



Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide, Release 10.6(x)

First Published: 2025-08-13

Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
<http://www.cisco.com>
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS REFERENCED IN THIS DOCUMENTATION ARE SUBJECT TO CHANGE WITHOUT NOTICE. EXCEPT AS MAY OTHERWISE BE AGREED BY CISCO IN WRITING, ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS DOCUMENTATION ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED.

The Cisco End User License Agreement and any supplemental license terms govern your use of any Cisco software, including this product documentation, and are located at: <https://www.cisco.com/c/en/us/about/legal/cloud-and-software/software-terms.html>. Cisco product warranty information is available at <https://www.cisco.com/c/en/us/products/warranty-listing.html>. US Federal Communications Commission Notices are found here <https://www.cisco.com/c/en/us/products/us-fcc-notice.html>.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any products and features described herein as in development or available at a future date remain in varying stages of development and will be offered on a when-and if-available basis. Any such product or feature roadmaps are subject to change at the sole discretion of Cisco and Cisco will have no liability for delay in the delivery or failure to deliver any products or feature roadmap items that may be set forth in this document.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

The documentation set for this product strives to use bias-free language. For the purposes of this documentation set, bias-free is defined as language that does not imply discrimination based on age, disability, gender, racial identity, ethnic identity, sexual orientation, socioeconomic status, and intersectionality. Exceptions may be present in the documentation due to language that is hardcoded in the user interfaces of the product software, language used based on RFP documentation, or language that is used by a referenced third-party product.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: <https://www.cisco.com/c/en/us/about/legal/trademarks.html>. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1721R)

© 2025 Cisco Systems, Inc. All rights reserved.



CONTENTS

Trademarks ?

PREFACE

Preface **xiii**

 Audience **xiii**

 Document Conventions **xiii**

 Related Documentation for Cisco Nexus 9000 Series Switches **xiv**

 Documentation Feedback **xiv**

 Communications, services, and additional information **xiv**

 Cisco Bug Search Tool **xv**

 Documentation feedback **xv**

CHAPTER 1

New and Changed Information **1**

 New and Changed Information **1**

CHAPTER 2

Overview **3**

 Licensing Requirements **3**

 Supported Platforms **3**

 Software Image **3**

 Software Compatibility **4**

 Spine/Leaf Topology **4**

 Modular Software Design **4**

 Serviceability **4**

 Switched Port Analyzer **4**

 Ethalyzer **5**

 Smart Call Home **5**

 Online Diagnostics **5**

Embedded Event Manager	5
Manageability	5
Simple Network Management Protocol	5
Configuration Verification and Rollback	5
Role-Based Access Control	6
Cisco NX-OS Device Configuration Methods	6
Programmability	6
Python API	6
Tcl	6
Cisco NX-API	6
Bash Shell	7
Broadcom Shell	7
Traffic Routing, Forwarding, and Management	7
Ethernet Switching	7
IP Routing	8
IP Services	8
IP Multicast	8
Quality of Service	9
Network Security Features	9
Supported Standards	10

CHAPTER 3	Using the Cisco NX-OS Setup Utility	17
	About the Cisco NX-OS Setup Utility	17
	Prerequisites for the Setup Utility	18
	Setting Up Your Cisco NX-OS Device	19
	Additional References for the Setup Utility	24
	Related Documents for the Setup Utility	24

CHAPTER 4	Using PowerOn Auto Provisioning	25
	About PowerOn Auto Provisioning	25
	Network Requirements for POAP	25
	Secure Download of POAP Script	26
	Network Requirements for Secure POAP	29
	Deployment Scenarios	29

SUDI Supported Device as File Server	29
Non-SUDI Supported Device as a File Server	30
Benchmark Configured Device	31
Secure POAP on a Device Shipped with Old Image	31
Troubleshooting Secure POAP	32
Disabling POAP	32
POAP Configuration Script	33
POAP Configuration Script	33
Using the POAP Script and POAP Script Options	34
Setting up the DHCP Server without DNS for POAP	37
Downloading and Using User Data, Agents, and Scripts as part of POAP	37
POAP Process	38
Power-Up Phase	39
USB Discovery Phase	40
DHCP Discovery Phase	40
Script Execution Phase	42
Post-Installation Reload Phase	42
POAPv3	42
Guidelines and Limitations for POAP	44
Setting Up the Network Environment to Use POAP	46
Configuring a Switch Using POAP	46
Creating md5 Files	47
Verifying the Device Configuration	49
Troubleshooting for POAP	50
Managing the POAP Personality	50
POAP Personality	50
Backing Up the POAP Personality	51
Configuring the POAP Personality	51
Restoring the POAP Personality	53
POAP Personality Sample Script	53

