



# Configuring AAA

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This chapter describes how to configure authentication, authorization, and accounting (AAA) on Cisco NX-OS devices.

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## About AAA

This section includes information about AAA on Cisco NX-OS devices.

## AAA Security Services

The AAA feature allows you to verify the identity of, grant access to, and track the actions of users managing a Cisco NX-OS device. Cisco NX-OS devices support Remote Access Dial-In User Service (RADIUS) or Terminal Access Controller Access Control System Plus (TACACS+) protocols.

Based on the user ID and password combination that you provide, Cisco NX-OS devices perform local authentication or authorization using the local database or remote authentication or authorization using one or more AAA servers. A preshared secret key provides security for communication between the Cisco NX-OS device and AAA servers. You can configure a common secret key for all AAA servers or for only a specific AAA server.

AAA security provides the following services:

**Authentication**

Identifies users, including login and password dialog, challenge and response, messaging support, and, depending on the security protocol that you select, encryption.

Authentication is the process of verifying the identity of the person or device accessing the Cisco NX-OS device, which is based on the user ID and password combination provided by the entity trying to access the Cisco NX-OS device. Cisco NX-OS devices allow you to perform local authentication (using the local lookup database) or remote authentication (using one or more RADIUS or TACACS+ servers).

**Authorization**

Provides access control. AAA authorization is the process of assembling a set of attributes that describe what the user is authorized to perform. Authorization in the Cisco NX-OS software is provided by attributes that are downloaded from AAA servers. Remote security servers, such as RADIUS and TACACS+, authorize users for specific rights by associating attribute-value (AV) pairs, which define those rights with the appropriate user.

**Accounting**

Provides the method for collecting information, logging the information locally, and sending the information to the AAA server for billing, auditing, and reporting.

The accounting feature tracks and maintains a log of every management session used to access the Cisco NX-OS device. You can use this information to generate reports for troubleshooting and auditing purposes. You can store accounting logs locally or send them to remote AAA servers.



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**Note** The Cisco NX-OS software supports authentication, authorization, and accounting independently. For example, you can configure authentication and authorization without configuring accounting.

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## Benefits of Using AAA

AAA provides the following benefits:

- Increased flexibility and control of access configuration
- Scalability
- Standardized authentication methods, such as RADIUS and TACACS+
- Multiple backup devices

## Remote AAA Services

Remote AAA services provided through RADIUS and TACACS+ protocols have the following advantages over local AAA services:

- It is easier to manage user password lists for each Cisco NX-OS device in the fabric.
- AAA servers are already deployed widely across enterprises and can be easily used for AAA services.
- You can centrally manage the accounting log for all Cisco NX-OS devices in the fabric.
- It is easier to manage user attributes for each Cisco NX-OS device in the fabric than using the local databases on the Cisco NX-OS devices.

## AAA Server Groups

You can specify remote AAA servers for authentication, authorization, and accounting using server groups. A server group is a set of remote AAA servers that implements the same AAA protocol. The purpose of a server group is to provide for failover servers in case a remote AAA server fails to respond. If the first remote server in the group fails to respond, the next remote server in the group is tried until one of the servers sends a response. If all the AAA servers in the server group fail to respond, then that server group option is considered a failure. If required, you can specify multiple server groups. If the Cisco NX-OS device encounters errors from the servers in the first group, it tries the servers in the next server group.

## AAA Service Configuration Options

The AAA configuration in Cisco NX-OS devices is service based, which means that you can have separate AAA configurations for the following services:

- User Telnet or Secure Shell (SSH) login authentication
- Console login authentication
- User management session accounting

This table provides the related CLI command for each AAA service configuration option.

**Table 1: AAA Service Configuration Commands**

AAA Service Configuration Option	Related Command
Telnet or SSH login	<b>aaa authentication login default</b>
Console login	<b>aaa authentication login console</b>
User session accounting	<b>aaa accounting default</b>

You can specify the following authentication methods for the AAA services:

### All RADIUS servers

Uses the global pool of RADIUS servers for authentication.

### Specified server groups

Uses specified RADIUS, TACACS+, or LDAP server groups you have configured for authentication.

### Local

Uses the local username or password database for authentication.

### None

Specifies that no AAA authentication be used.



**Note** If you specify the all RADIUS servers method, rather than a specified server group method, the Cisco NX-OS device chooses the RADIUS server from the global pool of configured RADIUS servers, in the order of configuration. Servers from this global pool are the servers that can be selectively configured in a RADIUS server group on the Cisco NX-OS device.

This table shows the AAA authentication methods that you can configure for the AAA services.

**Table 2: AAA Authentication Methods for AAA Services**

AAA Service	AAA Methods
Console login authentication	Server groups, local, and none
User login authentication	Server groups, local, and none
User management session accounting	Server groups and local

