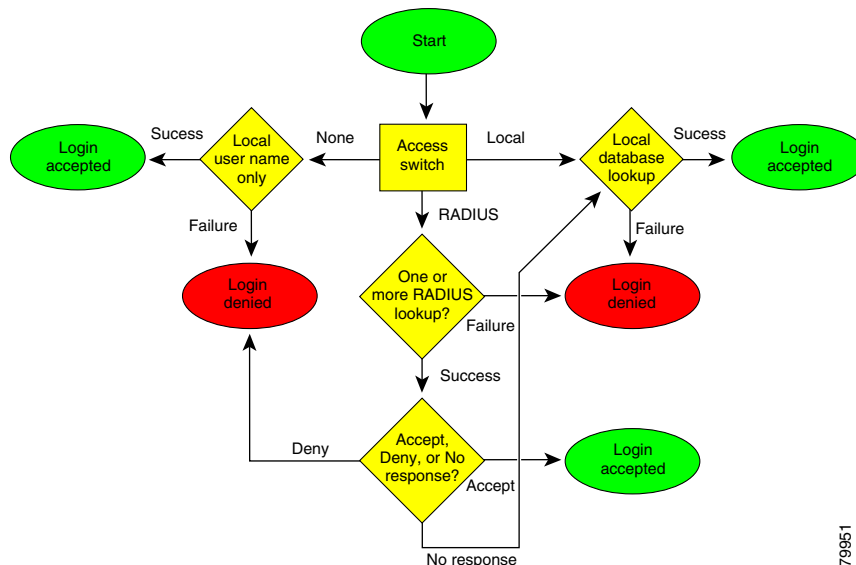
-
- Step 1** The switch software receives your user ID and password through a console or Telnet (or SSH) application.
- Step 2** The remote server is contacted if remote authentication is enabled, or else local authentication is performed.



Note If remote authentication is enabled but none of the servers are available (network failure), local authentication is performed.

- Step 3** If authentication is successful, you are given access to the switch with appropriate permissions based on the roles to which you belong. These roles can be configured locally or can be sent by the remote server during the authentication process.
- Step 4** If remote authentication is rejected, you are denied access and an appropriate message is issued.
-

Figure 14-3 Switch Authorization and Authentication Flow



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Configuring CLI Authentication Methods

You can configure remote and local authentication for Telnet, SSH, or console access. These commands are restricted to privileged users as determined by your administrator.

Setting AAA Authentication

You can individually set authentication options for console or Telnet (and SSH) access using the **aaa authentication login** command. Local authentication is always disabled by default (see the “Authentication and Authorization Process” section on page 14-4).

To configure the authentication option, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# aaa authentication login radius telnet switch(config)#	Enables Telnet authentication (and SSH) to use RADIUS.
	switch(config)# aaa authentication login radius console switch(config)#	Enables console authentication to use RADIUS.
	switch(config)# aaa authentication login local telnet	Enables only local authentication for Telnet (and SSH) access.
	Note This command applies to both Telnet and SSH.	The local option disables other authentication methods and configures local authentication to be used exclusively.
	switch(config)# aaa authentication login none console	Disables authentication for console access. User name authentication is still done.

Enabling or Disabling Telnet Access

You can use the **telnet server enable** command to enable Telnet access to the switch. By default, this service is enabled.

To enable or disable Telnet access to the switch, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# telnet server enable switch(config)#	Turns on Telnet access to the switch.
	switch(config)# no telnet server enable switch(config)#	Turns off Telnet access to the switch.

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Displaying CLI Authentication Commands

The **show authentication** command displays the configured authentication methods. See [Example 14-1](#).

Example 14-1 Displays Authentication Information

```
switch# show authentication
authentication method:none
    console:not enabled
    telnet/ssh:not enabled
authentication method:radius
    console:not enabled
    telnet/ssh:not enabled
authentication method:local
    console:enabled
    telnet/ssh:enabled
```

The **show telnet server** command displays the state of the Telnet access configuration. See [Example 14-2](#).

Example 14-2 Displays Telnet Server Details

```
switch# show telnet server
telnet service enabled
```

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Configuring Role-Based CLI Authorization

Switches in the Cisco MDS 9000 Family perform authentication based on roles. Role-based authorization limits access to switch operations by assigning users to roles. This kind of authentication restricts you to management operations based on the roles to which you have been added.

When you execute a command, perform command completion, or obtain context sensitive help, the switch software allows the operation to progress if you have permission to access that command.

To configure a new role or to modify the profile for an existing role, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# role name techdocs switch(config-role)#	Places you in the mode for the specified role (techdocs). Note The role submode prompt indicates that you are now in the role submode. This submode is now specific to the techdocs group.
	switch(config)# no role name techdocs	Deletes the role called techdocs.
Step 3	switch(config-role)# description Entire Tech. Docs. group	Includes all users in the Tech. Docs. group. The description is restricted to one line and can contain spaces.
	switch(config-role)# no description	Resets the description for the Tech. Docs. group.

Each role can contain multiple users and each user can be part of multiple roles. For example, if role1 users are only allowed to perform configuration commands, and role2 users are only allowed to perform debug commands, then if Joe belongs to both role1 and role2, he can perform configuration as well as debug commands.