CHAPTER 5

Using Network Plug and Play	55
About Network Plug and Play	55
Guidelines and Limitations for Network Plug and Play	62

Troubleshooting Examples for Network Plug and Play	63
--	----

CHAPTER 6**Understanding the Command-Line Interface 69**

About the CLI Prompt	69
Command Modes	70
EXEC Command Mode	70
Global Configuration Command Mode	70
Interface Configuration Command Mode	71
Subinterface Configuration Command Mode	72
Saving and Restoring a Command Mode	72
Exiting a Configuration Command Mode	73
Command Mode Summary	73
Special Characters	74
Keystroke Shortcuts	75
Abbreviating Commands	78
Completing a Partial Command Name	78
Identifying Your Location in the Command Hierarchy	79
Using the no Form of a Command	79
Configuring CLI Variables	80
About CLI Variables	80
Configuring CLI Session-Only Variables	81
Configuring Persistent CLI Variables	81
Command Aliases	82
About Command Aliases	82
Defining Command Aliases	83
Configuring Command Aliases for a User Session	84
Command Scripts	85
Running a Command Script	85
Echoing Information to the Terminal	85
Delaying Command Action	86
Context-Sensitive Help	87
Understanding Regular Expressions	88
Special Characters	88
Multiple-Character Patterns	89

Anchoring	89
Searching and Filtering show Command Output	89
Filtering and Searching Keywords	90
diff Utility	91
grep and egrep Utilities	92
less Utility	93
Mini AWK Utility	93
sed Utility	93
sort Utility	93
Searching and Filtering from the --More-- Prompt	94
Using the Command History	95
Recalling a Command	95
Controlling CLI History Recall	95
Configuring the CLI Edit Mode	96
Displaying the Command History	96
Enabling or Disabling the CLI Confirmation Prompts	97
Setting CLI Display Colors	97
Sending Commands to Modules	98
Sending Command Output in Email	99
BIOS Loader Prompt	101
Examples Using the CLI	101
Using the System-Defined Timestamp Variable	101
Using CLI Session Variables	101
Defining Command Aliases	102
Running a Command Script	102
Sending Command Output in Email	103

CHAPTER 7

Configuring Terminal Settings and Sessions 105

About Terminal Settings and Sessions	105
Terminal Session Settings	105
Console Port	105
Virtual Terminals	106
Default Settings for File System Parameters	106
Configuring the Console Port	106

Configuring Virtual Terminals	108
Configuring the Inactive Session Timeout	108
Configuring the Session Limit	109
Clearing Terminal Sessions	110
Displaying Terminal and Session Information	110

CHAPTER 8

Basic Device Management 113

About Basic Device Management	113
Device Hostname	113
Message-of-the-Day Banner	113
Device Clock	113
Clock Manager	114
Time Zone and Summer Time (Daylight Saving Time)	114
User Sessions	114
Default Settings for Basic Device Parameters	114
Changing the Device Hostname	114
Configuring the MOTD Banner	115
Configuring the Time Zone	117
Configuring Summer Time (Daylight Saving Time)	117
Manually Setting the Device Clock	119
Setting the Clock Manager	119
Managing Users	120
Displaying Information about the User Sessions	120
Sending a Message to Users	121
Verifying the Device Configuration	121

CHAPTER 9

Using the Device File Systems, Directories, and Files 123

About the Device File Systems, Directories, and Files	123
File Systems	123
Directories	124
Files	124
Guidelines and Limitations	125
Default Settings for File System Parameters	125
Configuring the FTP, HTTP, or TFTP Source Interface	125