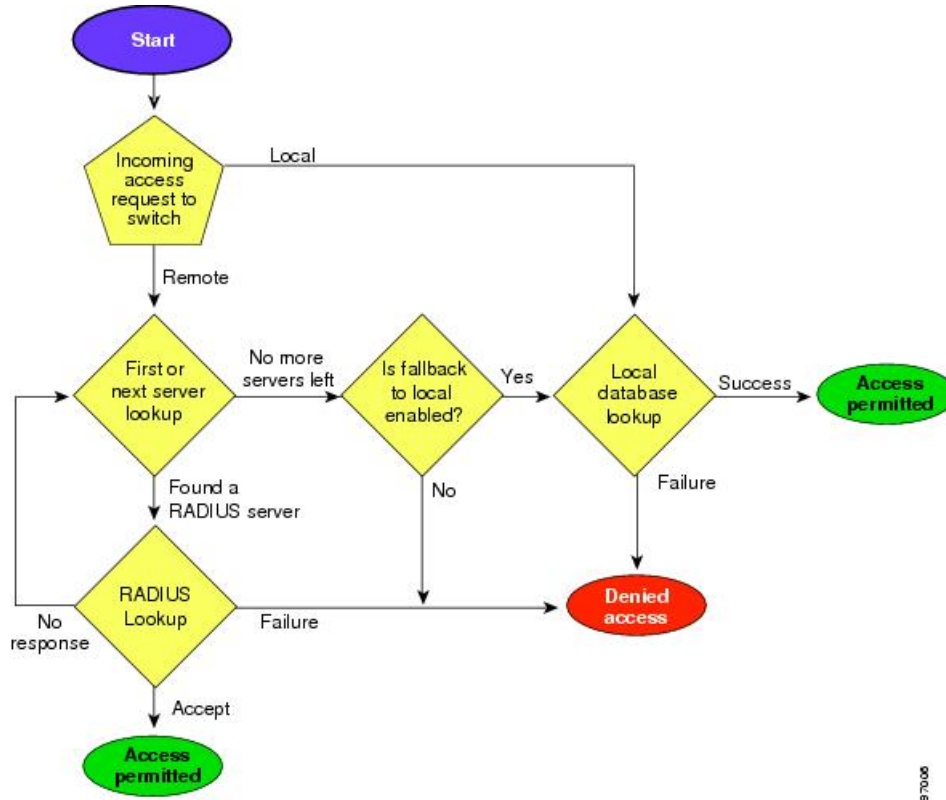


**Note** For console login authentication, user login authentication, and user management session accounting, the Cisco NX-OS device tries each option in the order specified. The local option is the default method when other configured options fail. You can disable the local option for the console or default login by using the **no aaa authentication login {console | default} fallback error local** command.

## Authentication and Authorization Process for User Login

**Figure 1: Authorization and Authentication Flow for User Login**

This figure shows a flow chart of the authentication and authorization process for user login.

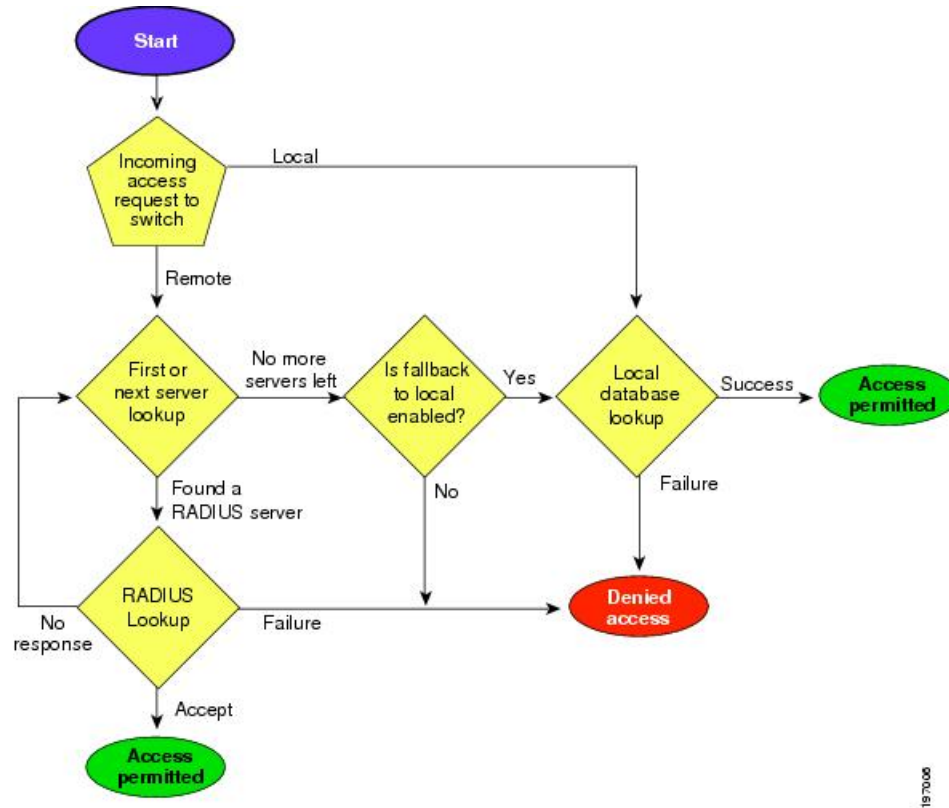


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## Workflow

**Figure 2: Authorization and Authentication Flow for User Login**

This figure shows a flow chart of the authentication and authorization process for user login.



Here is how the process works:

- Log in to the Cisco NX-OS device using Telnet, SSH, or console.
- Configure AAA server groups using the server group authentication method, then the device sends the request to the first AAA server.
  - If the AAA server fails to respond, the next AAA server is tried, continuing until the remote server responds to the authentication request.
  - If all AAA servers in the server group fail to respond, the servers in the next server group are tried.
  - If all configured methods fail, the local database is used for authentication, if console login fallback is disabled.
- If the Cisco NX-OS device successfully authenticates you through a remote AAA server, these possibilities apply:
  - If the AAA server protocol is RADIUS, user roles specified in the cisco-av-pair attribute are downloaded.
  - If the AAA server protocol is TACACS+, then another request is sent to the same server to get the user roles specified as custom attributes for the shell.

- The device logs you in and assigns roles configured in the local database when your username and password are successfully authenticated locally.



**Note** "No more server groups left" means that there is no response from any server in all server groups. "No more servers left" means that there is no response from any server within this server group.

## AES Password Encryption and Primary Encryption Keys

You can enable strong, reversible 128-bit Advanced Encryption Standard (AES) password encryption, also known as type-6 encryption. To start using type-6 encryption, you must enable the AES password encryption feature and configure a primary encryption key, which is used to encrypt and decrypt passwords.

After you enable AES password encryption and configure a primary key, all existing and newly created clear-text passwords for supported applications (currently RADIUS and TACACS+) are stored in type-6 encrypted format, unless you disable type-6 password encryption. You can also configure Cisco NX-OS to convert all existing weakly encrypted passwords to type-6 encrypted passwords.

## Prerequisites for AAA

Remote AAA servers have the following prerequisites:

- Ensure that at least one RADIUS, TACACS+, or LDAP server is reachable through IP.
- Ensure that the Cisco NX-OS device is configured as a client of the AAA servers.
- Ensure that the secret key is configured on the Cisco NX-OS device and the remote AAA servers.
- Ensure that the remote server responds to AAA requests from the Cisco NX-OS device.