Note

If you belong to multiple roles, you can execute a superset of all the commands permitted by these roles. Access to a command takes priority over being denied access to a command. For example, suppose you belong to a TechDocs group and you were denied access to configuration commands. However, you also belong to the engineering group and have access to configuration commands. In this case, you will have access to configuration commands.



Tip

Any role, when created, does not allow access to the required commands immediately. The administrator must configure appropriate rules for each role to allow access to the required commands.

Configuring Rules and Features for Each Role

The **rule** command specifies rules for a specific group using the order in which they were issued. The order is important because the order in which they were issued is the order in which they are applied.

The **feature** option specifies the features accessible for this rule (for example, FSPF, zone, VSAN, fcping, interface). If no features are specified, the rule applies to all **show**, **debug**, **clear**, configuration commands, and all **exec** commands.

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**Note**

In this case, **exec** commands refer to all commands in the EXEC mode that do not fall in the **show**, **debug**, and **clear**, categories. Up to 16 rules can be configured for each role.

To configure a new role or to modify the profile for an existing role, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# role name sangroup switch(config-role)#	Places you in role mode for the sangroup role submode.
Step 3	switch(config-role)# rule 1 permit config switch(config-role)# rule 2 deny config feature fspf switch(config-role)# rule 3 permit debug feature zone switch(config-role)# rule 4 permit exec feature fcping	Allows users belonging to the <i>sangroup</i> role to perform all configuration commands except fspf config commands. They can also perform zone debug commands and the fcping EXEC mode command.
Step 4	switch(config-role)# no rule 4	Deletes rule 4 which no longer permits the <i>sangroup</i> to perform the fcping command.

In Step 3, rule 1 is applied first, thus permitting all **config** commands to sangroup users. Rule 2 is applied next, denying FSPF configuration to sangroup users. As a result, sangroup users can perform all other **config** commands, except **fspf** configuration commands.

**Note**

The order of rule placement is important. If you had swapped these two rules and issued the **deny config feature fspf** rule first and issued the **permit config** rule next, you would be allowing all sangroup users to perform all configuration commands since the second rule globally overrode the first rule.

Displaying Role-Based CLI Information

Use the **show role** command to display rules configured on the switch including those rules that have not yet been committed to persistent storage. The rules are displayed by rule number and are based on each role. All roles are displayed even if role name is not specified. See [Example 14-3](#).

Example 14-3 Displays Information for All Roles

```
switch# show role
Role: network-admin
Description: Predefined Network Admin group. This role cannot be modified
Access to all the switch commands
Role: network-operator
Description: Predefined Network Operator group. This role cannot be modified
Access to Show commands and selected Exec commands
Role: sangroup
Description: SAN management group
-----
Rule  Type  Command-type  Feature
-----
1.   permit   config        *
2.    deny    config        fspf
3.   permit   debug         zone
4.   permit   exec          fcping
```


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Configuring CLI User Profiles

Every Cisco MDS 9000 Family switch user has related NMS information stored by the system. Your authentication information, user name, user password, password expiration date, and role membership are stored in your user profile. The CLI commands explained in this section enable you to create users and modify the profile of an existing user. These commands are restricted to privileged users as determined by your administrator.

Creating or Updating Users

The switches use the same command (**username**) to create a user and to update an existing user. The **expire** option determines the date on which the user account is disabled. The date is specified in the YYYY-MM-DD format. By default, the user account does not expire unless you explicitly configure it to expire.



Tip

The following words are reserved and cannot be used to configure users: bin, daemon, adm, lp, sync, shutdown, halt, mail, news, uucp, operator, games, gopher, ftp, nobody, nsd, mailnull, rpc, rpcuser, xfs, gdm, mtsuser, ftpuser, man, and sys



Note

User passwords are not displayed in the switch configuration file.

To configure a new user or to modify the profile of an existing user, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# username usam password abcd expire 2003-05-31 switch(config)#	Creates or updates the user account (usam) along with a password (abcd) that is set to expire on 2003-05-31. The password is limited to 64 characters.
	switch(config)# username msam password 0 abcd role network-operator switch(config)#	Creates or updates the user account (msam) along with a password (abcd) specified in clear text (indicated by 0). The password is limited to 64 characters.
Step 3	switch(config)# username user1 password 5 !@*asdsfsdfjh!@df switch(config)#	Specifies an encrypted (specified by 5) password (!@*asdsfsdfjh!@df) for the user account (user1).
	switch(config)# username usam role network-admin switch(config)#	Adds the specified user (usam) to the network-admin role.
	switch(config)# no username usam role vsan-admin switch(config)#	Deletes the specified user (usam) from the vsan-admin role.



Note

If the **update-snmpv3** option is used, specify the clear text and old SNMP password (see the “[Forcing Identical SNMP and CLI Passwords](#)” section on page 14-23).

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Displaying User Profile Information

Use the **show user-account** command to display configured information about user accounts. See Examples 14-4 to 14-6.