Working with Directories	126
Identifying the Current Directory	126
Changing the Current Directory	126
Creating a Directory	127
Displaying Directory Contents	127
Deleting a Directory	128
Accessing Directories on the Standby Supervisor Module	129
Working with Files	129
Moving Files	129
Copying Files	130
Copying Files Using HTTP or HTTPS	131
Deleting Files	131
Displaying File Contents	132
Displaying File Checksums	132
Compressing and Uncompressing Files	133
Displaying the Last Lines in a File	133
Redirecting show Command Output to a File	134
Finding Files	134
Formatting the Bootflash	135
Working with Archive Files	136
Creating an Archive File	136
Appending Files to an Archive File	137
Extracting Files from an Archive File	138
Displaying the Filenames in an Archive File	138
SSD Re-partitioning	139
Enable or Disable Tech-Support Command	141
Displaying Tech-support Blocked CLIs	141
Examples of Using the File System	142
Accessing Directories on Standby Supervisor Modules	142
Moving Files	142
Copying Files	143
Deleting a Directory	143
Displaying File Contents	144
Displaying File Checksums	144

Compressing and Uncompressing Files 145

Redirecting show Command Output 145

Finding Files 146

CHAPTER 10

Working with Configuration Files 147

About Configuration Files 147

Types of Configuration Files 147

Guidelines and Limitations for Configuration Files 148

Managing Configuration Files 148

Saving the Running Configuration to the Startup Configuration 148

Copying a Configuration File to a Remote Server 148

Downloading the Running Configuration From a Remote Server 149

Downloading the Startup Configuration From a Remote Server 150

Copying Configuration Files to an External Flash Memory Device 152

Copying the Running Configuration from an External Flash Memory Device 153

Copying the Startup Configuration From an External Flash Memory Device 154

Copying Configuration Files to an Internal File System 154

Rolling Back to a Previous Configuration 155

Removing the Configuration for a Missing Module 156

Erasing a Configuration 157

Clearing Inactive Configurations 158

Configuration Archive and Configuration Log 159

Information About Configuration Archive 159

Configuring the Characteristics of the Configuration Archive 160

Information About Configuration Log 161

Displaying Configuration Log Entries 162

Verifying the Device Configuration 163

Examples of Working with Configuration Files 165

Copying Configuration Files 165

Backing Up Configuration Files 165

Rolling Back to a Previous Configuration 165

CHAPTER 11

Nexus Switch Intersight Device Connector 167

Nexus Switch Intersight Device Connector Overview 167

Guidelines and Limitations	168
Configuring Nexus Switch to Intersight	168
Verifying NXDC configuration and status	170
Claiming Nexus Switches in Intersight	171



Preface

This preface includes the following sections:

- [Audience, on page xiii](#)
- [Document Conventions, on page xiii](#)
- [Related Documentation for Cisco Nexus 9000 Series Switches, on page xiv](#)
- [Documentation Feedback, on page xiv](#)
- [Communications, services, and additional information, on page xiv](#)

Audience

This publication is for network administrators who install, configure, and maintain Cisco Nexus switches.

Document Conventions

Command descriptions use the following conventions:

Convention	Description
bold	Bold text indicates the commands and keywords that you enter literally as shown.
<i>Italic</i>	Italic text indicates arguments for which you supply the values.
[x]	Square brackets enclose an optional element (keyword or argument).
[x y]	Square brackets enclosing keywords or arguments that are separated by a vertical bar indicate an optional choice.
{x y}	Braces enclosing keywords or arguments that are separated by a vertical bar indicate a required choice.
[x {y z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.

Convention	Description
<code>variable</code>	Indicates a variable for which you supply values, in context where italics cannot be used.
<code>string</code>	A nonquoted set of characters. Do not use quotation marks around the string or the string includes the quotation marks.

Examples use the following conventions:

Convention	Description
<code>screen font</code>	Terminal sessions and information the switch displays are in screen font.
<code>boldface screen font</code>	Information that you must enter is in boldface screen font.
<i><code>italic screen font</code></i>	Arguments for which you supply values are in italic screen font.
<code><></code>	Nonprinting characters, such as passwords, are in angle brackets.
<code>[]</code>	Default responses to system prompts are in square brackets.
<code>!, #</code>	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Related Documentation for Cisco Nexus 9000 Series Switches

The entire Cisco Nexus 9000 Series switch documentation set is available at the following URL:

https://www.cisco.com/en/US/products/ps13386/tsd_products_support_series_home.html

Documentation Feedback

To provide technical feedback on this document, or to report an error or omission, please send your comments to nexus9k-docfeedback@cisco.com. We appreciate your feedback.