## Guidelines and Limitations for AAA

AAA has the following guidelines and limitations:

- If you have a user account that is configured on the local Cisco NX-OS device that has the same name as a remote user account on an AAA server, the Cisco NX-OS software applies the user roles for the local user account to the remote user, not the user roles configured on the AAA server.
- Cisco Nexus 9000 Series switches support the **aaa authentication login ascii-authentication** command only for TACACS+ (and not for RADIUS).
- If you modify the default login authentication method (without using the **local** keyword), the configuration overrides the console login authentication method. To explicitly configure the console authentication method, use the **aaa authentication login console {group group-list [none] | local | none}** command.
- The **login block-for** and **login quiet-mode** configuration mode commands are renamed to **system login block-for** and **system login quiet-mode**, respectively.

- When you use the **system login quiet-mode access-class QUIET\_LIST** command, you must ensure that the access list is correctly defined to only block the specified traffic. For example, if you need to block only the user logins from untrusted hosts, then the access list should specify ports 22, 23, 80, and 443 corresponding to SSH, telnet, and HTTP-based access from those hosts.

## Default Settings for AAA

This table lists the default settings for AAA parameters.

**Table 3: Default AAA Parameter Settings**

Parameters	Default
Console authentication method	local
Default authentication method	local
Login authentication failure messages	Disabled
CHAP authentication	Disabled
MSCHAP authentication	Disabled
Default accounting method	local
Accounting log display length	250 KB

## Configuring AAA

This section describes the tasks for configuring AAA on Cisco NX-OS devices.



**Note** If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.



**Note** Cisco Nexus 9K Series switches support the CLI command, `aaa authentication login ascii-authentication`, only for TACAAS+, but not for RADIUS. Ensure that you have disabled `aaa authentication login ascii-authentication` switch so that the default authentication, PAP, is enabled. Otherwise, you will see syslog errors.

## Process for Configuring AAA

Follow these steps to configure AAA authentication and accounting:

1. If you want to use remote RADIUS, TACACS+, or LDAP servers for authentication, configure the hosts on your Cisco NX-OS device.

2. Configure console login authentication methods.
3. Configure default login authentication methods for user logins.
4. Configure default AAA accounting default methods.

## Configuring Console Login Authentication Methods

This section describes how to configure the authentication methods for the console login.

The authentication methods include the following:

- Global pool of RADIUS servers
- Named subset of RADIUS, TACACS+, or LDAP servers
- Local database on the Cisco NX-OS device
- Username only (none)

The default method is local, but you have the option to disable it.



**Note** The **group radius** and **group server-name** forms of the **aaa authentication** command refer to a set of previously defined RADIUS servers. Use the **radius-server host** command to configure the host servers. Use the **aaa group server radius** command to create a named group of servers.



**Note** If you perform a password recovery when remote authentication is enabled, local authentication becomes enabled for console login as soon as the password recovery is done. As a result, you can log into the Cisco NX-OS device through the console port using the new password. After login, you can continue to use local authentication, or you can enable remote authentication after resetting the admin password configured at the AAA servers. For more information about the password recovery process, see the *Cisco Nexus 9000 Series NX-OS Troubleshooting Guide*.

### Before you begin

Configure RADIUS, TACACS+, or LDAP server groups, as needed.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters configuration mode.
<b>Step 2</b>	<b>aaa authentication login console {group group-list [none]   local   none}</b>	Configures login authentication methods for the console.



	Command or Action	Purpose
	<b>Example:</b> <pre>switch(config)# aaa authentication login console group radius</pre>	<p>The <i>group-list</i> argument consists of a space-delimited list of group names. The group names are the following:</p> <p><b>radius</b>  Uses the global pool of RADIUS servers for authentication.</p> <p><b>named-group</b>  Uses a named subset of RADIUS, TACACS+, or LDAP servers for authentication.</p> <p>The <b>local</b> method uses the local database for authentication, and the <b>none</b> method specifies that no AAA authentication be used.</p> <p>The default console login method is <b>local</b>, which is used when no methods are configured or when all the configured methods fail to respond, unless fallback to local is disabled for the console login.</p>
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show aaa authentication</b>  <b>Example:</b> <pre>switch# show aaa authentication</pre>	Displays the configuration of the console login authentication methods.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Configuring Default Login Authentication Methods

The authentication methods include the following:

- Global pool of RADIUS servers
- Named subset of RADIUS, TACACS+, or LDAP servers
- Local database on the Cisco NX-OS device
- Username only

The default method is local, but you have the option to disable it.

**Before you begin**

Configure RADIUS, TACACS+, or LDAP server groups, as needed.

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters configuration mode.
<b>Step 2</b>	<b>aaa authentication login default {group group-list [none]   local   none}</b>  <b>Example:</b> <pre>switch(config)# aaa authentication login default group radius</pre>	<p>Configures the default authentication methods.</p> <p>The <i>group-list</i> argument consists of a space-delimited list of group names. The group names are the following:</p> <ul style="list-style-type: none"> <li>• <b>radius</b>—Uses the global pool of RADIUS servers for authentication.</li> <li>• <i>named-group</i>—Uses a named subset of RADIUS, TACACS+, or LDAP servers for authentication.</li> </ul> <p>The <b>local</b> method uses the local database for authentication, and the <b>none</b> method specifies that no AAA authentication be used. The default login method is <b>local</b>, which is used when no methods are configured or when all the configured methods fail to respond, unless fallback to local is disabled for the console login.</p> <p>You can configure one of the following:</p> <ul style="list-style-type: none"> <li>• AAA authentication groups</li> <li>• AAA authentication groups with no authentication</li> <li>• Local authentication</li> <li>• No authentication</li> </ul> <p><b>Note</b> The <b>local</b> keyword is not supported (and is not required) when configuring AAA authentication groups because local authentication is the default if remote servers are unreachable. For example, if you configure <b>aaa authentication login default group g1</b>, local authentication is tried if you are unable to authenticate using AAA group g1. In</p>

	Command or Action	Purpose
		contrast, if you configure <b>aaa authentication login default group g1 none</b> , no authentication is performed if you are unable to authenticate using AAA group g1.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show aaa authentication</b>  <b>Example:</b> <pre>switch# show aaa authentication</pre>	Displays the configuration of the default login authentication methods.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Disabling Fallback to Local Authentication

By default, if remote authentication is configured for console or default login and all AAA servers are unreachable (resulting in an authentication error), the Cisco NX-OS device falls back to local authentication to ensure that users aren't locked out of the device. However, you can disable fallback to local authentication in order to increase security.



