Cisco Nexus 3548 Switch NX-OS System Management Configuration Guide, Release 7.x

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CONTENTS

PREFACE

Preface xv

Audience xv

Document Conventions xv

Documentation Feedback xvi

Communications, Services, and Additional Information xvi

CHAPTER 1

New and Changed Information 1

New and Changed Information 1

CHAPTER 2

Overview 3

System Management Features 3

Licensing Requirements 5

Supported Platforms 5

CHAPTER 3

Configuring PTP 7

Information About PTP 7

PTP Device Types 8

PTP Process 9

High Availability for PTP 9

Licensing Requirements for PTP 10

Guidelines and Limitations for PTP 10

Default Settings for PTP 11

Configuring PTP 11

Configuring PTP Globally 11

Configuring PTP on an Interface 14

Configuring Multiple PTP Domains 15

Configuring PTP Grandmaster Clock 18
Configuring PTP Cost Interface 19
Configuring clock Identity 20
Verifying the PTP Configuration 21

CHAPTER 4 **Configuring NTP 23**
Information About NTP 23
NTP as a Time Server 24
Distributing NTP Using CFS 24
Clock Manager 24
Virtualization Support 24
Licensing Requirements for NTP 24
Guidelines and Limitations for NTP 25
Default Settings 25
Configuring NTP 26
Configuring NTP Server and Peer 26
Configuring NTP Authentication 28
Configuring NTP Access Restrictions 29
Configuring the NTP Source IP Address 30
Configuring the NTP Source Interface 31
Configuring NTP Logging 31
Enabling CFS Distribution for NTP 32
Commiting NTP Configuration Changes 32
Discarding NTP Configuration Changes 33
Releasing the CFS Session Lock 33
Verifying the NTP Configuration 34
Configuration Examples for NTP 35
Related Documents for NTP 36
Feature History for NTP 36

CHAPTER 5 **Configuring System Message Logging 37**
Information About System Message Logging 37
Syslog Servers 38
Guidelines and Limitations for System Message Logging 38

Default Settings for System Message Logging 38
Configuring System Message Logging 39
Configuring System Message Logging to Terminal Sessions 39
Configuring System Message Logging to a File 41
Configuring Module and Facility Messages Logging 42
Configuring Logging Timestamps 44
Configuring Syslog Servers 45
Configuring syslog on a UNIX or Linux System 47
Configuring syslog Server Configuration Distribution 48
Displaying and Clearing Log Files 49
Configuring DOM Logging 50
Enabling DOM Logging 50
Disabling DOM Logging 50
Verifying the DOM Logging Configuration 50
Verifying the System Message Logging Configuration 51

CHAPTER 6 **Configuring Smart Call Home 53**
Information About Smart Call Home 53
Smart Call Home Overview 54
Smart Call Home Destination Profiles 54
Smart Call Home Alert Groups 55
Smart Call Home Message Levels 56
Call Home Message Formats 57
Guidelines and Limitations for Smart Call Home 61
Prerequisites for Smart Call Home 61
Default Call Home Settings 61
Configuring Smart Call Home 62
Registering for Smart Call Home 62
Configuring Contact Information 62
Creating a Destination Profile 64
Modifying a Destination Profile 65
Associating an Alert Group with a Destination Profile 67
Adding Show Commands to an Alert Group 67
Configuring E-Mail Server Details 68

Configuring Periodic Inventory Notifications 69
Disabling Duplicate Message Throttling 70
Enabling or Disabling Smart Call Home 71
Testing the Smart Call Home Configuration 71
Verifying the Smart Call Home Configuration 72
Sample Syslog Alert Notification in Full-Text Format 73
Sample Syslog Alert Notification in XML Format 73

CHAPTER 7 **Configuring Session Manager** 77
Information About Session Manager 77
Guidelines and Limitations for Session Manager 77
Configuring Session Manager 78
Creating a Session 78
Configuring ACLs in a Session 78
Verifying a Session 79
Committing a Session 79
Saving a Session 79
Discarding a Session 79
Configuration Example for Session Manager 79
Verifying the Session Manager Configuration 80

CHAPTER 8 **Configuring the Scheduler** 81
Information About the Scheduler 81
Remote User Authentication 82
Scheduler Log Files 82
Licensing Requirements for the Scheduler 82
Guidelines and Limitations for the Scheduler 82
Default Settings for the Scheduler 83
Configuring the Scheduler 83
Enabling the Scheduler 83
Defining the Scheduler Log File Size 84
Configuring Remote User Authentication 84
Defining a Job 85
Deleting a Job 86

Defining a Timetable 86
Clearing the Scheduler Log File 88
Disabling the Scheduler 89
Verifying the Scheduler Configuration 89
Configuration Examples for the Scheduler 90
Creating a Scheduler Job 90
Scheduling a Scheduler Job 90
Displaying the Job Schedule 90
Displaying the Results of Running Scheduler Jobs 90
Standards for the Scheduler 91

CHAPTER 9 **Configuring SNMP** 93
Information About SNMP 93
SNMP Functional Overview 93
SNMP Notifications 94
SNMPv3 94
Security Models and Levels for SNMPv1, v2, and v3 94
User-Based Security Model 95
CLI and SNMP User Synchronization 96
Group-Based SNMP Access 97
Licensing Requirements for SNMP 97
Guidelines and Limitations for SNMP 97
Default SNMP Settings 97
Configuring SNMP 98
Configuring SNMP Users 98
Enforcing SNMP Message Encryption 99
Assigning SNMPv3 Users to Multiple Roles 99
Creating SNMP Communities 99
Filtering SNMP Requests 99
Configuring SNMP Notification Receivers 100
Configuring SNMP Notification Receivers with VRFs 101
Filtering SNMP Notifications Based on a VRF 102
Configuring SNMP for Inband Access 103
Enabling SNMP Notifications 104

Configuring Link Notifications 106
Disabling Link Notifications on an Interface 106
Enabling One-Time Authentication for SNMP over TCP 107
Assigning SNMP Switch Contact and Location Information 107
Configuring the Context to Network Entity Mapping 107
Disabling SNMP 108
Verifying the SNMP Configuration 108

CHAPTER 10 **Configuring RMON** 111
Information About RMON 111
RMON Alarms 111
RMON Events 112
Configuration Guidelines and Limitations for RMON 112
Configuring RMON 112
Configuring RMON Alarms 112
Configuring RMON Events 114
Verifying the RMON Configuration 114
Default RMON Settings 114

CHAPTER 11 **Configuring Online Diagnostics** 117
Information About Online Diagnostics 117
Bootup Diagnostics 117
Health Monitoring Diagnostics 118
Expansion Module Diagnostics 118
Configuring Online Diagnostics 119
Verifying the Online Diagnostics Configuration 120
Default Settings for Online Diagnostics 120

CHAPTER 12 **Configuring Embedded Event Manager** 121
About Embedded Event Manager 121
Embedded Event Manager Policies 122
Event Statements 122
Action Statements 123
VSH Script Policies 124

Licensing Requirements for Embedded Event Manager 124
Prerequisites for Embedded Event Manager 124
Default Settings for Embedded Event Manager 124
Defining an Environment Variable 124
Defining a User Policy Using the CLI 125
Configuring Event Statements 126
Configuring Action Statements 129
Defining a Policy Using a VSH Script 131
Registering and Activating a VSH Script Policy 131
Overriding a System Policy 132
Configuring Syslog as an EEM Publisher 133

CHAPTER 13 **Configuring SPAN** 135
Information About SPAN 135
Guidelines and Limitations for SPAN 135
SPAN Sources 136
Characteristics of Source Ports 136
SPAN Destinations 136
Characteristics of Destination Ports 137
SPAN and ERSPAN Filtering 137
Guidelines and Limitations for SPAN and ERSPAN Filtering 137
SPAN and ERSPAN Control-packet Filtering 138
SPAN and ERSPAN Sampling 138
Guidelines and Limitations for SPAN and ERSPAN Sampling 139
SPAN and ERSPAN Truncation 139
Guidelines and Limitations for SPAN and ERSPAN Truncation 139
Creating or Deleting a SPAN Session 139
Configuring an Ethernet Destination Port 140
Configuring Source Ports 141
Configuring Source Port Channels or VLANs 142
Configuring the Description of a SPAN Session 142
Activating a SPAN Session 143
Suspending a SPAN Session 143
Configuring a SPAN Filter 144

Configuring SPAN Sampling 145
Configuring SPAN Truncation 146
Displaying SPAN Information 147

CHAPTER 14 **Configuring ERSPAN 149**
Information About ERSPAN 149
ERSPAN Types 149
ERSPAN Sources 149
ERSPAN Destinations 150
ERSPAN Sessions 150
Multiple ERSPAN Sessions 151
ERSPAN Marker Packet 151
High Availability 151
Licensing Requirements for ERSPAN 151
Prerequisites for ERSPAN 152
Guidelines and Limitations for ERSPAN 152
Default Settings for ERSPAN 154
Configuring ERSPAN 154
Configuring an ERSPAN Source Session 154
Configuring an ERSPAN Destination Session 157
Shutting Down or Activating an ERSPAN Session 159
Configuring ERSPAN Filtering 161
Configuring ERSPAN Sampling 162
Configuring ERSPAN Truncation 164
Configuring an ERSPAN Marker Packet 165
Verifying the ERSPAN Configuration 166
Configuration Examples for ERSPAN 166
Configuration Example for an ERSPAN Source Session 166
Configuration Example for an ERSPAN Destination Session 167
Additional References 167
Related Documents 167

CHAPTER 15 **Configuring Warp SPAN 169**
Information About Warp SPAN 169

Guidelines and Limitations for Warp Span 170
Configuring Warp SPAN 171
Verifying Warp SPAN Mode Configuration 172
Feature History for Warp SPAN 173

CHAPTER 16 **Configuring DNS 175**
Information About DNS Client 175
Name Servers 175
DNS Operation 175
High Availability 176
Prerequisites for DNS Clients 176
Licensing Requirements for DNS Clients 176
Default Settings for DNS Clients 176
Configuring DNS Clients 176

CHAPTER 17 **Configuring Traffic Forwarding Modes 179**
Information About Warp Mode 179
Guidelines and Limitations for Warp Mode 179
Enabling and Disabling Warp Mode 180
Verifying Warp Mode Status 180
Feature History for Warp Mode 181

CHAPTER 18 **Configuring Active Buffer Monitoring 183**
Information About Active Buffer Monitoring 183
Active Buffer Monitoring Overview 183
Buffer Histogram Data Access and Collection 184
Configuring Active Buffer Monitoring 184
Displaying Buffer Histogram Data 185

CHAPTER 19 **Performing Software Maintenance Upgrades (SMUs) 191**
About SMUs 191
Package Management 192
Prerequisites for SMUs 192
Guidelines and Limitations for SMUs 193

Performing a Software Maintenance Upgrade for Cisco NX-OS 193
Preparing for Package Installation 193
Copying the Package File to a Local Storage Device or Network Server 194
Adding and Activating Packages 195
Committing the Active Package Set 196
Deactivating and Removing Packages 197
Displaying Installation Log Information 198

CHAPTER 20 **Monitoring Interface Statistics** 199
Monitoring Interface Statistics 199
Guidelines and Limitations for Monitoring Interface Statistics 200

CHAPTER 21 **Configuring Rollback** 201
Information About Rollbacks 201
Guidelines and Limitations for Rollbacks 201
Creating a Checkpoint 202
Implementing a Rollback 203
Verifying the Rollback Configuration 203

CHAPTER 22 **Configuring User Accounts and RBAC** 205
Information About User Accounts and RBAC 205
User Roles 205
Rules 206
User Role Policies 206
User Account Configuration Restrictions 207
User Password Requirements 207
Guidelines and Limitations for User Accounts 208
Configuring User Accounts 209
Configuring RBAC 210
Creating User Roles and Rules 210
Creating Feature Groups 211
Changing User Role Interface Policies 212
Changing User Role VLAN Policies 212
Verifying the User Accounts and RBAC Configuration 213

Configuring User Accounts Default Settings for the User Accounts and RBAC 213

Preface

The preface contains the following sections:

- Audience, on page xv
- Document Conventions, on page xv
- Documentation Feedback, on page xvi
- Communications, Services, and Additional Information, on page xvi

Audience

This publication is for network administrators who configure and maintain Cisco Nexus devices.

Document Conventions

Command descriptions use the following conventions:

Convention	Description
bold	Bold text indicates the commands and keywords that you enter literally as shown.
Italic	Italic text indicates arguments for which the user supplies the values.
[x]	Square brackets enclose an optional element (keyword or argument).
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical bar indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments 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.
`variable`	Indicates a variable for which you supply values, in context where italics cannot be used.

Convention	Description
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Examples use the following conventions:

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

Documentation Feedback

To provide technical feedback on this document, or to report an error or omission, please send your comments to: .

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Communications, Services, and Additional Information

- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
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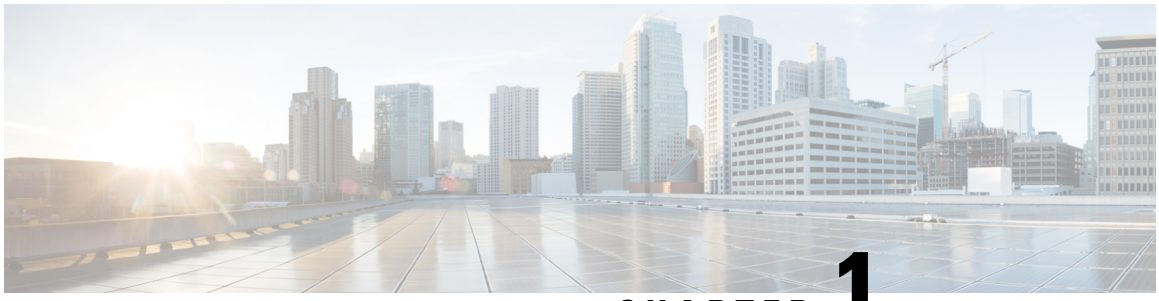
Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.



CHAPTER 1

New and Changed Information

This chapter contains the following sections:

- New and Changed Information, on page 1

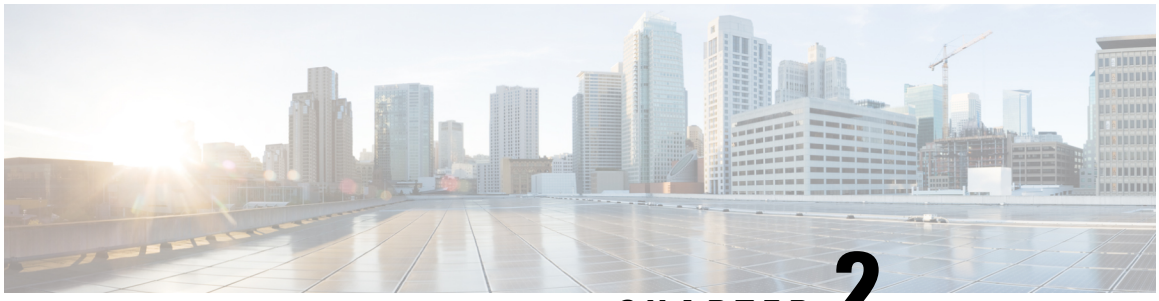
New and Changed Information

The following table provides an overview of the significant changes to this guide for this current release. The table does not provide an exhaustive list of all changes made to the configuration guides or of the new features in this release.

Table 1: New and Changed Features

Feature	Description	Added or Changed in Release	Where Documented
PTP ACL Redirect	Support for PTP unicast forwarding by hardware ACL.	7.0(3)I7(9)	Configuring PTP Globally, on page 11
Monitoring Interface Statistics	Introduced TCP based monitoring of interface statistics feature.	7.0(3)I7(7)	Monitoring Interface Statistics, on page 199
Performing Software Maintenance Upgrades (SMU)	This feature was introduced.	7.0(3)I7(2)	About SMUs, on page 191
No updates since Cisco NX-OS Release 6.x	First 7.x release.	Not applicable	Not applicable

New and Changed Information



CHAPTER 2

Overview

This chapter contains the following sections:

- System Management Features, on page 3
- Licensing Requirements, on page 5
- Supported Platforms, on page 5

System Management Features

The system management features documented in this guide are described below:

Feature	Description
Active Buffer Monitoring	The Active Buffer Monitoring feature provides detailed buffer occupancy data to help you detect network congestion, review past events to understand when and how network congestion is affecting network operations, understand historical trending, and identify patterns of application traffic flow.
Warp Mode	In warp mode, the access path is shortened by consolidating the forwarding table into single table, resulting in faster processing of frames and packets. In warp mode, latency is reduced by up to 20 percent.
User Accounts and RBAC	User accounts and role-based access control (RBAC) allow you to define the rules for an assigned role. Roles restrict the authorization that the user has to access management operations. Each user role can contain multiple rules and each user can have multiple roles.
Session Manager	Session Manager allows you to create a configuration and apply it in batch mode after the configuration is reviewed and verified for accuracy and completeness.

Feature	Description
Online Diagnostics	Cisco Generic Online Diagnostics (GOLD) define a common framework for diagnostic operations across Cisco platforms. The online diagnostic framework specifies the platform-independent fault-detection architecture for centralized and distributed systems, including the common diagnostics CLI and the platform-independent fault-detection procedures for boot-up and run-time diagnostics. The platform-specific diagnostics provide hardware-specific fault-detection tests and allow you to take appropriate corrective action in response to diagnostic test results.
System Message Logging	You can use system message logging to control the destination and to filter the severity level of messages that system processes generate. You can configure logging to a terminal session, a log file, and syslog servers on remote systems. System message logging is based on RFC 3164. For more information about the system message format and the messages that the device generates, see the *Cisco NX-OS System Messages Reference*.
Smart Call Home	Call Home provides an e-mail-based notification of critical system policies. Cisco NX-OS provides a range of message formats for optimal compatibility with pager services, standard e-mail, or XML-based automated parsing applications. You can use this feature to page a network support engineer, e-mail a Network Operations Center, or use Cisco Smart Call Home services to automatically generate a case with the Technical Assistance Center.
Configuration Rollback	The configuration rollback feature allows users to take a snapshot, or user checkpoint, of the Cisco NX-OS configuration and then reapply that configuration to a switch at any point without having to reload the switch. A rollback allows any authorized administrator to apply this checkpoint configuration without requiring expert knowledge of the features configured in the checkpoint.
SNMP	The Simple Network Management Protocol (SNMP) is an application-layer protocol that provides a message format for communication between SNMP managers and agents. SNMP provides a standardized framework and a common language used for the monitoring and management of devices in a network.

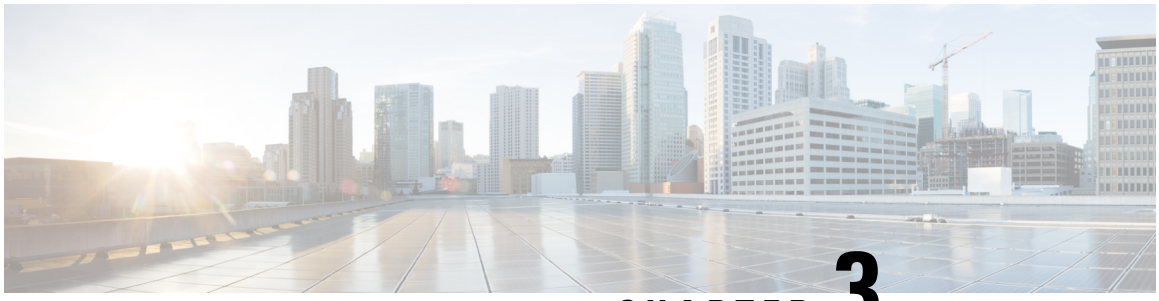
Feature	Description
RMON	RMON is an Internet Engineering Task Force (IETF) standard monitoring specification that allows various network agents and console systems to exchange network monitoring data. Cisco NX-OS supports RMON alarms, events, and logs to monitor Cisco NX-OS devices.
SPAN	The Switched Port Analyzer (SPAN) feature (sometimes called port mirroring or port monitoring) selects network traffic for analysis by a network analyzer. The network analyzer can be a Cisco SwitchProbe, a Fibre Channel Analyzer, or other Remote Monitoring (RMON) probes.

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

Starting with Cisco NX-OS release 7.0(3)I7(1), 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.



CHAPTER 3

Configuring PTP

This chapter contains the following sections:

- Information About PTP, on page 7
- PTP Device Types, on page 8
- PTP Process, on page 9
- High Availability for PTP, on page 9
- Licensing Requirements for PTP, on page 10
- Guidelines and Limitations for PTP, on page 10
- Default Settings for PTP, on page 11
- Configuring PTP, on page 11

Information About PTP

PTP is a time synchronization protocol for nodes distributed across a network. Its hardware timestamp feature provides greater accuracy than other time synchronization protocols such as the Network Time Protocol (NTP).

A PTP system can consist of a combination of PTP and non-PTP devices. PTP devices include ordinary clocks, boundary clocks, and transparent clocks. Non-PTP devices include ordinary network switches, routers, and other infrastructure devices.

PTP is a distributed protocol that specifies how real-time PTP clocks in the system synchronize with each other. These clocks are organized into a master-slave synchronization hierarchy with the grandmaster clock, which is the clock at the top of the hierarchy, determining the reference time for the entire system. Synchronization is achieved by exchanging PTP timing messages, with the members using the timing information to adjust their clocks to the time of their master in the hierarchy. PTP operates within a logical scope called a PTP domain.

Starting from Cisco NXOS Release 6.0(2)A8(3), PTP supports configuring multiple PTP clocking domains, PTP grandmaster capability, PTP cost on interfaces for slave and passive election, and clock identity.

All the switches in a multi-domain environment, belong to one domain. The switches that are the part of boundary clock, must have multi-domain feature enabled on them. Each domain has user configurable parameters such as domain priority, clock class threshold and clock accuracy threshold. The clocks in each domain remain synchronized with the master clock in that domain. If the GPS in a domain fails, the master clock in the domain synchronizes time and data sets associated with the announce messages from the master clock in the domain where the GPS is active. If the master clock from the highest priority domain does not meet the clock quality attributes, a clock in the subsequent domain that match the criteria is selected. The Best Master Clock Algorithm (BMCA) is used to select the master clock if none of the domains has the desired

clock quality attributes. If all the domains have equal priority and the threshold values less than master clock attributes or if the threshold values are greater than the master clock attributes, BMCA is used to select the master clock.

Grandmaster capability feature controls the switch's ability of propagating its clock to other devices that it is connected to. When the switch receives announce messages on an interface, it checks the clock class threshold and clock accuracy threshold values. If the values of these parameters are within the predefined limits, then the switch acts as per PTP standards specified in IEEE 1588v2. If the switch does not receive announce messages from external sources or if the parameters of the announce messages received are not within the predefined limits, the port state will be changed to listening mode. On a switch with no slave ports, the state of all the PTP enabled ports is rendered as listening and on a switch with one slave port, the BMCA is used to determine states on all PTP enabled ports. Convergence time prevents timing loops at the PTP level when grandmaster capability is disabled on a switch. If the slave port is not selected on the switch, all the ports on the switch will be in listening state for a minimum interval specified in the convergence time. The convergence time range is from 3 to 2600 seconds and the default value is 30 seconds.

The interface cost applies to each PTP enabled port if the switch has more than one path to grandmaster clock. The port with the least cost value is elected as slave and the rest of the ports will remain as passive ports.

The clock identity is a unique 8-octet array presented in the form of a character array based on the switch MAC address. The clock identity is determined from MAC according to the IEEE1588v2-2008 specifications. The clock ID is a combination of bytes in a VLAN MAC address as defined in IEEE1588v2.

PTP Device Types

The following clocks are common PTP devices:

Ordinary clock

Communicates with the network based on a single physical port, similar to an end host. An ordinary clock can function as a grandmaster clock.

Boundary clock

Typically has several physical ports, with each port behaving like a port of an ordinary clock. However, each port shares the local clock, and the clock data sets are common to all ports. Each port decides its individual state, either master (synchronizing other ports connected to it) or slave (synchronizing to a downstream port), based on the best clock available to it through all of the other ports on the boundary clock. Messages that are related to synchronization and establishing the master-slave hierarchy terminate in the protocol engine of a boundary clock and are not forwarded.

Transparent clock

Forwards all PTP messages like an ordinary switch or router but measures the residence time of a packet in the switch (the time that the packet takes to traverse the transparent clock) and in some cases the link delay of the ingress port for the packet. The ports have no state because the transparent clock does not need to synchronize to the grandmaster clock.

There are two kinds of transparent clocks:

End-to-end transparent clock

Measures the residence time of a PTP message and accumulates the times in the correction field of the PTP message or an associated follow-up message.

Peer-to-peer transparent clock

Measures the residence time of a PTP message and computes the link delay between each port and a similarly equipped port on another node that shares the link. For a packet, this incoming link delay is added to the residence time in the correction field of the PTP message or an associated follow-up message.

Note PTP operates only in boundary clock mode. We recommend that you deploy a Grand Master Clock (10 MHz) upstream. The servers contain clocks that require synchronization and are connected to the switch.

End-to-end transparent clock and peer-to-peer transparent clock modes are not supported.

PTP Process

The PTP process consists of two phases: establishing the master-slave hierarchy and synchronizing the clocks.

Within a PTP domain, each port of an ordinary or boundary clock follows this process to determine its state:

- Examines the contents of all received announce messages (issued by ports in the master state)
- Compares the data sets of the foreign master (in the announce message) and the local clock for priority, clock class, accuracy, and so on
- Determines its own state as either master or slave

After the master-slave hierarchy has been established, the clocks are synchronized as follows:

- The master sends a synchronization message to the slave and notes the time it was sent.
- The slave receives the synchronization message and notes the time that it was received. For every synchronization message, there is a follow-up message. The number of sync messages should be equal to the number of follow-up messages.
- The slave sends a delay-request message to the master and notes the time it was sent.
- The master receives the delay-request message and notes the time it was received.
- The master sends a delay-response message to the slave. The number of delay request messages should be equal to the number of delay response messages.
- The slave uses these timestamps to adjust its clock to the time of its master.

High Availability for PTP

Stateful restarts are not supported for PTP

Licensing Requirements for PTP

PTP requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Guidelines and Limitations for PTP

- In a Cisco Nexus 3500 only environment, PTP clock correction is expected to be in the 1- to 2-digit range, from 1 to 99 nanoseconds. However, in a mixed environment, PTP clock correction is expected to be up to 3 digits, from 100 to 999 nanoseconds.
- Beginning in Cisco NX-OS Release 7.0(3)I7(2) the Cisco Nexus 3500 Series switches support mixed non-negotiated mode of operation on master PTP ports. Meaning that when a slave client sends unicast delay request PTP packet, the Cisco Nexus 3500 responds with an unicast delay response packet. And, if the slave client sends multicast delay request PTP packet, the Cisco Nexus 3500 responds with a multicast delay response packet. For mixed non-negotiated mode to work, the source IP address used in the `ptp source <IP address>` configuration on the BC device must also be configured on any physical or logical interface of the BC device. The recommended best practice is to use the loopback interface of the device.
- PTP operates only in boundary clock mode. End-to-end transparent clock and peer-to-peer transparent clock modes are not supported.
- PTP operates when the clock protocol is set to PTP. Configuring PTP and NTP together is not supported.
- PTP supports transport over User Datagram Protocol (UDP). Transport over Ethernet is not supported.
- PTP supports only multicast communication. Negotiated unicast communication is not supported.
- PTP is limited to a single domain per network.
- When **ptp acl-redirect** is configured, PTP management packets are software forwarded. The management packets are expected to be within 100 packets/second to avoid CoPP drops.
- PTP-capable ports do not identify PTP packets and do not time-stamp or redirect those packets to CPU for processing unless you enable PTP on those ports. This means that if the PTP is disabled on a port, then the device will be capable of routing any multicast PTP packets, regardless of their type, assuming that there is a multicast state present for this. None of these multicast PTP packets from this port will be redirected to CPU for processing, because the exception used to redirect them to the CPU is programmed on a per-port basis, based on whether the PTP is enabled or not on the respective port.
- 1 pulse per second (1 PPS) input is not supported.
- PTP over IPv6 is not supported.
- Cisco Nexus 3500 Series switches support a maximum of 48 PTP sessions.
- Cisco Nexus switches should be synchronized from the neighboring master using a synchronization log interval that ranges from –3 to 1.

- All unicast and multicast PTP management messages will be forwarded as per the forwarding rules. All PTP management messages will be treated as regular multicast packets and process these in the same way as the other non-PTP multicast packets are processed by Cisco Nexus 3500 switches.
- Cisco Nexus 3500 Series switches do not support PTP on 40G interfaces.
- You must configure the incoming port as L3/SVI to enable forwarding of the PTP unicast packets.
- We recommend that Cisco Nexus 3500 switches do not participate in unicast negotiation between the unicast master and clients.
- One-step PTP is not supported on Cisco Nexus 3500 series platform switches.

Default Settings for PTP

The following table lists the default settings for PTP parameters.

Table 2: Default PTP Parameters

Parameters	Default
PTP	Disabled
PTP version	2
PTP domain	0. PTP multi domain is disabled by default.
PTP priority 1 value when advertising the clock	255
PTP priority 2 value when advertising the clock	255
PTP announce interval	1 log second
PTP sync interval	1 log second
PTP announce timeout	3 announce intervals
PTP minimum delay request interval	1 log second
PTP VLAN	1

Configuring PTP

Configuring PTP Globally

You can enable or disable PTP globally on a device. You can also configure various PTP clock parameters to help determine which clock in the network has the highest priority to be selected as the grandmaster.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `switch# configure terminal`	Enters global configuration mode.
Step 2	[**no**] **feature ptp** **Example:** `switch(config) # feature ptp`	Enables or disables PTP on the device. **Note** Enabling PTP on the switch does not enable PTP on each interface.
Step 3	[**no**] **ptp source** *ip-address* **Example:** `switch(config) # ptp source 10.2.3.4`	Configures the source IP address for all PTP packets. *ip-address*: IPv4 format.
Step 4	(Optional) [**no**] **ptp domain** *number* **Example:** `switch(config) # ptp domain 24`	Configures the domain number to use for this clock. PTP domains allow you to use multiple independent PTP clocking subdomains on a single network. *number*: Range is from 0 to 128.
Step 5	(Optional) [**no**] **ptp priority1** *value* **Example:** `switch(config) # ptp priority1 10`	Configures the priority1 value to use when advertising this clock. This value overrides the default criteria (clock quality, clock class, and so on) for the best master clock selection. Lower values take precedence. *value*: Range is from 0 to 255.
Step 6	(Optional) [**no**] **ptp priority2** *value* **Example:** `switch(config) # ptp priority2 20`	Configures the priority2 value to use when advertising this clock. This value is used to decide between two devices that are otherwise equally matched in the default criteria. For example, you can use the priority2 value to give a specific switch priority over other identical switches. *value*: Range is from 0 to 255.