Example 14-4 Displays All Users

```
switch# show users
switch# show users
admin    pts/7          Jan 12 20:56 (10.77.202.149)
admin    pts/9          Jan 12 23:29 (modena.cisco.com)
admin    pts/10         Jan 13 03:05 (dhcp-171-71-58-120.cisco.com)
admin    pts/11         Jan 13 01:53 (dhcp-171-71-49-49.cisco.com)
```

Example 14-5 Displays Information for a Specified User

```
switch# show user-account user1
user:user1
        this user account has no expiry date
        roles:network-operator
no password set. Local login not allowed
Remote login through RADIUS is possible
```

Example 14-6 Displays Information for All Users

```
switch# show user-account
show user-account
user:admin
        this user account has no expiry date
        roles:network-admin

user:usam
        expires on Sat May 31 00:00:00 2003
        roles:network-admin network-operator

user:msam
        this user account has no expiry date
        roles:network-operator

user:user1
        this user account has no expiry date
        roles:network-operator
no password set. local login not allowed
Remote login through RADIUS is possible
```

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Configuring CLI Accounting Parameters

Accounting refers to the log information that is kept for each management session in a switch. This information may be used to generate reports for troubleshooting purposes and user accountability. Accounting can be implemented locally or remotely (using RADIUS).

Setting the Accounting Log Size

The **aaa accounting logsize** command sets the size limit of the accounting log file in persistent storage. The default is 15,000 bytes.

To set the log file size, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# aaa accounting logsize 29000	Sets the size of the log file on the local disk. The default is 15,000 bytes.

Enabling RADIUS Accounting

To enable RADIUS accounting in a switch, follow these steps:

	Command	Purpose
Step 1	switch# config t	Enters configuration mode.
Step 2	switch(config)# aaa accounting method radius	Configures the RADIUS accounting method on the switch. By default, only local accounting is enabled.

You can clear the RADIUS accounting configuration by issuing the **no aaa accounting method radius** command.



Tip

The Cisco MDS 9000 Family switch uses *Interim-Update* RADIUS accounting-request packets to communicate accounting log information to the RADIUS server. The RADIUS server must be appropriately configured to log the information communicated in these packets. Several servers typically have *Log Update/Watchdog Packets* flag in the AAA client configuration. This flag should be turned on to ensure proper RADIUS accounting.



Note

Configuration operations are automatically recorded in the accounting log if they are performed in configuration mode. Additionally, important system events (for example, configuration save and system switchover) are also recorded in the accounting log.

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Displaying Accounting Configuration

The **show accounting** command displays configured accounting information. See Examples 14-7 to 14-9.

Example 14-7 Displays Configured Accounting Parameters.

```
switch# show accounting config
RADIUS accounting not enabled
local accounting enabled
```

Example 14-8 Displays Configured Log Size.

```
switch# show accounting logsize
maximum local accounting log size:29000
```

Example 14-9 Displays the Entire Log File.

```
switch# show accounting log
Tue Jan 15 06:03:24 1980:update:::Created interface vsan1

Tue Jan 15 06:15:08 1980:start:/dev/pts/0_316764908:admin
Tue Jan 15 07:26:10 1980:stop:/dev/pts/0_316764908:admin:vsh exited normally
Tue Jan 15 07:46:40 1980:update:/dev/ttyS0_316753046:admin:Alias test is created
on VSAN 1

Tue Jan 15 07:46:40 1980:update:/dev/ttyS0_316753046:admin:Alias test is removed
on VSAN 1

Tue Jan 15 08:01:57 1980:update:/dev/ttyS0_316753046:admin:in-order delivery gua
rantee settings changed in-order guarantee:yes
Tue Jan 15 08:02:31 1980:update:/dev/ttyS0_316753046:admin:Enabled IP routing

Tue Jan 15 08:09:51 1980:update:/dev/ttyS0_316753046:admin:Alias test is created
on VSAN 1

Tue Jan 15 08:09:52 1980:update:/dev/ttyS0_316753046:admin:Alias test is removed
on VSAN 1

Tue Jan 15 08:11:30 1980:update:/dev/ttyS0_316753046:admin:Zone test is created
on VSAN 1
.
.
.
Sat Jan 19 22:16:06 1980:update:/dev/pts/0_317167691:admin:Zone cisco is removed
on VSAN 1

Sat Jan 19 22:56:49 1980:stop:/dev/pts/0_317167691:admin:vsh exited normally
Sun Jan 20 17:07:50 1980:start:snmp_317236070_10.77.202.149:public
Sun Jan 20 17:07:50 1980:stop:snmp_317236070_10.77.202.149:public:
Mon Jan 21 03:38:03 1980:start:/dev/pts/0_317273883:admin
Mon Jan 21 04:08:25 1980:stop:/dev/pts/0_317273883:admin:vsh exited normally
Mon Jan 21 06:43:49 1980:start:/dev/pts/0_317285029:admin
Mon Jan 21 06:44:38 1980:stop:/dev/pts/0_317285029:admin:vsh exited normally
Mon Jan 21 07:24:16 1980:start:/dev/pts/0_317287456:admin
```

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Recovering Administrator Password

An administrator can recover a password from a local console connection.

The password recovery procedure must be performed on the supervisor module that becomes the active supervisor module after the recovery procedure is completed. To ensure the other supervisor module does not become the active module, you have two options:

- Physically remove the other supervisor module from the chassis, or
- Change the other supervisor module's console prompt to the `loader>` or `switch(boot)#` prompt (see the [“Recovery from the loader> Prompt”](#) section on page 5-30) until you complete this procedure.



Note Password recovery is not possible from a Telnet or SSH session.

