



## Overview

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The Cisco NX-OS software supports security features that can protect your network against degradation or failure and also against data loss or compromise resulting from intentional attacks and from unintended but damaging mistakes by well-meaning network users.

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## Licensing Requirements

For a complete explanation of Cisco NX-OS licensing recommendations and how to obtain and apply licenses, see the [Cisco NX-OS Licensing Guide](#).

## Authentication, Authorization, and Accounting

Authentication, authorization, and accounting (AAA) is an architectural framework for configuring a set of three independent security functions in a consistent, modular manner.

### **Authentication**

Provides the method of identifying users, including login and password dialog, challenge and response, messaging support, and, depending on the security protocol that you select, encryption. Authentication

is the way a user is identified prior to being allowed access to the network and network services. You configure AAA authentication by defining a named list of authentication methods and then applying that list to various interfaces.

#### **Authorization**

Provides the method for remote access control, including one-time authorization or authorization for each service, per-user account list and profile, user group support, and support of IP, IPX, ARA, and Telnet.

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. AAA authorization works by assembling a set of attributes that describe what the user is authorized to perform. These attributes are compared with the information contained in a database for a given user, and the result is returned to AAA to determine the user's actual capabilities and restrictions.

#### **Accounting**

Provides the method for collecting and sending security server information used for billing, auditing, and reporting, such as user identities, start and stop times, executed commands (such as PPP), number of packets, and number of bytes. Accounting enables you to track the services that users are accessing, as well as the amount of network resources that they are consuming.



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**Note** You can configure authentication outside of AAA. However, you must configure AAA if you want to use RADIUS or TACACS+, or if you want to configure a backup authentication method.

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## **RADIUS and TACACS+ Security Protocols**

AAA uses security protocols to administer its security functions. If your router or access server is acting as a network access server, AAA is the means through which you establish communication between your network access server and your RADIUS or TACACS+ security server.

The chapters in this guide describe how to configure the following security server protocols:

#### **RADIUS**

A distributed client/server system implemented through AAA that secures networks against unauthorized access. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a central RADIUS server that contains all user authentication and network service access information.

#### **TACACS+**

A security application implemented through AAA that provides a centralized validation of users who are attempting to gain access to a router or network access server. TACACS+ services are maintained in a database on a TACACS+ daemon running, typically, on a UNIX or Windows NT workstation. TACACS+ provides for separate and modular authentication, authorization, and accounting facilities.

## **LDAP**

The Lightweight Directory Access Protocol (LDAP) provides centralized validation of users attempting to gain access to a Cisco NX-OS device. LDAP allows a single access control server (the LDAP daemon) to provide authentication and authorization independently.

## SSH and Telnet

You can use the Secure Shell (SSH) server to enable an SSH client to make a secure, encrypted connection to a Cisco NX-OS device. SSH uses strong encryption for authentication. The SSH server in the Cisco NX-OS software can interoperate with publicly and commercially available SSH clients.

The SSH client in the Cisco NX-OS software works with publicly and commercially available SSH servers.

The Telnet protocol enables TCP/IP connections to a host. Telnet allows a user at one site to establish a TCP connection to a login server at another site and then passes the keystrokes from one device to the other. Telnet can accept either an IP address or a domain name as the remote device address.

## User Accounts and Roles

You can create and manage user accounts and assign roles that limit access to operations on the Cisco NX-OS device. Role-based access control (RBAC) allows you to define the rules for an assign role that restrict the authorization that the user has to access management operations.

## IP ACLs

IP ACLs are ordered sets of rules that you can use to filter traffic based on IPv4 information in the Layer 3 header of packets. Each rule specifies a set of conditions that a packet must satisfy to match the rule. When the Cisco NX-OS software determines that an IP ACL applies to a packet, it tests the packet against the conditions of all rules. The first match determines whether a packet is permitted or denied, or if there is no match, the Cisco NX-OS software applies the applicable default rule. The Cisco NX-OS software continues processing packets that are permitted and drops packets that are denied.

## MAC ACLs

MAC ACLs are ACLs that filter traffic using the information in the Layer 2 header of each packet. Each rule specifies a set of conditions that a packet must satisfy to match the rule. When the Cisco NX-OS software determines that a MAC ACL applies to a packet, it tests the packet against the conditions of all rules. The first match determines whether a packet is permitted or denied, or if there is no match, the Cisco NX-OS software applies the applicable default rule. The Cisco NX-OS software continues processing packets that are permitted and drops packets that are denied.

## VACLs

A VLAN ACL (VACL) is one application of an IP ACL or MAC ACL. You can configure VACLs to apply to all packets that are routed into or out of a VLAN or are bridged within a VLAN. VACLs are strictly for security packet filtering and for redirecting traffic to specific physical interfaces. VACLs are not defined by direction (ingress or egress).

## DHCP Snooping

DHCP snooping acts like a firewall between untrusted hosts and trusted DHCP servers. DHCP snooping performs the following activities:

- Validates DHCP messages received from untrusted sources and filters out invalid messages.
- Builds and maintains the DHCP snooping binding database, which contains information about untrusted hosts with leased IP addresses.
- Uses the DHCP snooping binding database to validate subsequent requests from untrusted hosts.

Dynamic ARP inspection (DAI) and IP Source Guard (IPSG) also use information stored in the DHCP snooping binding database.

## Password Encryption

The Advanced Encryption Standard (AES) password encryption feature stores all existing and newly created clear-text passwords for supported applications (currently RADIUS and TACACS+) in the strong and reversible type-6 encrypted format. A primary encryption key is used to encrypt and decrypt the passwords. You can also use this feature to convert all existing weakly encrypted passwords to type-6 encrypted passwords.

## Keychain Management

Keychain management allows you to create and maintain keychains, which are sequences of keys (sometimes called shared secrets). You can use keychains with features that secure communications with other devices by using key-based authentication. The device allows you to configure multiple keychains.

Some routing protocols that support key-based authentication can use a keychain to implement a hitless key rollover for authentication.

## Control Plane Policing

The Cisco NX-OS device provides control plane policing to prevent denial-of-service (DoS) attacks from impacting performance. The supervisor module of the Cisco NX-OS device has both the management plane and control plane and is critical to the operation of the network. Any disruption to the supervisor module would result in serious network outages. Excessive traffic to the supervisor module could overload it and slow down the performance of the entire Cisco NX-OS device. Attacks on the supervisor module can be of various types such as, denial-of-service (DoS) attacks that generate IP traffic streams to the control plane at a very high rate. These attacks result in the control plane spending a large amount of time in handling these packets, which makes the control plane unable to process genuine traffic.

## Rate Limits

Rate limits can prevent redirected packets for egress exceptions from overwhelming the supervisor module on a Cisco NX-OS device.

# Virtual Device Contexts

Cisco NX-OS can segment operating system and hardware resources into virtual device contexts (VDCs) that emulate virtual devices. The Cisco Nexus 3400-S Series switches currently do not support multiple VDCs. All switch resources are managed in the default VDC.