**Caution** Disabling fallback to local authentication can lock your Cisco NX-OS device, forcing you to perform a password recovery in order to gain access. To prevent being locked out of the device, we recommend that you disable fallback to local authentication for only the default login or the console login, not both.

### Before you begin

Configure remote authentication for the console or default login.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>no aaa authentication login {console   default} fallback error local</b>  <b>Example:</b> <pre>switch(config)# no aaa authentication login console fallback error local</pre>	<p>Disables fallback to local authentication for the console or default login if remote authentication is configured and all AAA servers are unreachable.</p> <p>The following message appears when you disable fallback to local authentication:</p> <pre>"WARNING!!! Disabling fallback can lock your switch."</pre>
<b>Step 3</b>	(Optional) <b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show aaa authentication</b>  <b>Example:</b> <pre>switch# show aaa authentication</pre>	Displays the configuration of the console and default login authentication methods.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Enabling the Default User Role for AAA Authentication

You can allow remote users who do not have a user role to log in to the Cisco NX-OS device through a RADIUS or TACACS+ remote authentication server using a default user role. When you disable the AAA default user role feature, remote users who do not have a user role cannot log in to the device.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters configuration mode.
<b>Step 2</b>	<b>aaa user default-role</b>  <b>Example:</b> <pre>switch(config)# aaa user default-role</pre>	<p>Enables the default user role for AAA authentication. The default is enabled.</p> <p>You can disable the default user role feature by using the <b>no</b> form of this command.</p>

	Command or Action	Purpose
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> switch(config)# <b>exit</b> switch#	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show aaa user default-role</b>  <b>Example:</b> switch# <b>show aaa user default-role</b>	Displays the AAA default user role configuration.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Enabling Login Authentication Failure Messages

When you log in, the login is processed by rolling over to the local user database if the remote AAA servers do not respond. In such cases, the following messages display on the user's terminal if you have enabled login failure messages:

```
Remote AAA servers unreachable; local authentication done.
```

```
Remote AAA servers unreachable; local authentication failed.
```

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b> switch(config)#	Enters configuration mode.
<b>Step 2</b>	<b>aaa authentication login error-enable</b>  <b>Example:</b> switch(config)# <b>aaa authentication login error-enable</b>	Enables login authentication failure messages. The default is disabled.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> switch(config)# <b>exit</b> switch#	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show aaa authentication</b>  <b>Example:</b> switch# <b>show aaa authentication</b>	Displays the login failure message configuration.

	Command or Action	Purpose
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Logging Successful and Failed Login Attempts

You can configure the switch to log all successful and failed login attempts to the configured syslog server.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal</pre>	Enters global configuration mode.
<b>Step 2</b>	Required: <b>[no] login on-failure log</b>  <b>Example:</b> <pre>switch(config)# login on-failure log</pre>	Logs all failed authentication messages to the configured syslog server only if the logging level is set to 6. With this configuration, the following syslog message appears after the failed login:  <pre>AUTHPRIV-3-SYSTEM_MSG: pam_aaa:Authentication failed for user admin from 172.22.00.00</pre> <p><b>Note</b> When logging level authpriv is 6, additional Linux kernel authentication messages appear along with the previous message. If these additional messages need to be ignored, the authpriv value should be set to 3.</p>
<b>Step 3</b>	Required: <b>[no] login on-success log</b>  <b>Example:</b> <pre>switch(config)# login on-success log switch(config)# logging level authpriv 6 switch(config)# logging level daemon 6</pre>	Logs all successful authentication messages to the configured syslog server only if the logging level is set to 6. With this configuration, the following syslog message appears after the successful login:  <pre>AUTHPRIV-6-SYSTEM_MSG: pam_aaa:Authentication success for user admin from 172.22.00.00</pre> <p><b>Note</b> When logging level authpriv is 6, additional Linux kernel authentication messages appear along with the previous message. If these</p>

	Command or Action	Purpose
		additional messages need to be ignored, the authpriv value should be set to 3.
<b>Step 4</b>	(Optional) <b>show login on-failure log</b>  <b>Example:</b> <code>switch(config)# show login on-failure log</code>	Displays whether the switch is configured to log failed authentication messages to the syslog server.
<b>Step 5</b>	(Optional) <b>show login on-successful log</b>  <b>Example:</b> <code>switch(config)# show login on-successful log</code>	Displays whether the switch is configured to log successful authentication messages to the syslog server.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <code>switch(config)# copy running-config startup-config</code>	Copies the running configuration to the startup configuration.

## Configuring Login Block Per User

Ensure that the switch is in global configuration mode.

The Login Block Per User feature helps detect suspected Denial of Service (DoS) attacks and to slow down dictionary attacks. This feature is applicable for local users and remote users. Use this task to configure login parameters to block a user after failed login attempts.



**Note** From Release 9.3(7), you can configure login block for remote users.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <code>switch# configure terminal</code>	Enters global configuration mode.
<b>Step 2</b>	<b>aaa authentication rejected attemptsinsecondsbanseconds</b>  <b>Example:</b> <code>switch(config)# aaa authentication rejected 3 in 20 ban 300</code>	Configures login parameters to block a user.  <b>Note</b> Use <b>no aaa authentication rejected</b> command to revert to the default login parameters.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b>	Exits to privileged EXEC mode.