To recover a administrator's password, follow these steps:

-
- Step 1** Reboot the switch.
- ```
switch# reload
The supervisor is going down for reboot NOW!
```
- Step 2** Press the **Ctrl-]** key sequence (when the switch begins its SAN-OS software boot sequence) to enter the `switch(boot)#` prompt (see [“Recovery Interruption”](#) section on page 5-26).
- ```
Ctrl-]
switch(boot)#
```
- Step 3** Change to configuration mode.
- ```
switch(boot)# config terminal
```
- Step 4** Enter the **admin-password** command to reset the administrator password.
- ```
switch(boot-config)# admin-password password
```
- Step 5** Exit to the EXEC mode.
- ```
switch(boot-config)# exit
switchboot#
```
- Step 6** Enter the **load** command to load the SAN-OS software.
- ```
switch(boot)# load bootflash:system.img
```
- Step 7** Save the software configuration.
- ```
switch# copy running-config startup-config
```
-

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## Configuring RADIUS Authentication

You can configure RADIUS query parameters. These commands are restricted to privileged users as determined by your administrator.

### Setting the RADIUS Server Address

You can add up to five (5) RADIUS servers using the **radius-server host** command. You can configure a RADIUS server to be a primary server so it is always contacted first. If you have not configured a primary server, the RADIUS servers are tried in the order they were configured.

To specify the RADIUS server address and the options, follow these steps:

|        | Command                                                                               | Purpose                                                                                                                                                                                                                                                       |
|--------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                               | Enters configuration mode.                                                                                                                                                                                                                                    |
| Step 2 | switch(config)# <b>radius-server host 10.10.0.0 primary</b><br>switch(config)#        | Adds 10.10.0.0 users to the RADIUS server list as the primary server. This server is always tried first.                                                                                                                                                      |
| Step 3 | switch(config)# <b>radius-server host 10.10.0.0 key HostKey</b><br>switch(config)#    | Specifies a key for the selected RADIUS server. This key overrides the key assigned using the <b>radius-server key</b> command. In this example, the host is 10.10.0.0 and the key is HostKey.                                                                |
| Step 4 | switch(config)# <b>radius-server host 10.10.0.0 auth-port 2003</b><br>switch(config)# | Specifies the destination UDP port number to which the RADIUS authentication messages should be sent. In this example, the host is 10.10.0.0 and the authentication port is 2003. The default authentication port is 1812, and the valid range is 0 to 65366. |
| Step 5 | switch(config)# <b>radius-server host 10.10.0.0 acct-port 2004</b><br>switch(config)# | Specifies the destination UDP port number to which RADIUS accounting messages should be sent. The default accounting port is 1813, and the valid range is 0 to 65366.                                                                                         |
| Step 6 | switch(config)# <b>radius-server host 10.10.0.0 accounting</b><br>switch(config)#     | Specifies this server to be used only for accounting purposes.<br><br><b>Note</b> If neither the <b>authentication</b> option nor the <b>accounting</b> options are specified, the server is used for both accounting and authentication purposes.            |
| Step 7 | switch(config)# <b>radius-server host radius1 primary</b><br>switch(config)#          | Specifies the server to be the primary server.                                                                                                                                                                                                                |
|        | switch(config)# <b>radius-server host radius2 key 0 abcd</b><br>switch(config)#       | Specifies a clear text key for the specified server. The key is restricted to 65 characters.                                                                                                                                                                  |
|        | switch(config)# <b>radius-server host radius3 key 7 1234</b><br>switch(config)#       | Specifies a reversible encrypted key for the specified server. The key is restricted to 65 characters.                                                                                                                                                        |

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## Setting the RADIUS Preshared Key

You need to configure the RADIUS preshared key to authenticate the switch to the RADIUS server. The length of the key is restricted to 65 characters and can include any printable ASCII characters (white spaces are not allowed). You can configure a global key to be used for all RADIUS server configurations on the switch. You can override this global key assignment by explicitly using the **key** option in the **radius-server host** command.

To set the RADIUS preshared key, follow these steps:

|        | Command                                                               | Purpose                                                                                                                                              |
|--------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                               | Enters configuration mode.                                                                                                                           |
| Step 2 | switch(config)# <b>radius-server key AnyWord</b><br>switch(config)#   | Configures a preshared key (AnyWord) to authenticate communication between the RADIUS client and server. The default is clear text.                  |
|        | switch(config)# <b>radius-server key 0 AnyWord</b><br>switch(config)# | Configures a preshared key (AnyWord) specified in clear text (indicated by 0) to authenticate communication between the RADIUS client and server.    |
|        | switch(config)# <b>radius-server key 7 public</b><br>switch(config)#  | Configures a preshared key (public) specified in encrypted text (indicated by 7) to authenticate communication between the RADIUS client and server. |

## Setting the RADIUS Server Time-Out Interval

To specify the time between retransmissions to the RADIUS servers, follow these steps:

|        | Command                                                            | Purpose                                                                                                                                                     |
|--------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                            | Enters configuration mode.                                                                                                                                  |
| Step 2 | switch(config)# <b>radius-server timeout 30</b><br>switch(config)# | Specifies the time (in seconds) between retransmissions to the RADIUS server. The default time-out is one (1) second. The time range in seconds is 1 to 60. |

You can revert the retransmission time to its default by issuing the **no radius-server timeout** command.

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## Setting Iterations of the RADIUS Server

By default, a switch retries a RADIUS server connection only once. This number can be configured. The maximum is five retries per server. You can revert the retry number to its default by issuing the **no radius-server retransmit** command.