Communications, services, and additional information

- To receive timely, relevant information from Cisco, sign up at [Cisco Profile Manager](#).
- To get the business impact you're looking for with the technologies that matter, visit [Cisco Services](#).
- To submit a service request, visit [Cisco Support](#).
- To discover and browse secure, validated enterprise-class apps, products, solutions, and services, visit [Cisco DevNet](#).
- To obtain general networking, training, and certification titles, visit [Cisco Press](#).
- To find warranty information for a specific product or product family, access [Cisco Warranty Finder](#).

Cisco Bug Search Tool

[Cisco Bug Search Tool](#) (BST) is a gateway to the Cisco bug-tracking system, which maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. The BST provides you with detailed defect information about your products and software.

Documentation feedback

To provide feedback about Cisco technical documentation, use the feedback form available in the right pane of every online document.



CHAPTER 1

New and Changed Information

- [New and Changed Information, on page 1](#)

New and Changed Information

Table 1: New and Changed Features

Feature	Description	Changed in Release	Where Documented
POAP support on N9336C-SE1	Added support for POAP on Cisco N9336C-SE1 switch	10.6(1)F	Guidelines and Limitations for POAP, on page 44



CHAPTER 2

Overview

This chapter contains these sections:

- [Licensing Requirements, on page 3](#)
- [Supported Platforms, on page 3](#)
- [Software Image, on page 3](#)
- [Software Compatibility, on page 4](#)
- [Serviceability, on page 4](#)
- [Manageability, on page 5](#)
- [Programmability, on page 6](#)
- [Traffic Routing, Forwarding, and Management, on page 7](#)
- [Quality of Service, on page 9](#)
- [Network Security Features, on page 9](#)
- [Supported Standards, on page 10](#)

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](#) and the [Cisco NX-OS Licensing Options Guide](#).

Supported Platforms

Use the [Nexus Switch Platform Support Matrix](#) to know from which Cisco NX-OS releases various Cisco Nexus 9000 and 3000 switches support a selected feature.

Software Image

The Cisco NX-OS software consists of one NXOS software image.

Software Compatibility

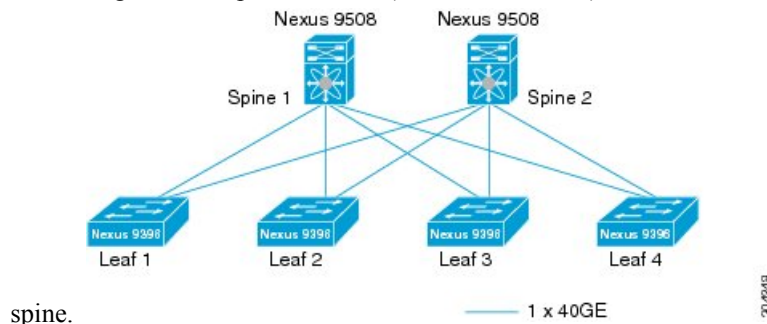
The Cisco NX-OS software interoperates with Cisco products that run any variant of the Cisco IOS software. The Cisco NX-OS software also interoperates with any networking operating system that conforms to the IEEE and RFC compliance standards.

Spine/Leaf Topology

The Cisco Nexus 9000 Series switches support a two-tier spine/leaf topology.

Figure 1: Spine/Leaf Topology

This figure shows an example of a spine/leaf topology with four leaf switches (Cisco Nexus 9396 or 93128) connecting into two spine switches (Cisco Nexus 9508) and two 40G Ethernet uplinks from each leaf to each



spine.

Modular Software Design

The Cisco NX-OS software supports distributed multithreaded processing on symmetric multiprocessors (SMPs), multi-core CPUs, and distributed data module processors. The Cisco NX-OS software offloads computationally intensive tasks, such as hardware table programming, to dedicated processors distributed across the data modules. The modular processes are created on demand, each in a separate protected memory space. Processes are started and system resources are allocated only when you enable a feature. A real-time preemptive scheduler helps to ensure the timely processing of critical functions.