	Command or Action	Purpose
	<code>switch(config)# exit</code>	
<b>Step 4</b>	(Optional) <b>show running config</b>  <b>Example:</b> <code>switch# show running config</code>	Displays the login parameters.
<b>Step 5</b>	<b>show aaa local user blocked</b>  <b>Example:</b> <code>switch# show aaa local user blocked</code>	Displays the blocked local users.
<b>Step 6</b>	<b>clear aaa local user blocked {username user  all}</b>  <b>Example:</b> <code>switch(config)# switch# clear aaa local user blocked username testuser</code>	Clears the blocked local users.  all –Clears all the blocked local users.
<b>Step 7</b>	<b>show aaa user blocked</b>  <b>Example:</b> <code>switch(config)# show aaa user blocked</code>	Displays all blocked local and remote users.
<b>Step 8</b>	(Optional) <b>clear aaa user blocked {username user  all}</b>  <b>Example:</b> <code>switch# clear aaa user blocked username testuser</code>	Clears all blocked local and remote users.  all – Clears all the blocked local and remote users.

### Example



**Note** Only network-admin, and vdc-admin have privileges to run the show and clear commands.

The following example shows how to configure the login parameters to block a user for 300 seconds when three login attempts fail within a period of 20 seconds:

```
switch(config)# aaa authentication rejected 3 in 20 ban 300
switch# show run | i rejected
aaa authentication rejected 3 in 20 ban 300
switch# show aaa local user blocked
Local-user      State
testuser        Watched (till 11:34:42 IST Nov 12 2020)
switch# clear aaa local user blocked username testuser
switch# show aaa user blocked
Local-user      State
testuser        Watched (till 11:34:42 IST Nov 12 2020)
switch# clear aaa user blocked username testuser
```



## Enabling CHAP Authentication

The Cisco NX-OS software supports the Challenge Handshake Authentication Protocol (CHAP), a challenge-response authentication protocol that uses the industry-standard Message Digest (MD5) hashing scheme to encrypt responses. You can use CHAP for user logins to a Cisco NX-OS device through a remote authentication server (RADIUS or TACACS+).

By default, the Cisco NX-OS device uses Password Authentication Protocol (PAP) authentication between the Cisco NX-OS device and the remote server. If you enable CHAP, you need to configure your RADIUS or TACACS+ server to recognize the CHAP vendor-specific attributes (VSAs).



**Note** Cisco Nexus 9K Series switches support the CLI command, `aaa authentication login ascii-authentication`, only for TACAAS+, but not for RADIUS. Ensure that you have disabled `aaa authentication login ascii-authentication` switch so that the default authentication, PAP, is enabled. Otherwise, you will see syslog errors. For example:

```
2017 Jun 14 16:14:15 N9K-1 %RADIUS-2-RADIUS_NO_AUTHEN_INFO: ASCII authentication not supported
2017 Jun 14 16:14:16 N9K-1 %AUTHPRIV-3-SYSTEM_MSG: pam_aaa:Authentication failed from
192.168.12.34 - dcos_sshd[16804]
```

This table shows the RADIUS and TACACS+ VSAs required for CHAP.

**Table 4: CHAP RADIUS and TACACS+ VSAs**

Vendor-ID Number	Vendor-Type Number	VSA	Description
311	11	CHAP-Challenge	Contains the challenge sent by an AAA server to a CHAP user. It can be used in both Access-Request and Access-Challenge packets.
211	11	CHAP-Response	Contains the response value provided by a CHAP user in response to the challenge. It is used only in Access-Request packets.

### Before you begin

Disable AAA ASCII authentication for logins.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <code>switch# configure terminal</code> <code>switch(config)#</code>	Enters configuration mode.
<b>Step 2</b>	<b>no aaa authentication login</b> <b>ascii-authentication</b>  <b>Example:</b>	Disables ASCII authentication.

	Command or Action	Purpose
	<code>switch(config)# no aaa authentication login ascii-authentication</code>	
<b>Step 3</b>	<b>aaa authentication login chap enable</b>  <b>Example:</b> <code>switch(config)# aaa authentication login chap enable</code>	Enables CHAP authentication. The default is disabled.  <b>Note</b> You cannot enable both CHAP and MSCHAP or MSCHAP V2 on your Cisco NX-OS device.
<b>Step 4</b>	(Optional) <b>exit</b>  <b>Example:</b> <code>switch(config)# exit</code> <code>switch#</code>	Exits configuration mode.
<b>Step 5</b>	(Optional) <b>show aaa authentication login chap</b>  <b>Example:</b> <code>switch# show aaa authentication login chap</code>	Displays the CHAP configuration.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <code>switch# copy running-config startup-config</code>	Copies the running configuration to the startup configuration.

## Enabling MSCHAP or MSCHAP V2 Authentication

Microsoft Challenge Handshake Authentication Protocol (MSCHAP) is the Microsoft version of CHAP. The Cisco NX-OS software also supports MSCHAP Version 2 (MSCHAP V2). You can use MSCHAP for user logins to a Cisco NX-OS device through a remote authentication server (RADIUS or TACACS+). MSCHAP V2 only supports user logins to a Cisco NX-OS device through remote authentication RADIUS servers. If you configure a TACACS+ group with MSCHAP V2, the AAA default login authentication uses the next configured method, or the local method, if no other server group is configured.



**Note** The Cisco NX-OS software may display the following message:

“ Warning: MSCHAP V2 is supported only with Radius.”

This warning message is informational only and does not affect MSCHAP V2 operation with RADIUS.

By default, the Cisco NX-OS device uses Password Authentication Protocol (PAP) authentication between the Cisco NX-OS device and the remote server. If you enable MSCHAP or MSCHAP V2, you need to configure your RADIUS server to recognize the MSCHAP and MSCHAP V2 vendor-specific attributes (VSAs).

This table shows the RADIUS VSAs required for MSCHAP.

**Table 5: MSCHAP and MSCHAP V2 RADIUS VSAs**

Vendor-ID Number	Vendor-Type Number	VSA	Description
311	11	MSCHAP-Challenge	Contains the challenge sent by an AAA server to an MSCHAP or MSCHAP V2 user. It can be used in both Access-Request and Access-Challenge packets.
211	11	MSCHAP-Response	Contains the response value provided by an MSCHAP or MSCHAP V2 user in response to the challenge. It is only used in Access-Request packets.