To specify the number of times that RADIUS servers should try to authenticate a user, follow these steps:

|        | Command                                                              | Purpose                                                                                                                        |
|--------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                              | Enters configuration mode.                                                                                                     |
| Step 2 | switch(config)# <b>radius-server retransmit 3</b><br>switch(config)# | Configures the number of times (3) the switch tries to connect to a RADIUS server(s) before reverting to local authentication. |

The worst case cumulative response or timeout latency from RADIUS servers for authentication should not be more than 50 sec. For example in the following configuration:

```
radius-server timeout 5
radius-server retransmit 3
radius-server host A authentication
radius-server host B authentication
```

The worst case cumulative response or timeout latency will be:

```
(5+1)*3 + (5+1)*3 = 36
^^^^^^^^ + ^^^^^^^^^ ^^^^^
server A server B total
```



### Note

You need to add one (1) to the retransmit count to calculate the total. The total number of tries equals the number of retransmits + 1.

## Defining Vendor-Specific Attributes

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific attributes (VSAs) between the network access server and the RADIUS server. The IETF uses attribute 26. VSAs allow vendors to support their own extended attributes that are not suitable for general use. The Cisco RADIUS implementation supports one vendor-specific option using the format recommended in the specification. The Cisco vendor ID is 9, and the supported option is vendor type 1, which is named `cisco-avpair`. The value is a string with the following format:

```
protocol : attribute sep value *
```

Where `protocol` is a Cisco attribute for a particular type of authorization, and `sep` is = for mandatory attributes, and \* is for optional attributes.

When you use RADIUS servers to authenticate yourself to a Cisco MDS 9000 Family switch, the RADIUS protocol directs the RADIUS server to return user attributes, like authorization information, along with authentication results. This authorization information is specified through VSAs.



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## VSA Format

The following VSA protocol options are supported:

- Shell protocol—used in Access-Accept packets to provide user profile information.
- Accounting protocol—used in Accounting-Request packets. If a value contains any white spaces, it should be put within double quotation marks.

The following attributes are supported:

- `roles`—This attribute lists all the roles to which the user belongs. The value field is a string storing the list of group names delimited by white space. For example, if you belong to roles `vsan-admin` and `storage-admin`, the value field would be `"vsan-admin storage-admin."` This subattribute is sent in the VSA portion of the Access-Accept frames from the RADIUS server, and it can only be used with the shell protocol value. This is an example using the roles attribute:

```
Cisco-AVPair = "shell: roles = "network-admin vsan-admin" "
```

- `accountinginfo`—This attribute stores additional accounting information besides the attributes covered by a standard RADIUS accounting protocol. This attribute is only sent in the VSA portion of the Account-Request frames from the RADIUS client on the switch, and it can only be used with the accounting protocol value.

## Authorization Process

The RADIUS based authorization process is as follows:

- 
- Step 1** The switch sends an Access-Request packet to the RADIUS server.
- Step 2** The RADIUS server responds with an Accept or Reject message.
- If Access-Reject is received, that means authentication has failed and no authorization information is sent.
  - If Access-Accept is received, that means authentication is successful and VSA is also sent along with the Access-Accept packet.
  - If no VSA data is sent, local authorization is used.
  - If your user name has no corresponding local account, a new account is created. This new account is locked and cannot be used for local login. It is deleted after 24 hours.
- Step 3** You are made a member of all groups indicated in the role list attribute in the VSA. You are removed from those roles if your role is not listed in the VSA group list.
-

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## Displaying RADIUS Server Details

Use the **show radius-server** command to display all configured RADIUS server parameters (see [Example 14-10](#)).



**Note**

Only administrators can view the RADIUS preshared key.

### Example 14-10 Displays Configured RADIUS Information

```
switch# show radius-server
Global RADIUS shared secret:Myxgqc
retransmission count:5
timeout value:10
following RADIUS servers are configured:
 myradius.cisco.users.com:
 available for authentication on port:1812
 available for accounting on port:1813
 172.22.91.37:
 available for authentication on port:1812
 available for accounting on port:1813
 RADIUS shared secret:23MhCUnD
 10.10.0.0:
 available for authentication on port:1812
 available for accounting on port:1813
 RADIUS shared secret:hostkey----> for administrators only
```

## Configuring SSH Services

The Telnet service is enabled by default on all Cisco MDS 9000 Family switches. Before enabling the SSH service, generate a host key pair. To generate a host key, use the **ssh key** command (see the “[Generating an SSH Host Key Pair](#)” section on page 14-19).

## Enabling SSH Service

By default, the SSH service is disabled. To enable SSH service, issue the **ssh server enable** command.

To enable or disable the SSH service, follow these steps:

|        | Command                                                | Purpose                                                                                      |
|--------|--------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                | Enters configuration mode.                                                                   |
| Step 2 | switch(config)# <b>ssh server enable</b><br>updated    | Enables the use of the SSH service.                                                          |
|        | switch(config)# <b>no ssh server enable</b><br>updated | Disables (default) the use of the SSH service and resets the switch to its factory defaults. |


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## Generating an SSH Host Key Pair

Be sure to have an SSH host key pair with the appropriate version before enabling the SSH service. The SSH service accepts three types of key pairs for use by SSH versions 1 and 2. Generate the SSH host key pair according to the SSH client version used. The number of bits specified for each key pair ranges from 768 to 2048.