Serviceability

The Cisco NX-OS software has serviceability functions that allow the device to respond to network trends and events. These features help you with network planning and improving response times.

Switched Port Analyzer

The Switched Port Analyzer (SPAN) feature allows you to analyze all traffic between ports (called the SPAN source ports) by nonintrusively directing the SPAN session traffic to a SPAN destination port that has an external analyzer attached to it. For more information about SPAN, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Ethanalyzer

Ethanalyzer is a Cisco NX-OS protocol analyzer tool based on the Wireshark (formerly Ethereal) open source code. Ethanalyzer is a command-line version of Wireshark for capturing and decoding packets. You can use Ethanalyzer to troubleshoot your network and analyze the control-plane traffic. For more information about Ethanalyzer, see the *Cisco Nexus 9000 Series NX-OS Troubleshooting Guide*.

Smart Call Home

The Call Home feature continuously monitors hardware and software components to provide e-mail-based notification of critical system events. A versatile range of message formats is available for optimal compatibility with standard e-mail and XML-based automated parsing applications. It offers alert grouping capabilities and customizable destination profiles. You can use this feature, for example, to send an e-mail message to a network operations center (NOC) and employ Cisco AutoNotify services to directly generate a case with the Cisco Technical Assistance Center (TAC). For more information about Smart Call Home, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Online Diagnostics

Cisco generic online diagnostics (GOLD) verify that hardware and internal data paths are operating as designed. Boot-time diagnostics, continuous monitoring, and on-demand and scheduled tests are part of the Cisco GOLD feature set. GOLD allows rapid fault isolation and continuous system monitoring. For information about configuring GOLD, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Embedded Event Manager

Cisco Embedded Event Manager (EEM) is a device and system management feature that helps you to customize behavior based on network events as they happen. For information about configuring EEM, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Manageability

This section describes the manageability features for the Cisco Nexus 9000 Series switches.

Simple Network Management Protocol

The Cisco NX-OS software is compliant with Simple Network Management Protocol (SNMP) version 1, version 2, and version 3. A large number of MIBs is supported. For more information about SNMP, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Configuration Verification and Rollback

The Cisco NX-OS software allows you to verify the consistency of a configuration and the availability of necessary hardware resources prior to committing the configuration. You can preconfigure a device and apply the verified configuration at a later time. Configurations also include checkpoints that allow you to roll back to a known good configuration as needed. For more information about rollbacks, see the *Cisco Nexus 9000 Series NX-OS System Management Configuration Guide*.

Role-Based Access Control

With role-based access control (RBAC), you can limit access to device operations by assigning roles to users. You can customize access and restrict it to the users who require it. For more information about RBAC, see the *Cisco Nexus 9000 Series NX-OS Security Configuration Guide*.

Cisco NX-OS Device Configuration Methods

You can use these methods to configure Cisco NX-OS devices:

- The CLI from a Secure Shell (SSH) session, a Telnet session, or the console port. SSH provides a secure connection to the device. The CLI configuration guides are organized by feature. For more information, see the Cisco NX-OS configuration guides. For more information about SSH and Telnet, see the *Cisco Nexus 9000 Series NX-OS Security Configuration Guide*.
- The XML management interface, which is a programmatic method based on the NETCONF protocol that complements the CLI. For more information, see the *Cisco NX-OS XML Interface User Guide*.
- The Cisco Nexus Dashboard Fabric Controller (NDFC) client, which runs on your local PC and uses web services on the Cisco NDFC server. The Cisco NDFC server configures the device over the XML management interface. For more information about the Cisco NDFC client, see the *Cisco NDFC Fundamentals Guide*.

Programmability

This section describes the programmability features for the Cisco Nexus 9000 Series switches.

Python API

Python is an easy-to-learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms. The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python website: <http://www.python.org/>. The Python scripting capability gives programmatic access to the CLI to perform various tasks and Power-On Auto Provisioning (POAP) or Embedded Event Manager (EEM) actions. For more information about the Python API and Python scripting, see the *Cisco Nexus 9000 Series NX-OS Programmability Guide*.

Tcl

Tool Command Language (Tcl) is a scripting language. With Tcl, you gain more flexibility in your use of the CLI commands on the device. You can use Tcl to extract certain values in the output of a **show** command, perform switch configurations, run Cisco NX-OS commands in a loop, or define EEM policies in a script.