### Before you begin

Disable AAA ASCII authentication for logins.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b> switch(config)#	Enters configuration mode.
<b>Step 2</b>	<b>no aaa authentication login ascii-authentication</b>  <b>Example:</b> switch(config)# <b>no aaa authentication login ascii-authentication</b>	Disables ASCII authentication.
<b>Step 3</b>	<b>aaa authentication login {mschap   mschapv2} enable</b>  <b>Example:</b> switch(config)# <b>aaa authentication login mschap enable</b>	Enables MSCHAP or MSCHAP V2 authentication. The default is disabled.  <b>Note</b> You cannot enable both MSCHAP and MSCHAP V2 on your Cisco NX-OS device.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> switch(config)# <b>exit</b> switch#	Exits configuration mode.
<b>Step 5</b>	(Optional) <b>show aaa authentication login {mschap   mschapv2}</b>  <b>Example:</b>	Displays the MSCHAP or MSCHAP V2 configuration.

	Command or Action	Purpose
	switch# <b>show aaa authentication login mschap</b>	
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# <b>copy running-config startup-config</b>	Copies the running configuration to the startup configuration.

## Configuring AAA Authorization on LDAP Servers

You can configure the default AAA authorization method for LDAP servers.

### Before you begin

Enable LDAP.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b> switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>aaa authorization ssh-certificate default {group group-list [none]   local   none}</b>  <b>Example:</b> switch(config)# <b>aaa authorization ssh-certificate default group ldap1 ldap2</b>	Configures the default AAA authorization method for the LDAP servers.  The <b>ssh-certificate</b> keyword configures LDAP or local authorization with certificate authentication. The default authorization is local authorization, which is the list of authorized commands for the user's assigned role.  The <i>group-list</i> argument consists of a space-delimited list of LDAP server group names. Servers belonging to this group are contacted for AAA authorization. The <b>local</b> method uses the local database for authorization, and the <b>none</b> method specifies that no AAA authorization be used.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> switch(config)# <b>exit</b> switch#	Exits global configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	(Optional) <b>show aaa authorization [all]</b>  <b>Example:</b> switch# show aaa authorization	Displays the AAA authorization configuration. The <b>all</b> keyword displays the default values.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

**Related Topics**[Enabling TACACS+](#)

## Configuring AAA Accounting Default Methods

Cisco NX-OS software supports TACACS+ and RADIUS methods for accounting. Cisco NX-OS devices report user activity to TACACS+ or RADIUS security servers in the form of accounting records. Each accounting record contains accounting attribute-value (AV) pairs and is stored on the AAA server.

When you activate AAA accounting, the Cisco NX-OS device reports these attributes as accounting records, which are then stored in an accounting log on the security server.

You can create default method lists defining specific accounting methods, which include the following:

**RADIUS server group**

Uses the global pool of RADIUS servers for accounting.

**Specified server group**

Uses a specified RADIUS or TACACS+ server group for accounting.

**Local**

Uses the local username or password database for accounting.



**Note** If you have configured server groups and the server groups do not respond, by default, the local database is used for authentication.

**Before you begin**

Configure RADIUS or TACACS+ server groups, as needed.

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# configure terminal switch(config)#	Enters configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>aaa accounting default {group <i>group-list</i>   local}</b>  <b>Example:</b> <pre>switch(config)# aaa accounting default group radius</pre>	<p>Configures the default accounting method.</p> <p>The <i>group-list</i> argument consists of a space-delimited list of group names. The group names are the following:</p> <ul style="list-style-type: none"> <li>• <b>radius</b>—Uses the global pool of RADIUS servers for accounting.</li> <li>• <b>named-group</b>—Uses a named subset of TACACS+ or RADIUS servers for accounting.</li> </ul> <p>The <b>local</b> method uses the local database for accounting.</p> <p>The default method is <b>local</b>, which is used when no server groups are configured or when all the configured server groups fail to respond.</p>
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	<b>(Optional) show aaa accounting</b>  <b>Example:</b> <pre>switch# show aaa accounting</pre>	Displays the configuration AAA accounting default methods.
<b>Step 5</b>	<b>(Optional) copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Using AAA Server VSAs with Cisco NX-OS Devices

You can use vendor-specific attributes (VSAs) to specify Cisco NX-OS user roles and SNMPv3 parameters on AAA servers.

### About VSAs

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating 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-av-pair`. The value is a string with the following format:

```
protocol : attribute separator value *
```

The protocol is a Cisco attribute for a particular type of authorization, the separator is = (equal sign) for mandatory attributes, and \* (asterisk) indicates optional attributes.

When you use RADIUS servers for authentication on a Cisco NX-OS device, the RADIUS protocol directs the RADIUS server to return user attributes, such as authorization information, along with authentication results. This authorization information is specified through VSAs.

## VSA Format

The following VSA protocol options are supported by the Cisco NX-OS software:

### 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, put it within double quotation marks.

The following attributes are supported by the Cisco NX-OS software:

### roles

Lists all the roles assigned to the user. The value field is a string that stores the list of group names delimited by white space. For example, if you belong to role network-operator and network-admin, the value field would be network-operator network-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. These examples use the roles attribute:

```
shell:roles=network-operator network-admin
shell:roles*network-operator network-admin
```

The following examples show the roles attribute as supported by FreeRADIUS:

```
Cisco-AVPair = shell:roles=\network-operator network-admin\
Cisco-AVPair = shell:roles*\network-operator network-admin\
```



### Note

When you specify a VSA as shell:roles\*"network-operator network-admin" or "shell:roles\*\network-operator network-admin\", this VSA is flagged as an optional attribute and other Cisco devices ignore this attribute.

### accountinginfo

Stores accounting information in addition to the attributes covered by a standard RADIUS accounting protocol. This attribute is sent only 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-related PDUs.

## Specifying Cisco NX-OS User Roles and SNMPv3 Parameters on AAA Servers

You can use the VSA cisco-av-pair on AAA servers to specify user role mapping for the Cisco NX-OS device using this format:

```
shell:roles="roleA roleB ..."
```

If you do not specify the role option in the cisco-av-pair attribute, the default user role is network-operator.