Step 7	(Optional) [**no**] **ptp acl-redirect**
	Example:
	`switch (config)# ptp acl-redirect`
		Configures the system to forward PTP unicast packets in hardware using ACL entries.
		Note
		Make sure that the TCAM SUP region size is greater than 48 or the following error message is display when you attempt to enter the command:
		`switch(config)# ptp acl-redirect`
		`ERROR: PTP acl-redirect supported only`

	Command or Action	Purpose
		if TCAM sup size is greater than 48 2020 May 6 21:27:04 switch %ACLQOS-SLOT1-2-ACLQOS_OOTR: Tcam resource exhausted: Need to reconfigure SUP region
Step 8	(Optional) **show ptp brief** **Example:** `switch(config) # show ptp brief`	Displays the PTP status.
Step 9	(Optional) **show ptp clock** **Example:** `switch(config) # show ptp clock`	Displays the properties of the local clock.
Step 10	**copy running-config startup-config** **Example:** `switch(config) # copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure PTP globally on the device, specify the source IP address for PTP communications, and configure a preference level for the clock:

```
switch# configure terminal
switch(config)# feature ptp
switch(config)# ptp source 10.10.10.1
switch(config)# ptp priority1 1
switch(config)# ptp priority2 1
switch(config)# show ptp brief
PTP port status
-----------------------
Port State
------- --------------
switch(config)# show ptp clock
PTP Device Type: Boundary clock
Clock Identity : 0:22:55:ff:ff:79:a4:c1
Clock Domain: 0
Number of PTP ports: 0
Priority1 : 1
Priority2 : 1
Clock Quality:
Class : 248
Accuracy : 254
Offset (log variance) : 65535
Offset From Master : 0
Mean Path Delay : 0
Steps removed : 0
Local clock time:Sun Jul 3 14:13:24 2011
switch(config)#
```

Configuring PTP on an Interface

After you globally enable PTP, it is not enabled on all supported interfaces by default. You must enable PTP interfaces individually.

Before you begin

Make sure that you have globally enabled PTP on the switch and configured the source IP address for PTP communication.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **interface ethernet** *slot/port*	Specifies the interface on which you are enabling PTP and enters interface configuration mode.
Step 3	(Optional) switch(config-if) # [**no**] **ptp announce** {**interval** *log seconds* | **timeout** *count*}	Configures the interval between PTP announce messages on an interface or the number of PTP intervals before a timeout occurs on an interface. The range for the PTP announcement interval is from 0 to 4 seconds, and the range for the interval timeout is from 2 to 10.
Step 4	(Optional) switch(config-if) # [**no**] **ptp delay request minimum interval** *log seconds*	Configures the minimum interval allowed between PTP delay-request messages when the port is in the master state. The range is from -1 to -6 log seconds. Where, log (-2) = 4 frames per second.
Step 5	(Optional) switch(config-if) # [**no**] **ptp sync interval** *log seconds*	Configures the interval between PTP synchronization messages on an interface. The range for the PTP synchronization interval is from -3 log second to 1 log second
Step 6	(Optional) switch(config-if) # [**no**] **ptp vlan** *vlan-id*	Specifies the VLAN for the interface where PTP is being enabled. You can only enable PTP on one VLAN on an interface. The range is from 1 to 4094.
Step 7	(Optional) switch(config-if) # **show ptp brief**	Displays the PTP status.
Step 8	(Optional) switch(config-if) # **show ptp port interface** *interface slot/port*	Displays the status of the PTP port.

	Command or Action	Purpose
Step 9	(Optional) switch(config-if)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure PTP on an interface and configure the intervals for the announce, delay-request, and synchronization messages:

```
switch# configure terminal
switch(config)# interface ethernet 2/1

switch(config-if)# ptp announce interval 3
switch(config-if)# ptp announce timeout 2
switch(config-if)# ptp delay-request minimum interval 4
switch(config-if)# ptp sync interval -1
switch(config-if)# show ptp brief
PTP port status
-----------------------
Port State
------- --------------
Eth2/1 Master
switch(config-if)# show ptp port interface ethernet 1/1
PTP Port Dataset: Eth1/1
Port identity: clock identity: f4:4e:05:ff:fe:84:7e:7c
Port identity: port number: 0
PTP version: 2
Port state: Slave
VLAN info: 1
Delay request interval(log mean): 0
Announce receipt time out: 3
Peer mean path delay: 0
Announce interval(log mean): 1
Sync interval(log mean): 1
Delay Mechanism: End to End
Cost: 255
Domain: 5
switch(config-if)#
```

Configuring Multiple PTP Domains

You can configure multiple PTP clocking domains on a single network. Each domain has a priority value associated with it. The default value is 255.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # [**no**] **feature ptp**	Enables or disables PTP on the device. **Note**

	Command or Action	Purpose
		Enabling PTP on the switch does not enable PTP on each interface.
Step 3	switch(config) # [**no**] **ptp source** *ip-address* [**vrf** *vrf*]	Configures the source IP address for all PTP packets. The *ip-address* can be in IPv4 format.
Step 4	switch(config) # [**no**] **ptp multi-domain**	Enables configuring multi domain feature on the switch. It also allow you to set the attributes such as priority, clock-class threshold , clock-accuracy threshold, transition priorities etc. on the switch.
Step 5	switch(config) # [**no**] **ptp domain** *value* **priority** *value*	Specify the values for the domain and priority. The range for the domain *value* is from 0 to 127. The default value of the domain is 0 The range for the priority *value* is from 0 to 255. The default value of the priority is 255
Step 6	switch(config) # [**no**] **ptp domain** *value* **clock-class-threshold** *value*	Specify the values for domain and clock class threshold. The default value is 248. The range for the domain *value* is from 0 to 127. The range for the clock-class-threshold *value* is from 0 to 255. **Note** It is not necessary that a clock class threshold value ensure election of the slave clock on any ports. The switch uses this value to determine whether the source clock is traceable. If the clock class value from the peer is higher or equal than the *clock class threshold* value in a domain, the switch runs BMCA to elect the slave port from a domain. If none of the domains has the clock class below the threshold value, the switch runs BMCA on all the PTP enabled ports to elect the best clock.
Step 7	switch(config) # [**no**] **ptp domain** *value* **clock-accuracy-threshold** *value*	Specify the values for domain and clock accuracy threshold. The default value is 254. The range for the domain *value* is from 0 to 127. The range for the clock-accuracy-threshold *value* is from 0 to 255.

	Command or Action	Purpose
Step 8	switch(config) # [**no**] **ptp multi-domain transition-attributes priority1** *value*	Sets the *domain transition-attributes priority1* value that is used when sending a packet out from this domain to a peer domain. The value of the *priority1* in the announce message from the remote port is replaced by the value of *domain transition-attributes priority1* when the announce message has to be transmitted to a peer in a domain, that is different from that of the slave interface. The default value is 255. The range for the transition-attributes priority1 *value* is from 0 to 255.
Step 9	switch(config) # [**no**] **ptp multi-domain transition-attributes priority2** *value*	Sets the *domain transition-attributes priority2* value that is used when sending a packet out from this domain to a peer domain. The value of the *priority2* in the announce message from the remote port is replaced by the value of *domain transition-attributes priority2* when the announce message has to be transmitted to a peer in a domain, that is different from that of the slave interface. The default value is 255. The range for the transition-attributes priority2 *value* is from 0 to 255.
Step 10	switch(config-if) # [**no**] **ptp domain** *value*	Associates a domain on a PTP enabled interface. If you do not configure the domain specifically on an interface, it takes the default value (0). The range for the domain *value* is from 0 to 127.

Example

The following example shows the PTP domains configured on a switch:

```
switch(config)# show ptp domain data
MULTI DOMAIN : ENABLED
GM CAPABILITY : ENABLED
PTP DEFAULT DOMAIN : 0
PTP TRANSITION PRIORITY1 : 20
PTP TRANSITION PRIORITY2 : 255
PTP DOMAIN PROPERTY
Domain-Number Domain-Priority Clock-Class Clock-Accuracy Ports
0         255        248             254             Eth1/1
1           1         1              254

switch(config)#
```

The following example shows the domains associated with each PTP enabled interfaces:

```
switch(config)# show ptp interface domain
PTP port interface domain
-------------------------
Port         Domain
-------  -----------------
Eth1/1        0
      1         1              254

switch(config)#
```

Configuring PTP Grandmaster Clock

You can configure convergence time to prevent timing loops at the PTP level when grandmaster capability is disabled on a switch. Grandmaster capability is enabled on the device by default.

.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # [**no**] **feature ptp**	Enables or disables PTP on the device. **Note** Enabling PTP on the switch does not enable PTP on each interface.
Step 3	switch(config) # [**no**] **ptp source** *ip-address* [**vrf** *vrf*]	Configures the source IP address for all PTP packets. The *ip-address* can be in IPv4 format.
Step 4	switch(config) # **no ptp grandmaster-capable** [*convergence-time*]	Disables grandmaster capability on the switch. Prevents the device from acting as a grandmaster when there is no external grandmaster available in any domains. The default convergence time is 30 seconds.
Step 5	switch(config) # [**no**] **ptp domain** *value* **clock-class-threshold** *value*	Specify the values for domain and clock class threshold. *Clock class threshold* defines the threshold value of clock class that the device uses to determine whether the source clock can be considered as a grandmaster clock. The range for the domain *value* is from 0 to 127. The range for the clock-class-threshold *value* is from 0 to 255. **Note** The switch uses this value to determine whether the source clock is traceable. If the

	Command or Action	Purpose
		clock class value from all the peers is higher than the clock class threshold value, the BMCA may change all the port state to listening.
Step 6	switch(config) # [**no**] **ptp domain** *value* **clock-accuracy-threshold** *value*	Specify the values for domain and clock accuracy threshold The range for the domain *value* is from 0 to 127. The range for the clock-accuracy-threshold *value* is from 0 to 255.
Step 7	switch(config) # **ptp grandmaster-capable**	Enables grandmaster capability on a switch.

Example

The following example displays the PTP clock information:

```
switch(config-if)# show ptp clock
PTP Device Type: Boundary clock
Clock Identity : f4:4e:05:ff:fe:84:7e:7c
Clock Domain: 5
Number of PTP ports: 2
Priority1 : 129
Priority2 : 255
Clock Quality:
Class : 248
Accuracy : 254
Offset (log variance) : 65535
Offset From Master : 0
Mean Path Delay : 391
Steps removed : 1
Local clock time:Wed Nov 9 10:31:21 2016
switch(config-if)#
```

Configuring PTP Cost Interface

You can configure interface cost on each PTP enabled port on a Cisco Nexus 3500 switch. The cost applies to each PTP enabled port if the switch has more than one path to grandmaster clock.

.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # [**no**] **feature ptp**	Enables or disables PTP on the device. **Note**

	Command or Action	Purpose
		Enabling PTP on the switch does not enable PTP on each interface.
Step 3	switch(config) # [**no**] **ptp source** *ip-address* [**vrf** *vrf*]	Configures the source IP address for all PTP packets. The *ip-address* can be in IPv4 format.
Step 4	switch(config) # **interface ethernet** *slot/port*	Specifies the interface on which you are enabling PTP and enters interface configuration mode.
Step 5	switch(config-if) # [**no**] **ptp cost** *value*	Associate cost on a PTP enabled interface. The interface having the least cost becomes the slave interface. The range for the cost is from 0 to 255. The default value is 255.

Example

The following example shows cost that is associated with each PTP enabled interfaces:

```
switch(config)# show ptp cost
PTP port costs
-----------------------
Port         Cost
-------  --------------
Eth1/1        255
switch(config)#
```

Configuring clock Identity

You can configure clock identity on a Cisco Nexus 3500 switch. The default clock identity is a unique 8-octet array presented in the form of a character array based on the switch MAC address.

.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # [**no**] **feature ptp**	Enables or disables PTP on the device. **Note** Enabling PTP on the switch does not enable PTP on each interface.

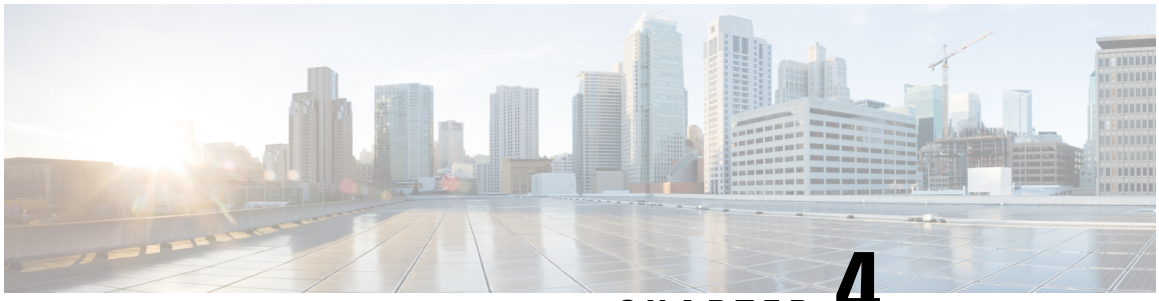
	Command or Action	Purpose
Step 3	switch(config-if) # **ptp clock-identity** *MAC Address*	Assigns 6 byte MAC address for PTP clock-identity. Default clock identity is based on the MAC address of the switch. The clock-identity is defined as per IEEE standard (MAC-48 Byte0 | MAC-48 Byte1 | MAC-48 Byte2 | FF | FE | MAC-48 Bytes3-5).

Verifying the PTP Configuration

Use one of the following commands to verify the configuration:

Table 3: PTP Show Commands

Command	Purpose
show ptp brief	Displays the PTP status.
show ptp clock	Displays the properties of the local clock, including the clock identity.
show ptp clock foreign-masters-record	Displays the state of foreign masters known to the PTP process. For each foreign master, the output displays the clock identity, basic clock properties, and whether the clock is being used as a grandmaster.
show ptp corrections	Displays the last few PTP corrections.
show ptp parent	Displays the properties of the PTP parent.
show ptp port interface ethernet *slot/port*	Displays the status of the PTP port on the switch.
show ptp domain data	Displays multiple domain data, domain priority, clock threshold and information about grandmaster capabilities.
show ptp interface domain	Displays information about the interface to domain association.
show ptp cost	Displays PTP port to cost association.
show ptp detail	Displays the list of all connected peers for each PTP port and indicates whether the role is static or dynamic.
show ptp time-property	Displays the PTP clock properties.



CHAPTER 4

Configuring NTP

This chapter contains the following sections:

- Information About NTP, on page 23
- NTP as a Time Server, on page 24
- Distributing NTP Using CFS, on page 24
- Clock Manager, on page 24
- Virtualization Support, on page 24
- Licensing Requirements for NTP, on page 24
- Guidelines and Limitations for NTP, on page 25
- Default Settings, on page 25
- Configuring NTP, on page 26
- Related Documents for NTP, on page 36
- Feature History for NTP, on page 36

Information About NTP

The Network Time Protocol (NTP) synchronizes the time of day among a set of distributed time servers and clients so that you can correlate events when you receive system logs and other time-specific events from multiple network devices. NTP uses the User Datagram Protocol (UDP) as its transport protocol. All NTP communications use Coordinated Universal Time (UTC).

An NTP server usually receives its time from an authoritative time source, such as a radio clock or an atomic clock attached to a time server, and then distributes this time across the network. NTP is extremely efficient; no more than one packet per minute is necessary to synchronize two machines to within a millisecond of each other.

NTP uses a stratum to describe the distance between a network device and an authoritative time source:

- A stratum 1 time server is directly attached to an authoritative time source (such as a radio or atomic clock or a GPS time source).
- A stratum 2 NTP server receives its time through NTP from a stratum 1 time server.

Before synchronizing, NTP compares the time reported by several network devices and does not synchronize with one that is significantly different, even if it is a stratum 1. Because Cisco NX-OS cannot connect to a radio or atomic clock and act as a stratum 1 server, we recommend that you use the public NTP servers

available on the Internet. If the network is isolated from the Internet, Cisco NX-OS allows you to configure the time as though it were synchronized through NTP, even though it was not.

Note You can create NTP peer relationships to designate the time-serving hosts that you want your network device to consider synchronizing with and to keep accurate time if a server failure occurs.

The time kept on a device is a critical resource, so we strongly recommend that you use the security features of NTP to avoid the accidental or malicious setting of incorrect time. Two mechanisms are available: an access list-based restriction scheme and an encrypted authentication mechanism.

NTP as a Time Server

the Cisco NX-OS device can use NTP to distribute time. Other devices can configure it as a time server. You can also configure the device to act as an authoritative NTP server, enabling it to distribute time even when it is not synchronized to an outside time source.

Distributing NTP Using CFS

Cisco Fabric Services (CFS) distributes the local NTP configuration to all Cisco devices in the network. After enabling CFS on your device, a network-wide lock is applied to NTP whenever an NTP configuration is started. After making the NTP configuration changes, you can discard or commit them. In either case, the CFS lock is then released from the NTP application.

Clock Manager

Clocks are resources that need to be shared across different processes.

The clock manager allows you to specify the protocol to control the various clocks in the system. Once you specify the protocol, the system clock starts updating.

Virtualization Support

NTP recognizes virtual routing and forwarding (VRF) instances. NTP uses the default VRF if you do not configure a specific VRF for the NTP server and NTP peer.

Licensing Requirements for NTP

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	NTP requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you.

Guidelines and Limitations for NTP

NTP has the following configuration guidelines and limitations:

- To configure NTP, you must have connectivity to at least one server that is running NTP.
- NTP operates when the clock protocol is set to NTP. Configuring PTP and NTP together is not supported.
- You should have a peer association with another device only when you are sure that your clock is reliable (which means that you are a client of a reliable NTP server).
- A peer configured alone takes on the role of a server and should be used as a backup. If you have two servers, you can configure several devices to point to one server and the remaining devices to point to the other server. You can then configure a peer association between these two servers to create a more reliable NTP configuration.
- If you have only one server, you should configure all the devices as clients to that server.
- You can configure up to 64 NTP entities (servers and peers).
- If CFS is disabled for NTP, then NTP does not distribute any configuration and does not accept a distribution from other devices in the network.
- After CFS distribution is enabled for NTP, the entry of an NTP configuration command locks the network for NTP configuration until a commit command is entered. During the lock, no changes can be made to the NTP configuration by any other device in the network except the device that initiated the lock.
- If you use CFS to distribute NTP, all devices in the network should have the same VRFs configured as you use for NTP.
- If you configure NTP in a VRF, ensure that the NTP server and peers can reach each other through the configured VRFs.
- You must manually distribute NTP authentication keys on the NTP server and Cisco NX-OS devices across the network.

Default Settings

Table 4: Default NTP Parameters

Parameters	Default
NTP authentication	disabled
NTP access	enabled
NTP logging	disabled

Configuring NTP

Configuring NTP Server and Peer

You can configure an NTP server and peer.

Before you begin

Make sure you know the IP address or DNS names of your NTP server and its peers.

If you plan to use CFS to distribute your NTP configuration to other devices, then you should have already completed the following:

- Enabled CFS distribution.
- Enabled CFS for NTP.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **ntp server** {*ip-address* | *ipv6-address* | *dns-name*} [**key** *key-id*] [**maxpoll** *max-poll*] [**minpoll** *min-poll*] [**prefer**] [**use-vrf** *vrf-name*]	Forms an association with a server. Use the **key** keyword to configure a key to be used while communicating with the NTP server. The range for the key-id argument is from 1 to 65535. Use the **maxpoll** and **minpoll** keywords to configure the maximum and minimum intervals in which to poll a server. The range for the *max-poll* and *min-poll* arguments is from 4 to 16 (configured as powers of 2, so effectively 16 to 65536 seconds), and the default values are 6 and 4, respectively (*maxpoll* default = 64 seconds, *minpoll* default = 16 seconds). Use the **prefer** keyword to make this the preferred NTP server for the device. Use the **use-vrf** keyword to configure the NTP server to communicate over the specified VRF. The **vrf-name** argument can be default, management, or any case-sensitive alphanumeric string up to 32 characters. **Note** If you configure a key to be used while communicating with the NTP server, make

	Command or Action	Purpose
		sure that the key exists as a trusted key on the device.
Step 3	switch(config)# [**no**] **ntp peer** {*ip-address* | *ipv6-address* | *dns-name*} [**key** *key-id*] [**maxpoll** *max-poll*] [**minpoll** *min-poll*] [**prefer**] [**use-vrf** *vrf-name*]	Forms an association with a peer. You can specify multiple peer associations. Use the **key** keyword to configure a key to be used while communicating with the NTP peer. The range for the key-id argument is from 1 to 65535. Use the **maxpoll** and **minpoll** keywords to configure the maximum and minimum intervals in which to poll a server. The range for the *max-poll* and *min-poll* arguments is from 4 to 17 (configured as powers of 2, so effectively 16 to 131072 seconds), and the default values are 6 and 4, respectively (*maxpoll* default = 64 seconds, *minpoll* default = 16 seconds). Use the **prefer** keyword to make this the preferred NTP server for the device. Use the **use-vrf** keyword to configure the NTP server to communicate over the specified VRF. The **vrf-name** argument can be default, management, or any case-sensitive alphanumeric string up to 32 characters.
Step 4	(Optional) switch(config)# **show ntp peers**	Displays the configured server and peers. **Note** A domain name is resolved only when you have a DNS server configured.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure an NTP server and peer:

```
switch# config t
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# ntp server 192.0.2.10 key 10 use-vrf Red
switch(config)# ntp peer 2001:0db8::4101 prefer use-vrf Red
switch(config)# show ntp peers
-------------------------------------------------
Peer IP Address Serv/Peer
-------------------------------------------------
2001:0db8::4101 Peer (configured)
192.0.2.10 Server (configured)
```

```
switch(config)# copy running-config startup-config
[########################################] 100%
switch(config)#
```

Configuring NTP Authentication

You can configure the device to authenticate the time sources to which the local clock is synchronized. When you enable NTP authentication, the device synchronizes to a time source only if the source carries one of the authentication keys specified by the **ntp trusted-key** command. The device drops any packets that fail the authentication check and prevents them from updating the local clock. NTP authentication is disabled by default.

Before you begin

Make sure that you configured the NTP server with the authentication keys that you plan to specify in this procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **ntp authentication-key** *number* **md5** *md5-string*	Defines the authentication keys. The device does not synchronize to a time source unless the source has one of these authentication keys and the key number is specified by the **ntp trusted-key** *number* command.
Step 3	(Optional) switch(config)# **show ntp authentication-keys**	Displays the configured NTP authentication keys.
Step 4	switch(config)# [**no**]**ntp trusted-key** *number*	Specifies one or more keys that a time source must provide in its NTP packets in order for the device to synchronize to it. The range for trusted keys is from 1 to 65535. This command provides protection against accidentally synchronizing the device to a time source that is not trusted.
Step 5	(Optional) switch(config)# **show ntp trusted-keys**	Displays the configured NTP trusted keys.
Step 6	switch(config)# [**no**] **ntp authenticate**	Enables or disables the NTP authentication feature. NTP authentication is disabled by default.
Step 7	(Optional) switch(config)# **show ntp authentication-status**	Displays the status of NTP authentication.

	Command or Action	Purpose
Step 8	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure the device to synchronize only to time sources that provide authentication key 42 in their NTP packets:

```
switch# config t
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# ntp authentication-key 42 md5 aNiceKey
switch(config)# ntp trusted-key 42
switch(config)# ntp authenticate
switch(config)# copy running-config startup-config
[########################################] 100%
switch(config)#
```

Configuring NTP Access Restrictions

You can control access to NTP services by using access groups. Specifically, you can specify the types of requests that the device allows and the servers from which it accepts responses.

If you do not configure any access groups, NTP access is granted to all devices. If you configure any access groups, NTP access is granted only to the remote device whose source IP address passes the access list criteria.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **ntp access-group** {**peer** | **serve** | **serve-only** | **query-only**} *access-list-name*	Creates or removes an access group to control NTP access and applies a basic IP access list. The access group options are scanned in the following order, from least restrictive to most restrictive. However, if NTP matches a deny ACL rule in a configured peer, ACL processing stops and does not continue to the next access group option. • The **peer** keyword enables the device to receive time requests and NTP control queries and to synchronize itself to the servers specified in the access list. • The **serve** keyword enables the device to receive time requests and NTP control queries from the servers specified in the

	Command or Action	Purpose
		access list but not to synchronize itself to the specified servers. • The **serve-only** keyword enables the device to receive only time requests from servers specified in the access list. • The **query-only** keyword enables the device to receive only NTP control queries from the servers specified in the access list.
Step 3	(Optional) switch(config)# **show ntp access-groups**	Displays the NTP access group configuration.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure the device to allow it to synchronize to a peer from access group “accesslist1”:

```
switch# config t
switch(config)# ntp access-group peer accesslist1
switch(config)# show ntp access-groups
Access List Type
----------------------------
accesslist1 Peer
switch(config)# copy running-config startup-config
[########################################] 100%
switch(config)#
```

Configuring the NTP Source IP Address

NTP sets the source IP address for all NTP packets based on the address of the interface through which the NTP packets are sent. You can configure NTP to use a specific source IP address.

To configure the NTP source IP address, use the following command in global configuration mode:

Procedure

	Command or Action	Purpose
Step 1	switch(config)# [**no**] **ntp source** *ip-address*	Configures the source IP address for all NTP packets. The *ip-address* can be in IPv4 or IPv6 format.

Example

This example shows how to configure NTP to a source IP address:

```
switch(config)# ntp source 192.0.2.1
```

Configuring the NTP Source Interface

You can configure NTP to use a specific interface.

To configure the NTP source interface, use the following command in global configuration mode:

Procedure

	Command or Action	Purpose
Step 1	switch(config)# [**no**] **ntp source-interface** *interface*	Configures the source interface for all NTP packets. Use the **?** keyword to display a list of supported interfaces.

Example

This example shows how to configure NTP to a specific interface:

```
switch(config)# ntp source-interface
ethernet 2/1
```

Configuring NTP Logging

You can configure NTP logging in order to generate system logs with significant NTP events. NTP logging is disabled by default.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **ntp logging**	Enables or disables system logs to be generated with significant NTP events. NTP logging is disabled by default.
Step 3	(Optional) switch(config)# **show ntp logging-status**	Displays the NTP logging configuration status.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to enable NTP logging in order to generate system logs with significant NTP events:

```
switch# config t
switch(config)# ntp logging
switch(config)# copy running-config startup-config
[########################################] 100%
switch(config)#
```

Enabling CFS Distribution for NTP

You can enable CFS distribution for NTP in order to distribute the NTP configuration to other CFS-enabled devices.

Before you begin

Make sure that you have enabled CFS distribution for the device.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **ntp distribute**	Enables or disables the device to receive NTP configuration updates that are distributed through CFS.
Step 3	(Optional) switch(config)# **show ntp status**	Displays the NTP CFS distribution status.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to enable CFS distribution for NTP:

```
switch# config t
Enter configuration commands, one per
line. End with CNTL/Z.
switch(config)# ntp distribute
switch(config)# copy running-config
startup-config
```

Commiting NTP Configuration Changes

When you commit the NTP configuration changes, the effective database is overwritten by the configuration changes in the pending database and all the devices in the network receive the same configuration.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ntp commit**	Distributes the NTP configuration changes to all Cisco NX-OS devices in the network and releases the CFS lock. This command overwrites the effective database with the changes made to the pending database.

Example

This example shows how to commit the NTP configuration changes:

```
switch(config)# ntp commit
```

Discarding NTP Configuration Changes

After making the configuration changes, you can choose to discard the changes instead of committing them. If you discard the changes, Cisco NX-OS removes the pending database changes and releases the CFS lock.

To discard NTP configuration changes, use the following command in global configuration mode:

Procedure

	Command or Action	Purpose
Step 1	switch(config)# **ntp abort**	Discards the NTP configuration changes in the pending database and releases the CFS lock. Use this command on the device where you started the NTP configuration.

Example

This example shows how to discard the NTP configuration changes:

```
switch(config)# ntp abort
```

Releasing the CFS Session Lock

If you have performed an NTP configuration and have forgotten to release the lock by either committing or discarding the changes, you or another administrator can release the lock from any device in the network. This action also discards pending database changes.

To release the session lock from any device and discard any pending database changes, use the following command in global configuration mode:

Procedure

	Command or Action	Purpose
Step 1	switch(config)# **clear ntp session**	Discards the NTP configuration changes in the pending database and releases the CFS lock.

Example

This example shows how to release the CFS session lock:

```
switch(config)# clear ntp session
```

Verifying the NTP Configuration

To display the NTP configuration, perform one of the following tasks:

Use the **clear ntp session** command to clear the NTP sessions.

Use the **clear ntp statistics** command to clear the NTP statistics.

Procedure

	Command or Action	Purpose
Step 1	**show ntp access-groups**	Displays the NTP access group configuration.
Step 2	**show ntp authentication-keys**	Displays the configured NTP authentication keys.
Step 3	**show ntp authentication-status**	Displays the status of NTP authentication.
Step 4	**show ntp logging-status**	Displays the NTP logging status.
Step 5	**show ntp peer-status**	Displays the status for all NTP servers and peers.
Step 6	**show ntp peers**	Displays all the NTP peers.
Step 7	**show ntp pending**	Displays the temporary CFS database for NTP.
Step 8	**show ntp pending-diff**	Displays the difference between the pending CFS database and the current NTP configuration.
Step 9	**show ntp rts-update**	Displays the RTS update status.
Step 10	**show ntp session status**	Displays the NTP CFS distribution session information.
Step 11	**show ntp source**	Displays the configured NTP source IP address.

	Command or Action	Purpose
Step 12	**show ntp source-interface**	Displays the configured NTP source interface.
Step 13	**show ntp statistics** {**io** | **local** | **memory** | **peer** {**ipaddr** {*ipv4-addr* | *ipv6-addr*} | **name** *peer-name*}}	Displays the NTP statistics.
Step 14	**show ntp status**	Displays the NTP CFS distribution status.
Step 15	**show ntp trusted-keys**	Displays the configured NTP trusted keys.
Step 16	**show running-config ntp**	Displays NTP information.

Configuration Examples for NTP

This example shows how to configure an NTP server and peer, enable NTP authentication, enable NTP logging, and then save the configuration in startup so that it is saved across reboots and restarts:

```
switch# config terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# ntp server 192.0.2.105 key 42
switch(config)# ntp peer 2001:0db8::4101
switch(config)# show ntp peers
-------------------------------------------------
     Peer IP Address            Serv/Peer
-------------------------------------------------
     2001:db8::4101          Peer (configured)
     192.0.2.105           Server (configured)
switch(config)# ntp authentication-key 42 md5 aNiceKey
switch(config)# show ntp authentication-keys
-----------------------------
  Auth key        MD5 String
-----------------------------
     42           aNicekey
switch(config)# ntp trusted-key 42
switch(config)# show ntp trusted-keys
Trusted Keys:
42
switch(config)# ntp authenticate
switch(config)# show ntp authentication-status
Authentication enabled.
switch(config)# ntp logging
switch(config)# show ntp logging
NTP logging enabled.
switch(config)# copy running-config startup-config
[########################################] 100%
switch(config)#
```

This example shows an NTP access group configuration with the following restrictions:

- Peer restrictions are applied to IP addresses that pass the criteria of the access list named “peer-acl.”
- Serve restrictions are applied to IP addresses that pass the criteria of the access list named “serve-acl.”
- Serve-only restrictions are applied to IP addresses that pass the criteria of the access list named “serve-only-acl.”