Cisco NX-API

The Cisco NX-API provides web-based programmatic access to the Cisco Nexus 9000 Series switches. This support is delivered through the NX-API open-source web server. The Cisco NX-API exposes the complete configuration and management capabilities of the command-line interface (CLI) through web-based APIs.

You can configure the switch to publish the output of the API calls in either XML or JSON format. For more information about the Cisco NX-API, see the *Cisco Nexus 9000 Series NX-OS Programmability Guide*.



Note NX-API performs authentication through a programmable authentication module (PAM) on the switch. Use cookies to reduce the number of PAM authentications and thus reduce the load on PAM.

Bash Shell

The Cisco Nexus 9000 Series switches support direct Linux shell access. With Linux shell support, you can access the Linux system on the switch in order to use Linux commands and manage the underlying system. For more information about Bash shell support, see the *Cisco Nexus 9000 Series NX-OS Programmability Guide*.

Broadcom Shell

The Cisco Nexus 9000 Series switch front-panel and fabric module line cards contain several Broadcom ASICs. You can use the CLI to access the command-line shell (bcm shell) for these ASICs. The benefit of using this method to access the bcm shell is that you can use Cisco NX-OS command extensions such as **pipe include** and **redirect output to file** to manage the output. In addition, the activity is recorded in the system accounting log for audit purposes, unlike commands entered directly from the bcm shell, which are not recorded in the accounting log. For more information about Broadcom shell support, see the *Cisco Nexus 9000 Series NX-OS Programmability Guide*.



Caution Use Broadcom shell commands with caution and only under the direct supervision or request of Cisco Support personnel.

Traffic Routing, Forwarding, and Management

This section describes the traffic routing, forwarding, and management features supported by the Cisco NX-OS software.

Ethernet Switching

The Cisco NX-OS software supports high-density, high-performance Ethernet systems and provides the following Ethernet switching features:

- IEEE 802.1D-2004 Rapid and Multiple Spanning Tree Protocols (802.1w and 802.1s)
- IEEE 802.1Q VLANs and trunks
- IEEE 802.3ad link aggregation
- Unidirectional Link Detection (UDLD) in aggressive and standard modes

For more information, see the *Cisco Nexus 9000 Series NX-OS Interfaces Configuration Guide* and the *Cisco Nexus 9000 Series NX-OS Layer 2 Switching Configuration Guide*.

IP Routing

The Cisco NX-OS software supports IP version 4 (IPv4) and IP version 6 (IPv6) and the following routing protocols:

- Open Shortest Path First (OSPF) Protocol Versions 2 (IPv4) and 3 (IPv6)
- Intermediate System-to-Intermediate System (IS-IS) Protocol (IPv4 and IPv6)
- Border Gateway Protocol (BGP) (IPv4 and IPv6)
- Enhanced Interior Gateway Routing Protocol (EIGRP) (IPv4 only)
- Routing Information Protocol Version 2 (RIPv2) (IPv4 only)

The Cisco NX-OS software implementations of these protocols are fully compliant with the latest standards and include 4-byte autonomous system numbers (ASNs) and incremental shortest path first (SPF). All unicast protocols support Non-Stop Forwarding Graceful Restart (NSF-GR). All protocols support all interface types, including Ethernet interfaces, VLAN interfaces, subinterfaces, port channels, and loopback interfaces.

For more information, see the *Cisco Nexus 9000 Series NX-OS Unicast Routing Configuration Guide*.

IP Services

The following IP services are available in the Cisco NX-OS software:

- Virtual routing and forwarding (VRF)
- Dynamic Host Configuration Protocol (DHCP) helper
- Hot Standby Router Protocol (HSRP)
- Enhanced object tracking
- Policy-based routing (PBR)
- Unicast graceful restart for all protocols in IPv4 unicast graceful restart for OPSFv3 in IPv6

For more information, see the *Cisco Nexus 9000 Series NX-OS Unicast Routing Configuration Guide*.