The SNMPv3 attributes should come together, either before the shell attributes or after. You can also specify your SNMPv3 authentication and privacy protocol attributes as follows:

```
snmpv3:auth="SHA" priv="AES-128" shell:roles="network-admin" shell:priv-lvl=15
```

```
shell:roles="network-admin" shell:priv-lvl=15 snmpv3:auth="SHA" priv="AES-128"
```

The SNMPv3 authentication protocol options are SHA and MD5. The privacy protocol options are AES-128 and DES. If you do not specify these options in the cisco-av-pair attribute, MD5 and DES are the default authentication protocols.

## Configuring Secure Login Features

### Configuring Login Parameters

You can configure login parameters to automatically block further login attempts when a possible denial-of-service (DoS) attack is detected and slow down dictionary attacks by enforcing a quiet period if multiple failed connection attempts are detected.



**Note** This feature restarts if a system switchover occurs or the AAA process restarts.



**Note** The **login block-for** and **login quiet-mode** configuration mode commands have been renamed to **system login block-for** and **system login quiet-mode**, respectively.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>[no] system login block-for</b> <i>seconds</i> <b>attempts</b> <i>tries</i> <b>within</b> <i>seconds</i>  <b>Example:</b> switch(config)# <b>system login block-for</b> 100 <b>attempts</b> 2 <b>within</b> 60	Configures the quiet mode time period. The range for all arguments is from 1 to 65535.  The example shows how to configure the switch to enter a 100-second quiet period if 2 failed login attempts are exceeded within 60 seconds.  After you enter this command, all login attempts made through Telnet or SSH are denied during the quiet period. Access control lists (ACLs) are not exempt from the quiet period until the <b>system</b> command is entered.  <b>Note</b>



	Command or Action	Purpose
		You must enter this command before any other login command can be used.
<b>Step 3</b>	(Optional) <b>[no] system login quiet-mode access-class <i>acl-name</i></b>  <b>Example:</b> <pre>switch(config)# <b>system login quiet-mode access-class myacl</b></pre>	Specifies an ACL that is to be applied to the switch when it changes to quiet mode. When the switch is in quiet mode, all login requests are denied, and the only available connection is through the console.
<b>Step 4</b>	(Optional) <b>show system login [failures]</b>  <b>Example:</b> <pre>switch(config)# <b>show system login</b></pre>	Displays the login parameters. The <b>failures</b> option displays information related only to failed login attempts.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch(config)# <b>copy running-config startup-config</b></pre>	Copies the running configuration to the startup configuration.

## Restricting User Login Sessions

You can restrict the maximum number of simultaneous login sessions per user. Doing so prevents users from having multiple unwanted sessions and solves the potential security issue of unauthorized users accessing a valid SSH or Telnet session.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# <b>configure terminal</b></pre>	Enters global configuration mode.
<b>Step 2</b>	<b>[no] user max-logins <i>max-logins</i></b>  <b>Example:</b> <pre>switch(config)# <b>user max-logins 1</b></pre>	Restricts the maximum number of simultaneous login sessions per user. The range is from 1 to 7. If you set the maximum login limit as 1, only one Telnet or SSH session is allowed per user.  <b>Note</b> The configured login limit applies to all users. You cannot set a different limit for individual users.
<b>Step 3</b>	(Optional) <b>show running-config all   i max-login</b>  <b>Example:</b> <pre>switch(config)# <b>show running-config all   i max-login</b></pre>	Displays the maximum number of login sessions allowed per user.

	Command or Action	Purpose
<b>Step 4</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch(config)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Restricting the Password Length

You can restrict the minimum and maximum length of the user password. This feature enables you to increase system security by forcing the user to provide a strong password.

### Before you begin

You must enable password strength checking using the **password strength-check** command. If you restrict the password length but do not enable password strength checking and the user enters a password that is not within the restricted length, an error appears, but a user account is created. To enforce the password length and prevent a user account from being created, you must enable password strength checking and restrict the password length.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal</pre>	Enters global configuration mode.
<b>Step 2</b>	<b>[no] userpassphrase {min-length min-length   max-length max-length}</b>  <b>Example:</b> <pre>switch(config)# userpassphrase min-length 8 max-length 80</pre>	Restricts the minimum and/or maximum length of the user password. The minimum password length is from 4 to 127 characters, and the maximum password length is from 80 to 127 characters.
<b>Step 3</b>	(Optional) <b>show userpassphrase {length   max-length   min-length}</b>  <b>Example:</b> <pre>switch(config)# show userpassphrase length</pre>	Displays the minimum and maximum length of the user password.
<b>Step 4</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch(config)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Enabling the Password Prompt for the Username

You can configure the switch to prompt the user to enter a password after entering the username.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>password prompt username</b>  <b>Example:</b> switch(config)# <b>password prompt username</b> Password prompt username is enabled. After providing the required options in the username command, press enter. User will be prompted for the username password and password will be hidden. Note: Choosing password key in the same line while configuring user account, password will not be hidden.	Configures the switch to prompt the user to enter a password after she enters the <b>username</b> command without the <b>password</b> option or the <b>snmp-server user</b> command. The password that the user enters will be hidden. You can use the <b>no</b> form of this command to disable this feature.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch(config)# <b>copy running-config startup-config</b>	Copies the running configuration to the startup configuration.

## Configuring the Shared Secret for RADIUS or TACACS+

The shared secret that you configure for remote authentication and accounting between the switch and the RADIUS or TACACS+ server should be hidden because it is sensitive information. You can use a separate command to generate an encrypted shared secret for the **radius-server [host] key** and **tacacs-server [host] key** commands. The SHA256 hashing method is used to store the encrypted shared secret.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	<b>generate type7_encrypted_secret</b>  <b>Example:</b> switch(config)# <b>generate type7_encrypted_secret</b> Type-7 (Vigenere) Encryption, Use this encrypted secret to configure radius and tacacs shared secret with key type 7. Copy complete secret with double quotes.  Enter plain text secret:	Configures the RADIUS or TACACS+ shared secret with key type 7. You are prompted to enter the shared secret in plain text twice. The secret is hidden as you enter it. Then an encrypted version of the secret appears.  <b>Note</b> You can generate the encrypted equivalent of a plain-text secret separately and configure the encrypted shared secret later using the

	Command or Action	Purpose
	Confirm plain text secret: Type 7 Encrypted secret is : "fewhg"	<b>radius-server [host] key</b> and <b>tacacs-server [host] key</b> commands.
<b>Step 3</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b>  switch(config)# <b>copy running-config startup-config</b>	Copies the running configuration to the startup configuration.