- Query-only restrictions are applied to IP addresses that pass the criteria of the access list named "query-only-acl."

```
switch# config terminal
switch(config)# ntp peer 10.1.1.1
switch(config)# ntp peer 10.2.2.2
switch(config)# ntp peer 10.3.3.3
switch(config)# ntp peer 10.4.4.4
switch(config)# ntp peer 10.5.5.5
switch(config)# ntp peer 10.6.6.6
switch(config)# ntp peer 10.7.7.7
switch(config)# ntp peer 10.8.8.8
switch(config)# ntp access-group peer peer-acl
switch(config)# ntp access-group serve serve-acl
switch(config)# ntp access-group serve-only serve-only-acl
switch(config)# ntp access-group query-only query-only-acl

switch(config)# ip access-list peer-acl
switch(config-acl)# 10 permit ip host 10.1.1.1 any
switch(config-acl)# 20 permit ip host 10.8.8.8 any

switch(config)# ip access-list serve-acl
switch(config-acl)# 10 permit ip host 10.4.4.4 any
switch(config-acl)# 20 permit ip host 10.5.5.5 any

switch(config)# ip access-list serve-only-acl
switch(config-acl)# 10 permit ip host 10.6.6.6 any
switch(config-acl)# 20 permit ip host 10.7.7.7 any

switch(config)# ip access-list query-only-acl
switch(config-acl)# 10 permit ip host 10.2.2.2 any
switch(config-acl)# 20 permit ip host 10.3.3.3 any
```

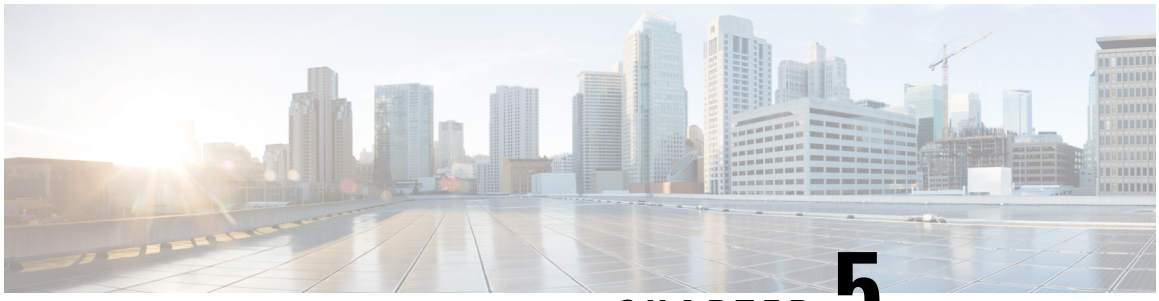
Related Documents for NTP

Related Topic	Document Title
NTP CLI commands	*Cisco Nexus 3548 Switch NX-OS System Management Command Reference Guide*

Feature History for NTP

This table includes only the updates for those releases that have resulted in additions or changes to the feature.

Feature Name	Releases	Feature Information
NTP	5.0(3)A1(1)	This feature was introduced.



CHAPTER 5

Configuring System Message Logging

This chapter contains the following sections:

- Information About System Message Logging, on page 37
- Guidelines and Limitations for System Message Logging, on page 38
- Default Settings for System Message Logging, on page 38
- Configuring System Message Logging, on page 39
- Configuring DOM Logging, on page 50
- Verifying the System Message Logging Configuration, on page 51

Information About System Message Logging

You can use system message logging to control the destination and to filter the severity level of messages that system processes generate. You can configure logging to terminal sessions, a log file, and syslog servers on remote systems.

For more information about the system message format and the messages that the device generates, see the *Cisco NX-OS System Messages Reference*.

By default, the Cisco Nexus device outputs messages to terminal sessions.

By default, the switch logs system messages to a log file.

The following table describes the severity levels used in system messages. When you configure the severity level, the system outputs messages at that level and lower.

Table 5: System Message Severity Levels

Level	Description
0 – emergency	System unusable
1 – alert	Immediate action needed
2 – critical	Critical condition
3 – error	Error condition
4 – warning	Warning condition
5 – notification	Normal but significant condition

Level	Description
6 – informational	Informational message only
7 – debugging	Appears during debugging only

The switch logs the most recent 100 messages of severity 0, 1, or 2 to the NVRAM log. You cannot configure logging to the NVRAM.

You can configure which system messages should be logged based on the facility that generated the message and its severity level.

Syslog Servers

Syslog servers run on remote systems that are configured to log system messages based on the syslog protocol. You can configure the Cisco Nexus Series switch to send logs to up to eight syslog servers.

To support the same configuration of syslog servers on all switches in a fabric, you can use Cisco Fabric Services (CFS) to distribute the syslog server configuration.

Note When the switch first initializes, messages are sent to syslog servers only after the network is initialized.

Guidelines and Limitations for System Message Logging

System message logging has the following configuration guidelines and limitations:

- System messages are logged to the console and the logfile by default.

Default Settings for System Message Logging

The following table lists the default settings for system message logging parameters.

Table 6: Default System Message Logging Parameters

Parameters	Default
Console logging	Enabled at severity level 2
Monitor logging	Enabled at severity level 2
Log file logging	Enabled to log messages at severity level 5
Module logging	Enabled at severity level 5
Facility logging	Enabled

Parameters	Default
Time-stamp units	Seconds
Syslog server logging	Disabled
Syslog server configuration distribution	Disabled

Configuring System Message Logging

Configuring System Message Logging to Terminal Sessions

You can configure the switch to log messages by their severity level to console, Telnet, and Secure Shell sessions.

By default, logging is enabled for terminal sessions.

Procedure

	Command or Action	Purpose
Step 1	switch# **terminal monitor**	Copies syslog messages from the console to the current terminal session.
Step 2	switch# **configure terminal**	Enters global configuration mode.
Step 3	switch(config)# **logging console** [*severity-level*]	Enables the switch to log messages to the console session based on a specified severity level or higher (a lower number value indicates a higher severity level). Severity levels range from 0 to 7: • 0 – emergency • 1 – alert • 2 – critical • 3 – error • 4 – warning • 5 – notification • 6 – informational • 7 – debugging If the severity level is not specified, the default of 2 is used.
Step 4	(Optional) switch(config)# **no logging console** [*severity-level*]	Disables logging messages to the console.

	Command or Action	Purpose
Step 5	switch(config)# **logging monitor** [*severity-level*]	Enables the switch to log messages to the monitor based on a specified severity level or higher (a lower number value indicates a higher severity level). Severity levels range from 0 to 7: • 0 – emergency • 1 – alert • 2 – critical • 3 – error • 4 – warning • 5 – notification • 6 – informational • 7 – debugging If the severity level is not specified, the default of 2 is used. The configuration applies to Telnet and SSH sessions.
Step 6	(Optional) switch(config)# **no logging monitor** [*severity-level*]	Disables logging messages to Telnet and SSH sessions.
Step 7	(Optional) switch# **show logging console**	Displays the console logging configuration.
Step 8	(Optional) switch# **show logging monitor**	Displays the monitor logging configuration.
Step 9	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure a logging level of 3 for the console:

```
switch# configure terminal
switch(config)# logging console 3
```

The following example shows how to display the console logging configuration:

```
switch# show logging console
Logging console:                enabled (Severity: error)
```

The following example shows how to disable logging for the console:

```
switch# configure terminal
```

```
switch(config)# no logging console
```

The following example shows how to configure a logging level of 4 for the terminal session:

```
switch# terminal monitor
switch# configure terminal
switch(config)# logging monitor 4
```

The following example shows how to display the terminal session logging configuration:

```
switch# show logging monitor
Logging monitor:                 enabled (Severity: warning)
```

The following example shows how to disable logging for the terminal session:

```
switch# configure terminal
switch(config)# no logging monitor
```

Configuring System Message Logging to a File

You can configure the switch to log system messages to a file. By default, system messages are logged to the file log:messages.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **logging logfile** *logfile-name severity-level* [**size** *bytes*]	Configures the name of the log file used to store system messages and the minimum severity level to log. You can optionally specify a maximum file size. The default severity level is 5 and the file size is 4194304. Severity levels range from 0 to 7: • 0 – emergency • 1 – alert • 2 – critical • 3 – error • 4 – warning • 5 – notification • 6 – informational • 7 – debugging

	Command or Action	Purpose
		The file size is from 4096 to 10485760 bytes.
Step 3	(Optional) switch(config)# **no logging logfile** [*logfile-name severity-level* [**size** *bytes*]]	Disables logging to the log file. You can optionally specify a maximum file size. The default severity level is 5 and the file size is 4194304.
Step 4	(Optional) switch# **show logging info**	Displays the logging configuration. You can optionally specify a maximum file size. The default severity level is 5 and the file size is 4194304.
Step 5	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure a switch to log system messages to a file:

```
switch# configure terminal
switch(config)# logging logfile my_log 6 size 4194304
```

The following example shows how to display the logging configuration (some of the output has been removed for brevity):

```
switch# show logging info
Logging console:                enabled (Severity: debugging)
Logging monitor:                enabled (Severity: debugging)
Logging timestamp:              Seconds
Logging server:                 disabled
Logging logfile:                enabled
        Name - my_log: Severity - informational Size - 4194304
Facility        Default Severity        Current Session Severity
--------        ----------------        ------------------------
aaa                     3                       3
afm                     3                       3
altos                   3                       3
auth                    0                       0
authpriv                3                       3
bootvar                 5                       5
callhome                2                       2
capability              2                       2
cdp                     2                       2
cert_enroll             2                       2
...
```

Configuring Module and Facility Messages Logging

You can configure the severity level and time-stamp units of messages logged by modules and facilities.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **logging module** [*severity-level*]	Enables module log messages that have the specified severity level or higher. Severity levels range from 0 to 7: • 0 – emergency • 1 – alert • 2 – critical • 3 – error • 4 – warning • 5 – notification • 6 – informational • 7 – debugging If the severity level is not specified, the default of 5 is used.
Step 3	switch(config)# **logging level** *facility severity-level*	Enables logging messages from the specified facility that have the specified severity level or higher. Severity levels from 0 to 7: • 0 – emergency • 1 – alert • 2 – critical • 3 – error • 4 – warning • 5 – notification • 6 – informational • 7 – debugging To apply the same severity level to all facilities, use the all facility. For defaults, see the **show logging level** command. **Note** If the default severity and current session severity of a component is the same, then the logging level for the component will not be displayed in the running configuration.

	Command or Action	Purpose
Step 4	(Optional) switch(config)# **no logging module** [*severity-level*]	Disables module log messages.
Step 5	(Optional) switch(config)# **no logging level** [*facility severity-level*]	Resets the logging severity level for the specified facility to its default level. If you do not specify a facility and severity level, the switch resets all facilities to their default levels.
Step 6	(Optional) switch# **show logging module**	Displays the module logging configuration.
Step 7	(Optional) switch# **show logging level** [*facility*]	Displays the logging level configuration and the system default level by facility. If you do not specify a facility, the switch displays levels for all facilities.
Step 8	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure the severity level of module and specific facility messages:

```
switch# configure terminal
switch(config)# logging module 3
switch(config)# logging level aaa 2
```

Configuring Logging Timestamps

You can configure the time-stamp units of messages logged by the Cisco Nexus Series switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **logging timestamp** {**microseconds** | **milliseconds** | **seconds**}	Sets the logging time-stamp units. By default, the units are seconds.
Step 3	(Optional) switch(config)# **no logging timestamp** {**microseconds** | **milliseconds** | **seconds**}	Resets the logging time-stamp units to the default of seconds.
Step 4	(Optional) switch# **show logging timestamp**	Displays the logging time-stamp units configured.

	Command or Action	Purpose
Step 5	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure the time-stamp units of messages:

```
switch# configure terminal
switch(config)# logging timestamp milliseconds
switch(config)# exit
switch# show logging timestamp
Logging timestamp:              Milliseconds
```

Configuring Syslog Servers

You can configure up to eight syslog servers that reference remote systems where you want to log system messages.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**logging server** *host* [*severity-level* [**use-vrf** *vrf-name* [**facility** *facility*]]] **Example:** `switch(config)# logging server 172.28.254.254 5 use-vrf default facility local3`	Configures a host to receive syslog messages. • The *host* argument identifies the hostname or the IPv4 or IPv6 address of the syslog server host. • The *severity-level* argument limits the logging of messages to the syslog server to a specified level. Severity levels range from 0 to 7. See Table 5: System Message Severity Levels , on page 37. • The **use vrf** *vrf-name* keyword identifies the default or management values for the VRF name. If a specific VRF is not identified, management is the default. The **show running** command output can display or not display the VRF based on the following configuration scenarios: • You have not configured any VRF and the system takes the management

	Command or Action	Purpose
		VRF as the default. Then this VRF is not displayed in the output. • You have configured management VRF. Then this VRF is not displayed in the output as the system identifies it as the default. • You have configured any other VRF. Then this VRF is displayed in the output. **Note** The current Cisco Fabric Services (CFS) distribution does not support VRF. If CFS distribution is enabled, the logging server configured with the default VRF is distributed as the management VRF. • The facility argument names the syslog facility type. The default outgoing facility is local7. The facilities are listed in the command reference for the Cisco Nexus Series software that you are using. **Note** Debugging is a CLI facility but the debug syslogs are not sent to the server.
Step 3	(Optional) **no logging server** *host* **Example:** `switch(config)# no logging server 172.28.254.254 5`	Removes the logging server for the specified host.
Step 4	(Optional) **show logging server** **Example:** `switch# show logging server`	Displays the syslog server configuration.
Step 5	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following examples show how to configure a syslog server:

```
switch# configure terminal
switch(config)# logging server 172.28.254.254 5
use-vrf default facility local3

switch# configure terminal
switch(config)# logging server 172.28.254.254 5 use-vrf management facility local3
```

Configuring syslog on a UNIX or Linux System

You can configure a syslog server on a UNIX or Linux system by adding the following line to the /etc/syslog.conf file:

facility.level <five tab characters> *action*

The following table describes the syslog fields that you can configure.

Table 7: syslog Fields in syslog.conf

Field	Description
Facility	Creator of the message, which can be auth, authpriv, cron, daemon, kern, lpr, mail, mark, news, syslog, user, local0 through local7, or an asterisk (*) for all. These facility designators allow you to control the destination of messages based on their origin. **Note** Check your configuration before using a local facility.
Level	Minimum severity level at which messages are logged, which can be debug, info, notice, warning, err, crit, alert, emerg, or an asterisk (*) for all. You can use none to disable a facility.
Action	Destination for messages, which can be a filename, a hostname preceded by the at sign (@), or a comma-separated list of users or an asterisk (*) for all logged-in users.

Procedure

Step 1 Log debug messages with the local7 facility in the file /var/log/myfile.log by adding the following line to the /etc/syslog.conf file:

```
debug.local7            /var/log/myfile.log
```

Step 2 Create the log file by entering these commands at the shell prompt:

```
$ touch /var/log/myfile.log
$ chmod 666 /var/log/myfile.log
```

Step 3 Make sure that the system message logging daemon reads the new changes by checking myfile.log after entering this command:

```
$ kill -HUP ~cat /etc/syslog.pid~
```

Configuring syslog Server Configuration Distribution

You can distribute the syslog server configuration to other switches in the network by using the Cisco Fabric Services (CFS) infrastructure.

After you enable syslog server configuration distribution, you can modify the syslog server configuration and view the pending changes before committing the configuration for distribution. As long as distribution is enabled, the switch maintains pending changes to the syslog server configuration.

Note If the switch is restarted, the syslog server configuration changes that are kept in volatile memory might get lost.

Before you begin

You must have configured one or more syslog servers.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **logging distribute**	Enables distribution of the syslog server configuration to network switches using the CFS infrastructure. By default, distribution is disabled.
Step 3	switch(config)# **logging commit**	Commits the pending changes to the syslog server configuration for distribution to the switches in the fabric.
Step 4	switch(config)# **logging abort**	Cancels the pending changes to the syslog server configuration.
Step 5	(Optional) switch(config)# **no logging distribute**	Disables the distribution of the syslog server configuration to network switches using the CFS infrastructure. You cannot disable distribution when configuration changes are pending. See the **logging commit** and **logging abort** commands. By default, distribution is disabled.
Step 6	(Optional) switch# **show logging pending**	Displays the pending changes to the syslog server configuration.
Step 7	(Optional) switch# **show logging pending-diff**	Displays the differences from the current syslog server configuration to the pending changes of the syslog server configuration.

	Command or Action	Purpose
Step 8	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Displaying and Clearing Log Files

You can display or clear messages in the log file and the NVRAM.

Procedure

	Command or Action	Purpose
Step 1	switch# **show logging last** *number-lines*	Displays the last number of lines in the logging file. You can specify from 1 to 9999 for the last number of lines.
Step 2	switch# **show logging logfile** [**start-time** *yyyy mmm dd hh:mm:ss*] [**end-time** *yyyy mmm dd hh:mm:ss*]	Displays the messages in the log file that have a time stamp within the span entered. If you do not enter an end time, the current time is used. You enter three characters for the month time field and digits for the year and day time fields.
Step 3	switch# **show logging nvram** [**last** *number-lines*]	Displays the messages in the NVRAM. To limit the number of lines displayed, you can enter the last number of lines to display. You can specify from 1 to 100 for the last number of lines.
Step 4	switch# **clear logging logfile**	Clears the contents of the log file.
Step 5	switch# **clear logging nvram**	Clears the logged messages in NVRAM.

Example

The following example shows how to display messages in a log file:

```
switch# show logging last 40
switch# show logging logfile start-time 2007 nov 1 15:10:0
switch# show logging nvram last 10
```

The following example shows how to clear messages in a log file:

```
switch# clear logging logfile
switch# clear logging nvram
```

Configuring DOM Logging

Enabling DOM Logging

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **system ethernet dom polling**	Enables transceiver digital optical monitoring periodic polling.

Example

The following example shows how to enable DOM logging.

```
switch# configure terminal
switch(config)# system ethernet dom polling
```

Disabling DOM Logging

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **no system ethernet dom polling**	Disables transceiver digital optical monitoring periodic polling.

Example

The following example shows how to disable DOM logging.

```
switch# configure terminal
switch(config)# no system ethernet dom polling
```

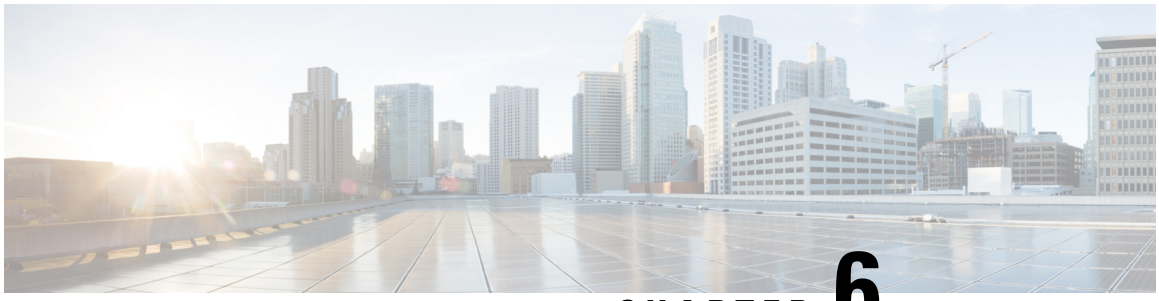
Verifying the DOM Logging Configuration

Command	Purpose
show system ethernet dom polling status	Displays the transceiver digital optical monitoring periodic polling status.

Verifying the System Message Logging Configuration

Use these commands to verify system message logging configuration information:

Command	Purpose
show logging console	Displays the console logging configuration.
show logging info	Displays the logging configuration.
show logging ip access-list cache	Displays the IP access list cache.
show logging ip access-list cache detail	Displays detailed information about the IP access list cache.
show logging ip access-list status	Displays the status of the IP access list cache.
show logging last *number-lines*	Displays the last number of lines of the log file.
show logging level [*facility*]	Displays the facility logging severity level configuration.
show logging logfile [**start-time** *yyyy mmm dd hh:mm:ss*] [**end-time** *yyyy mmm dd hh:mm:ss*]	Displays the messages in the log file.
show logging module	Displays the module logging configuration.
show logging monitor	Displays the monitor logging configuration.
show logging nvram [**last** *number-lines*]	Displays the messages in the NVRAM log.
show logging pending	Displays the syslog server pending distribution configuration.
show logging pending-diff	Displays the syslog server pending distribution configuration differences.
show logging server	Displays the syslog server configuration.
show logging session	Displays the logging session status.
show logging status	Displays the logging status.
show logging timestamp	Displays the logging time-stamp units configuration.



CHAPTER 6

Configuring Smart Call Home

This chapter contains the following sections:

- Information About Smart Call Home, on page 53
- Guidelines and Limitations for Smart Call Home, on page 61
- Prerequisites for Smart Call Home, on page 61
- Default Call Home Settings, on page 61
- Configuring Smart Call Home, on page 62
- Verifying the Smart Call Home Configuration, on page 72
- Sample Syslog Alert Notification in Full-Text Format, on page 73
- Sample Syslog Alert Notification in XML Format, on page 73

Information About Smart Call Home

Smart Call Home provides e-mail-based notification of critical system events. Cisco Nexus Series switches provide a range of message formats for optimal compatibility with pager services, standard e-mail, or XML-based automated parsing applications. You can use this feature to page a network support engineer, e-mail a Network Operations Center, or use Cisco Smart Call Home services to automatically generate a case with the Technical Assistance Center (TAC).

If you have a service contract directly with Cisco, you can register your devices for the Smart Call Home service. Smart Call Home provides fast resolution of system problems by analyzing Smart Call Home messages sent from your devices and providing background information and recommendations. For issues that can be identified as known, particularly GOLD diagnostics failures, Automatic Service Requests will be generated by the Cisco TAC.

Smart Call Home offers the following features:

- Continuous device health monitoring and real-time diagnostic alerts.
- Analysis of Smart Call Home messages from your device and, where appropriate, Automatic Service Request generation, routed to the appropriate TAC team, including detailed diagnostic information to speed problem resolution.
- Secure message transport directly from your device or through a downloadable Transport Gateway (TG) aggregation point. You can use a TG aggregation point in cases that require support for multiple devices or in cases where security requirements mandate that your devices may not be connected directly to the Internet.

- Web-based access to Smart Call Home messages and recommendations, inventory and configuration information for all Smart Call Home devices, and field notices, security advisories, and end-of-life information.

Smart Call Home Overview

You can use Smart Call Home to notify an external entity when an important event occurs on your device. Smart Call Home delivers alerts to multiple recipients that you configure in destination profiles.

Smart Call Home includes a fixed set of predefined alerts on your switch. These alerts are grouped into alert groups and CLI commands that are assigned to execute when an alert in an alert group occurs. The switch includes the command output in the transmitted Smart Call Home message.

The Smart Call Home feature offers the following:

- Automatic execution and attachment of relevant CLI command output.
- Multiple message format options such as the following:
  - Short Text—Text that is suitable for pagers or printed reports.
  - Full Text—Fully formatted message information that is suitable for human reading.
  - XML—Matching readable format that uses the Extensible Markup Language (XML) and the Adaptive Messaging Language (AML) XML schema definition (XSD). The XML format enables communication with the Cisco TAC.
- Multiple concurrent message destinations. You can configure up to 50 e-mail destination addresses for each destination profile.

Smart Call Home Destination Profiles

A Smart Call Home destination profile includes the following information:

- One or more alert groups—The group of alerts that trigger a specific Smart Call Home message if the alert occurs.
- One or more e-mail destinations—The list of recipients for the Smart Call Home messages that are generated by alert groups assigned to this destination profile.
- Message format—The format for the Smart Call Home message (short text, full text, or XML).
- Message severity level—The Smart Call Home severity level that the alert must meet before the switch generates a Smart Call Home message to all e-mail addresses in the destination profile. The switch does not generate an alert if the Smart Call Home severity level of the alert is lower than the message severity level set for the destination profile.

You can also configure a destination profile to allow periodic inventory update messages by using the inventory alert group that will send out periodic messages daily, weekly, or monthly.

Cisco Nexus switches support the following predefined destination profiles:

- CiscoTAC-1—Supports the Cisco-TAC alert group in XML message format.
- full-text-destination—Supports the full text message format.

• short-text-destination—Supports the short text message format.

Smart Call Home Alert Groups

An alert group is a predefined subset of Smart Call Home alerts that are supported in all Cisco Nexus devices. Alert groups allow you to select the set of Smart Call Home alerts that you want to send to a predefined or custom destination profile. The switch sends Smart Call Home alerts to e-mail destinations in a destination profile only if that Smart Call Home alert belongs to one of the alert groups associated with that destination profile and if the alert has a Smart Call Home message severity at or above the message severity set in the destination profile.

The following table lists the supported alert groups and the default CLI command output included in Smart Call Home messages generated for the alert group.

Table 8: Alert Groups and Executed Commands

Alert Group	Description	Executed Commands
Cisco-TAC	All critical alerts from the other alert groups destined for Smart Call Home.	Execute commands based on the alert group that originates the alert.
Diagnostic	Events generated by diagnostics.	**show diagnostic result module all detail** **show moduleshow version** **show tech-support platform callhome**
Supervisor hardware	Events related to supervisor modules.	**show diagnostic result module all detail** **show moduleshow version** **show tech-support platform callhome**
Linecard hardware	Events related to standard or intelligent switching modules.	**show diagnostic result module all detail** **show moduleshow version** **show tech-support platform callhome**
Configuration	Periodic events related to configuration.	**show version** **show module** **show running-config all** **show startup-config**
System	Events generated by a failure of a software system that is critical to unit operation.	**show system redundancy status** **show tech-support**
Environmental	Events related to power, fan, and environment-sensing elements such as temperature alarms.	**show environment** **show logging last 1000** **show module show version** **show tech-support platform callhome**

Alert Group	Description	Executed Commands
Inventory	Inventory status that is provided whenever a unit is cold booted, or when FRUs are inserted or removed. This alert is considered a noncritical event, and the information is used for status and entitlement.	**show module** **show version** **show license usage** **show inventory** **show sprom all** **show system uptime**

Smart Call Home maps the syslog severity level to the corresponding Smart Call Home severity level for syslog port group messages.

You can customize predefined alert groups to execute additional **show** commands when specific events occur and send that **show** output with the Smart Call Home message.

You can add **show** commands only to full text and XML destination profiles. Short text destination profiles do not support additional **show** commands because they only allow 128 bytes of text.

Smart Call Home Message Levels

Smart Call Home allows you to filter messages based on their level of urgency. You can associate each destination profile (predefined and user defined) with a Smart Call Home message level threshold. The switch does not generate any Smart Call Home messages with a value lower than this threshold for the destination profile. The Smart Call Home message level ranges from 0 (lowest level of urgency) to 9 (highest level of urgency), and the default is 0 (the switch sends all messages).

Smart Call Home messages that are sent for syslog alert groups have the syslog severity level mapped to the Smart Call Home message level.

Note Smart Call Home does not change the syslog message level in the message text.

The following table shows each Smart Call Home message level keyword and the corresponding syslog level for the syslog port alert group.

Table 9: Severity and Syslog Level Mapping

Smart Call Home Level	Keyword	Syslog Level	Description
9	Catastrophic	N/A	Network-wide catastrophic failure.
8	Disaster	N/A	Significant network impact.
7	Fatal	Emergency (0)	System is unusable.
6	Critical	Alert (1)	Critical conditions that indicate that immediate attention is needed.
5	Major	Critical (2)	Major conditions.

Smart Call Home Level	Keyword	Syslog Level	Description
4	Minor	Error (3)	Minor conditions.
3	Warning	Warning (4)	Warning conditions.
2	Notification	Notice (5)	Basic notification and informational messages.
1	Normal	Information (6)	Normal event signifying return to normal state.
0	Debugging	Debug (7)	Debugging messages.

Call Home Message Formats

Call Home supports the following message formats:

- Short text message format
- Common fields for all full text and XML messages
- Inserted fields for a reactive or proactive event message
- Inserted fields for an inventory event message
- Inserted fields for a user-generated test message

The following table describes the short text formatting option for all message types.

Table 10: Short Text Message Format

Data Item	Description
Device identification	Configured device name
Date/time stamp	Time stamp of the triggering event
Error isolation message	Plain English description of triggering event
Alarm urgency level	Error level such as that applied to a system message

The following table describes the common event message format for full text or XML.

Table 11: Common Fields for All Full Text and XML Messages

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Time stamp	Date and time stamp of event in ISO time notation: *YYYY-MM-DD HH:MM:SS GMT+HH:MM*	/aml/header/time

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Message name	Name of message. Specific event names are listed in the preceding table.	/aml/header/name
Message type	Name of message type, such as reactive or proactive.	/aml/header/type
Message group	Name of alert group, such as syslog.	/aml/header/group
Severity level	Severity level of message.	/aml/header/level
Source ID	Product type for routing.	/aml/header/source
Device ID	Unique device identifier (UDI) for the end device that generated the message. This field should be empty if the message is nonspecific to a device. The format is *type@Sid@serial*: • *type* is the product model number from backplane IDPROM. • @ is a separator character. • *Sid* is C, identifying the serial ID as a chassis serial number. • *serial* is the number identified by the Sid field. An example is WS-C6509@C@12345678	/aml/ header/deviceID
Customer ID	Optional user-configurable field used for contract information or other ID by any support service.	/aml/ header/customerID
Contract ID	Optional user-configurable field used for contract information or other ID by any support service.	/aml/ header /contractID
Site ID	Optional user-configurable field used for Cisco-supplied site ID or other data meaningful to alternate support service.	/aml/ header/siteID

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Server ID	If the message is generated from the device, this is the unique device identifier (UDI) of the device. The format is *type@Sid@serial*: • *type* is the product model number from backplane IDPROM. • @ is a separator character. • *Sid* is C, identifying the serial ID as a chassis serial number. • *serial* is the number identified by the Sid field. An example is WS-C6509@C@12345678	/aml/header/serverID
Message description	Short text that describes the error.	/aml/body/msgDesc
Device name	Node that experienced the event (hostname of the device).	/aml/body/sysName
Contact name	Name of person to contact for issues associated with the node that experienced the event.	/aml/body/sysContact
Contact e-mail	E-mail address of person identified as the contact for this unit.	/aml/body/sysContactEmail
Contact phone number	Phone number of the person identified as the contact for this unit.	/aml/body/sysContactPhoneNumber
Street address	Optional field that contains the street address for RMA part shipments associated with this unit.	/aml/body/sysStreetAddress
Model name	Model name of the device (the specific model as part of a product family name).	/aml/body/chassis/name
Serial number	Chassis serial number of the unit.	/aml/body/chassis/serialNo
Chassis part number	Top assembly number of the chassis.	/aml/body/chassis/partNo
Fields specific to a particular alert group message are inserted here.		
The following fields may be repeated if multiple CLI commands are executed for this alert group.		

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Command output name	Exact name of the issued CLI command.	/aml/attachments/attachment/name
Attachment type	Specific command output.	/aml/attachments/attachment/type
MIME type	Either plain text or encoding type.	/aml/attachments/attachment/mime
Command output text	Output of command automatically executed.	/aml/attachments/attachment/atdata

The following table describes the reactive event message format for full text or XML.

Table 12: Inserted Fields for a Reactive or Proactive Event Message

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Chassis hardware version	Hardware version of chassis.	/aml/body/chassis/hwVersion
Supervisor module software version	Top-level software version.	/aml/body/chassis/swVersion
Affected FRU name	Name of the affected FRU that is generating the event message.	/aml/body/fru/name
Affected FRU serial number	Serial number of the affected FRU.	/aml/body/fru/serialNo
Affected FRU part number	Part number of the affected FRU.	/aml/body/fru/partNo
FRU slot	Slot number of the FRU that is generating the event message.	/aml/body/fru/slot
FRU hardware version	Hardware version of the affected FRU.	/aml/body/fru/hwVersion
FRU software version	Software version(s) that is running on the affected FRU.	/aml/body/fru/swVersion

The following table describes the inventory event message format for full text or XML.