- The **rsa1** option generates the RSA1 key pair for the SSH version 1 protocol.
- The **dsa** option generates the DSA key pair for the SSH version 2 protocol.
- The **rsa** option generates the RSA key pair for the SSH version 2 protocol.

To generate the SSH host key pair, follow these steps:

|        | Command                                                                                                       | Purpose                                                                                                                                                                  |
|--------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                                                       | Enters configuration mode.                                                                                                                                               |
| Step 2 | switch(config)# <b>ssh key rsa1 1024</b><br>generating rsa1 key.....<br>generated rsa1 key<br>switch(config)# | Generates the RSA1 host key pair.                                                                                                                                        |
|        | switch(config)# <b>ssh key dsa 1024</b><br>generating dsa key.....<br>generated dsa key<br>switch(config)#    | Generates the DSA host key pair.                                                                                                                                         |
|        | switch(config)# <b>ssh key rsa 1024</b><br>generating rsa key.....<br>generated rsa key<br>switch(config)#    | Generates the RSA host key pair.                                                                                                                                         |
|        | switch(config)# <b>no ssh key rsa 1024</b><br>cleared RSA keys<br>switch(config)#                             | Clears the RSA host key pair configuration.                                                                                                                              |
|        |                                                                                                               | <br><b>Caution</b> If you delete all of the SSH keys, you cannot start a new session. |

## Using the force Option

If the SSH key pair option is already generated for the required version, use the **force** option to overwrite the previously generated key pair.

To overwrite the previously generated key pair, follow these steps:

|        | Command                                                                                                                                                                                                                                                                      | Purpose                                                                                                                                         |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                                                                                                                                                                                                                      | Enters configuration mode.                                                                                                                      |
| Step 2 | switch(config)# <b>ssh key dsa 768</b><br>ssh key dsa 512<br>dsa keys already present, use force<br>option to overwrite them<br>switch(config)# <b>ssh key dsa 512 force</b><br>deleting old dsa key.....<br>generating dsa key.....<br>generated dsa key<br>switch(config)# | Tries to set the host key pair. If a required host key pair is already configured, use the <b>force</b> option to overwrite that host key pair. |
|        |                                                                                                                                                                                                                                                                              | Deletes the old DSA key and sets the host key pair using the new bit specification.                                                             |

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## Displaying SSH Protocol Status

Use the **show ssh server** command to display the status of the SSH protocol (enabled or disabled) and the versions that are enabled for that switch. See [Example 14-11](#).

### ***Example 14-11 Displays SSH Protocol Status***

```
switch# show ssh server
ssh is enabled
version 1 enabled
version 2 enabled
```

Use the **show ssh key** command to display the host key pair details for the specified key or for all keys, if no key is specified. See [Example 14-12](#).

### ***Example 14-12 Displays Host Key Pair Details***

```
switch# show ssh key
rsa1 Keys generated:Sun Jan 13 07:16:26 1980

1024 35

fingerprint:
1024 67:76:02:bd:3e:8d:f5:ad:59:5a:1e:c4:5e:44:03:07

could not retrieve rsa key information

dsa Keys generated:Sun Jan 13 07:40:08 1980

ssh-dss AAAAB3NzaC1kc3MAAABBAJTCRQOydNRe12v7uiO6Fix+OTn8eGdnnDVxw5eJs5OcOEXOyjaW
cMMYsEgxc9ada1NElp8Wy7GPMWGOQYj9CU0AAAAVAMCcWhNN18zFNOIPo7cU3t7d0iEbAAAAQBdQ8UAO
i/Cti84qFb3kTqXlS9mEhdQUo01HcH5bw5PKfj2Y/dLR437zCBKXetPj4p7mhQ6Fq5os8RZtJEyOsNsA
AABAA0oxZbPyWeR5NHATXiyXdPI7j9i8fgyn9FNipMkOF2Mn75Mi/1qQ4NIq0gQNvQOx27uCeQlRts/Q
wI4q68/eaw==

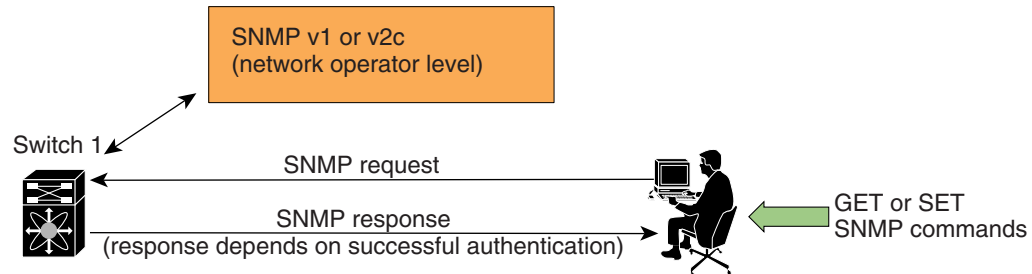
fingerprint:
512 f7:cc:90:3d:f5:8a:a9:ca:48:76:9f:f8:6e:71:d4:ae
```

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## SNMP Security

SNMP is an application layer protocol that facilitates the exchange of management information between network devices. In all Cisco MDS 9000 Family switches, three SNMP versions are available: SNMPv1, SNMPv2c, and SNMPv3 (see [Figure 14-4](#)).

**Figure 14-4** SNMP Security



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### Note

Users and roles configured through the CLI are different from users and roles configured through SNMP. These configurations do not directly correspond with each other. However, you can configure both CLI and SNMP identically, if required.