## Monitoring and Clearing the Local AAA Accounting Log

The Cisco NX-OS device maintains a local log for the AAA accounting activity. You can monitor this log and clear it.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>show accounting log</b> [ <i>size</i>   <b>last-index</b>   <b>start-seqnum</b> <i>number</i>   <b>start-time</b> <i>year month day hh:mm:ss</i> ]  <b>Example:</b>  switch# <b>show accounting log</b>	Displays the accounting log contents. By default, the command output contains up to 250,000 bytes of the accounting log. You can use the <i>size</i> argument to limit command output. The range is from 0 to 250000 bytes. You can also specify a starting sequence number or a starting time for the log output. The range of the starting index is from 1 to 1000000. Use the <b>last-index</b> keyword to display the value of the last index number in the accounting log file.
<b>Step 2</b>	(Optional) <b>clear accounting log [logflash]</b>  <b>Example:</b>  switch# <b>clear aaa accounting log</b>	Clears the accounting log contents. The <b>logflash</b> keyword clears the accounting log stored in the logflash.

## Verifying the AAA Configuration

To display AAA configuration information, perform one of the following tasks:

Command	Purpose
<b>show aaa accounting</b>	Displays AAA accounting configuration.
<b>show aaa authentication</b> [ <b>login</b> { <b>ascii-authentication</b>   <b>chap</b>   <b>error-enable</b>   <b>mschap</b>   <b>mschapv2</b> }]	Displays AAA authentication login configuration information.

Command	Purpose
<code>show aaa groups</code>	Displays the AAA server group configuration.
<code>show login [failures]</code>	Displays the login parameters. The <b>failures</b> option displays information related only to failed login attempts.  <b>Note</b> The <b>clear login failures</b> command clears the login failures in the current watch period.
<code>show login on-failure log</code>	Displays whether the switch is configured to log failed authentication messages to the syslog server.
<code>show login on-successful log</code>	Displays whether the switch is configured to log successful authentication messages to the syslog server.
<code>show running-config aaa [all]</code>	Displays the AAA configuration in the running configuration.
<code>show running-config all   i max-login</code>	Displays the maximum number of login sessions allowed per user.
<code>show startup-config aaa</code>	Displays the AAA configuration in the startup configuration.
<code>show userpassphrase {length   max-length   min-length}</code>	Displays the minimum and maximum length of the user password.

## Configuration Examples for AAA

The following example shows how to configure AAA:

```
aaa authentication login default group radius
aaa authentication login console group radius
aaa accounting default group radius
```

## Configuration Examples for Login Parameters

The following example shows how to configure the switch to enter a 100-second quiet period if 3 failed login attempts is exceeded within 60 seconds. This example shows no login failures.

```
switch# configure terminal
switch(config)# login block-for 100 attempts 3 within 60
switch(config)# show login
```

No Quiet-Mode access list has been configured, default ACL will be applied.

Switch is enabled to watch for login Attacks.  
If more than 3 login failures occur in 60 seconds or less,  
logins will be disabled for 100 seconds.

Switch presently in Normal-Mode.  
Current Watch Window remaining time 45 seconds.  
Present login failure count 0.

```
switch(config)# show login failures
*** No logged failed login attempts with the device.***
```

The following example shows how to configure a quiet-mode ACL. All login requests are denied during the quiet period except hosts from the myacl ACL. This example also shows a login failure.

```
switch# configure terminal
switch(config)# login block-for 100 attempts 3 within 60
switch(config)# login quiet-mode access-class myacl
```

```
switch(config)# show login
```

Switch is enabled to watch for login Attacks.  
If more than 3 login failures occur in 60 seconds or less,  
logins will be disabled for 100 seconds.

Switch presently in Quiet-Mode.  
Will remain in Quiet-Mode for 98 seconds.  
Denying logins from all sources.

```
switch(config)# show login failures
Information about last 20 login failure's with the device.
```

Username	Line	SourceIPAddr	Appname	TimeStamp
asd	/dev/pts/0	171.70.55.158	login	Mon Aug 3 18:18:54 2015
qweq	/dev/pts/0	171.70.55.158	login	Mon Aug 3 18:19:02 2015
qwe	/dev/pts/0	171.70.55.158	login	Mon Aug 3 18:19:08 2015

## Configuration Examples for the Password Prompt Feature

The following example shows how to configure the switch to prompt the user to enter a password after she enters the **username** command and the error message that displays if she does not enter a password.

```
switch# configure terminal
switch(config)# password prompt username
Password prompt username is enabled.
```

After providing the required options in the username command, press enter.  
 User will be prompted for the username password and password will be hidden.  
 Note: Choosing password key in the same line while configuring user account, password will not be hidden.

```
switch(config)# username user1
Enter password:
Confirm password:
warning: password for user:user1 not set. S/he may not be able to login
```

The following example shows how to configure the switch to prompt the user to enter a password after she enters the **snmp-server user** command and the prompts that then display to the user.

```
switch# configure terminal
switch(config)# password prompt username
Password prompt username is enabled.
After providing the required options in the username command, press enter.
User will be prompted for the username password and password will be hidden.
Note: Choosing password key in the same line while configuring user account, password will not be hidden.
```

```
N9K-1(config)# snmp-server user user1
Enter auth md5 password (Press Enter to Skip):
Enter auth sha password (Press Enter to Skip):
```

## Additional References for AAA

This section includes additional information related to implementing AAA.

### Related Documents

Related Topic	Document Title
Cisco NX-OS Licensing	<i>Cisco NX-OS Licensing Guide</i>

### Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

### MIBs

MIBs	MIBs Link
MIBs related to AAA	To locate and download supported MIBs, go to the following URL: <a href="https://cisco.github.io/cisco-mibs/supportlists/nexus9000/Nexus9000MIBSupportList.html">https://cisco.github.io/cisco-mibs/supportlists/nexus9000/Nexus9000MIBSupportList.html</a>