Table 13: Inserted Fields for an Inventory Event Message

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Chassis hardware version	Hardware version of the chassis.	/aml/body/chassis/hwVersion
Supervisor module software version	Top-level software version.	/aml/body/chassis/swVersion
FRU name	Name of the affected FRU that is generating the event message.	/aml/body/fru/name
FRU s/n	Serial number of the FRU.	/aml/body/fru/serialNo
FRU part number	Part number of the FRU.	/aml/body/fru/partNo

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
FRU slot	Slot number of the FRU.	/aml/body/fru/slot
FRU hardware version	Hardware version of the FRU.	/aml/body/fru/hwVersion
FRU software version	Software version(s) that is running on the FRU.	/aml/body/fru/swVersion

The following table describes the user-generated test message format for full text or XML.

Table 14: Inserted Fields for a User-Generated Test Message

Data Item (Plain Text and XML)	Description (Plain Text and XML)	XML Tag (XML Only)
Process ID	Unique process ID.	/aml/body/process/id
Process state	State of process (for example, running or halted).	/aml/body/process/processState
Process exception	Exception or reason code.	/aml/body/process/exception

Guidelines and Limitations for Smart Call Home

- If there is no IP connectivity, or if the interface in the virtual routing and forwarding (VRF) instance to the profile destination is down, the switch cannot send Smart Call Home messages.
- Operates with any SMTP e-mail server.

Prerequisites for Smart Call Home

- You must have e-mail server connectivity.
- You must have access to contact name (SNMP server contact), phone, and street address information.
- You must have IP connectivity between the switch and the e-mail server.
- You must have an active service contract for the device that you are configuring.

Default Call Home Settings

Table 15: Default Call Home Parameters

Parameters	Default
Destination message size for a message sent in full text format	4000000
Destination message size for a message sent in XML format	4000000

Parameters	Default
Destination message size for a message sent in short text format	4000
SMTP server port number if no port is specified	25
Alert group association with profile	All for full-text-destination and short-text-destination profiles. The cisco-tac alert group for the CiscoTAC-1 destination profile.
Format type	XML
Call Home message level	0 (zero)

Configuring Smart Call Home

Registering for Smart Call Home

Before you begin

- Know the sMARTnet contract number for your switch
- Know your e-mail address
- Know your Cisco.com ID

Procedure

Step 1 In a browser, navigate to the Smart Call Home web page:

http://www.cisco.com/go/smartcall/

Step 2 Under **Getting Started**, follow the directions to register Smart Call Home.

What to do next

Configure contact information.

Configuring Contact Information

You must configure the e-mail, phone, and street address information for Smart Call Home. You can optionally configure the contract ID, customer ID, site ID, and switch priority information.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **snmp-server contact** *sys-contact*	Configures the SNMP sysContact.
Step 3	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 4	switch(config-callhome)# **email-contact** *email-address*	Configures the e-mail address for the primary person responsible for the switch. The *email-address* can be up to 255 alphanumeric characters in an e-mail address format. **Note** You can use any valid e-mail address. The address cannot contain spaces.
Step 5	switch(config-callhome)# **phone-contact** *international-phone-number*	Configures the phone number in international phone number format for the primary person responsible for the device. The *international-phone-number* can be up to 17 alphanumeric characters and must be in international phone number format. **Note** The phone number cannot contain spaces. Use the plus (+) prefix before the number.
Step 6	switch(config-callhome)# **streetaddress** *address*	Configures the street address for the primary person responsible for the switch. The *address* can be up to 255 alphanumeric characters. Spaces are accepted.
Step 7	(Optional) switch(config-callhome)# **contract-id** *contract-number*	Configures the contract number for this switch from the service agreement. The *contract-number* can be up to 255 alphanumeric characters.
Step 8	(Optional) switch(config-callhome)# **customer-id** *customer-number*	Configures the customer number for this switch from the service agreement. The *customer-number* can be up to 255 alphanumeric characters.
Step 9	(Optional) switch(config-callhome)# **site-id** *site-number*	Configures the site number for this switch. The *site-number* can be up to 255 alphanumeric characters in free format.

	Command or Action	Purpose
Step 10	(Optional) switch(config-callhome)# **switch-priority** *number*	Configures the switch priority for this switch. The range is from 0 to 7, with 0 being the highest priority and 7 the lowest. The default is 7. **Note** Switch priority is used by the operations personnel or TAC support personnel to decide which Call Home message should be responded to first. You can prioritize Call Home alerts of the same severity from each switch.
Step 11	(Optional) switch# **show callhome**	Displays a summary of the Smart Call Home configuration.
Step 12	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure the contact information for Call Home:

```
switch# configuration terminal
switch(config)# snmp-server contact personname@companyname.com
switch(config)# callhome
switch(config-callhome)# email-contact personname@companyname.com
switch(config-callhome)# phone-contact +1-800-123-4567
switch(config-callhome)# street-address 123 Anystreet St., Anycity, Anywhere
```

What to do next

Create a destination profile.

Creating a Destination Profile

You must create a user-defined destination profile and configure the message format for that new destination profile.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.

	Command or Action	Purpose
Step 3	switch(config-callhome)# **destination-profile** {**ciscoTAC-1** {**alert-group** *group* | **email-addr** *address* | **http** *URL* | **transport-method** {**email** | **http**}} | *profilename* {**alert-group** *group* | **email-addr** *address* | **format** {**XML** | **full-txt** | **short-txt**} | **http** *URL* | **message-level** *level* | **message-size** *size* | **transport-method** {**email** | **http**}} | **full-txt-destination** {**alert-group** *group* | **email-addr** *address* | **http** *URL* | **message-level** *level* | **message-size** *size* | **transport-method** {**email** | **http**}} | **short-txt-destination** {**alert-group** *group* | **email-addr** *address* | **http** *URL* | **message-level** *level* | **message-size** *size* | **transport-method** {**email** | **http**}}}	Creates a new destination profile and sets the message format for the profile. The profile-name can be any alphanumeric string up to 31 characters. For further details about this command, see the command reference for your platform.
Step 4	(Optional) switch# **show callhome destination-profile** [**profile** *name*]	Displays information about one or more destination profiles.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to create a destination profile for Smart Call Home:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# destination-profile Noc101 format full-text
```

Modifying a Destination Profile

You can modify the following attributes for a predefined or user-defined destination profile:

- Destination address—The actual address, pertinent to the transport mechanism, to which the alert should be sent.
- Message formatting—The message format used for sending the alert (full text, short text, or XML).
- Message level—The Call Home message severity level for this destination profile.
- Message size—The allowed length of a Call Home message sent to the e-mail addresses in this destination profile.

Note You cannot modify or delete the CiscoTAC-1 destination profile.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome)# **destination-profile** {*name* | **full-txt-destination** | **short-txt-destination**} **email-addr** *address*	Configures an e-mail address for a user-defined or predefined destination profile. You can configure up to 50 e-mail addresses in a destination profile.
Step 4	**destination-profile** {*name* | **full-txt-destination** | **short-txt-destination**} **message-level** *number*	Configures the Smart Call Home message severity level for this destination profile. The switch sends only alerts that have a matching or higher Smart Call Home severity level to destinations in this profile. The range for the *number* is from 0 to 9, where 9 is the highest severity level.
Step 5	switch(config-callhome)# **destination-profile** {*name* | **full-txt-destination** | **short-txt-destination**} **message-size** *number*	Configures the maximum message size for this destination profile. The range is from 0 to 5000000 for full-txt-destination and the default is 2500000. The range is from 0 to 100000 for short-txt-destination and the default is 4000. The value is 5000000 for CiscoTAC-1, which is not changeable.
Step 6	(Optional) switch# **show callhome destination-profile** [**profile** *name*]	Displays information about one or more destination profiles.
Step 7	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to modify a destination profile for Smart Call Home:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# destination-profile full-text-destination email-addr
person@example.com
switch(config-callhome)# destination-profile full-text-destination message-level 5
switch(config-callhome)# destination-profile full-text-destination message-size 10000
switch(config-callhome)#
```

What to do next

Associate an alert group with a destination profile.

Associating an Alert Group with a Destination Profile

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome)# **destination-profile** *name* **alert-group** {**All** | **Cisco-TAC** | **Configuration** | **Diagnostic** | **Environmental** | **Inventory** | **License** | **Linecard-Hardware** | **Supervisor-Hardware** | **Syslog-group-port** | **System** | **Test**}	Associates an alert group with this destination profile. Use the **All** keyword to associate all alert groups with the destination profile.
Step 4	(Optional) switch# **show callhome destination-profile** [**profile** *name*]	Displays information about one or more destination profiles.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to associate all alert groups with the destination profile Noc101:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# destination-profile Noc101 alert-group All
switch(config-callhome)#
```

What to do next

Optionally, you can add **show** commands to an alert group and configure the SMTP e-mail server.

Adding Show Commands to an Alert Group

You can assign a maximum of five user-defined **show** commands to an alert group.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.

	Command or Action	Purpose
Step 3	switch(config-callhome)# **alert-group** {**Configuration** | **Diagnostic** | **Environmental** | **Inventory** | **License** | **Linecard-Hardware** | **Supervisor-Hardware** | **Syslog-group-port** | **System** | **Test**} **user-def-cmd** *show-cmd*	Adds the **show** command output to any Call Home messages sent for this alert group. Only valid **show** commands are accepted. **Note** You cannot add user-defined **show** commands to the CiscoTAC-1 destination profile.
Step 4	(Optional) switch# **show callhome user-def-cmds**	Displays information about all user-defined **show** commands added to alert groups.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to add the **show ip routing** command to the Cisco-TAC alert group:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# alert-group Configuration user-def-cmd show ip routing
switch(config-callhome)#
```

What to do next

Configure Smart Call Home to connect to the SMTP e-mail server.

Configuring E-Mail Server Details

You must configure the SMTP server address for the Smart Call Home functionality to work. You can also configure the from and reply-to e-mail addresses.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome)# **transport email smtp-server** *ip-address* [**port** *number*] [**use-vrf** *vrf-name*]	Configures the SMTP server as either the domain name server (DNS) name, IPv4 address, or IPv6 address. The *number* range is from1 to 65535. The default port number is 25.

	Command or Action	Purpose
		Optionally, you can configure the VRF instance to use when communicating with this SMTP server.
Step 4	(Optional) switch(config-callhome)# **transport email from** *email-address*	Configures the e-mail from field for Smart Call Home messages.
Step 5	(Optional) switch(config-callhome)# **transport email reply-to** *email-address*	Configures the e-mail reply-to field for Smart Call Home messages.
Step 6	(Optional) switch# **show callhome transport-email**	Displays information about the e-mail configuration for Smart Call Home.
Step 7	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure the e-mail options for Smart Call Home messages:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# transport email smtp-server 192.0.2.10 use-vrf Red
switch(config-callhome)# transport email from person@example.com
switch(config-callhome)# transport email reply-to person@example.com
switch(config-callhome)#
```

What to do next

Configure periodic inventory notifications.

Configuring Periodic Inventory Notifications

You can configure the switch to periodically send a message with an inventory of all software services currently enabled and running on the device with hardware inventory information. The switch generates two Smart Call Home notifications; periodic configuration messages and periodic inventory messages.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome)# **periodic-inventory notification** [**interval** *days*] [**timeofday** *time*]	Configures periodic inventory messages. The **interval** *days* range is from 1 to 30 days. The default is 7 days.

	Command or Action	Purpose
		The **timeofday** *time* is in HH:MM format.
Step 4	(Optional) switch# **show callhome**	Displays information about Smart Call Home.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure the periodic inventory messages to generate every 20 days:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# periodic-inventory notification interval 20
switch(config-callhome)#
```

What to do next

Disable duplicate message throttling.

Disabling Duplicate Message Throttling

You can limit the number of duplicate messages received for the same event. By default, the switch limits the number of duplicate messages received for the same event. If the number of duplicate messages sent exceeds 30 messages within a 2-hour time frame, the switch discards further messages for that alert type.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome) # **no duplicate-message throttle**	Disables duplicate message throttling for Smart Call Home. Duplicate message throttling is enabled by default.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to disable duplicate message throttling:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# no duplicate-message throttle
switch(config-callhome)#
```

What to do next

Enable Smart Call Home.

Enabling or Disabling Smart Call Home

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome) # [**no**] **enable**	Enables or disables Smart Call Home. Smart Call Home is disabled by default.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to enable Smart Call Home:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# enable
switch(config-callhome)#
```

What to do next

Optionally, generate a test message.

Testing the Smart Call Home Configuration

Before you begin

Verify that the message level for the destination profile is set to 2 or lower.

Important Smart Call Home testing fails when the message level for the destination profile is set to 3 or higher.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **callhome**	Enters Smart Call Home configuration mode.
Step 3	switch(config-callhome) # **callhome send diagnostic**	Sends the specified Smart Call Home message to all configured destinations.
Step 4	switch(config-callhome) # **callhome test**	Sends a test message to all configured destinations.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to enable Smart Call Home:

```
switch# configuration terminal
switch(config)# callhome
switch(config-callhome)# callhome send diagnostic
switch(config-callhome)# callhome test
switch(config-callhome)#
```

Verifying the Smart Call Home Configuration

Use one of the following commands to verify the configuration:

Command	Purpose
show callhome	Displays the status for Smart Call Home.
show callhome destination-profile *name*	Displays one or more Smart Call Home destination profiles.
show callhome pending-diff	Displays the differences between he pending and running Smart Call Home configuration.
show callhome status	Displays the Smart Call Home status.
show callhome transport-email	Displays the e-mail configuration for Smart Call Home.
show callhome user-def-cmds	Displays CLI commands added to any alert groups.
show running-config [**callhome** | **callhome-all**]	Displays the running configuration for Smart Call Home.
show startup-config callhome	Displays the startup configuration for Smart Call Home.

Command	Purpose
show tech-support callhome	Displays the technical support output for Smart Call Home.

Sample Syslog Alert Notification in Full-Text Format

This sample shows the full-text format for a syslog port alert-group notification:

```
source:MDS9000
Switch Priority:7
Device Id:WS-C6509@C@FG@07120011
Customer Id:Example.com
Contract Id:123
Site Id:San Jose
Server Id:WS-C6509@C@FG@07120011
Time of Event:2018-02-08T11:10:44
Message Name:SYSLOG_ALERT
Message Type:Syslog
Severity Level:2
System Name:10.76.100.177
Contact Name:User Name
Contact Email:person@example.com
Contact Phone:+1-408-555-1212
Street Address:#1234 Any Street, Any City, Any State, 12345
Event Description:2018 Feb  8 11:10:44 10.76.100.177 %PORT-5-IF_TRUNK_UP:
%$VLAN 1%$ Interface e2/5, vlan 1 is up
syslog_facility:PORT
start chassis information:
Affected Chassis:WS-C6509
Affected Chassis Serial Number:FG@07120011
Affected Chassis Hardware Version:0.104
Affected Chassis Software Version:3.1(1)
Affected Chassis Part No:73-8607-01
end chassis information:
```

Sample Syslog Alert Notification in XML Format

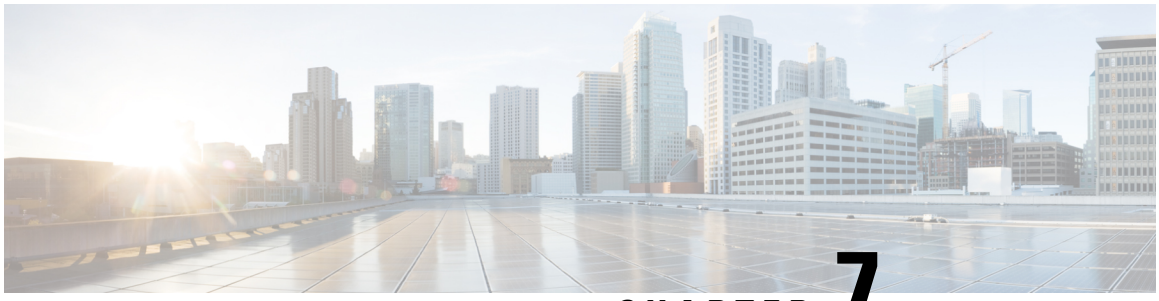
This sample shows the XML format for a syslog port alert-group notification:

```
From: example
Sent: Wednesday, Feb 25, 2018 7:20 AM
To: User (user)
Subject: System Notification From Router - syslog - 2018-02-25 14:19:55
GMT+00:00
<?xml version="1.0" encoding="UTF-8"?>
<soap-env:Envelope xmlns:soap-env="http://www.w3.org/2003/05/soap-envelope">
<soap-env:Header>
<aml-session:Session xmlns:aml-session="http://www.example.com/2004/01/aml-session"
soap-env:mustUnderstand="true" soap-env:role=
"http://www.w3.org/2003/05/soap-envelope/role/next">
<aml-session:To>http://tools.example.com/services/DDCEService</aml-session:To>
<aml-session:Path>
<aml-session:Via>http://www.example.com/appliance/uri</aml-session:Via>
</aml-session:Path>
<aml-session:From>http://www.example.com/appliance/uri</aml-session:From>
<aml-session:MessageId>M2:69000101:C9D9E20B</aml-session:MessageId>
</aml-session:Session>
</soap-env:Header>
```

```
<soap-env:Body>
<aml-block:Block xmlns:aml-block="http://www.example.com/2004/01/aml-block">
<aml-block:Header>
<aml-block:Type>http://www.example.com/2005/05/callhome/syslog</aml-block:Type>
<aml-block:CreationDate>2018-02-25 14:19:55 GMT+00:00</aml-block:CreationDate>
<aml-block:Builder>
<aml-block:Name>Cat6500</aml-block:Name>
<aml-block:Version>2.0</aml-block:Version>
</aml-block:Builder>
<aml-block:BlockGroup>
<aml-block:GroupId>G3:69000101:C9F9E20C</aml-block:GroupId>
<aml-block:Number>0</aml-block:Number>
<aml-block:IsLast>true</aml-block:IsLast>
<aml-block:IsPrimary>true</aml-block:IsPrimary>
<aml-block:WaitForPrimary>false</aml-block:WaitForPrimary>
</aml-block:BlockGroup>
<aml-block:Severity>2</aml-block:Severity>
</aml-block:Header>
<aml-block:Content>
<ch:Call Home xmlns:ch="http://www.example.com/2005/05/callhome" version="1.0">
<ch:EventTime>2018-02-25 14:19:55 GMT+00:00</ch:EventTime>
<ch:MessageDescription>03:29:29: %CLEAR-5-COUNTERS: Clear counter on all
interfaces by console</ch:MessageDescription>
<ch:Event>
<ch:Type>syslog</ch:Type>
<ch:SubType>
</ch:SubType>
<ch:Brand>Cisco Systems</ch:Brand>
<ch:Series>Catalyst 6500 Series Switches</ch:Series>
</ch:Event>
<ch:CustomerData>
<ch:UserData>
<ch:Email>person@example.com</ch:Email>
</ch:UserData>
<ch:ContractData>
<ch:CustomerId>12345</ch:CustomerId>
<ch:SiteId>building 1</ch:SiteId>
<ch:ContractId>abcdefg12345</ch:ContractId>
<ch:DeviceId>WS-C6509@C@69000101</ch:DeviceId>
</ch:ContractData>
<ch:SystemInfo>
<ch:Name>Router</ch:Name>
<ch:Contact>
</ch:Contact>
<ch:ContactEmail>user@example.com</ch:ContactEmail>
<ch:ContactPhoneNumber>+1-408-555-1212</ch:ContactPhoneNumber>
<ch:StreetAddress>#1234 Any Street, Any City, Any State, 12345
</ch:StreetAddress>
</ch:SystemInfo>
</ch:CustomerData>
<ch:Device>
<rme:Chassis xmlns:rme="http://www.example.com/rme/4.0">
<rme:Model>WS-C6509</rme:Model>
<rme:HardwareVersion>1.0</rme:HardwareVersion>
<rme:SerialNumber>69000101</rme:SerialNumber>
<rme:AdditionalInformation>
<rme:AD name="PartNumber" value="73-3438-03 01" />
<rme:AD name="SoftwareVersion" value="4.0(20080421:012711)" />
</rme:AdditionalInformation>
</rme:Chassis>
</ch:Device>
</ch:Call Home>
</aml-block:Content>
<aml-block:Attachments>
```

```
<aml-block:Attachment type="inline">
<aml-block:Name>show logging</aml-block:Name>
<aml-block:Data encoding="plain">
<![CDATA[Syslog logging: enabled (0 messages dropped, 0 messages
rate-limited, 0 flushes, 0 overruns, xml disabled, filtering disabled)
    Console logging: level debugging, 53 messages logged, xml disabled,
filtering disabled    Monitor logging: level debugging, 0 messages logged,
xml disabled,filtering disabled    Buffer logging: level debugging,
53 messages logged, xml disabled,      filtering disabled    Exception
Logging: size (4096 bytes)    Count and timestamp logging messages: disabled
    Trap logging: level informational, 72 message lines logged
Log Buffer (8192 bytes):
00:00:54: curr is 0x20000
00:00:54: RP: Currently running ROMMON from F2 region
00:01:05: %SYS-5-CONFIG_I: Configured from memory by console
00:01:09: %SYS-5-RESTART: System restarted --Cisco IOS Software,
s72033_rp Software (s72033_rp-ADVENTERPRISEK9_DBG-VM), Experimental
Version 12.2(20070421:012711) Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Thu 26-Feb-18 15:54 by xxx
Firmware compiled 11-Apr-07 03:34 by integ Build [100]00:01:01: %PFREDUN-6-ACTIVE:
 Initializing as ACTIVE processor for this switch00:01:01: %SYS-3-LOGGER_FLUSHED:
System was paused for 00:00:00 to ensure console debugging output.00:03:00: SP: SP:
 Currently running ROMMON from F1 region00:03:07: %C6K_PLATFORM-SP-4-CONFREG_BREAK
_ENABLED: The default factory setting for config register is 0x2102.It is advisable
 to retain 1 in 0x2102 as it prevents returning to ROMMON when break is issued.00:03:18:
 %SYS-SP-5-RESTART: System restarted --Cisco IOS Software, s72033_sp Software
 (s72033_sp-ADVENTERPRISEK9_DBG-VM), Experimental Version 12.2(20070421:012711)Copyright
 (c) 1986-2007 by Cisco Systems, Inc.
Compiled Thu 26-Apr-07 18:00 by xxx
00:03:18: %SYS-SP-6-BOOTTIME: Time taken to reboot after reload =  339 seconds
00:03:18: %OIR-SP-6-INSPS: Power supply inserted in slot 1
00:03:18: %C6KPWR-SP-4-PSOK: power supply 1 turned on.
00:03:18: %OIR-SP-6-INSPS: Power supply inserted in slot00:01:09: %SSH-5-ENABLED:
 SSH 1.99 has been enabled
00:03:18: %C6KPWR-SP-4-PSOK: power supply 2 turned on.
00:03:18: %C6KPWR-SP-4-PSREDUNDANTMISMATCH: power supplies rated outputs do not match.
00:03:18: %C6KPWR-SP-4-PSREDUNDANTBOTHSUPPLY: in power-redundancy mode, system is
 operating on both power supplies.
00:01:10: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
00:01:10: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
00:03:20: %C6KENV-SP-4-FANHIOUTPUT: Version 2 high-output fan-tray is in effect
00:03:22: %C6KPWR-SP-4-PSNOREDUNDANCY: Power supplies are not in full redundancy,
 power usage exceeds lower capacity supply
00:03:26: %FABRIC-SP-5-FABRIC_MODULE_ACTIVE: The Switch Fabric Module in slot 6
 became active.
00:03:28: %DIAG-SP-6-RUN_MINIMUM: Module 6: Running Minimal Diagnostics...
00:03:50: %DIAG-SP-6-DIAG_OK: Module 6: Passed Online Diagnostics
00:03:50: %OIR-SP-6-INSCARD: Card inserted in slot 6, interfaces are now online
00:03:51: %DIAG-SP-6-RUN_MINIMUM: Module 3: Running Minimal Diagnostics...
00:03:51: %DIAG-SP-6-RUN_MINIMUM: Module 7: Running Minimal Diagnostics...
00:03:51: %DIAG-SP-6-RUN_MINIMUM: Module 9: Running Minimal Diagnostics...
00:01:51: %MFIB_CONST_RP-6-REPLICATION_MODE_CHANGE: Replication Mode Change Detected.
 Current system replication mode is Ingress
00:04:01: %DIAG-SP-6-DIAG_OK: Module 3: Passed Online Diagnostics
00:04:01: %OIR-SP-6-DOWNGRADE: Fabric capable module 3 not at an appropriate hardware
 revision level, and can only run in flowthrough mode
00:04:02: %OIR-SP-6-INSCARD: Card inserted in slot 3, interfaces are now online
00:04:11: %DIAG-SP-6-DIAG_OK: Module 7: Passed Online Diagnostics
00:04:14: %OIR-SP-6-INSCARD: Card inserted in slot 7, interfaces are now online
00:04:35: %DIAG-SP-6-DIAG_OK: Module 9: Passed Online Diagnostics
00:04:37: %OIR-SP-6-INSCARD: Card inserted in slot 9, interfaces are now online
00:00:09: DaughterBoard (Distributed Forwarding Card 3)
Firmware compiled 11-Apr-07 03:34 by integ Build [100]
00:00:22: %SYS-DFC4-5-RESTART: System restarted --
```

```
Cisco DCOS Software, c6lc2 Software (c6lc2-SPDBG-VM), Experimental Version 4.0
(20080421:012711)Copyright (c) 1986-2018 by Cisco Systems, Inc.
Compiled Thu 26-Feb-18 17:20 by xxx
00:00:23: DFC4: Currently running ROMMON from F2 region
00:00:25: %SYS-DFC2-5-RESTART: System restarted --
Cisco IOS Software, c6slc Software (c6slc-SPDBG-VM), Experimental Version 12.2
(20070421:012711)Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Thu 26-Apr-08 16:40 by username1
00:00:26: DFC2: Currently running ROMMON from F2 region
00:04:56: %DIAG-SP-6-RUN_MINIMUM: Module 4: Running Minimal Diagnostics...
00:00:09: DaughterBoard (Distributed Forwarding Card 3)
Firmware compiled 11-Apr-08 03:34 by integ Build [100]
slot_id is 8
00:00:31: %FLASHFS_HES-DFC8-3-BADCARD: /bootflash:: The flash card seems to
 be corrupted
00:00:31: %SYS-DFC8-5-RESTART: System restarted --
Cisco DCOS Software, c6lc2 Software (c6lc2-SPDBG-VM), Experimental Version 4.0
(20080421:012711)Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 26-Feb-18 17:20 by username1
00:00:31: DFC8: Currently running ROMMON from S (Gold) region
00:04:59: %DIAG-SP-6-RUN_MINIMUM: Module 2: Running Minimal Diagnostics...
00:05:12: %DIAG-SP-6-RUN_MINIMUM: Module 8: Running Minimal Diagnostics...
00:05:13: %DIAG-SP-6-RUN_MINIMUM: Module 1: Running Minimal Diagnostics...
00:00:24: %SYS-DFC1-5-RESTART: System restarted --
Cisco DCOS Software, c6slc Software (c6slc-SPDBG-VM), Experimental Version 4.0
(20080421:012711)Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 26-Feb-18 16:40 by username1
00:00:25: DFC1: Currently running ROMMON from F2 region
00:05:30: %DIAG-SP-6-DIAG_OK: Module 4: Passed Online Diagnostics
00:05:31: %SPAN-SP-6-SPAN_EGRESS_REPLICATION_MODE_CHANGE: Span Egress HW
Replication Mode Change Detected. Current replication mode for unused asic
 session 0 is Centralized
00:05:31: %SPAN-SP-6-SPAN_EGRESS_REPLICATION_MODE_CHANGE: Span Egress HW
Replication Mode Change Detected. Current replication mode for unused asic
 session 1 is Centralized
00:05:31: %OIR-SP-6-INSCARD: Card inserted in slot 4, interfaces are now online
00:06:02: %DIAG-SP-6-DIAG_OK: Module 1: Passed Online Diagnostics
00:06:03: %OIR-SP-6-INSCARD: Card inserted in slot 1, interfaces are now online
00:06:31: %DIAG-SP-6-DIAG_OK: Module 2: Passed Online Diagnostics
00:06:33: %OIR-SP-6-INSCARD: Card inserted in slot 2, interfaces are now online
00:04:30: %XDR-6-XDRIPCNOTIFY: Message not sent to slot 4/0 (4) because of IPC
 error timeout. Disabling linecard. (Expected during linecard OIR)
00:06:59: %DIAG-SP-6-DIAG_OK: Module 8: Passed Online Diagnostics
00:06:59: %OIR-SP-6-DOWNGRADE_EARL: Module 8 DFC installed is not identical to
 system PFC and will perform at current system operating mode.
00:07:06: %OIR-SP-6-INSCARD: Card inserted in slot 8, interfaces are now online
Router#]]>
</aml-block:Data>
</aml-block:Attachment>
</aml-block:Attachments>
</aml-block:Block>
</soap-env:Body>
</soap-env:Envelope>
```



CHAPTER 7

Configuring Session Manager

This chapter contains the following sections:

- Information About Session Manager, on page 77
- Guidelines and Limitations for Session Manager, on page 77
- Configuring Session Manager, on page 78
- Verifying the Session Manager Configuration, on page 80

Information About Session Manager

Session Manager allows you to implement your configuration changes in batch mode. Session Manager works in the following phases:

- Configuration session—Creates a list of commands that you want to implement in session manager mode.
- Validation—Provides a basic semantic check on your configuration. Cisco NX-OS returns an error if the semantic check fails on any part of the configuration.
- Verification—Verifies the configuration as a whole, based on the existing hardware and software configuration and resources. Cisco NX-OS returns an error if the configuration does not pass this verification phase.
- Commit— Cisco NX-OS verifies the complete configuration and implements the changes atomically to the device. If a failure occurs, Cisco NX-OS reverts to the original configuration.
- Abort—Discards the configuration changes before implementation.

You can optionally end a configuration session without committing the changes. You can also save a configuration session.

Guidelines and Limitations for Session Manager

Session Manager has the following configuration guidelines and limitations:

- Session Manager supports only the access control list (ACL) feature.
- You can create up to 32 configuration sessions.
- You can configure a maximum of 20,000 commands across all sessions.

Configuring Session Manager

Creating a Session

You can create up to 32 configuration sessions.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure session** *name*	Creates a configuration session and enters session configuration mode. The name can be any alphanumeric string. Displays the contents of the session.
Step 2	(Optional) switch(config-s)# **show configuration session** [*name*]	Displays the contents of the session.
Step 3	(Optional) switch(config-s)# **save** *location*	Saves the session to a file. The location can be in bootflash or volatile.