SNMP users are different from CLI users. SNMP users also have role-based authentication for roles and authorization purposes.

## SNMP Version 1 and Version 2c

SNMPv1 and SNMPv2c use a community string match for user authentication. Community strings provided a weak form of access control in earlier versions of SNMP. SNMPv3 provides much improved access control using strong authentication and should be preferred over SNMPv1 and SNMPv2c wherever it is supported.

## SNMP Version 3

SNMPv3 is an interoperable standards-based protocol for network management. SNMPv3 provides secure access to devices by a combination of authenticating and encrypting frames over the network. The security features provided in SNMPv3 are:

- Message integrity—Ensures that a packet has not been tampered with in-transit.
- Authentication—Determines the message is from a valid source.
- Encryption—Scrambles the packet contents to prevent it from being seen by unauthorized sources.

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SNMPv3 provides for both security models and security levels. A security model is an authentication strategy that is set up for a user and the role in which the user resides. A security level is the permitted level of security within a security model. A combination of a security model and a security level determines which security mechanism is employed when handling an SNMP packet.

## Group-Based SNMP Access



### Note

Because *group* is a standard SNMP term used industry-wide, we refer to role(s) as group(s) in this SNMP section.

SNMP access rights are organized by groups. Each group in SNMP is similar to a role through the CLI. Each group is defined with three accesses: read access, write access, and notification access. Each access can be enabled or disabled within each group.

Switches in the Cisco MDS 9000 Family are preconfigured with two default groups: network-admin and network-operator. The network-admin role has the access rights to define custom roles with custom privileges. You can begin communicating with the agent once the your user name is created, your roles are set up by your administrator, and you are added to the roles.



### Note

Users and roles configured through the CLI are different from users and groups configured through SNMP. These configurations do not directly correspond with each other. However, you can configure both CLI and SNMP identically, if required.

## Creating SNMP Groups

You can create SNMP groups through SNMP by configuring a group entry in the `vcacmAccessTable` on the switch.

Refer to RFC2575.

## Creating and Modifying Users

You can create users or modify existing users using SNMP or the CLI.

- SNMP—Create a user as a clone of an existing user in the `vsmUserTable` on the switch. Once you have created the user, change the cloned secret key before activating the user. Refer to RFC2574.



### Note

You must explicitly configure password(s) for SNMP users. The SNMP user passwords are not generated as the part of the configuration file as they are not portable across devices. The password is limited to a minimum of 8 characters and a maximum of 64 characters.



### Tip

An SNMP user must be created on each switch to which the user requires access. If the user is managing 10 switches, each of the 10 switches must have the SNMP user defined.

- CLI—You can create a user or modify an existing user using the `snmp-server user` command.

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By default only two groups are available in a Cisco MDS 9000 Family switch—network-operator and network-admin. To assign a user to a new SNMP group, you must first create the SNMP group.



### Note

SNMP groups can only be created in SNMP (see the “Creating SNMP Groups” section on page 14-22).

To create or modify SNMP users using the CLI, follow these steps:

|        | Command                                                                                                                         | Purpose                                                                                                                                                              |
|--------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                                                                         | Enters configuration mode.                                                                                                                                           |
| Step 2 | switch(config)# <b>snmp-server user joe network-admin auth sha abcd1234</b><br>switch(config)#                                  | Creates or modifies the settings for a user (joe) in the network-admin group using the HMAC-SHA-96 authentication password (abcd1234).                               |
|        | switch(config)# <b>snmp-server user sam network-admin auth md5 abcdefgh</b><br>switch(config)#                                  | Creates or modifies the settings for a user (sam) in the network-admin group using the HMAC-MD5-96 authentication password (abcdefgh).                               |
|        | switch(config)# <b>snmp-server user Bill network-admin auth sha abcd1234 priv abcdefgh</b><br>switch(config)#                   | Creates or modifies the settings for a user (network-admin) in the network-admin group using the HMAC-SHA-96 authentication level and privacy encryption parameters. |
|        | switch(config)# <b>no snmp-server user usernameA</b><br>switch(config)#                                                         | Deletes the user (usernameA) and all associated parameters.                                                                                                          |
|        | switch(config)# <b>snmp-server user user1 network-admin auth md5 0xab0211gh priv 0x45abf342 localizedkey</b><br>switch(config)# | Specifies the password to be in localized key format (see RFC2574). The localized key is provided in the hex format (for example, 0xacbdef).                         |



### Note

Avoid using the **localizedkey** option when configuring an SNMP user from CLI. The localized keys are not portable across devices as they contain device engine ID information. If a configuration file is copied to the device, the passwords may not be set correctly if the configuration file was generated at a different device. Explicitly configure the desired passwords after copying the configuration into the device.

## Forcing Identical SNMP and CLI Passwords

You can force the SNMPv3 password and the CLI password to be the same. You must know the SNMPv3 password to change the password using the CLI. Use CLI password to synchronize the SNMP password. The password is limited to a minimum of 8 characters and a maximum of 64 characters.



### Caution

To change the SNMP password, a clear text CLI password is required.

To modify the secret key for an SNMPv3 user, refer to RFC2574.