IP Multicast

The Cisco NX-OS software includes the following multicast protocols and functions:

- Protocol Independent Multicast (PIM) Version 2 (PIMv2)
- PIM sparse mode (Any-Source Multicast [ASM] for IPv4)
- Anycast rendezvous point (Anycast-RP)
- Multicast NSF for IPv4
- RP-Discovery using bootstrap router (BSR) (Auto-RP and static)

- Internet Group Management Protocol (IGMP) Versions 1, 2, and 3 router role
- IGMPv2 host mode
- IGMP snooping
- Multicast Source Discovery Protocol (MSDP) (for IPv4)



Note The Cisco NX-OS software does not support PIM dense mode.

For more information, see the *Cisco Nexus 9000 Series NX-OS Multicast Routing Configuration Guide*.

Quality of Service

The Cisco NX-OS software supports quality of service (QoS) functions for classification, marking, queuing, policing, and scheduling. Modular QoS CLI (MQC) supports all QoS features. You can use MQC to provide uniform configurations across various Cisco platforms. For more information, see the *Cisco Nexus 9000 Series NX-OS Quality of Service Configuration Guide*.

Network Security Features

The Cisco NX-OS software includes the following security features:

- Control Plane Policing (CoPP)
- Message-digest algorithm 5 (MD5) routing protocol authentication
- Authentication, authorization, and accounting (AAA)
- RADIUS and TACACS+
- SSH Protocol Version 2
- SNMPv3
- Policies based on MAC and IPv4 addresses supported by named ACLs (port-based ACLs [PACLs], VLAN-based ACLs [VACLs], and router-based ACLs [RACLs])
- Traffic storm control (unicast, multicast, and broadcast)

For more information, see the *Cisco Nexus 9000 Series NX-OS Security Configuration Guide*.

Supported Standards

This table lists the IEEE compliance standards.

Table 2: IEEE Compliance Standards

Standard	Description
802.1D	MAC Bridges
802.1p	Class of Service Tagging for Ethernet frames
802.1Q	VLAN Tagging
802.1s	Multiple Spanning Tree Protocol
802.1w	Rapid Spanning Tree Protocol
802.3ab	1000Base-T (10/100/1000 Ethernet over copper)
802.3ad	Link aggregation with LACP
802.3ae	10-Gigabit Ethernet

This table lists the RFC compliance standards. For information on each RFC, see www.ietf.org.

Table 3: RFC Compliance Standards

Standard	Description
BGP	
RFC 1997	<i>BGP Communities Attribute</i>
RFC 2385	<i>Protection of BGP Sessions via the TCP MD5 Signature Option</i>
RFC 2439	<i>BGP Route flap damping</i>
RFC 2519	<i>A Framework for Inter-Domain Route Aggregation</i>
RFC 2545	<i>Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing</i>
RFC 2858	<i>Multiprotocol Extensions for BGP-4</i>
RFC 2918	<i>Route Refresh Capability for BGP-4</i>
RFC 3065	<i>Autonomous System Confederations for BGP</i>

Standard	Description
RFC 3392	<i>Capabilities Advertisement with BGP-4</i>
RFC 4271	<i>BGP version 4</i>
RFC 4273	<i>BGP4 MIB - Definitions of Managed Objects for BGP-4</i>
RFC 4456	<i>BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP)</i>
RFC 4486	<i>Subcodes for BGP cease notification message</i>
RFC 4724	<i>Graceful Restart Mechanism for BGP</i>
RFC 4893	<i>BGP Support for Four-octet AS Number Space</i>
RFC 5004	<i>Avoid BGP Best Path Transitions from One External to Another</i>
RFC 5396	<i>Textual Representation of Autonomous System (AS) Numbers</i> Note RFC 5396 is partially supported. The asplain and asdot notations are supported, but the asdot+ notation is not.
RFC 5549	<i>Advertising IPv4 Network Layer Reachability Information with an IPv6 Next Hop</i>
RFC 5668	<i>4-Octet AS Specific BGP Extended Community</i>
ietf-draft	Bestpath transition avoidance (draft-ietf-idr-avoid-transition-05.txt)
ietf-draft	Peer table objects (draft-ietf-idr-bgp4-mib-15.txt)
ietf-draft	Dynamic Capability (draft-ietf-idr-dynamic-cap-03.txt)
IP Multicast	