Configuring ACLs in a Session

You can configure ACLs within a configuration session.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure session** *name*	Creates a configuration session and enters session configuration mode. The name can be any alphanumeric string.
Step 2	switch(config-s)# **ip access-list** *name*	Creates an ACL.
Step 3	(Optional) switch(config-s-acl)# **permit** *protocol source destination*	Adds a permit statement to the ACL.
Step 4	switch(config-s-acl)# **interface** *interface-type number*	Enters interface configuration mode.
Step 5	switch(config-s-if)# **ip port access-group** *name* **in**	Adds a port access group to the interface.
Step 6	(Optional) switch# **show configuration session** [*name*]	Displays the contents of the session.

Verifying a Session

To verify a session, use the following command in session mode:

Command	Purpose
switch(config-s)# **verify** [**verbose**]	Verifies the commands in the configuration session.

Committing a Session

To commit a session, use the following command in session mode:

Command	Purpose
switch(config-s)# **commit** [**verbose**]	Commits the commands in the configuration session.

Saving a Session

To save a session, use the following command in session mode:

Command	Purpose
switch(config-s)# **save** *location*	(Optional) Saves the session to a file. The location can be in bootflash or volatile.

Discarding a Session

To discard a session, use the following command in session mode:

Command	Purpose
switch(config-s)# **abort**	Discards the configuration session without applying the commands.

Configuration Example for Session Manager

The following example shows how to create a configuration session for ACLs:

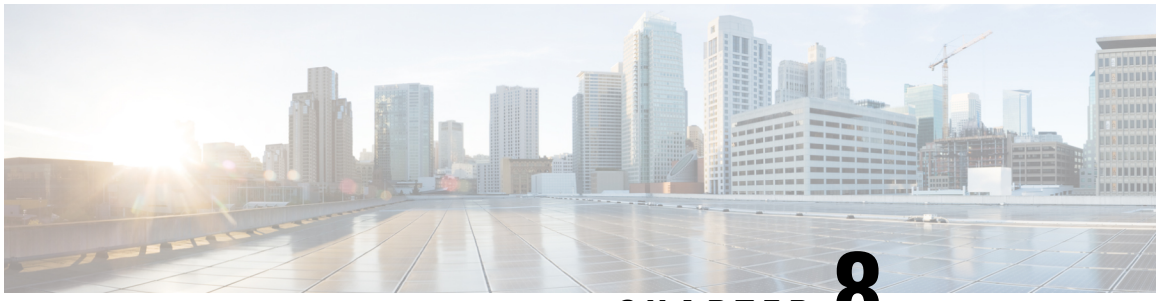
```
switch# configure session name test2
switch(config-s)# ip access-list acl2
switch(config-s-acl)# permit tcp any any
switch(config-s-acl)# exit
switch(config-s)# interface Ethernet 1/4
switch(config-s-ip)# ip port access-group acl2 in
switch(config-s-ip)# exit
switch(config-s)# verify
switch(config-s)# exit
```

```
switch# show configuration session test2
```

Verifying the Session Manager Configuration

To verify Session Manager configuration information, perform one of the following tasks:

Command	Purpose
show configuration session [*name*]	Displays the contents of the configuration session.
show configuration session status [*name*]	Displays the status of the configuration session.
show configuration session summary	Displays a summary of all the configuration sessions.



CHAPTER 8

Configuring the Scheduler

This chapter contains the following sections:

- Information About the Scheduler, on page 81
- Licensing Requirements for the Scheduler, on page 82
- Guidelines and Limitations for the Scheduler, on page 82
- Default Settings for the Scheduler, on page 83
- Configuring the Scheduler, on page 83
- Verifying the Scheduler Configuration, on page 89
- Configuration Examples for the Scheduler, on page 90
- Standards for the Scheduler, on page 91

Information About the Scheduler

The scheduler allows you to define and set a timetable for maintenance activities such as the following:

- Quality of service policy changes
- Data backup
- Saving a configuration

Jobs consist of a single command or multiple commands that define routine activities. Jobs can be scheduled one time or at periodic intervals.

The scheduler defines a job and its timetable as follows:

Job

A routine task or tasks defined as a command list and completed according to a specified schedule.

Schedule

The timetable for completing a job. You can assign multiple jobs to a schedule.

A schedule is defined as either periodic or one-time only:

- Periodic mode— A recurring interval that continues until you delete the job. You can configure the following types of intervals:
  - Daily— Job is completed once a day.

- Weekly— Job is completed once a week.
- Monthly—Job is completed once a month.
- Delta—Job begins at the specified start time and then at specified intervals (days:hours:minutes).

- One-time mode—Job is completed only once at a specified time.

Remote User Authentication

Before starting a job, the scheduler authenticates the user who created the job. Because user credentials from a remote authentication are not retained long enough to support a scheduled job, you must locally configure the authentication passwords for users who create jobs. These passwords are part of the scheduler configuration and are not considered a locally configured user.

Before starting the job, the scheduler validates the local password against the password from the remote authentication server.

Scheduler Log Files

The scheduler maintains a log file that contains the job output. If the size of the job output is greater than the size of the log file, the output is truncated.

Licensing Requirements for the Scheduler

This feature does not require a license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Guidelines and Limitations for the Scheduler

- The scheduler can fail if it encounters one of the following while performing a job:
  - If a feature license is expired when a job for that feature is scheduled.
  - If a feature is disabled at the time when a job for that feature is scheduled.
- Verify that you have configured the time. The scheduler does not apply a default timetable. If you create a schedule, assign jobs, and do not configure the time, the job is not started.
- While defining a job, verify that no interactive or disruptive commands (for example, **copy bootflash:** *file* **ftp:***URI*, **write erase**, **reload**, and other similar commands) are specified because the job is started and conducted noninteractively. When a reload job is scheduled for a given time and executed, the switch goes into a boot loop. Hence it should not be used in scheduler configuration.

Default Settings for the Scheduler

Table 16: Default Command Scheduler Parameters

Parameters	Default
Scheduler state	Disabled
Log file size	16 KB

Configuring the Scheduler

Enabling the Scheduler

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **feature scheduler**	Enables the scheduler.
Step 3	(Optional) switch(config) # **show scheduler config**	Displays the scheduler configuration.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to enable the scheduler:

```
switch# configure terminal
switch(config)# feature scheduler
switch(config)# show scheduler config
config terminal
   feature scheduler
   scheduler logfile size 16
end
switch(config)#
```

Defining the Scheduler Log File Size

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **scheduler logfile size** *value*	Defines the scheduler log file size in kilobytes. The range is from 16 to 1024. The default log file size is 16. **Note** If the size of the job output is greater than the size of the log file, the output is truncated.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to define the scheduler log file size:

```
switch# configure terminal
switch(config)# scheduler logfile size 1024
switch(config)#
```

Configuring Remote User Authentication

Remote users must authenticate with their clear text password before creating and configuring jobs.

Remote user passwords are always shown in encrypted form in the output of the **show running-config** command. The encrypted option (**7**) in the command supports the ASCII device configuration.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **scheduler aaa-authentication password** [**0** | **7**] *password*	Configures a password for the user who is currently logged in. To configure a clear text password, enter **0**. To configure an encrypted password, enter **7**.
Step 3	switch(config) # **scheduler aaa-authentication username** *name* **password** [**0** | **7**] *password*	Configures a clear text password for a remote user.

	Command or Action	Purpose
Step 4	(Optional) switch(config) # **show running-config | include "scheduler aaa-authentication"**	Displays the scheduler password information.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure a clear text password for a remote user called NewUser:

```
switch# configure terminal
switch(config) # scheduler aaa-authentication
username NewUser password z98y76x54b
switch(config) # copy running-config startup-config
switch(config) #
```

Defining a Job

After you define a job, you cannot modify or remove commands. To change the job, you must delete it and create a new one.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **scheduler job name** *name*	Creates the job with the specified name and enters the job configuration mode. The *name* is restricted to 31 characters.
Step 3	switch(config-job) # *command1* **;** [*command2* **;***command3* **;** ...	Defines the sequence of commands for the specified job. Separate commands with spaces and semicolons (;). Creates the filename using the current timestamp and switch name.
Step 4	(Optional) switch(config-job) # **show scheduler job** [*name*]	Displays the job information. The *name* is restricted to 31 characters.
Step 5	(Optional) switch(config-job) # **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to:

- Create a scheduler job named "backup-cfg"
- Save the running configuration to a file in the bootflash
- Copy the file from the bootflash to a TFTP server
- Save the change to the startup configuration

```
switch# configure terminal
switch(config) # scheduler job name backup-cfg
switch(config-job) # copy running-config
tftp://1.2.3.4/$(SWITCHNAME)-cfg.$(TIMESTAMP) vrf management
switch(config-job) # copy running-config startup-config
```

Deleting a Job

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **no scheduler job name** *name*	Deletes the specified job and all commands defined within it. The *name* is restricted to 31 characters.
Step 3	(Optional) switch(config-job) # **show scheduler job** [*name*]	Displays the job information.
Step 4	(Optional) switch(config-job) # **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to delete a job called configsave:

```
switch# configure terminal
switch(config)# no scheduler job name configsave
switch(config-job)# copy running-config startup-config
switch(config-job)#
```

Defining a Timetable

You must configure a timetable. Otherwise, jobs will not be scheduled.

If you do not specify the time for the **time** commands, the scheduler assumes the current time. For example, if the current time is March 24, 2008, 22:00 hours,jobs are started as follows:

- For the **time start 23:00 repeat 4:00:00** command, the scheduler assumes a start time of March 24, 2008, 23:00 hours.
- For the **time daily 55** command, the scheduler assumes a start time every day at 22:55 hours.
- For the **time weekly 23:00** command, the scheduler assumes a start time every Friday at 23:00 hours.
- For the **time monthly 23:00** command, the scheduler assumes a start time on the 24th of every month at 23:00 hours.

Note The scheduler will not begin the next occurrence of a job before the last one completes. For example, you have scheduled a job to be completed at one-minute intervals beginning at 22:00; but the job requires two minutes to complete. The scheduler starts the first job at 22:00, completes it at 22:02, and then observes a one-minute interval before starting the next job at 22:03.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **scheduler schedule name** *name*	Creates a new scheduler and enters schedule configuration mode for that schedule. The *name* is restricted to 31 characters.
Step 3	switch(config-schedule) # **job name** *name*	Associates a job with this schedule. You can add multiple jobs to a schedule. The *name* is restricted to 31 characters.
Step 4	switch(config-schedule) # **time daily** *time*	Indicates the job starts every day at a designated time, specified as HH:MM.
Step 5	switch(config-schedule) # **time weekly** [[*day-of-week*:] *HH*:] *MM*	Indicates that the job starts on a specified day of the week. The day of the week is represented by an integer (for example, **1** for Sunday, **2** for Monday) or as an abbreviation (for example, **sun**, **mon**). The maximum length for the entire argument is 10 characters.
Step 6	switch(config-schedule) # **time monthly** [[*day-of-month*:] *HH*:] *MM*	Indicates that the job starts on a specified day each month. If you specify 29, 30, or 31, the job is started on the last day of each month.

	Command or Action	Purpose
Step 7	switch(config-schedule) # **time start** {**now repeat** *repeat-interval* | *delta-time* [**repeat** *repeat-interval*]}	Indicates the job starts periodically. The start-time format is [[[[yyyy:]mmm:]dd:]HH]:MM. • *delta-time*— Specifies the amount of time to wait after the schedule is configured before starting a job. • **now**— Specifies that the job starts two minutes from now. • **repeat** *repeat-interval*— Specifies the frequency at which the job is repeated.
Step 8	(Optional) switch(config-schedule) # **show scheduler config**	Displays the scheduler information.
Step 9	(Optional) switch(config-schedule) # **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to define a timetable where jobs start on the 28th of each month at 23:00 hours:

```
switch# configure terminal
switch(config)# scheduler schedule name weekendbackupqos
switch(config-scheduler)# job name offpeakzoning
switch(config-scheduler)# time monthly 28:23:00
switch(config-scheduler)# copy running-config startup-config
switch(config-scheduler)#
```

Clearing the Scheduler Log File

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **clear scheduler logfile**	Clears the scheduler log file.

Example

This example shows how to clear the scheduler log file:

```
switch# configure terminal
switch(config)# clear scheduler logfile
```

Disabling the Scheduler

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **no feature scheduler**	Disables the scheduler.
Step 3	(Optional) switch(config) # **show scheduler config**	Displays the scheduler configuration.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to disable the scheduler:

```
switch# configure terminal
switch(config) # no feature scheduler
switch(config) # copy running-config startup-config
switch(config) #
```

Verifying the Scheduler Configuration

Use one of the following commands to verify the configuration:

Table 17: Scheduler Show Commands

Command	Purpose
show scheduler config	Displays the scheduler configuration.
show scheduler job [**name** *name*]	Displays the jobs configured.
show scheduler logfile	Displays the contents of the scheduler log file.
show scheduler schedule [**name** *name*]	Displays the schedules configured.

Configuration Examples for the Scheduler

Creating a Scheduler Job

This example shows how to create a scheduler job that saves the running configuration to a file in the bootflash. The job then copies the file from the bootflash to a TFTP server (the filename is created using the current timestamp and switch name):

```
switch# configure terminal
switch(config)# scheduler job name backup-cfg
switch(config-job)# copy running-config
tftp://1.2.3.4/$(SWITCHNAME)-cfg.$(TIMESTAMP) vrf management
switch(config-job)# end
switch(config)#
```

Scheduling a Scheduler Job

This example shows how to schedule a scheduler job called backup-cfg to run daily at 1 a.m.:

```
switch# configure terminal
switch(config)# scheduler schedule name daily
switch(config-schedule)# job name backup-cfg
switch(config-schedule)# time daily 1:00
switch(config-schedule)# end
switch(config)#
```

Displaying the Job Schedule

This example shows how to display the job schedule:

```
switch# show scheduler schedule
Schedule Name       : daily
---------------------------
User Name           : admin
Schedule Type       : Run every day at 1 Hrs 00 Mins
Last Execution Time : Fri Jan 2 1:00:00 2009
Last Completion Time: Fri Jan 2 1:00:01 2009
Execution count     : 2
----------------------------------------------
     Job Name            Last Execution Status
----------------------------------------------
back-cfg                          Success (0)
switch(config)#
```

Displaying the Results of Running Scheduler Jobs

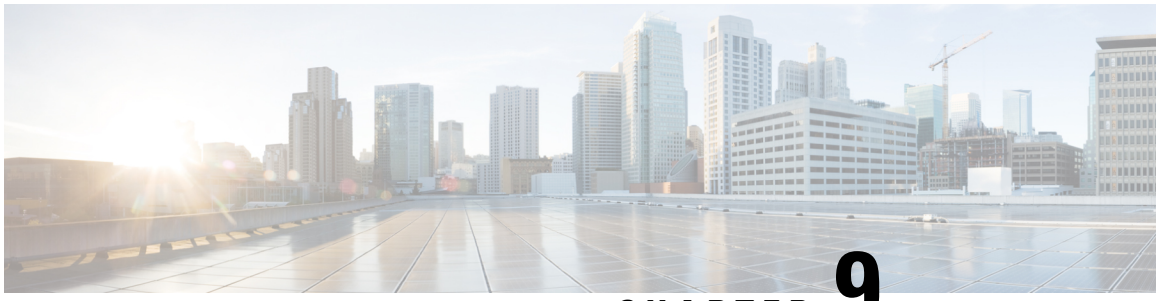
This example shows how to display the results of scheduler jobs that have been executed by the scheduler:

```
switch# show scheduler logfile
Job Name       : back-cfg                       Job Status: Failed (1)
Schedule Name  : daily                          User Name : admin
Completion time: Fri Jan 1  1:00:01 2009
-------------------------------- Job Output --------------------------------
`cli var name timestamp 2009-01-01-01.00.00`
`copy running-config bootflash:/$(HOSTNAME)-cfg.$(timestamp)`
```

```
`copy bootflash:/switch-cfg.2009-01-01-01.00.00 tftp://1.2.3.4/ vrf management `
copy: cannot access file '/bootflash/switch-cfg.2009-01-01-01.00.00'
==============================================================================
Job Name       : back-cfg                       Job Status: Success (0)
Schedule Name  : daily                          User Name : admin
Completion time: Fri Jan 2  1:00:01 2009
-------------------------------- Job Output --------------------------------
`cli var name timestamp 2009-01-02-01.00.00`
`copy running-config bootflash:/switch-cfg.2009-01-02-01.00.00`
`copy bootflash:/switch-cfg.2009--01-02-01.00.00 tftp://1.2.3.4/ vrf management `
Connection to Server Established.
[                       ]         0.50KBTrying to connect to tftp server......
[######                 ]        24.50KB
TFTP put operation was successful
==============================================================================
switch#
```

Standards for the Scheduler

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



CHAPTER 9

Configuring SNMP

This chapter contains the following sections:

- Information About SNMP, on page 93
- Licensing Requirements for SNMP, on page 97
- Guidelines and Limitations for SNMP, on page 97
- Default SNMP Settings, on page 97
- Configuring SNMP, on page 98
- Disabling SNMP, on page 108
- Verifying the SNMP Configuration, on page 108

Information About SNMP

The Simple Network Management Protocol (SNMP) is an application-layer protocol that provides a message format for communication between SNMP managers and agents. SNMP provides a standardized framework and a common language used for the monitoring and management of devices in a network.

SNMP Functional Overview

The SNMP framework consists of three parts:

- An SNMP manager—The system used to control and monitor the activities of network devices using SNMP.
- An SNMP agent—The software component within the managed device that maintains the data for the device and reports these data, as needed, to managing systems. The Cisco Nexus device supports the agent and MIB. To enable the SNMP agent, you must define the relationship between the manager and the agent.
- A managed information base (MIB)—The collection of managed objects on the SNMP agent

Note Cisco NX-OS does not support SNMP sets for Ethernet MIBs.

The Cisco Nexus device supports SNMPv1, SNMPv2c, and SNMPv3. Both SNMPv1 and SNMPv2c use a community-based form of security.

SNMP is defined in RFC 3410 (http://tools.ietf.org/html/rfc3410), RFC 3411 (http://tools.ietf.org/html/rfc3411), RFC 3412 (http://tools.ietf.org/html/rfc3412), RFC 3413 (http://tools.ietf.org/html/rfc3413), RFC 3414 (http://tools.ietf.org/html/rfc3414), RFC 3415 (http://tools.ietf.org/html/rfc3415), RFC 3416 (http://tools.ietf.org/html/rfc3416), RFC 3417 (http://tools.ietf.org/html/rfc3417), RFC 3418 (http://tools.ietf.org/html/rfc3418), and RFC 3584 (http://tools.ietf.org/html/rfc3584).

SNMP Notifications

A key feature of SNMP is the ability to generate notifications from an SNMP agent. These notifications do not require that requests be sent from the SNMP manager. Notifications can indicate improper user authentication, restarts, the closing of a connection, loss of connection to a neighbor router, or other significant events.

Cisco NX-OS generates SNMP notifications as either traps or informs. A trap is an asynchronous, unacknowledged message sent from the agent to the SNMP managers listed in the host receiver table. Informs are asynchronous messages sent from the SNMP agent to the SNMP manager which the manager must acknowledge receipt of.

Traps are less reliable than informs because the SNMP manager does not send any acknowledgment when it receives a trap. The switch cannot determine if the trap was received. An SNMP manager that receives an inform request acknowledges the message with an SNMP response protocol data unit (PDU). If the Cisco Nexus device never receives a response, it can send the inform request again.

You can configure Cisco NX-OS to send notifications to multiple host receivers.

SNMPv3

SNMPv3 provides secure access to devices by a combination of authenticating and encrypting frames over the network. The security features provided in SNMPv3 are the following:

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

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

Security Models and Levels for SNMPv1, v2, and v3

The security level determines if an SNMP message needs to be protected from disclosure and if the message needs to be authenticated. The various security levels that exist within a security model are as follows:

- noAuthNoPriv—Security level that does not provide authentication or encryption. This level is not supported for SNMPv3.
- authNoPriv—Security level that provides authentication but does not provide encryption.
- authPriv—Security level that provides both authentication and encryption.

Three security models are available: SNMPv1, SNMPv2c, and SNMPv3. The security model combined with the security level determine the security mechanism applied when the SNMP message is processed.

Table 18: SNMP Security Models and Levels

Model	Level	Authentication	Encryption	What Happens
v1	noAuthNoPriv	Community string	No	Uses a community string match for authentication.
v2c	noAuthNoPriv	Community string	No	Uses a community string match for authentication.
v3	authNoPriv	HMAC-MD5, or HMAC-SHA	No	Provides authentication based on the Hash-Based Message Authentication Code (HMAC) Message Digest 5 (MD5) algorithm or the HMAC Secure Hash Algorithm (SHA).
v3	authPriv	HMAC-MD5, or HMAC-SHA	DES	Provides authentication based on the HMAC-MD5 or HMAC-SHA algorithms. Provides Data Encryption Standard (DES) 56-bit encryption in addition to authentication based on the Cipher Block Chaning (CBC) DES (DES-56) standard.

User-Based Security Model

SNMPv3 User-Based Security Model (USM) refers to SNMP message-level security and offers the following services:

- Message integrity—Ensures that messages have not been altered or destroyed in an unauthorized manner and that data sequences have not been altered to an extent greater than can occur nonmaliciously.
- Message origin authentication—Confirms that the claimed identity of the user who received the data was originated.
- Message confidentiality—Ensures that information is not made available or disclosed to unauthorized individuals, entities, or processes.

SNMPv3 authorizes management operations only by configured users and encrypts SNMP messages.

Cisco NX-OS uses two authentication protocols for SNMPv3:

- HMAC-MD5-96 authentication protocol
- HMAC-SHA-96 authentication protocol

Cisco NX-OS uses Advanced Encryption Standard (AES) as one of the privacy protocols for SNMPv3 message encryption and conforms with RFC 3826.

The **priv** option offers a choice of DES or 128-bit AES encryption for SNMP security encryption. The **priv** option and the **aes-128** token indicates that this privacy password is for generating a 128-bit AES key #.The AES priv password can have a minimum of eight characters. If the passphrases are specified in clear text, you can specify a maximum of 64 characters. If you use the localized key, you can specify a maximum of 130 characters.

Note For an SNMPv3 operation using the external AAA server, you must use AES for the privacy protocol in user configuration on the external AAA server.

CLI and SNMP User Synchronization

SNMPv3 user management can be centralized at the Access Authentication and Accounting (AAA) server level. This centralized user management allows the SNMP agent in Cisco NX-OS to leverage the user authentication service of the AAA server. Once user authentication is verified, the SNMP PDUs are processed further. Additionally, the AAA server is also used to store user group names. SNMP uses the group names to apply the access/role policy that is locally available in the switch.

Any configuration changes made to the user group, role, or password results in database synchronization for both SNMP and AAA.

Cisco NX-OS synchronizes user configuration in the following ways:

- The **auth** passphrase specified in the **snmp-server user** command becomes the password for the CLI user.
- The password specified in the **username** command becomes the **auth** and **priv** passphrases for the SNMP user.
- If you create or delete a user using either SNMP or the CLI, the user is created or deleted for both SNMP and the CLI.
- User-role mapping changes are synchronized in SNMP and the CLI.
- Role changes (deletions or modifications from the CLI) are synchronized to SNMP.

Note When you configure passphrase/password in localized key/encrypted format, Cisco NX-OS does not synchronize the user information (passwords, rules, etc.).

Group-Based SNMP Access

Note Because a group is a standard SNMP term used industry-wide, roles are referred to as groups in this SNMP section.

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

You can begin communicating with the agent once your username is created, your roles are set up by your administrator, and you are added to the roles.

Licensing Requirements for SNMP

This feature does not require a license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Guidelines and Limitations for SNMP

- Commands configured using SNMP SET should be deleted using SNMP SET only. Commands configured using Command Line Interface(CLI) or NX-API should be deleted using CLI or NX-API only.
- Cisco NX-OS supports read-only access to Ethernet MIBs. For more information about supported MIBs, see the following URL:

  http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml
- Cisco NX-OS does not support the SNMPv3 noAuthNoPriv security level.
- Commands configured using SNMP SET should be deleted using SNMP SET only. Commands configured using Command Line Interface(CLI) or NX-API should be deleted using CLI or NX-API only.

Default SNMP Settings

Table 19: Default SNMP Parameters

Parameters	Default
license notifications	Enabled
linkUp/Down notification type	ietf-extended

Configuring SNMP

Configuring SNMP Users

Note The commands used to configure SNMP users in Cisco NX-OS are different from those used to configure users in Cisco IOS.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	switch(config)# **snmp-server user** *name* [**auth** {**md5** | **sha**} *passphrase* [**auto**] [**priv** [**aes-128**] *passphrase*] [**engineID** *id*] [**localizedkey**]] **Example:** `switch(config)# snmp-server user Admin auth sha abcd1234 priv abcdefgh`	Configures an SNMP user with authentication and privacy parameters. The passphrase can be any case-sensitive, alphanumeric string up to 64 characters. If you use the **localizedkey** keyword, the passphrase can be any case-sensitive, alphanumeric string up to 130 characters. The engineID format is a 12-digit, colon-separated decimal number.
Step 3	(Optional) switch# **show snmp user** **Example:** `switch(config)# show snmp user`	Displays information about one or more SNMP users.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure an SNMP user:

```
switch# config t
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# snmp-server user Admin auth sha abcd1234 priv abcdefgh
```

Enforcing SNMP Message Encryption

You can configure SNMP to require authentication or encryption for incoming requests. By default, the SNMP agent accepts SNMPv3 messages without authentication and encryption. When you enforce privacy, Cisco NX-OS responds with an authorization error for any SNMPv3 PDU request that uses a security level parameter of either **noAuthNoPriv** or **authNoPriv**.

Use the following command in global configuration mode to enforce SNMP message encryption for a specific user:

Command	Purpose
switch(config)# **snmp-server user** *name* **enforcePriv**	Enforces SNMP message encryption for this user.

Use the following command in global configuration mode to enforce SNMP message encryption for all users:

Command	Purpose
switch(config)# **snmp-server globalEnforcePriv**	Enforces SNMP message encryption for all users.

Assigning SNMPv3 Users to Multiple Roles

After you configure an SNMP user, you can assign multiple roles for the user.

Note Only users who belong to a network-admin role can assign roles to other users.

Command	Purpose
switch(config)# **snmp-server user** *name group*	Associates this SNMP user with the configured user role.

Creating SNMP Communities

You can create SNMP communities for SNMPv1 or SNMPv2c.

Command	Purpose
switch(config)# **snmp-server community** *name group* {**ro** | **rw**}	Creates an SNMP community string.

Filtering SNMP Requests

You can assign an access list (ACL) to a community to filter incoming SNMP requests. If the assigned ACL allows the incoming request packet, SNMP processes the request. If the ACL denies the request, SNMP drops the request and sends a system message.

Create the ACL with the following parameters:

- Source IP address
- Destination IP address

- Source port
- Destination port
- Protocol (UDP or TCP)

The ACL applies to both IPv4 and IPv6 over UDP and TCP. After creating the ACL, assign the ACL to the SNMP community.

Tip For more information about creating ACLs, see the NX-OS security configuration guide for the Cisco Nexus Series software that you are using.

Use the following command in global configuration mode to assign an IPv4 or IPv6 ACL to an SNMPv3 community to filter SNMP requests:

Command	Purpose
switch(config)# **snmp-server community** *name* [**use-ipv4acl** *ipv4acl-name*] [**use-ipv6acl** *ipv6acl-name*] `switch(config)# snmp-server community public use-ipv4acl myacl`	Assigns an IPv4 or IPv6 ACL to an SNMPv3 community to filter SNMP requests.

Configuring SNMP Notification Receivers

You can configure Cisco NX-OS to generate SNMP notifications to multiple host receivers.

You can configure a host receiver for SNMPv1 traps in a global configuration mode.

Command	Purpose
switch(config)# **snmp-server host** *ip-address* **traps version 1** *community* [**udp_port** *number*]	Configures a host receiver for SNMPv1 traps. The *ip-address* can be an IPv4 or IPv6 address. The community can be any alphanumeric string up to 255 characters. The UDP port number range is from 0 to 65535.

You can configure a host receiver for SNMPv2c traps or informs in a global configuration mode.

Command	Purpose
switch(config)# **snmp-server host** *ip-address* {**traps** | **informs**} **version 2c** *community* [**udp_port** *number*]	Configures a host receiver for SNMPv2c traps or informs. The *ip-address* can be an IPv4 or IPv6 address. The community can be any alphanumeric string up to 255 characters. The UDP port number range is from 0 to 65535.

You can configure a host receiver for SNMPv3 traps or informs in a global configuration mode.

Command	Purpose
switch(config)# **snmp-server host** *ip-address* {**traps** | **informs**} **version 3** {**auth** | **noauth** | **priv**} *username* [**udp_port** *number*]	Configures a host receiver for SNMPv2c traps or informs. The *ip-address* can be an IPv4 or IPv6 address. The username can be any alphanumeric string up to 255 characters. The UDP port number range is from 0 to 65535.

Note The SNMP manager must know the user credentials (authKey/PrivKey) based on the SNMP engineID of the Cisco Nexus device to authenticate and decrypt the SNMPv3 messages.

The following example shows how to configure a host receiver for an SNMPv1 trap:

```
switch(config)# snmp-server host 192.0.2.1 traps version 1 public
```

The following example shows how to configure a host receiver for an SNMPv2 inform:

```
switch(config)# snmp-server host 192.0.2.1 informs version 2c public
```

The following example shows how to configure a host receiver for an SNMPv3 inform:

```
switch(config)# snmp-server host 192.0.2.1 informs version 3 auth NMS
```

Configuring SNMP Notification Receivers with VRFs

You can configure Cisco NX-OS to use a configured VRF to reach the host receiver. SNMP adds entries into the cExtSnmpTargetVrfTable of the CISCO-SNMP-TARGET-EXT-MIB when you configure the VRF reachability and filtering options for an SNMP notification receiver.

Note You must configure the host before configuring the VRF reachability or filtering options.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch# **snmp-server host** *ip-address* **use-vrf** *vrf_name* [**udp_port** *number*]	Configures SNMP to use the selected VRF to communicate with the host receiver. The IP address can be an IPv4 or IPv6 address. The VRF name can be any alphanumeric string up to 255 characters. The UDP port number range is from 0 to 65535. This command adds an entry into thc ExtSnmpTargetVrfTable of the CISCO-SNMP-TARGET-EXT-MB.

	Command or Action	Purpose
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure the SNMP server host with IP address 192.0.2.1 to use the VRF named "Blue:"

```
switch# configuration terminal
switch(config)# snmp-server host 192.0.2.1 use-vrf Blue
switch(config)# copy running-config startup-config
```

Filtering SNMP Notifications Based on a VRF

You can configure Cisco NX-OS filter notifications based on the VRF in which the notification occurred.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **snmp-server host** *ip-address* **filter-vrf** *vrf_name* [**udp_port** *number*]	Filters notifications to the notification host receiver based on the configured VRF. The IP address can be an IPv4 or IPv6 address. The VRF name can be any alphanumeric string up to 255 characters. The UDP port number range is from 0 to 65535. This command adds an entry into thc ExtSnmpTargetVrfTable of the CISCO-SNMP-TARGET-EXT-MB.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure filtering of SNMP notifications based on a VRF:

```
switch# configuration terminal
switch(config)# snmp-server host 192.0.2.1 filter-vrf Red
switch(config)# copy running-config startup-config
```

Configuring SNMP for Inband Access

You can configure SNMP for inband access using the following:

- Using SNMP v2 without context—You can use a community that is mapped to a context. In this case, the SNMP client does not need to know about the context.
- Using SNMP v2 with context—The SNMP client needs to specify the context by specifying a community; for example, <community>@<context>.
- Using SNMP v3—You can specify the context.