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To update the SNMPv3 password from the CLI, follow these steps:

|        | Command                                                                                         | Purpose                                                                                                                                                            |
|--------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                                         | Enters configuration mode.                                                                                                                                         |
| Step 2 | switch(config)# <b>username joe password wxyz6789 update-snmpv3 abcd1234</b><br>switch(config)# | Updates the SNMPv3 password for the specified user (joe). The local CLI password and the SNMP password are updated. If user Joe does not exist, the command fails. |

## Assigning Users to Groups

Once the user and the group are created, the administrator should configure an entry in the vacmSecurityToGroupTable to add the configured user to a configured group.

To assign users to groups through SNMP, refer to RFC2575.

To assign users to groups through the CLI, refer to the procedure specified in the “[Creating and Modifying Users](#)” section on page 14-22.

## Adding or Deleting Communities

You can configure read-only or read-write access for SNMP users by using the **snmp-server community** CLI command. Use the **no** form of the command to delete the configured community. Refer to RFC2576.

To create an SNMPv1 or SNMPv2c community, follow these steps:

|        | Command                                                                           | Purpose                                                    |
|--------|-----------------------------------------------------------------------------------|------------------------------------------------------------|
| Step 1 | switch# <b>config t</b>                                                           | Enters configuration mode.                                 |
| Step 2 | switch(config)# <b>snmp-server community snmp_Community ro</b><br>switch(config)# | Adds read-only access for the specified SNMP community.    |
|        | switch(config)# <b>snmp-server community snmp_Community rw</b><br>switch(config)# | Adds read-write access for the specified SNMP community.   |
|        | switch(config)# <b>no snmp-server community snmp_Community</b><br>switch(config)# | Deletes access for the specified SNMP community (default). |

## Displaying SNMP Security Information

Use the **show snmp** commands to display configured SNMP information (see [Example 14-13](#) and [14-15](#)).

### *Example 14-13 Displays SNMP User Details*

```
switch# show snmp user
User Group Auth Priv
----- ----- ---- ----
steve network-admin md5 des
sadmin network-admin md5 des
stever network-operator md5 des
```



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#### Example 14-14 Displays SNMP Community Information

```
switch# show snmp community
Community Access
----- -
private rw
public ro
v93RACqPNH ro
```

#### Example 14-15 Displays SNMP Host Information

```
switch# show snmp host
Host Port Version Level Type SecName

171.16.126.34 2162 v2c noauth trap public
171.16.75.106 2162 v2c noauth trap public
171.31.124.81 2162 v2c noauth trap public
171.31.157.193 2162 v2c noauth trap public
171.31.157.98 2162 v2c noauth trap public
171.31.49.25 2162 v2c noauth trap public
171.31.49.32 2188 v2c noauth trap public
171.31.49.49 2162 v2c noauth trap public
171.31.49.49 3514 v2c noauth trap public
171.31.49.54 2162 v2c noauth trap public
171.31.58.54 2162 v2c noauth trap public
171.31.58.81 2162 v2c noauth trap public
171.31.58.97 1635 v2c noauth trap public
171.31.58.97 2162 v2c auth trap public
171.31.58.97 3545 v2c auth trap public
172.22.00.43 2162 v2c noauth trap public
172.22.00.65 2162 v2c noauth trap public
172.22.05.234 2162 v2c noauth trap public
172.22.05.98 1050 v2c noauth trap public
```

## Displaying SNMP Counter Information

The **show snmp** command displays counter information for SNMP contact, location, and packet settings. This command provides information that is used entirely by the Cisco MDS 9000 Family Fabric Manager (see the *Cisco MDS 9000 Family Fabric Manager User Guide*). See [Example 14-16](#).

#### Example 14-16 Displays SNMP

```
switch# show snmp
switch# show snmp
sys contact:
sys location:

1631 SNMP packets input
 0 Bad SNMP versions
 0 Unknown community name
 0 Illegal operation for community name supplied
 0 Encoding errors
 64294 Number of requested variables
 1 Number of altered variables
 1628 Get-request PDUs
 0 Get-next PDUs
 1 Set-request PDUs
152725 SNMP packets output
 0 Too big errors
 1 No such name errors
```

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```

0 Bad values errors
0 General errors

Community Access

public rw

User Group Auth Priv

admin network-admin md5 no

```

## Default Security Settings

Table 14-2 lists the default settings for all security features in any switch.

**Table 14-2 Default Security Settings**

| Parameters                             | Default                                                                                                       |
|----------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Roles in each switch (for CLI users)   | Two default roles—network-operator and network-admin.                                                         |
| Group in each switch (for SNMP users)  | Two default roles—network-operator and network-admin.                                                         |
| AAA authentication login               | Local authentication is enabled. If the Telnet or SSH options are not specified, the command applies to both. |
| Telnet server                          | Enabled.                                                                                                      |
| Accounting log file size on local disk | 15,000 bytes.                                                                                                 |
| User's account expiration              | Does not expire unless you explicitly configure it to expire.                                                 |
| RADIUS server timeout interval         | The default time-out is five (5) seconds.                                                                     |
| RADIUS preshared key                   | No key is configured.                                                                                         |
| RADIUS server connection attempts      | A switch tries to connect to a RADIUS server up to 3 times.                                                   |
| RADIUS Authentication messages         | 1812 messages sent by destination UDP port.                                                                   |
| RADIUS Accounting messages             | 1813 messages sent by destination UDP port.                                                                   |
| User name                              | admin.                                                                                                        |
| User password                          | admin.                                                                                                        |