Standard	Description
RFC 2236	<i>Internet Group Management Protocol, Version 2</i>
RFC 3376	<i>Internet Group Management Protocol, Version 3</i>
RFC 3446	<i>Anycast Rendezvous Point (RP) mechanism using Protocol Independent Multicast (PIM) and Multicast Source Discovery Protocol (MSDP)</i>
RFC 3569	<i>An Overview of Source-Specific Multicast (SSM)</i>
RFC 3618	<i>Multicast Source Discovery Protocol (MSDP)</i>
RFC 4601	<i>Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)</i>
RFC 4607	<i>Source-Specific Multicast for IP</i>
RFC 4610	<i>Anycast-RP Using Protocol Independent Multicast (PIM)</i>
RFC 6187	<i>X.509v3 Certificates for Secure Shell Authentication</i>
RFC 9465	<i>PIM Null-Register Packing</i>
ietf-draft	Mtrace server functionality, to process mtrace-requests, draft-ietf-idmr-traceroute-ipm-07.txt
IP Services	
RFC 768	<i>UDP</i>
RFC 783	<i>TFTP</i>
RFC 791	<i>IP</i>
RFC 792	<i>ICMP</i>
RFC 793	<i>TCP</i>
RFC 826	<i>ARP</i>
RFC 854	<i>Telnet</i>
RFC 959	<i>FTP</i>

Standard	Description
RFC 1027	<i>Proxy ARP</i>
RFC 8573	<i>NTP security is enhanced with the AES128CMAC authentication mechanism</i>
RFC 7822	<i>NTP v4</i>
RFC 1305	<i>NTP v3</i>
RFC 1519	<i>CIDR</i>
RFC 1542	<i>BootP relay</i>
RFC 1591	<i>DNS client</i>
RFC 1812	<i>IPv4 routers</i>
RFC 2131	<i>DHCP Helper</i>
RFC 2338	<i>VRRP</i>
IS-IS	
RFC 1142 (OSI 10589)	<i>OSI 10589 Intermediate system to intermediate system intra-domain routing exchange protocol</i>
RFC 1195	<i>Use of OSI IS-IS for routing in TCP/IP and dual environment</i>
RFC 2763	<i>Dynamic Hostname Exchange Mechanism for IS-IS</i>
RFC 2966	<i>Domain-wide Prefix Distribution with Two-Level IS-IS</i>
RFC 2973	<i>IS-IS Mesh Groups</i>
RFC 3277	<i>IS-IS Transient Blackhole Avoidance</i>
RFC 3373	<i>Three-Way Handshake for IS-IS Point-to-Point Adjacencies</i>
RFC 3567	<i>IS-IS Cryptographic Authentication</i>
RFC 3847	<i>Restart Signaling for IS-IS</i>
ietf-draft	Internet Draft Point-to-point operation over LAN in link-state routing protocols (draft-ietf-isis-igp-p2p-over-lan-06.txt)

Standard	Description
OSPF	
RFC 2328	<i>OSPF Version 2</i>
RFC 2370	<i>OSPF Opaque LSA Option</i>
RFC 2740	<i>OSPF for IPv6 (OSPF version 3)</i>
RFC 3101	<i>OSPF Not-So-Stubby-Area (NSSA) Option</i>
RFC 3137	<i>OSPF Stub Router Advertisement</i>
RFC 3509	<i>Alternative Implementations of OSPF Area Border Routers</i>
RFC 3623	<i>Graceful OSPF Restart</i>
RFC 4750	<i>OSPF Version 2 MIB</i>
Per-Hop Behavior (PHB)	
RFC 2597	<i>Assured Forwarding PHB Group</i>
RFC 3246	<i>An Expedited Forwarding PHB</i>
RIP	
RFC 1724	<i>RIPv2 MIB extension</i>
RFC 2082	<i>RIPv2 MD5 Authentication</i>
RFC 2453	<i>RIP Version 2</i>
SNMP	
RFC 2579	<i>Textual Conventions for SMIPv2</i>
RFC 2819	<i>Remote Network Monitoring Management Information Base</i>
RFC 2863	<i>The Interfaces Group MIB</i>
RFC 3164	<i>The BSD syslog Protocol</i>
RFC 3176	<i>InMon Corporation's sFlow: A Method for Monitoring Traffic in Switched and Routed Networks</i>
RFC 3411 and RFC 3418	<i>An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks</i>