Procedure

	Command or Action	Purpose
Step 1	switch# **configuration terminal**	Enters global configuration mode.
Step 2	switch(config)# **snmp-server context** *context-name* **vrf** *vrf-name*	Maps an SNMP context to the management VRF or default VRF. Custom VRFs are not supported. The names can be any alphanumeric string up to 32 characters. **Note** By default, SNMP sends the traps using the management VRF. If you do not want to use the management VRF, you must use this command to specify the desired VRF.
Step 3	switch(config)# **snmp-server community** *community-name* **group** *group-name*	Maps an SNMPv2c community to an SNMP context and identifies the group to which the community belongs. The names can be any alphanumeric string up to 32 characters.
Step 4	switch(config)# **snmp-server mib community-map** *community-name* **context** *context-name*	Maps an SNMPv2c community to an SNMP context. The names can be any alphanumeric string up to 32 characters.

Example

The following SNMPv2 example shows how to map a community named snmpdefault to a context:

```
switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# snmp-server context def vrf default
switch(config)# snmp-server community snmpdefault group network-admin
switch(config)# snmp-server mib community-map snmpdefault context def
switch(config)#
```

The following SNMPv2 example shows how to configure and inband access to the community comm which is not mapped:

```
switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# snmp-server context def vrf default
```

```
switch(config)# snmp-server community comm group network-admin
switch(config)#
```

The following SNMPv3 example shows how to use a v3 username and password:

```
switch# config t
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# snmp-server context def vrf default
switch(config)#
```

Enabling SNMP Notifications

You can enable or disable notifications. If you do not specify a notification name, Cisco NX-OS enables all notifications.

Note The **snmp-server enable traps** CLI command enables both traps and informs, depending on the configured notification host receivers.

The following table lists the CLI commands that enable the notifications for Cisco NX-OS MIBs.

Table 20: Enabling SNMP Notifications

MIB	Related Commands
All notifications	**snmp-server enable traps**
BRIDGE-MIB	**snmp-server enable traps bridge newroot** **snmp-server enable traps bridge topologychange**
CISCO-AAA-SERVER-MIB	**snmp-server enable traps aaa**
ENITY-MIB, CISCO-ENTITY-FRU-CONTROL-MIB, CISCO-ENTITY-SENSOR-MIB	**snmp-server enable traps entity** **snmp-server enable traps entity fru**
CISCO-LICENSE-MGR-MIB	**snmp-server enable traps license**
IF-MIB	**snmp-server enable traps link**
CISCO-PSM-MIB	**snmp-server enable traps port-security**
SNMPv2-MIB	**snmp-server enable traps snmp** **snmp-server enable traps snmp authentication**
CISCO-FCC-MIB	**snmp-server enable traps fcc**
CISCO-DM-MIB	**snmp-server enable traps fcdomain**
CISCO-NS-MIB	**snmp-server enable traps fcns**

MIB	Related Commands
CISCO-FCS-MIB	**snmp-server enable traps fcs discovery-complete** **snmp-server enable traps fcs request-reject**
CISCO-FDMI-MIB	**snmp-server enable traps fdmi**
CISCO-FSPF-MIB	**snmp-server enable traps fspf**
CISCO-PSM-MIB	**snmp-server enable traps port-security**
CISCO-RSCN-MIB	**snmp-server enable traps rscn** **snmp-server enable traps rscn els** **snmp-server enable traps rscn ils**
CISCO-ZS-MIB	**snmp-server enable traps zone** **snmp-server enable traps zone default-zone-behavior-change** **snmp-server enable traps zone enhanced-zone-db-change** **snmp-server enable traps zone merge-failure** **snmp-server enable traps zone merge-success** **snmp-server enable traps zone request-reject** **snmp-server enable traps zone unsupp-mem**
CISCO-CONFIG-MAN-MIB **Note** Supports no MIB objects except the following notification: ccmCLIRunningConfigChanged	**snmp-server enable traps config**

Note The license notifications are enabled by default.

To enable the specified notification in the global configuration mode, perform one of the following tasks:

Command	Purpose
switch(config)# **snmp-server enable traps**	Enables all SNMP notifications.
switch(config)# **snmp-server enable traps aaa** [**server-state-change**]	Enables the AAA SNMP notifications.
switch(config)# **snmp-server enable traps entity** [**fru**]	Enables the ENTITY-MIB SNMP notifications.
switch(config)# **snmp-server enable traps license**	Enables the license SNMP notification.
switch(config)# **snmp-server enable traps port-security**	Enables the port security SNMP notifications.

Command	Purpose
switch(config)# **snmp-server enable traps snmp** [**authentication**]	Enables the SNMP agent notifications.

Configuring Link Notifications

You can configure which linkUp/linkDown notifications to enable on a device. You can enable the following types of linkUp/linkDown notifications:

- cieLinkDown—Enables the Cisco extended link state down notification.
- cieLinkUp—Enables the Cisco extended link state up notification.
- cisco-xcvr-mon-status-chg—Enables the Cisco interface transceiver monitor status change notification.
- delayed-link-state-change—Enables the delayed link state change.
- extended-linkUp—Enables the Internet Engineering Task Force (IETF) extended link state up notification.
- extended-linkDown—Enables the IETF extended link state down notification.
- linkDown—Enables the IETF Link state down notification.
- linkUp—Enables the IETF Link state up notification.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**snmp-server enable traps link** [**cieLinkDown** | **cieLinkUp** | **cisco-xcvr-mon-status-chg** | **delayed-link-state-change**] | **extended-linkUp** | **extended-linkDown** | **linkDown** | **linkUp**] **Example:** `switch(config)# snmp-server enable traps link cieLinkDown`	Enables the link SNMP notifications.

Disabling Link Notifications on an Interface

You can disable linkUp and linkDown notifications on an individual interface. You can use these limit notifications on a flapping interface (an interface that transitions between up and down repeatedly).

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface** *type slot*/*port*	Specifies the interface to be changed.
Step 3	switch(config -if)# **no snmp trap link-status**	Disables SNMP link-state traps for the interface. This feature is enabled by default.

Enabling One-Time Authentication for SNMP over TCP

You can enable a one-time authentication for SNMP over a TCP session.

Command	Purpose
switch(config)# **snmp-server tcp-session** [**auth**]	Enables a one-time authentication for SNMP over a TCP session. This feature is disabled by default.

Assigning SNMP Switch Contact and Location Information

You can assign the switch contact information, which is limited to 32 characters (without spaces), and the switch location.

Procedure

	Command or Action	Purpose
Step 1	switch# **configuration terminal**	Enters global configuration mode.
Step 2	switch(config)# **snmp-server contact** *name*	Configures sysContact, the SNMP contact name.
Step 3	switch(config)# **snmp-server location** *name*	Configures sysLocation, the SNMP location.
Step 4	(Optional) switch# **show snmp**	Displays information about one or more destination profiles.
Step 5	(Optional) switch# **copy running-config startup-config**	Saves this configuration change.

Configuring the Context to Network Entity Mapping

You can configure an SNMP context to map to a logical network entity, such as a protocol instance or VRF.

Procedure

	Command or Action	Purpose
Step 1	switch# **configuration terminal**	Enters global configuration mode.
Step 2	switch(config)# **snmp-server context** *context-name* [**instance** *instance-name*] [**vrf** *vrf-name*] [**topology** *topology-name*]	Maps an SNMP context to a protocol instance, VRF, or topology. The names can be any alphanumeric string up to 32 characters.
Step 3	switch(config)# **snmp-server mib community-map** *community-name* **context** *context-name*	Maps an SNMPv2c community to an SNMP context. The names can be any alphanumeric string up to 32 characters.
Step 4	(Optional) switch(config)# **no snmp-server context** *context-name* [**instance** *instance-name*] [**vrf** *vrf-name*] [**topology** *topology-name*]	Deletes the mapping between an SNMP context and a protocol instance, VRF, or topology. The names can be any alphanumeric string up to 32 characters. **Note** Do not enter an instance, VRF, or topology to delete a context mapping. If you use the **instance**, **vrf**, or **topology** keywords, you configure a mapping between the context and a zero-length string.

Disabling SNMP

Procedure

	Command or Action	Purpose

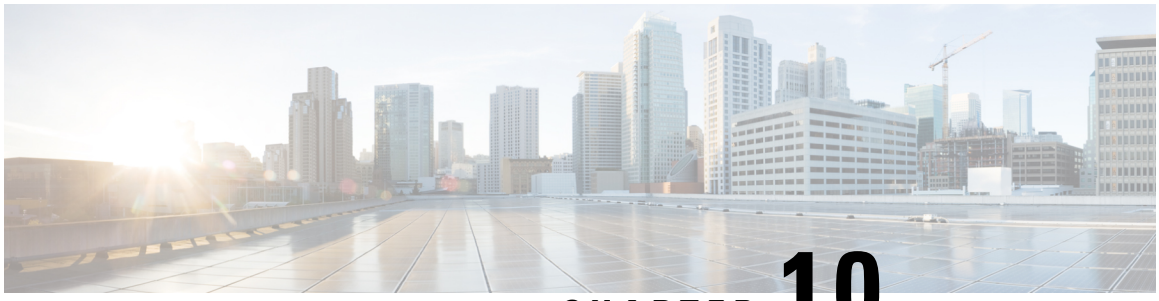
Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	switch(config) # **no snmp-server protocol enable** **Example:** `no snmp-server protocol enable`	Disables SNMP. SNMP is disabled by default.

Verifying the SNMP Configuration

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

Command	Purpose
show snmp	Displays the SNMP status.
show snmp community	Displays the SNMP community strings.
show snmp engineID	Displays the SNMP engineID.
show snmp group	Displays SNMP roles.
show snmp sessions	Displays SNMP sessions.
show snmp trap	Displays the SNMP notifications enabled or disabled.
show snmp user	Displays SNMPv3 users.



CHAPTER 10

Configuring RMON

This chapter contains the following sections:

- Information About RMON, on page 111
- Configuration Guidelines and Limitations for RMON, on page 112
- Configuring RMON, on page 112
- Verifying the RMON Configuration, on page 114
- Default RMON Settings, on page 114

Information About RMON

RMON is an Internet Engineering Task Force (IETF) standard monitoring specification that allows various network agents and console systems to exchange network monitoring data. The Cisco NX-OS supports RMON alarms, events, and logs to monitor Cisco Nexus device.

An RMON alarm monitors a specific management information base (MIB) object for a specified interval, triggers an alarm at a specified threshold value (threshold), and resets the alarm at another threshold value. You can use alarms with RMON events to generate a log entry or an SNMP notification when the RMON alarm triggers.

RMON is disabled by default and no events or alarms are configured in Cisco Nexus devices. You can configure your RMON alarms and events by using the CLI or an SNMP-compatible network management station.

RMON Alarms

You can set an alarm on any MIB object that resolves into an SNMP INTEGER type. The specified object must be an existing SNMP MIB object in standard dot notation (for example, 1.3.6.1.2.1.2.2.1.17 represents ifOutOctets.17).

When you create an alarm, you specify the following parameters:

- MIB object to monitor
- Sampling interval—The interval that the Cisco Nexus device uses to collect a sample value of the MIB object.
- Sample type—Absolute samples take the current snapshot of the MIB object value. Delta samples take two consecutive samples and calculate the difference between them.

- Rising threshold—The value at which the Cisco Nexus device triggers a rising alarm or resets a falling alarm.
- Falling threshold—The value at which theCisco Nexus device triggers a falling alarm or resets a rising alarm.
- Events—The action that the Cisco Nexus device takes when an alarm (rising or falling) triggers.

Note Use the hcalarms option to set an alarm on a 64-bit integer MIB object.

For example, you can set a delta type rising alarm on an error counter MIB object. If the error counter delta exceeds this value, you can trigger an event that sends an SNMP notification and logs the rising alarm event. This rising alarm does not occur again until the delta sample for the error counter drops below the falling threshold.

Note The falling threshold must be less than the rising threshold.

RMON Events

You can associate a particular event to each RMON alarm. RMON supports the following event types:

- SNMP notification—Sends an SNMP risingAlarm or fallingAlarm notification when the associated alarm triggers.
- Log—Adds an entry in the RMON log table when the associated alarm triggers.
- Both—Sends an SNMP notification and adds an entry in the RMON log table when the associated alarm triggers.

You can specify a different even for a falling alarm and a rising alarm.

Configuration Guidelines and Limitations for RMON

RMON has the following configuration guidelines and limitations:

- You must configure an SNMP user and a notification receiver to use the SNMP notification event type.
- You can only configure an RMON alarm on a MIB object that resolves to an integer.

Configuring RMON

Configuring RMON Alarms

You can configure RMON alarms on any integer-based SNMP MIB object.

You can optionally specify the following parameters:

- The eventnumber to trigger if the rising or falling threshold exceeds the specified limit.
- The owner of the alarm.

Ensure you have configured an SNMP user and enabled SNMP notifications.

Before you begin

Ensure you have configured an SNMP user and enabled SNMP notifications.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **rmon alarm** *index mib-object sample-interval* {**absolute** | **delta**} **rising-threshold** *value* [*event-index*] **falling-threshold** *value* [*event-index*] [**owner** *name*]	Creates an RMON alarm. The value range is from –2147483647 to 2147483647. The owner name can be any alphanumeric string.
Step 3	switch(config)# **rmon hcalarm** *index mib-object sample-interval* {**absolute** | **delta**} **rising-threshold-high** *value* **rising-threshold-low** *value* [*event-index*] **falling-threshold-high** *value* **falling-threshold-low** *value* [*event-index*] [**owner** *name*] [**storagetype** *type*]	Creates an RMON high-capacity alarm. The value range is from –2147483647 to 2147483647. The owner name can be any alphanumeric string. The storage type range is from 1 to 5.
Step 4	(Optional) switch# **show rmon** {**alarms** | **hcalarms**}	Displays information about RMON alarms or high-capacity alarms.
Step 5	(Optional) switch# **copy running-config startup-config**	Saves this configuration change.

Example

The following example shows how to configure RMON alarms:

```
switch# configure terminal
switch(config)# rmon alarm 1 1.3.6.1.2.1.2.2.1.17.83886080 5 delta rising-threshold 5 1
falling-threshold 0 owner test
switch(config)# exit
switch# show rmon alarms
Alarm 1 is active, owned by test
 Monitors 1.3.6.1.2.1.2.2.1.17.83886080 every 5 second(s)
 Taking delta samples, last value was 0
 Rising threshold is 5, assigned to event 1
```

```
Falling threshold is 0, assigned to event 0
On startup enable rising or falling alarm
```

Configuring RMON Events

You can configure RMON events to associate with RMON alarms. You can reuse the same event with multiple RMON alarms.

Ensure you have configured an SNMP user and enabled SNMP notifications.

Before you begin

Ensure that you have configured an SNMP user and enabled SNMP notifications.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **rmon event** *index* [**description** *string*] [**log**] [**trap**] [**owner** *name*]	Configures an RMON event. The description string and owner name can be any alphanumeric string.
Step 3	(Optional) switch(config)# **show rmon** {**alarms** | **hcalarms**}	Displays information about RMON alarms or high-capacity alarms.
Step 4	(Optional) switch# **copy running-config startup-config**	Saves this configuration change.

Verifying the RMON Configuration

Use the following commands to verify the RMON configuration information:

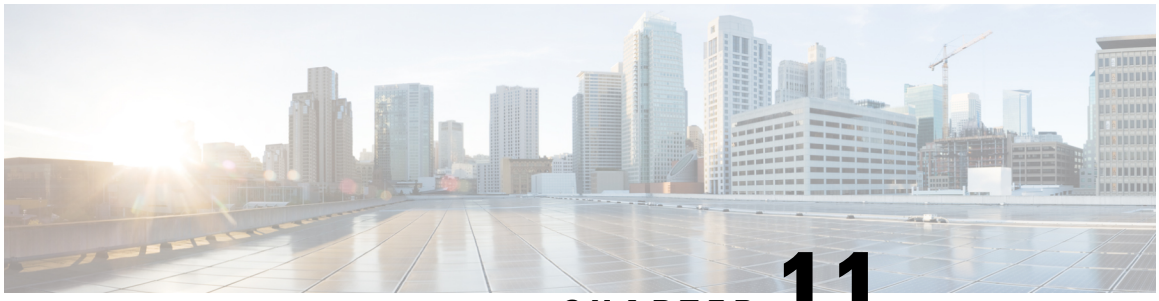
Command	Purpose
show rmon alarms	Displays information about RMON alarms.
show rmon events	Displays information about RMON events.
show rmon hcalarms	Displays information about RMON hcalarms.
show rmon logs	Displays information about RMON logs.

Default RMON Settings

The following table lists the default settings for RMON parameters.

Table 21: Default RMON Parameters

Parameters	Default
Alarms	None configured.
Events	None configured.



CHAPTER 11

Configuring Online Diagnostics

This chapter contains the following sections:

- Information About Online Diagnostics, on page 117
- Configuring Online Diagnostics, on page 119
- Verifying the Online Diagnostics Configuration, on page 120
- Default Settings for Online Diagnostics, on page 120

Information About Online Diagnostics

Online diagnostics provide verification of hardware components during switch bootup or reset, and they monitor the health of the hardware during normal switch operation.

Cisco Nexus Series switches support bootup diagnostics and runtime diagnostics. Bootup diagnostics include disruptive tests and nondisruptive tests that run during system bootup and system reset.

Runtime diagnostics (also known as health monitoring diagnostics) include nondisruptive tests that run in the background during normal operation of the switch.

Bootup Diagnostics

Bootup diagnostics detect faulty hardware before bringing the switch online. Bootup diagnostics also check the data path and control path connectivity between the supervisor and the ASICs. The following table describes the diagnostics that are run only during switch bootup or reset.

Table 22: Bootup Diagnostics

Diagnostic	Description
PCIe	Tests PCI express (PCIe) access.
NVRAM	Verifies the integrity of the NVRAM.
In band port	Tests connectivity of the inband port to the supervisor.
Management port	Tests the management port.
Memory	Verifies the integrity of the DRAM.

Bootup diagnostics also include a set of tests that are common with health monitoring diagnostics.

Bootup diagnostics log any failures to the onboard failure logging (OBFL) system. Failures also trigger an LED display to indicate diagnostic test states (on, off, pass, or fail).

You can configure Cisco Nexus device to either bypass the bootup diagnostics or run the complete set of bootup diagnostics.

Health Monitoring Diagnostics

Health monitoring diagnostics provide information about the health of the switch. They detect runtime hardware errors, memory errors, software faults, and resource exhaustion.

Health monitoring diagnostics are nondisruptive and run in the background to ensure the health of a switch that is processing live network traffic.

The following table describes the health monitoring diagnostics for the switch.

Table 23: Health Monitoring Diagnostics Tests

Diagnostic	Description
LED	Monitors port and system status LEDs.
Power Supply	Monitors the power supply health state.
Temperature Sensor	Monitors temperature sensor readings.
Test Fan	Monitors the fan speed and fan control.

The following table describes the health monitoring diagnostics that also run during system boot or system reset.

Table 24: Health Monitoring and Bootup Diagnostics Tests

Diagnostic	Description
SPROM	Verifies the integrity of backplane and supervisor SPROMs.
Fabric engine	Tests the switch fabric ASICs.
Fabric port	Tests the ports on the switch fabric ASIC.
Forwarding engine	Tests the forwarding engine ASICs.
Forwarding engine port	Tests the ports on the forwarding engine ASICs.
Front port	Tests the components (such as PHY and MAC) on the front ports.

Expansion Module Diagnostics

During the switch bootup or reset, the bootup diagnostics include tests for the in-service expansion modules in the switch.

When you insert an expansion module into a running switch, a set of diagnostics tests are run. The following table describes the bootup diagnostics for an expansion module. These tests are common with the bootup diagnostics. If the bootup diagnostics fail, the expansion module is not placed into service.

Table 25: Expansion Module Bootup and Health Monitoring Diagnostics

Diagnostic	Description
SPROM	Verifies the integrity of backplane and supervisor SPROMs.
Fabric engine	Tests the switch fabric ASICs.
Fabric port	Tests the ports on the switch fabric ASIC.
Forwarding engine	Tests the forwarding engine ASICs.
Forwarding engine port	Tests the ports on the forwarding engine ASICs.
Front port	Tests the components (such as PHY and MAC) on the front ports.

Health monitoring diagnostics are run on in-service expansion modules. The following table describes the additional tests that are specific to health monitoring diagnostics for expansion modules.

Table 26: Expansion Module Health Monitoring Diagnostics

Diagnostic	Description
LED	Monitors port and system status LEDs.
Temperature Sensor	Monitors temperature sensor readings.

Configuring Online Diagnostics

You can configure the bootup diagnostics to run the complete set of tests, or you can bypass all bootup diagnostic tests for a faster module boot up time.

Note We recommend that you set the bootup online diagnostics level to complete. We do not recommend bypassing the bootup online diagnostics.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **diagnostic bootup level** [**complete** | **bypass**]	Configures the bootup diagnostic level to trigger diagnostics when the device boots, as follows: • **complete**—Performs all bootup diagnostics. This is the default value.

	Command or Action	Purpose
		• **bypass**—Does not perform any bootup diagnostics.
Step 3	(Optional) switch# **show diagnostic bootup level**	Displays the bootup diagnostic level (bypass or complete) that is currently in place on the switch.

Example

The following example shows how to configure the bootup diagnostics level to trigger the complete diagnostics:

```
switch# configure terminal
switch(config)# diagnostic bootup level complete
```

Verifying the Online Diagnostics Configuration

Use the following commands to verify online diagnostics configuration information:

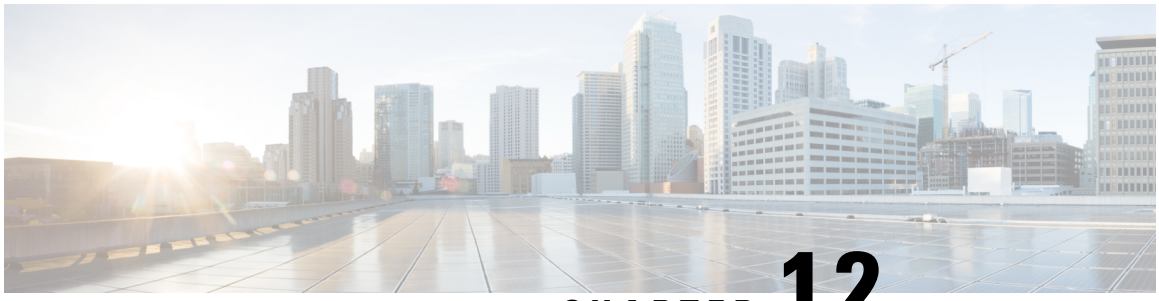
Command	Purpose
show diagnostic bootup level	Displays the bootup diagnostics level.
show diagnostic result module *slot*	Displays the results of the diagnostics tests.

Default Settings for Online Diagnostics

The following table lists the default settings for online diagnostics parameters.

Table 27: Default Online Diagnostics Parameters

Parameters	Default
Bootup diagnostics level	complete



CHAPTER 12

Configuring Embedded Event Manager

This chapter contains the following sections:

- About Embedded Event Manager, on page 121
- Embedded Event Manager Policies, on page 122
- Licensing Requirements for Embedded Event Manager, on page 124
- Prerequisites for Embedded Event Manager, on page 124
- Default Settings for Embedded Event Manager, on page 124
- Defining an Environment Variable, on page 124
- Defining a User Policy Using the CLI, on page 125
- Configuring Event Statements, on page 126
- Configuring Action Statements, on page 129
- Defining a Policy Using a VSH Script, on page 131
- Registering and Activating a VSH Script Policy, on page 131
- Overriding a System Policy, on page 132
- Configuring Syslog as an EEM Publisher, on page 133

About Embedded Event Manager

The ability to detect and handle critical events in the Cisco NX-OS system is important for high availability. The Embedded Event Manager (EEM) provides a central, policy-driven framework to detect and handle events in the system by monitoring events that occur on your device and taking action to recover or troubleshoot these events, based on your configuration..

EEM consists of three major components:

Event statements

Events to monitor from another Cisco NX-OS component that may require some action, workaround, or notification.

Action statements

An action that EEM can take, such as sending an e-mail or disabling an interface, to recover from an event.

Policies

An event paired with one or more actions to troubleshoot or recover from the event.

Without EEM, each individual component is responsible for detecting and handling its own events. For example, if a port flaps frequently, the policy of "putting it into errDisable state" is built into ETHPM.

Embedded Event Manager Policies

An EEM policy consists of an event statement and one or more action statements. The event statement defines the event to look for as well as the filtering characteristics for the event. The action statement defines the action EEM takes when the event occurs.

For example, you can configure an EEM policy to identify when a card is removed from the device and log the details related to the card removal. By setting up an event statement that tells the system to look for all instances of card removal and an then with an action statement that tells the system to log the details.

You can configure EEM policies using the command line interface (CLI) or a VSH script.

EEM gives you a device-wide view of policy management. Once EEM policies are configured, the corresponding actions are triggered. All actions (system or user-configured) for triggered events are tracked and maintained by the system.

Preconfigured System Policies

Cisco NX-OS has a number of preconfigured system policies. These system policies define many common events and actions for the device. System policy names begin with two underscore characters (__).

Some system policies can be overridden. In these cases, you can configure overrides for either the event or the action. The overrides that you configure take the place of the system policy.

Note Override policies must include an event statement. Override policies without event statements override all possible events for the system policy.

To view the preconfigured system polices and determine which polices you can override, use the **show event manager system-policy** command.

User-Created Policies

User-created policies allow you to customize EEM policies for your network. If a user policy is created for an event, actions in the policy are triggered only after EEM triggers the system policy actions related to the same event.

Log Files

The log file that contains data that is related to EEM policy matches is maintained in the event_archive_1 log file located in the /log/event_archive_1 directory.

Event Statements

Any device activity for which some action, such as a workaround or notification, is taken is considered an event by EEM. In many cases, events are related to faults in the device, such as when an interface or a fan malfunctions.

Event statements specify which event or events triggers a policy to run.

Tip You can configure EEM to trigger an EEM policy that is based on a combination of events by creating and differentiating multiple EEM events in the policy and then defining a combination of events to trigger a custom action.

EEM defines event filters so that only critical events or multiple occurrences of an event within a specified time period trigger an associated action.

Some commands or internal events trigger other commands internally. These commands are not visible, but will still match the event specification that triggers an action. You cannot prevent these commands from triggering an action, but you can check which event triggered an action.

Supported Events

EEM supports the following events in event statements:

- Counter events
- Fan absent events
- Fan bad events
- Memory thresholds events
- Events being used in overridden system policies.
- SNMP notification events
- Syslog events
- System manager events
- Temperature events
- Track events

Action Statements

Action statements describe the action that is triggered by a policy when an event occurs. Each policy can have multiple action statements. If no action is associated with a policy, EEM still observes events but takes no actions.

In order for triggered events to process default actions, you must configure the EEM policy to allow the default action. For example, if you match a CLI command in a match statement, you must add the event-default action statement to the EEM policy or EEM does not allow the command to execute.

Note When configuring action statements within your user policy or overriding policy, it is important that you confirm that action statements do not negate each other or adversely affect the associated system policy.

Supported Actions

EEM supports the following actions in action statements:

- Execute any CLI commands
- Update a counter
- Reload the device
- Generate a syslog message
- Generate an SNMP notification
- Use the default action for the system policy

VSH Script Policies

You can write policies in a VSH script, by using a text editor. Policies that are written using a VSH script have an event statement and action statement(s) just as other policies, and these policies can either augment or override system policies.

After you define your VSH script policy, copy it to the device and activate it.

Licensing Requirements for Embedded Event Manager

This feature does not require a license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for Embedded Event Manager

You must have network-admin privileges to configure EEM.

Default Settings for Embedded Event Manager

Table 28: Default EEM Parameters

Parameters	Default
System Policies	Active

Defining an Environment Variable

Defining an environment variable is an optional step but is useful for configuring common values for repeated use in multiple policies.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**event manager environment** *variable-name variable-value* **Example:** `switch(config) # event manager environment emailto "admin@anyplace.com"`	Creates an environment variable for EEM. The *variable-name* can be any case-sensitive, alphanumeric string up to 29 characters. The *variable-value* can be any quoted case-sensitive, alphanumeric string up to 39 characters.
Step 3	(Optional) **show event manager environment** {*variable-name* | **all**} **Example:** `switch(config) # show event manager environment all`	Displays information about the configured environment variables.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

What to do next

Configure a User Policy.

Defining a User Policy Using the CLI

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**event manager applet** *applet-name* **Example:**	Registers the applet with EEM and enters applet configuration mode. The applet-name can be any case-sensitive, alphanumeric string up to 29 characters.

	Command or Action	Purpose
	`switch(config)# event manager applet monitorShutdown` `switch(config-applet)#`	
Step 3	(Optional) **description** *policy-description* **Example:** `switch(config-applet)# description "Monitors interface shutdown."`	Configures a descriptive string for the policy. The string can be any alphanumeric string up to 80 characters. Enclose the string in quotation marks.
Step 4	**event** *event-statement* **Example:** `switch(config-applet)# event cli match "shutdown"`	Configures the event statement for the policy.
Step 5	(Optional) **tag** *tag* {**and** | **andnot** | **or**} *tag* [**and** | **andnot** | **or** {*tag*}] {**happens** *occurs* **in** *seconds*} **Example:** `switch(config-applet)# tag one or two happens 1 in 10000`	Correlates multiple events in the policy. The range for the *occurs* argument is from 1 to 4294967295. The range for the *seconds* argument is from 0 to 4294967295 seconds.
Step 6	**action** *number*[.*number2*] *action-statement* **Example:** `switch(config-applet)# action 1.0 cli show interface e 3/1`	Configures an action statement for the policy. Repeat this step for multiple action statements.
Step 7	(Optional) **show event manager policy-state** *name* [**module** *module-id*] **Example:** `switch(config-applet)# show event manager policy-state monitorShutdown`	Displays information about the status of the configured policy.
Step 8	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

What to do next

Configure event statements and action statements.

Configuring Event Statements

Use one of the following commands in EEM configuration mode (config-applet) to configure an event statement:

Before you begin

Define a user policy.

Procedure

	Command or Action	Purpose
Step 1	**event cli** [**tag** *tag*] **match** *expression* [**count** *repeats* | **time** *seconds* **Example:** `switch(config-applet) # event cli match "shutdown"`	Triggers an event if you enter a command that matches the regular expression. The **tag** *tag* keyword-argument pair identifies this specific event when multiple events are included in the policy. The *repeats* range is from 1 to 65000. The *time* range is from 0 to 4294967295, where 0 indicates no time limit.
Step 2	**event counter** [**tag** *tag*] **name** *counter* **entry-val** *entry* **entry-op** {**eq** | **ge** | **gt** | **le** | **lt** | **ne**} {**exit-val** *exit* **exit-op** {**eq** | **ge** | **gt** | **le** | **lt** | **ne**} **Example:** `switch(config-applet) # event counter name mycounter entry-val 20 gt`	Triggers an event if the counter crosses the entry threshold based on the entry operation. The event resets immediately. Optionally, you can configure the event to reset after the counter passes the exit threshold. The **tag** *tag* keyword-argument pair identifies this specific event when multiple events are included in the policy. The *counter* name can be any case-sensitive, alphanumeric string up to 28 characters. The *entry* and *exit* value ranges are from 0 to 2147483647.
Step 3	**event fanabsent** [**fan** *number*] **time** *seconds* **Example:** `switch(config-applet) # event fanabsent time 300`	Triggers an event if a fan is removed from the device for more than the configured time, in seconds. The *number* range is is from 1 to 1 and is module-dependent. The *seconds* range is from 10 to 64000.
Step 4	**event fanbad** [**fan** *number*] **time** *seconds* **Example:** `switch(config-applet) # event fanbad time 3000`	Triggers an event if a fan fails for more than the configured time, in seconds. The *number* range is module-dependent. The *seconds* range is from 10 to 64000.
Step 5	**event memory** {**critical** | **minor** | **severe**} **Example:** `switch(config-applet) # event memory critical`	Triggers an event if a memory threshold is crossed.

	Command or Action	Purpose
Step 6	**event policy-default count** *repeats* [**time** *seconds*] **Example:** `switch(config-applet) # event policy-default count 3`	Uses the event configured in the system policy. Use this option for overriding policies. The *repeats* range is from 1 to 65000. The *seconds* range is from 0 to 4294967295, where 0 indicates no time limit.
Step 7	**event snmp** [**tag** *tag*] **oid** *oid* **get-type** {**exact** | **next**} **entry-op** {**eq** | **ge** | **gt** | **le** | **lt** | **ne**} **entry-val** *entry* [**exit-comb** {**and** | **or**}]**exit-op** {**eq** | **ge** | **gt** | **le** | **lt** | **ne**} **exit-val** *exit* **exit-time** *time* **polling-interval** *interval* **Example:** `switch(config-applet) # event snmp oid 1.3.6.1.2.1.31.1.1.1.6 get-type next entry-op lt 300 entry-val 0 exit-op eq 400 exit-time 30 polling-interval 300`	Triggers an event if the SNMP OID crosses the entry threshold based on the entry operation. The event resets immediately, or optionally you can configure the event to reset after the counter passes the exit threshold. The OID is in dotted decimal notation. The **tag** *tag* keyword-argument pair identifies this specific event when multiple events are included in the policy. The *entry* and *exit* value ranges are from 0 to 18446744073709551615. The *time*, in seconds, is from 0 to 2147483647. The *interval*, in seconds, is from 0 to 2147483647.
Step 8	**event sysmgr memory** [**module** *module-num*] **major** *major-percent* **minor** *minor-percent* **clear** *clear-percent* **Example:** `switch(config-applet) # event sysmgr memory minor 80`	Triggers an event if the specified system manager memory threshold is exceeded. The *percent* range is from 1 to 99.
Step 9	**event temperature** [**module** *slot*] [**sensor** *number*] **threshold** {**any** | **down** | **up**} **Example:** `switch(config-applet) # event temperature module 2 threshold any`	Triggers an event if the temperature sensor exceeds the configured threshold. The *sensor* range is from 1 to 18.
Step 10	**event track** [**tag** *tag*] *object-number* **state** {**any** | **down** | **up** **Example:** `switch(config-applet) # event track 1 state down`	Triggers an event if the tracked object is in the configured state. The **tag** *tag* keyword-argument pair identifies this specific event when multiple events are included in the policy. The *object-number* range is from 1 to 500.

What to do next

Configure action statements.

If you have already configured action statements or choose not to, complete any of the optional tasks:

- Define a policy using a VSH script. Then, register and activate a VSH script policy.
- Configure memory thresholds
- Configure the syslog as an EEM publisher.
- Verify your EEM configuration.

Configuring Action Statements

You can configure an action by using one of the following commands in EEM configuration mode (config-applet):

Note If you want to allow a triggered event to process any default actions, you must configure the EEM policy to allow the default action. For example, if you match a command in a match statement, you must add the event-default action statement to the EEM policy or EEM does not allow the command to execute. You can use the **terminal event-manager bypass** command to allow all EEM policies with matches to execute the command.

Before you begin

Define a user policy.

Procedure

	Command or Action	Purpose
Step 1	**action** *number*[*.number2*] **cli** *command1*[*command2.*] [**local**] **Example:** `switch(config-applet) # action 1.0 cli "show interface e 3/1"`	Runs the configured commands. You can optionally run the commands on the module where the event occurred. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9.
Step 2	**action** *number*[*.number2*] **counter name** *counter* **value** *val* **op** {**dec** | **inc** | **nop** | **set**} **Example:** `switch(config-applet) # action 2.0 counter name mycounter value 20 op inc`	Modifies the counter by the configured value and operation. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9. The *counter* can be any case-sensitive, alphanumeric string up to 28 characters.

	Command or Action	Purpose
		The *val* can be an integer from 0 to 2147483647 or a substituted parameter.
Step 3	**action** *number*[.*number2*] **event-default** **Example:** `switch(config-applet) # action 1.0 event-default`	Completes the default action for the associated event. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9.
Step 4	**action** *number*[.*number2*] **policy-default** **Example:** `switch(config-applet) # action 1.0 policy-default`	Completes the default action for the policy that you are overriding. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9.
Step 5	**action** *number*[.*number2*] **reload** [**module** *slot* [- *slot*]] **Example:** `switch(config-applet) # action 1.0 reload module 3-5`	Forces one or more modules to the entire system to reload. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9.
Step 6	**action** *number*[.*number2*] **snmp-trap** [**intdata1** *integer-data1*] [**intdata2** *integer-data2*] [**strdata** *string-data*] **Example:** `switch(config-applet) # action 1.0 snmp-trap strdata "temperature problem"`	Sends an SNMP trap with the configured data. The action label is in the format number1.number2. The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9. The *data* elements can be any number up to 80 digits. The *string* can be any alphanumeric string up to 80 characters.
Step 7	**action** *number*[.*number2*] **syslog** [**priority** *prio-val*] **msg** *error-message* **Example:** `switch(config-applet) # action 1.0 syslog priority notifications msg "cpu high"`	Sends a customized syslog message at the configured priority. The action label is in the format number1.number2.

	Command or Action	Purpose
		The *number* can be any number from 1 to 16 digits. The range for *number2* is from 0 to 9. The *error-message* can be any quoted alphanumeric string up to 80 characters.

What to do next

Configure event statements.

If you have already configured event statements or choose not to, complete any of the optional tasks:

- Define a policy using a VSH script. Then, register and activate a VSH script policy.
- Configure memory thresholds
- Configure the syslog as an EEM publisher.
- Verify your EEM configuration.

Defining a Policy Using a VSH Script

This is an optional task. Complete the following steps if you are using a VSH script to write EEM policies:

Procedure

Step 1 In a text editor, list the commands that define the policy.

Step 2 Name the text file and save it.

Step 3 Copy the file to the following system directory: bootflash://eem/user_script_policies

What to do next

Register and activate a VSH script policy.

Registering and Activating a VSH Script Policy

This is an optional task. Complete the following steps if you are using a VSH script to write EEM policies.

Before you begin

Define a policy using a VSH script and copy the file to the system directory.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**event manager policy** *policy-script* **Example:** `switch(config)# event manager policy moduleScript`	Registers and activates an EEM script policy. The *policy-script* can be any case-sensitive, alphanumeric string up to 29 characters.
Step 3	(Optional) **event manager policy internal** *name* **Example:** `switch(config)# event manager policy internal moduleScript`	Registers and activates an EEM script policy. The *policy-script* can be any case-sensitive alphanumeric string up to 29 characters.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

What to do next

Complete any of the following, depending on your system requirements:

- Configure memory thresholds.
- Configure the syslog as an EEM publisher.
- Verify your EEM configuration.

Overriding a System Policy

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	(Optional) **show event manager policy-state** *system-policy*	Displays information about the system policy that you want to override, including thresholds.

	Command or Action	Purpose

	Example:
	`switch(config-applet)# show event manager policy-state __ethpm_link_flap`
	`Policy __ethpm_link_flap`
	`Cfg count : 5`
	`Cfg time interval : 10.000000 (seconds)`
	`Hash default, Count 0`
		Use the **show event manager system-policy** command to find the system policy names.

Step 3	**event manager applet** *applet-name* **override** *system-policy*
	Example:
	`switch(config-applet)# event manager applet`
	`ethport override __ethpm_link_flap`
	`switch(config-applet)#`
		Overrides a system policy and enters applet configuration mode.
		The *applet-name* can be any case-sensitive, alphanumeric string up to 80 characters.
		The *system-policy* must be one of the system policies.

Step 4	**description** *policy-description* **Example:** `switch(config-applet)# description "Overrides link flap policy"`	Configures a descriptive string for the policy. The *policy-description* can be any case-sensitive, alphanumeric string up to 80 characters, but it must be enclosed in quotation marks.
Step 5	**event** *event-statement* **Example:** `switch(config-applet)# event policy-default count 2 time 1000`	Configures the event statement for the policy.
Step 6	**section** *number action-statement* **Example:** `switch(config-applet)# action 1.0 syslog priority warnings msg "Link is flapping."`	Configures an action statement for the policy. For multiple action statements, repeat this step.
Step 7	(Optional) **show event manager policy-state** *name* **Example:** `switch(config-applet)# show event manager policy-state ethport`	Displays information about the configured policy.
Step 8	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Configuring Syslog as an EEM Publisher

Configuring syslog as an EEM publisher allows you to monitor syslog messages from the switch.

Note The maximum number of searchable strings to monitor syslog messages is 10.

Before you begin

- Confirm that EEM is available for registration by the syslog.
- Confirm that the syslog daemon is configured and executed.

Procedure

	Command or Action	Purpose

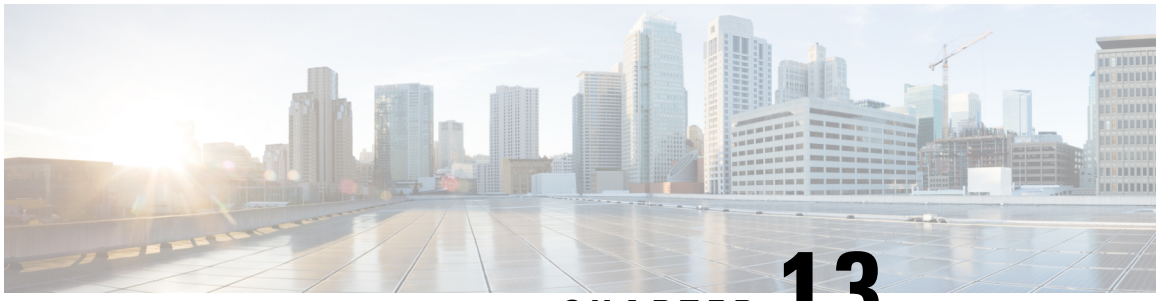
Step 1	**configure terminal**
	Example:
	`switch# configure terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**event manager applet** *applet-name*
	Example:
	`switch(config)# event manager applet abc`
	`switch (config-appliet)#`
		Registers an applet with EEM and enters applet configuration mode.

Step 3	**event syslog** [**tag** *tag*] {**occurs** *number* | **period** *seconds* | **pattern** *msg-text* | **priority** *priority*} **Example:** `switch(config-applet)# event syslog occurs 10`	Registers an applet with EEM and enters applet configuration mode.
Step 4	(Optional) **copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

What to do next

Verify your EEM configuration.



CHAPTER 13

Configuring SPAN

This chapter contains the following sections:

- Information About SPAN, on page 135
- Guidelines and Limitations for SPAN, on page 135
- SPAN Sources, on page 136
- Characteristics of Source Ports, on page 136
- SPAN Destinations, on page 136
- Characteristics of Destination Ports, on page 137
- SPAN and ERSPAN Filtering, on page 137
- SPAN and ERSPAN Sampling, on page 138
- SPAN and ERSPAN Truncation, on page 139
- Creating or Deleting a SPAN Session, on page 139
- Configuring an Ethernet Destination Port, on page 140
- Configuring Source Ports, on page 141
- Configuring Source Port Channels or VLANs, on page 142
- Configuring the Description of a SPAN Session, on page 142
- Activating a SPAN Session, on page 143
- Suspending a SPAN Session, on page 143
- Configuring a SPAN Filter, on page 144
- Configuring SPAN Sampling, on page 145
- Configuring SPAN Truncation, on page 146
- Displaying SPAN Information, on page 147

Information About SPAN

The Switched Port Analyzer (SPAN) feature (sometimes called port mirroring or port monitoring) selects network traffic for analysis by a network analyzer. The network analyzer can be a Cisco SwitchProbe or other Remote Monitoring (RMON) probes.

Guidelines and Limitations for SPAN

SPAN have the following guideline and limitation:

- Beginning with Cisco NX-OS Release 6.0(2)A8(6), you can monitor the same source interfaces (physical port or port-channel) in multiple local SPAN sessions.

SPAN Sources

SPAN sources refer to the interfaces from which traffic can be monitored. The Cisco Nexus device supports Ethernet, port channels, and VLANs as SPAN sources. With VLANs, all supported interfaces in the specified VLAN are included as SPAN sources. You can choose the SPAN traffic in the ingress direction, the egress direction, or both directions for Ethernet source interfaces:

- Ingress source (Rx)—Traffic entering the device through this source port is copied to the SPAN destination port.
- Egress source (Tx)—Traffic exiting the device through this source port is copied to the SPAN destination port.

Characteristics of Source Ports

A source port, also called a monitored port, is a switched interface that you monitor for network traffic analysis. The switch supports any number of ingress source ports (up to the maximum number of available ports on the switch) and any number of source VLANs.

A source port has these characteristics:

- Can be of Ethernet, port channel, or VLAN port type.
- Cannot be a destination port.
- Can be configured with a direction (ingress, egress, or both) to monitor. For VLAN sources, the monitored direction can only be ingress and applies to all physical ports in the group. The RX/TX option is not available for VLAN SPAN sessions.
- Can be in the same or different VLANs.

Note

- The maximum number of source ports per SPAN session is 128 ports.

SPAN Destinations

SPAN destinations refer to the interfaces that monitors source ports. The Cisco Nexus Series device supports Ethernet interfaces as SPAN destinations.

Characteristics of Destination Ports

Each local SPAN session must have a destination port (also called a monitoring port) that receives a copy of traffic from the source ports or VLANs. A destination port has these characteristics:

- Can be any physical port. Source Ethernet and FCoE ports cannot be destination ports.
- Cannot be a source port.
- Cannot be a port channel.
- Does not participate in spanning tree while the SPAN session is active.
- Is excluded from the source list and is not monitored if it belongs to a source VLAN of any SPAN session.
- Receives copies of sent and received traffic for all monitored source ports.
- The same destination interface cannot be used for multiple SPAN sessions. However, an interface can act as a destination for a SPAN and an ERSPAN session.

SPAN and ERSPAN Filtering

A SPAN or ERSPAN session can be used to monitor all the traffic on all the source interfaces. This volume of traffic can cause packet drops if there are congestions or if the destination bandwidth is not enough to monitor all the traffic.

Cisco NX-OS Release 6.0(2)A4(1) provides the ability to filter out specific SPAN or ERSPAN traffic flows that must be monitored. Filtering is achieved by creating a filter and attaching it to a SPAN or ERSPAN session. Only the packets that match the filter are mirrored.

Filtering can be of the following types:

- MAC-based
- IP-based
- VLAN-based

Guidelines and Limitations for SPAN and ERSPAN Filtering

SPAN and ERSPAN filtering have the following guidelines and limitations:

- Cisco Nexus 3500 Series switches drop the SPAN copies while spanning an interface in the rx direction and another interface in the tx direction when the traffic starts. It happens due to the default SPAN threshold limit being low and it cannot handle the burst traffic for SPAN. Use the CLI command **hardware profile buffer span-threshold <xx>** to increase the SPAN threshold.

Note Increasing the SPAN threshold affects the shared buffer allocation. It allocates the SPAN buffers from the shared buffer pool.

- The span-threshold least value has been updated from 0 to 2. When you set the span-threshold to a lowest value of 2, the SPAN buffer occupied is 528. When you use the negate command **no hardware profile buffer span-threshold 2**, the span-threshold value is 208. The default value is lesser then the least value of span-threshold.
- When a source interface in a SPAN session is operationally down, then that SPAN session will not go operationally down. This behavior does not impact any functionality
- SPAN filtering supports only 16 filters. These filters can be a combination of VLAN-based, IP-based, and MAC-based filters.
- When a SPAN session is configured with a multicast router port being the source port, the destination port sees all the multicast traffic even when there is no traffic that is actually being forwarded to the source port. This is due to a current limitation of the multicast/SPAN implementation.
- SPAN filtering is applicable for all the traffic of the switch except the SPAN source interface traffic.
- You can configure only one IP-based, one MAC-based and one VLAN-based filter per SPAN session.
- The number of filters is further restricted by the number of SPAN sessions and the type of source as follows:
  - A maximum of 8 MAC-based, 8 IP-based or 8 VLAN-based filters can be configured.
  - A maximum of 4 IP-based, 4 MAC-based or 4 VLAN-based filters can be attached to all interface-based SPAN sessions.
  - A maximum of 8 IP-based, 8 MAC-based or 8 VLAN-based filters can be attached to all VLAN-based SPAN sessions.
- Filters can be used only in the ingress direction. This is not configurable.
- A SPAN session must be up to for filters to work.
- You cannot configure filters on ERSPAN-dst sessions.
- You cannot configure filters on Warp SPAN sessions.
- The control-packet filter is always applied in the egress direction.
- The control-packet filter is recommended when both, the source and the destination interfaces of the ERSPAN session are PTP enabled.

SPAN and ERSPAN Control-packet Filtering

Cisco NX-OS Release 6.0(2)A8(9) provides the ability to filter out CPU generated packets going out of the SPAN source interface. Control-packet filter is applied in the egress direction, and is therefore effective on source interfaces enabled for Tx mirroring.

SPAN and ERSPAN Sampling

Cisco NX-OS Release 6.0(2)A4(1) supports sampling of source packets for each SPAN or ERSPAN session. Monitoring only a sample number of source packets helps reduce SPAN or ERSPAN bandwidth. This sample is defined by a range that you can configure. For example, if you configure the range as 2, 1 out of every 2

source packets will be spanned. Similarly, if you configure the range as 1023, 1 out of every 1023 packets will be spanned. This method provides an accurate count of SPAN or ERSPAN source packets, but it does not include any time-related information about the spanned packets.

By default, SPAN and ERSPAN sampling are disabled. To use sampling, you must enable it for each SPAN or ERSPAN session.

Guidelines and Limitations for SPAN and ERSPAN Sampling

SPAN and ERSPAN sampling have the following guidelines and limitations:

- Sampling is only supported for local and ERSPAN-src sessions.
- Sampling is not supported for ERSPAN-dst sessions.
- Sampling is not supported for Warp SPAN sessions.
- The supported sampling range is from 2 to 1023.

SPAN and ERSPAN Truncation

Cisco NX-OS Release 6.0(2)A4(1) introduces truncation of source packets for each SPAN or ERSPAN session based on the size of their MTU. Truncation helps reduce SPAN or ERSPAN bandwidth by reducing the size of packets monitored. MTU truncation can be set from 64 bytes to 1518 bytes. Any SPAN or ERSPAN packet that is larger than the configured MTU size is truncated to the given size with a 4-byte offset. For example, if you configure the MTU as 300 bytes, the maximum size of the replicated packet is 304 bytes.

By default, SPAN and ERSPAN truncation are disabled. To use truncation, you must enable it for each SPAN or ERSPAN session.

Guidelines and Limitations for SPAN and ERSPAN Truncation

SPAN and ERSPAN truncation have the following guidelines and limitations:

- Truncation is only supported for local and ERSPAN-src sessions.
- Truncation is not supported for ERSPAN-dst sessions.
- Truncation is not supported for Warp SPAN sessions.
- The supported MTU range is from 64 bytes to 1518 bytes.

Creating or Deleting a SPAN Session

You create a SPAN session by assigning a session number using the **monitor session** command. If the session already exists, any additional configuration information is added to the existing session.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** *session-number*	Enters the monitor configuration mode. New session configuration is added to the existing session configuration.

Example

The following example shows how to configure a SPAN monitor session:

```
switch# configure terminal
switch(config) # monitor session 2
switch(config) #
```

Configuring an Ethernet Destination Port

You can configure an Ethernet interface as a SPAN destination port.

Note The SPAN destination port can only be a physical port on the switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface ethernet** *slot*/*port*	Enters interface configuration mode for the Ethernet interface with the specified slot and port. **Note** To enable the **switchport monitor** command on virtual ethernet ports, you can use the **interface vethernet** *slot*/*port* command.
Step 3	switch(config-if)# **switchport monitor**	Enters monitor mode for the specified Ethernet interface. Priority flow control is disabled when the port is configured as a SPAN destination.
Step 4	switch(config-if)# **exit**	Reverts to global configuration mode.
Step 5	switch(config)# **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.

	Command or Action	Purpose
Step 6	switch(config-monitor)# **destination interface ethernet** *slot*/*port*	Configures the Ethernet SPAN destination port. **Note** To enable the virtual ethernet port as destination interface in the monitor configuration, you can use the **destination interface vethernet** *slot*/*port* command.

Example

The following example shows how to configure an Ethernet SPAN destination port (HIF):

```
switch# configure terminal
switch(config)# interface ethernet100/1/24
switch(config-if)# switchport monitor
switch(config-if)# exit
switch(config)# monitor session 1
switch(config-monitor)# destination interface ethernet100/1/24
switch(config-monitor)#
```

The following example shows how to configure a virtual ethernet (VETH) SPAN destination port:

```
switch# configure terminal
switch(config)# interface vethernet10
switch(config-if)# switchport monitor
switch(config-if)# exit
switch(config)# monitor session 2
switch(config-monitor)# destination interface vethernet10
switch(config-monitor)#
```

Configuring Source Ports

Source ports can only be Ethernet ports.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **monitor session** *session-number*	Enters monitor configuration mode for the specified monitoring session.
Step 3	switch(config-monitor) # **source interface** *type slot*/*port* [**rx** | **tx** | **both**]	Adds an Ethernet SPAN source port and specifies the traffic direction in which to duplicate packets. You can enter a range of Ethernet, Fibre Channel, or virtual Fibre Channel ports. You can specify the traffic direction to duplicate as ingress (Rx), egress (Tx), or both. By default, the direction is both.

Example

```
switch# configure terminal
switch(config)# monitor session 2
switch(config-monitor)# source interface ethernet 1/16
switch(config-monitor)#
```

Configuring Source Port Channels or VLANs

You can configure the source channels for a SPAN session. These ports can be port channels and VLANs. The monitored direction can be ingress, egress, or both and applies to all physical ports in the group.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.
Step 3	switch(config-monitor) # **source** {**interface** {**port-channel** | **san-port-channel**} *channel-number* [**rx** | **tx** | **both**] | **vlan** *vlan-range* | **vsan** *vsan-range* }	Configures port channel, SAN port channel, VLAN, or VSAN sources. For VLAN or VSAN sources, the monitored direction is implicit.

Example

The following example shows how to configure a port channel SPAN source:

```
switch# configure terminal
switch(config)# monitor session 2
switch(config-monitor)# source interface port-channel 1 rx
switch(config-monitor)# source interface port-channel 3 tx
switch(config-monitor)# source interface port-channel 5 both
switch(config-monitor)#
```

The following example shows how to configure a VLAN SPAN source:

```
switch# configure terminal
switch(config)# monitor session 2
switch(config-monitor)# source vlan 1
switch(config-monitor)#
```

Configuring the Description of a SPAN Session

For ease of reference, you can provide a descriptive name for a SPAN session.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.
Step 3	switch(config-monitor) # **description** *description*	Creates a descriptive name for the SPAN session.

Example

The following example shows how to configure a SPAN session description:

```
switch# configure terminal
switch(config) # monitor session 2
switch(config-monitor) # description monitoring ports eth2/2-eth2/4
switch(config-monitor) #
```

Activating a SPAN Session

The default is to keep the session state shut. You can open a session that duplicates packets from sources to destinations.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **no monitor session** {**all** | *session-number*} **shut**	Opens the specified SPAN session or all sessions.

Example

The following example shows how to activate a SPAN session:

```
switch# configure terminal
switch(config) # no monitor session 3 shut
```

Suspending a SPAN Session

By default, the session state is **shut**.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **monitor session** {**all** | *session-number*} **shut**	Suspends the specified SPAN session or all sessions.

Example

The following example shows how to suspend a SPAN session:

```
switch# configure terminal
switch(config) # monitor session 3 shut
switch(config) #
```

Configuring a SPAN Filter

You can configure SPAN filters for local and ERSPAN-source sessions only.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.
Step 3	switch(config-monitor)# **source** {**interface** {**port-channel**} *channel-number* [**rx** | **tx** | **both**] | **vlan** *vlan-range*}	Configures port channel or VLAN sources. For VLAN sources, the monitored direction is implicit.
Step 4	switch(config-monitor)# **filter** {**ip** *source-ip-address source-ip-mask destination-ip-address destination-ip-mask*}	Creates a SPAN filter.
Step 5	switch(config-monitor)# **destination interface ethernet** *slot/port*	Configures the Ethernet SPAN destination port.

Example

The following example shows how to configure an IP-based SPAN filter for a local session:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# monitor session 1
switch(config-monitor)# source interface Ethernet 1/7 rx
switch(config-monitor)# filter ip 10.1.1.1 255.255.255.255 20.1.1.1 255.255.255.255
```

```
switch(config-monitor)# destination interface Ethernet 1/48
switch(config-monitor)# no shut
switch(config-monitor)#
```

The following example shows how to configure a VLAN-based SPAN filter for a local session:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# monitor session 3
switch(config-monitor)# source vlan 200
switch(config-monitor)# destination interface Ethernet 1/4
switch(config-monitor)# no shut
switch(config-monitor)#
```

Configuring SPAN Sampling

You can configure sampling for local and ERSPAN-source sessions only.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.
Step 3	switch(config-monitor)# **source** {**interface** {**port-channel**} *channel-number* [**rx** | **tx** | **both**] | **vlan** *vlan-range*}	Configures port channel or VLAN sources. For VLAN sources, the monitored direction is implicit.
Step 4	switch(config-monitor)# **sampling** *sampling-range*	Configures a range for spanning packets. If the range is defined as *n*, every nth packet will be spanned. The sampling range is between 2 and 1023.
Step 5	switch(config-monitor)# **destination interface ethernet** *slot/port*	Configures the Ethernet SPAN destination port.

Example

The following example shows how to configure sampling on a VLAN for a local session:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# monitor session 1
switch(config-monitor)# source vlan 100
switch(config-monitor)# sampling 10
switch(config-monitor)# destination interface ethernet 1/48
switch(config-monitor)# no shut
switch(config-monitor)# show monitor session 1
   session 1
```

```
---------------
type              : local
state             : up
sampling          : 10
source intf       :
    rx            : Eth1/3        Eth1/7
    tx            :
    both          :
source VLANs      :
    rx            : 100
destination ports : Eth1/48

Legend: f = forwarding enabled, l = learning enabled
```

The following example shows how to configure sampling on an Ethernet interface for a local session:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# monitor session 3
switch(config-monitor)# source interface ethernet 1/8
switch(config-monitor)# sampling 20
switch(config-monitor)# destination interface ethernet 1/4
switch(config-monitor)# show monitor session 3
   session 3
---------------
type              : local
state             : down (No operational src/dst)
sampling          : 20
source intf       :
    rx            : Eth1/8
    tx            : Eth1/8
    both          : Eth1/8
source VLANs      :
    rx            : 200
destination ports : Eth1/4

Legend: f = forwarding enabled, l = learning enabled
```

Configuring SPAN Truncation

You can configure truncation for local and ERSPAN-source sessions only.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** *session-number*	Enters monitor configuration mode for the specified SPAN session.
Step 3	switch(config-monitor) # **source** {**interface** {**port-channel**} *channel-number* [**rx** | **tx** | **both**] | **vlan** *vlan-range*}	Configures port channel or VLAN sources. For VLAN sources, the monitored direction is implicit.

	Command or Action	Purpose
Step 4	switch(config-monitor) # **mtu** *size*	Configures the MTU size for truncation. Any SPAN packet that is larger than the configured MTU size is truncated to the configured size with a 4-byte offset. The MTU truncation size is between 64 bytes and 1518 bytes.
Step 5	switch(config-monitor)# **destination interface ethernet** *slot/port*	Configures the Ethernet SPAN destination port.

Example

The following example shows how to configure MTU truncation for a local session:

```
switch# configure terminal
switch(config)# monitor session 5
switch(config-monitor)# source interface ethernet 1/5 both
switch(config-monitor)# mtu 512
switch(config-monitor)# destination interface Ethernet 1/39
switch(config-monitor)# no shut
switch(config-monitor)# show monitor session 5
   session 5
---------------
type              : local
state             : down (No operational src/dst)
mtu               : 512
source intf       :
    rx            : Eth1/5
    tx            : Eth1/5
    both          : Eth1/5
source VLANs      :
    rx            :
destination ports : Eth1/39

Legend: f = forwarding enabled, l = learning enabled
```

Displaying SPAN Information

Procedure

	Command or Action	Purpose
Step 1	switch# **show monitor** [**session** {**all** | *session-number* | **range** *session-range*} [**brief**]]	Displays the SPAN configuration.

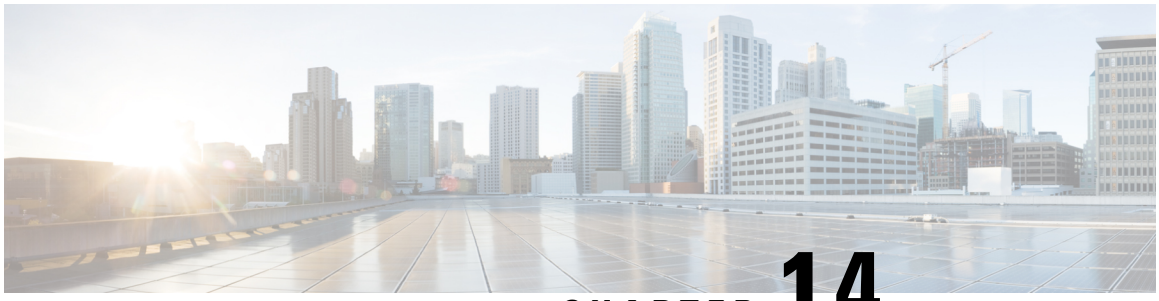
Example

The following example shows how to display SPAN session information:

```
switch# show monitor
SESSION  STATE        REASON                   DESCRIPTION
-------  -----------  -----------------------  --------------------------------
2        up           The session is up
3        down         Session suspended
4        down         No hardware resource
```

The following example shows how to display SPAN session details:

```
switch# show monitor session 2
   session 2
---------------
type              : local
state             : up
source intf       :
source VLANs      :
    rx            :
destination ports : Eth3/1
```



CHAPTER 14

Configuring ERSPAN

This chapter contains the following sections:

- Information About ERSPAN, on page 149
- Licensing Requirements for ERSPAN, on page 151
- Prerequisites for ERSPAN, on page 152
- Guidelines and Limitations for ERSPAN, on page 152
- Default Settings for ERSPAN, on page 154
- Configuring ERSPAN, on page 154
- Configuration Examples for ERSPAN, on page 166
- Additional References, on page 167

Information About ERSPAN

The Cisco NX-OS system supports the Encapsulated Remote Switching Port Analyzer (ERSPAN) feature on both source and destination ports. ERSPAN transports mirrored traffic over an IP network.

ERSPAN consists of an ERSPAN source session, routable ERSPAN generic routing encapsulation (GRE)-encapsulated traffic, and an ERSPAN destination session. You can separately configure ERSPAN source sessions and destination sessions on different switches.

ERSPAN Types

ERSPAN Type III supports all of the ERSPAN Type II features and functionality and adds these enhancements:

- Provides timestamp information in the ERSPAN Type III header that can be used to calculate packet latency among edge, aggregate, and core switches.
- Identifies possible traffic sources using the ERSPAN Type III header fields.

ERSPAN Sources

The interfaces from which traffic can be monitored are called ERSPAN sources. Sources designate the traffic to monitor and whether to copy ingress, egress, or both directions of traffic. ERSPAN sources include the following:

- Ethernet ports and port channels.

- VLANs—When a VLAN is specified as an ERSPAN source, all supported interfaces in the VLAN are ERSPAN sources.

ERSPAN source ports have the following characteristics:

- A port configured as a source port cannot also be configured as a destination port.
- ERSPAN does not monitor any packets that are generated by the supervisor, regardless of their source.

ERSPAN Destinations

ERSPAN destination sessions capture packets sent by ERSPAN source sessions on Ethernet ports or port channels and send them to the destination port. Destination ports receive the copied traffic from ERSPAN sources.

ERSPAN destination sessions are identified by the configured source IP address and ERSPAN ID. This allows multiple source sessions to send ERSPAN traffic to the same destination IP and ERSPAN ID and allows you to have multiple sources terminating at a single destination simultaneously.

ERSPAN destination ports have the following characteristics:

- A port configured as a destination port cannot also be configured as a source port.
- Destination ports do not participate in any spanning tree instance or any Layer 3 protocols.
- Ingress and ingress learning options are not supported on monitor destination ports.
- Host Interface (HIF) port channels and fabric port channel ports are not supported as SPAN destination ports.

ERSPAN Sessions

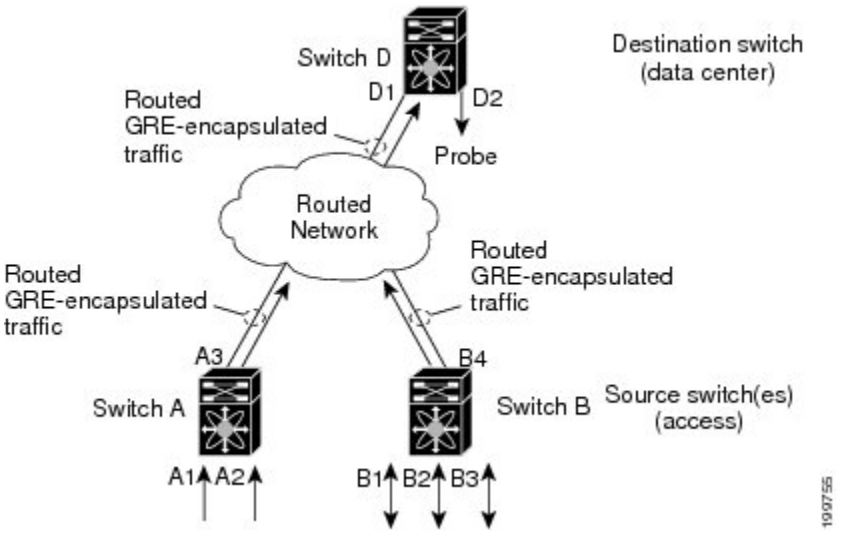
You can create ERSPAN sessions that designate sources and destinations to monitor.

When configuring ERSPAN source sessions, you must configure the destination IP address. When configuring ERSPAN destination sessions, you must configure the source IP address. See ERSPAN Sources, on page 149 for the properties of source sessions and ERSPAN Destinations, on page 150 for the properties of destination sessions.

Note Only eight unidirectional, or four bidirectional ERSPAN or SPAN source sessions can run simultaneously across all switches. Only 20 ERSPAN destination sessions can run simultaneously across all switches.

The following figure shows an ERSPAN configuration.

Figure 1: ERSPAN Configuration



Multiple ERSPAN Sessions

You can define up to eight unidirectional ERSPAN source or SPAN sessions, or four bidirectional ERSPAN source or SPAN sessions at one time. You can shut down any unused ERSPAN sessions.

For information about shutting down ERSPAN sessions, see Shutting Down or Activating an ERSPAN Session, on page 159.

ERSPAN Marker Packet

The type III ERSPAN header carries a hardware generated 32-bit timestamp. This timestamp field wraps periodically. When the switch is set to 1 ns granularity, this field wraps every 4.29 seconds. Such a wrap time makes it difficult to interpret the real value of the timestamp.

To recover the real value of the ERSPAN timestamp, Cisco NX-OS Release 6.0(2)A4(1) introduces a periodical marker packet to carry the original UTC timestamp information and provide a reference for the ERSPAN timestamp. The marker packet is sent out in 1-second intervals. Therefore, the destination site can detect the 32-bit wrap by checking the difference between the timestamp of the reference packet and the packet order.

High Availability

The ERSPAN feature supports stateless and stateful restarts. After a reboot or supervisor switchover, the running configuration is applied.

Licensing Requirements for ERSPAN

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	ERSPAN requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *License and Copyright Information for Cisco NX-OS Software* available at the following URL: http://www.cisco.com/en/US/docs/switches/datacenter/sw/4_0/nx-os/licensing/guide/nx-os_lisns.html

Prerequisites for ERSPAN

ERSPAN has the following prerequisite:

- You must first configure the Ethernet interfaces for ports on each device to support the desired ERSPAN configuration. For more information, see the Interfaces configuration guide for your platform.

Guidelines and Limitations for ERSPAN

ERSPAN has the following configuration guidelines and limitations:

- ERSPAN supports the following:
  - ERSPAN source session type (Packets are encapsulated as GRE-tunnel packets and sent on the IP network.)
  - ERSPAN destination session type (Support for decapsulating the ERSPAN packet is available. The encapsulated packet is decapsulated at the destination box and the plain decapsulated packet is spanned to a front panel port at the ERSPAN terminating point.)
- ERSPAN source sessions are shared with local SPAN sessions. You can configure a maximum of eight ERSPAN source or SPAN source sessions in a single direction; If both receive and transmit sources are configured in the same session, it counts as two sessions and you can configure four such bidirectional sessions at one time.
- If you install Cisco NX-OS 5.0(3)U2(2), configure ERSPAN, and then downgrade to a lower version of software, the ERSPAN configuration is lost. This situation occurs because ERSPAN is not supported in versions before Cisco NX-OS 5.0(3)U2(2).

  For information about a similar SPAN limitation, see Guidelines and Limitations for SPAN, on page 135.
- ERSPAN is not supported for packets generated by the supervisor.
- ERSPAN sessions are terminated identically at the destination router.
- ERSPAN is not supported for management ports.
- A destination port can be configured in multiple ERSPAN session at a time.
- You cannot configure a port as both a source and destination port.

- A single ERSPAN session can include mixed sources in any combination of the following:
  - Ethernet ports or port channels but not subinterfaces.
  - VLANs or port channels, which can be assigned to port channel subinterfaces.
  - The port channels to the control plane CPU.

Note ERSPAN does not monitor any packets that are generated by the supervisor, regardless of their source.

- Destination ports do not participate in any spanning tree instance or Layer 3 protocols.
- When an ERSPAN session contains source ports that are monitored in the transmit or transmit and receive direction, packets that these ports receive may be replicated to the ERSPAN destination port even though the packets are not actually transmitted on the source ports. Some examples of this behavior on source ports include:
  - Traffic that results from flooding
  - Broadcast and multicast traffic
- When Nexus 3548 is the ERSPAN destination, GRE headers are stripped off before sending mirrored packets out of the terminating point.
- ERSPAN does not support 1588 granularity mode, and rejects this mode if selected.
- ERSPAN supports 100 microseconds (μs), 100 nanoseconds (ns), and ns granularity.
- ERSPAN sends all timestamps in 32-bit format. Therefore, the timestamp field will wrap periodically. When the switch is set to ns granularity, this field will wrap every 4.29 seconds.
- A Layer 3 subinterface cannot be configured as an ERSPAN source interface.
- All ERSPAN sources terminating in a single destination box must use the same destination IP address.
- You cannot configure different source IP addresses in different ERSPAN destination sessions.
- Layer 3 switched traffic from VLAN X to VLAN Y, which is spanned through the ERSPAN source in either the Rx or Tx direction, will carry VLAN information in the ERSPAN header of VLAN X (the VLAN before Layer 3 switching or ingress VLAN).
- Multicast flood packets that do not go out of the ERSPAN source interface, which is configured for the egress (Tx) direction, can still reach the ERSPAN destination. This is because egress spanned packets are spanned before the original egress port is selectively enabled to receive specific frames and drop others, whereas the span for the Nexus 3548 switch application-specific integrated circuit (ASIC) is based on the monitor port's property. As a result, the spanned packet is still sent to the remote destination. This is expected behavior from platforms specific to multicast flood and is not seen for other traffic streams.
- Replicated multicast packets sent out of the ERSPAN source in the Tx direction are not sent to the ERSPAN destination.
- Beginning with Cisco NX-OS Release 6.0(2)A8(6), you can monitor the same source interfaces (physical port or port-channel) in multiple ERSPAN (type 2 or type 3) sessions.

- Configuring IP Filter on ERSPAN or Local SPAN with VLAN as source is not supported.

Default Settings for ERSPAN

The following table lists the default settings for ERSPAN parameters.

Table 29: Default ERSPAN Parameters

Parameters	Default
ERSPAN sessions	Created in the shut state.

Configuring ERSPAN

Configuring an ERSPAN Source Session

You can configure an ERSPAN session on the local device only. By default, ERSPAN sessions are created in the shut state.

For sources, you can specify Ethernet ports, port channels, and VLANs. A single ERSPAN session can include mixed sources in any combination of Ethernet ports or VLANs.

Note ERSPAN does not monitor any packets that are generated by the supervisor, regardless of their source.

Procedure

	Command or Action	Purpose

Step 1	**configure terminal**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**monitor erspan origin ip-address** *ip-address* **global** **Example:** `switch(config)# monitor erspan origin ip-address 10.0.0.1 global`	Configures the ERSPAN global origin IP address.
Step 3	**monitor erspan granularity 100_ns**{**100_us**|**100_ns**|**ns**} **Example:** `switch(config)# monitor erspan granularity 100_ns`	Configures the granularity of all ERSPAN sessions.

	Command or Action	Purpose
Step 4	**no monitor session** {*session-number* | **all**} **Example:** `switch(config)# no monitor session 3`	Clears the configuration of the specified ERSPAN session. The new session configuration is added to the existing session configuration.

Step 5	**monitor session** {*session-number* | **all**} **type erspan-source**
	Example:
	`switch(config)# monitor session 3 type erspan-source`
	`switch(config-erspan-src)#`
		Configures an ERSPAN source session.

Step 6	**header-type** *version* **Example:** `switch(config-erspan-src)# header-type 3`	(Optional) Changes the ERSPAN source session from Type II to Type III.
Step 7	**description** *description* **Example:** `switch(config-erspan-src)# description erspan_src_session_3`	Configures a description for the session. By default, no description is defined. The description can be up to 32 alphanumeric characters.

Step 8	**source** {[**interface**[*type slot/port*[*-port*][, *type slot/port[-port*]]] [**port-channel** *channel-number*]] | [**vlan** {*number* | *range*}]} [**rx** | **tx** | **both**]
	Example:
	`switch(config-erspan-src)# source interface ethernet 2/1-3, ethernet 3/1 rx`
	Example:
	`switch(config-erspan-src)# source interface port-channel 2`
	Example:
	`switch(config-erspan-src)# source interface sup-eth 0 both`
	Example:
	`switch(config-monitor)# source interface ethernet 101/1/1-3`	

Step 9	(Optional) Repeat Step 6 to configure all ERSPAN sources.	—
Step 10	**destination ip** *ip-address* **Example:** `switch(config-erspan-src)# destination ip 10.1.1.1`	Configures the destination IP address in the ERSPAN session. Only one destination IP address is supported per ERSPAN source session.

	Command or Action	Purpose
Step 11	**erspan-id** *erspan-id* **Example:** `switch(config-erspan-src)# erspan-id 5`	Configures the ERSPAN ID for the ERSPAN source session. The ERSPAN range is from 1 to 1023. This ID uniquely identifies a source and destination ERSPAN session pair. The ERSPAN ID configured in the corresponding destination ERSPAN session must be same as the one configured in the source session.
Step 12	**vrf** *vrf-name* **Example:** `switch(config-erspan-src)# vrf default`	Configures the VRF that the ERSPAN source session uses for traffic forwarding.
Step 13	(Optional) **ip ttl** *ttl-number* **Example:** `switch(config-erspan-src)# ip ttl 25`	Configures the IP time-to-live (TTL) value for the ERSPAN traffic. The range is from 1 to 255.
Step 14	(Optional) **ip dscp** *dscp-number* **Example:** `switch(config-erspan-src)# ip dscp 42`	Configures the differentiated services code point (DSCP) value of the packets in the ERSPAN traffic. The range is from 0 to 63.
Step 15	**no shut** **Example:** `switch(config-erspan-src)# no shut`	Enables the ERSPAN source session. By default, the session is created in the shut state. **Note** Only two ERSPAN source sessions can be running simultaneously.
Step 16	(Optional) **show monitor session** {**all** | *session-number* | **range** *session-range*} **Example:** `switch(config-erspan-src)# show monitor session 3`	Displays the ERSPAN session configuration.
Step 17	(Optional) **show running-config monitor** **Example:** `switch(config-erspan-src)# show running-config monitor`	Displays the running ERSPAN configuration.
Step 18	(Optional) **show startup-config monitor** **Example:** `switch(config-erspan-src)# show startup-config monitor`	Displays the ERSPAN startup configuration.
Step 19	(Optional) **copy running-config startup-config** **Example:**	Copies the running configuration to the startup configuration.

	Command or Action	Purpose
	`switch(config-erspan-src)# copy running-config startup-config`	

Configuring an ERSPAN Destination Session

You can configure an ERSPAN destination session to copy packets from a source IP address to destination ports on the local device. By default, ERSPAN destination sessions are created in the shut state.

Before you begin

Ensure that you have already configured the destination ports in monitor mode.

Procedure

	Command or Action	Purpose

Step 1	**config t**
	Example:
	`switch# config t`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**interface ethernet** *slot/port*[*-port*]
	Example:
	`switch(config)# interface ethernet 2/5`
	`switch(config-if)#`
		Enters interface configuration mode on the selected slot and port or range of ports.

Step 3	**switchport** **Example:** `switch(config-if)# switchport`	Configures switchport parameters for the selected slot and port or range of ports.
Step 4	**switchport mode** [**access** | **trunk**] **Example:** `switch(config-if)# switchport mode trunk`	Configures the following switchport modes for the selected slot and port or range of ports: • access • trunk
Step 5	**switchport monitor** **Example:** `switch(config-if)# switchport monitor`	Configures the switch interface in monitor mode. To configure an interface to be an ERSPAN or SPAN destination (using the **destination interface ethernet** *interface* command), it must first be configured in monitor mode.
Step 6	Repeat Steps 2 to 5 to configure monitoring on additional ERSPAN destinations.	—

	Command or Action	Purpose
Step 7	**no monitor session** {*session-number* | **all**} **Example:** `switch(config-if)# no monitor session 3`	Clears the configuration of the specified ERSPAN session. The new session configuration is added to the existing session configuration.

Step 8	**monitor session** {*session-number* | **all**} **type erspan-destination**
	Example:
	`switch(config-if)# monitor session 3 type erspan-destination`
	`switch(config-erspan-dst)#`
		Configures an ERSPAN destination session.

Step 9	**description** *description* **Example:** `switch(config-erspan-dst)# description erspan_dst_session_3`	Configures a description for the session. By default, no description is defined. The description can be up to 32 alphanumeric characters.
Step 10	**source ip** *ip-address* **Example:** `switch(config-erspan-dst)# source ip 10.1.1.1`	Configures the source IP address in the ERSPAN session. Only one source IP address is supported per ERSPAN destination session. This IP address must match the destination IP address that is configured in the corresponding ERSPAN source session.
Step 11	**destination** {[**interface** [*type slot/port*[*-port*], [*type slot/port* [*port*]]]} **Example:** `switch(config-erspan-dst)# destination interface ethernet 2/5`	Configures a destination for copied source packets. You can configure only interfaces as a destination. **Note** You can configure destination ports as trunk ports.
Step 12	**erspan-id** *erspan-id* **Example:** `switch(config-erspan-dst)# erspan-id 5`	Configures the ERSPAN ID for the ERSPAN session. The range is from 1 to 1023. This ID uniquely identifies a source and destination ERSPAN session pair. The ERSPAN ID configured in the corresponding destination ERSPAN session must be same as the one configured in the source session.
Step 13	**no shut** **Example:** `switch(config)# no shut`	Enables the ERSPAN destination session. By default, the session is created in the shut state. **Note** Only 16 active ERSPAN destination sessions can be running simultaneously.
Step 14	(Optional) **show monitor session** {**all** | *session-number* | **range** *session-range*} **Example:**	Displays the ERSPAN session configuration.

	Command or Action	Purpose
	`switch(config)# show monitor session 3`	
Step 15	(Optional) **show running-config monitor** **Example:** `switch(config-erspan-src)# show running-config monitor`	Displays the running ERSPAN configuration.
Step 16	(Optional) **show startup-config monitor** **Example:** `switch(config-erspan-src)# show startup-config monitor`	Displays the ERSPAN startup configuration.
Step 17	(Optional) **copy running-config startup-config** **Example:** `switch(config-erspan-src)# copy running-config startup-config`	Copies the running configuration to the startup configuration.

Shutting Down or Activating an ERSPAN Session

You can shut down ERSPAN sessions to discontinue the copying of packets from sources to destinations. Because only a specific number of ERSPAN sessions can be running simultaneously, you can shut down a session to free hardware resources to enable another session. By default, ERSPAN sessions are created in the shut state.

You can enable ERSPAN sessions to activate the copying of packets from sources to destinations. To enable an ERSPAN session that is already enabled but operationally down, you must first shut it down and then enable it. You can shut down and enable the ERSPAN session states with either a global or monitor configuration mode command.

Procedure

	Command or Action	Purpose

Step 1	**configuration terminal**
	Example:
	`switch# configuration terminal`
	`switch(config)#`
		Enters global configuration mode.

Step 2	**monitor session** {*session-range* | **all**} **shut** **Example:** `switch(config)# monitor session 3 shut`	Shuts down the specified ERSPAN sessions. The session range is from 1 to 48.. By default, sessions are created in the shut state.
Step 3	**no monitor session** {*session-range* | **all**} **shut** **Example:**	Resumes (enables) the specified ERSPAN sessions. The session range is from 1 to 48.. By default, sessions are created in the shut state. .

	Command or Action	Purpose
	`switch(config)# no monitor session 3 shut`	**Note** If a monitor session is enabled but its operational status is down, then to enable the session, you must first specify the **monitor session shut** command followed by the **no monitor session shut** command.

Step 4	**monitor session** *session-number* **type erspan-source**
	Example:
	`switch(config)# monitor session 3 type erspan-source`
	`switch(config-erspan-src)#`
		Enters the monitor configuration mode for the ERSPAN source type. The new session configuration is added to the existing session configuration.

Step 5	**monitor session** *session-number* **type erspan-destination** **Example:** `switch(config-erspan-src)# monitor session 3 type erspan-destination`	Enters the monitor configuration mode for the ERSPAN destination type.
Step 6	**shut** **Example:** `switch(config-erspan-src)# shut`	Shuts down the ERSPAN session. By default, the session is created in the shut state.
Step 7	**no shut** **Example:** `switch(config-erspan-src)# no shut`	Enables the ERSPAN session. By default, the session is created in the shut state.
Step 8	(Optional) **show monitor session all** **Example:** `switch(config-erspan-src)# show monitor session all`	Displays the status of ERSPAN sessions.
Step 9	(Optional) **show running-config monitor** **Example:** `switch(config-erspan-src)# show running-config monitor`	Displays the running ERSPAN configuration.
Step 10	(Optional) **show startup-config monitor** **Example:** `switch(config-erspan-src)# show startup-config monitor`	Displays the ERSPAN startup configuration.
Step 11	(Optional) **copy running-config startup-config** **Example:**	Copies the running configuration to the startup configuration.

	Command or Action	Purpose
	`switch(config-erspan-src)# copy running-config startup-config`	

Configuring ERSPAN Filtering

You can configure SPAN filters for local and ERSPAN-source sessions only. SPAN and ERSPAN Filtering, on page 137 provides more information about filters.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** {*session-number* | **all**} **type erspan-source**	Configures an ERSPAN source session.
Step 3	switch(config-erspan-src)# **filter** {**ip** *source-ip-address source-ip-mask destination-ip-address destination-ip-mask*}	Creates an ERSPAN filter.
Step 4	switch(config-erspan-src)# **erspan-id** *erspan-id*	Configures the ERSPAN ID for the ERSPAN source session. The ERSPAN range is from 1 to 1023. This ID uniquely identifies a source and destination ERSPAN session pair. The ERSPAN ID configured in the corresponding destination ERSPAN session must be same as the one configured in the source session.
Step 5	switch(config-erspan-src)# **vrf** *vrf-name*	Configures the VRF that the ERSPAN source session uses for traffic forwarding.
Step 6	switch(config-erspan-src)# **destination ip** *ip-address*	Configures the destination IP address in the ERSPAN session. Only one destination IP address is supported per ERSPAN source session.
Step 7	switch(config-erspan-src)# **source** [**interface** [*type slot/port*] | **port-channel** *channel-number*] | [**vlan** *vlan-range*] [**rx** | **tx** | **both**]	Configures the sources and traffic direction in which to copy packets. You can enter a range of Ethernet ports, a port channel, or a range of VLANs. You can configure one or more sources, as either a series of comma-separated entries or a range of numbers. You can specify up to 128 interfaces. You can specify the traffic direction to copy as ingress, egress, or both. The default direction is both.

Example

The following example shows how to configure an MAC-based filter for an ERSPAN-source session:

```
switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# monitor session 2 type erspan-source
switch(config-erspan-src)# filter abcd.ef12.3456 1111.2222.3333 1234.5678.9012 1111.2222.3333
switch(config-erspan-src)# erspan-id 20
switch(config-erspan-src)# vrf default
switch(config-erspan-src)# destination ip 200.1.1.1
switch(config-erspan-src)# source interface Ethernet 1/47 rx
switch(config-erspan-src)# no shut
switch(config-erspan-src)#
```

The following example shows how to configure a VLAN-based filter for an ERSPAN-source session:

```
switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# monitor session 2 type erspan-source
switch(config-erspan-src)# filter abcd.ef12.3456 1111.2222.3333 1234.5678.9012 1111.2222.3333
switch(config-erspan-src)# erspan-id 21
switch(config-erspan-src)# vrf default
switch(config-erspan-src)# destination ip 200.1.1.1
switch(config-erspan-src)# source interface Ethernet 1/47 rx
switch(config-erspan-src)# source vlan 315
switch(config-erspan-src)# mtu 200
switch(config-erspan-src)# no shut
switch(config-erspan-src)#
```

Configuring ERSPAN Sampling

You can configure sampling for local and ERSPAN-source sessions only. SPAN and ERSPAN Sampling, on page 138 provides more information about sampling.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** {*session-number* | **all**} **type erspan-source**	Configures an ERSPAN source session.
Step 3	switch(config-erspan-src)# **sampling** *sampling-range*	Configures a range for spanning packets. If the range is defined as n, every nth packet will be spanned. The sampling range is between 2 and 1023.
Step 4	switch(config-erspan-src)# **erspan-id** *erspan-id*	Configures the ERSPAN ID for the ERSPAN source session. The ERSPAN range is from 1 to 1023. This ID uniquely identifies a source and destination ERSPAN session pair. The ERSPAN ID configured in the corresponding

	Command or Action	Purpose
		destination ERSPAN session must be same as the one configured in the source session.
Step 5	switch(config-erspan-src)# **vrf** *vrf-name*	Configures the VRF that the ERSPAN source session uses for traffic forwarding.
Step 6	switch(config-erspan-src)# **destination ip** *ip-address*	Configures the destination IP address in the ERSPAN session. Only one destination IP address is supported per ERSPAN source session.
Step 7	switch(config-erspan-src)# **source** [**interface** *type slot/port* | **port-channel** *channel-number*] | [**vlan** *vlan-range*] [**rx** | **tx** | **both**]	Configures the sources and traffic direction in which to copy packets. You can enter a range of Ethernet ports, a port channel, or a range of VLANs. You can configure one or more sources, as either a series of comma-separated entries or a range of numbers. You can specify up to 128 interfaces. You can specify the traffic direction to copy as ingress, egress, or both. The default direction is both.

Example

The following example shows how to configure sampling for an ERSPAN-source session:

```
switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# monitor session 2 type erspan-source
switch(config-erspan-src)# sampling 40
switch(config-erspan-src)# erspan-id 30
switch(config-erspan-src)# vrf default
switch(config-erspan-src)# destination ip 200.1.1.1
switch(config-erspan-src)# source interface ethernet 1/47
switch(config-erspan-src)# show monitor session 2
session 2
---------------
type : erspan-source
state : up
granularity : 100 microseconds
erspan-id : 30
vrf-name : default
destination-ip : 200.1.1.1
ip-ttl : 255
ip-dscp : 0
header-type : 2
mtu : 200
sampling : 40
origin-ip : 150.1.1.1 (global)
source intf :
rx : Eth1/47
tx : Eth1/47
both : Eth1/47
```

```
source VLANs :
rx : 315
switch(config-erspan-src)#
```

Configuring ERSPAN Truncation

You can configure truncation for local and ERSPAN-source sessions only. SPAN and ERSPAN Truncation, on page 139 provides more information about truncation.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **monitor session** {*session-number* | **all**} **type erspan-source**	Configures an ERSPAN source session.
Step 3	switch(config-erspan-src)# **mtu** *size*	Configures the MTU size for truncation. Any SPAN packet that is larger than the configured MTU size is truncated to the configured size with a 4-byte offset. The MTU truncation size is between 64 bytes and 1518 bytes.
Step 4	switch(config-erspan-src)# **erspan-id** *erspan-id*	Configures the ERSPAN ID for the ERSPAN source session. The ERSPAN range is from 1 to 1023. This ID uniquely identifies a source and destination ERSPAN session pair. The ERSPAN ID configured in the corresponding destination ERSPAN session must be same as the one configured in the source session.
Step 5	switch(config-erspan-src)# **vrf** *vrf-name*	Configures the VRF that the ERSPAN source session uses for traffic forwarding.
Step 6	switch(config-erspan-src)# **destination ip** *ip-address*	Configures the destination IP address in the ERSPAN session. Only one destination IP address is supported per ERSPAN source session.
Step 7	switch(config-erspan-src)# **source** [**interface** *type slot/port* | **port-channel** *channel-number*] | [**vlan** *vlan-range*] [**rx** | **tx** | **both**]	Configures the sources and traffic direction in which to copy packets. You can enter a range of Ethernet ports, a port channel, or a range of VLANs. You can configure one or more sources, as either a series of comma-separated entries or a range of numbers. You can specify up to 128 interfaces.

	Command or Action	Purpose
		You can specify the traffic direction to copy as ingress, egress, or both. The default direction is both.

Example

The following example shows how to configure MTU truncation for an ERSPAN-source session:

```
switch# configure terminal
switch(config)# monitor session 6 type erspan-source
switch(config-erspan-src)# mtu 1096
switch(config-erspan-src)# erspan-id 40
switch(config-erspan-src)# vrf default
switch(config-erspan-src)# destination ip 200.1.1.1
switch(config-erspan-src)# source interface ethernet 1/40
switch(config-erspan-src)# show monitor session 6
session 6
---------------
type : erspan-source
state : down (Session admin shut)
granularity : 100 microseconds
erspan-id : 40
vrf-name : default
destination-ip : 200.1.1.1
ip-ttl : 255
ip-dscp : 0
header-type : 2
mtu : 1096
origin-ip : 150.1.1.1 (global)
source intf :
rx : Eth1/40
tx : Eth1/40
both : Eth1/40
source VLANs :
rx :
```

Configuring an ERSPAN Marker Packet

Use the following commands to configure an ERSPAN marker packet:

Command	Purpose
marker-packet seconds	Enables the ERSPAN marker packet for a session. The interval can range from 1 second to 4 seconds.
marker-packet milliseconds	Enables the ERSPAN marker packet for a session. The interval can range from 100 milliseconds to 900 milliseconds, with increments in multiples of 100.
no marker-packet	Disables the ERSPAN marker packet for a session.

Example

This example shows how to enable the ERSPAN marker packet with an interval of 2 seconds:

Note Configuring the interval parameter is optional. If you enable the marker-packet without specifying a parameter, it uses the default or existing interval as the interval value. The **marker-packet** command only enables the marker-packet.

```
switch# configure terminal
switch(config)# monitor erspan origin ip-address 172.28.15.250 global
switch(config)# monitor session 1 type erspan-source
switch(config)# header-type 3
switch(config-erspan-src)# erspan-id 1
switch(config-erspan-src)# ip ttl 16
switch(config-erspan-src)# ip dscp 5
switch(config-erspan-src)# vrf default
switch(config-erspan-src)# destination ip 9.1.1.2
switch(config-erspan-src)# source interface e1/15 both
switch(config-erspan-src)# marker-packet 2
switch(config-erspan-src)# no shut
switch(config-erspan-src)# exit
```

Verifying the ERSPAN Configuration

Use the following command to verify the ERSPAN configuration information:

Command	Purpose
show monitor session {**all** | *session-number* | **range** *session-range*}	Displays the ERSPAN session configuration.
show running-config monitor	Displays the running ERSPAN configuration.
show startup-config monitor	Displays the ERSPAN startup configuration.

Configuration Examples for ERSPAN

Configuration Example for an ERSPAN Source Session

The following example shows how to configure an ERSPAN source session:

```
switch# config t
switch(config)# interface e14/30
switch(config-if)# no shut
switch(config-if)# exit
switch(config)# monitor erspan origin ip-address 3.3.3.3 global
switch(config)# monitor erspan granularity 100_ns
switch(config-erspan-src)# header-type 3
switch(config)# monitor session 1 type erspan-source
```

```
switch(config-erspan-src)# source interface e14/30
switch(config-erspan-src)# erspan-id 1
switch(config-erspan-src)# ip ttl 16
switch(config-erspan-src)# ip dscp 5
switch(config-erspan-src)# destination ip 9.1.1.2
switch(config-erspan-src)# no shut
switch(config-erspan-src)# exit
switch(config)# show monitor session 1
```

Note **switch(config)# monitor erspan granularity 100_ns** and **switch(config-erspan-src)# header-type 3** are used only while configuring Type III source sessions.

Configuration Example for an ERSPAN Destination Session

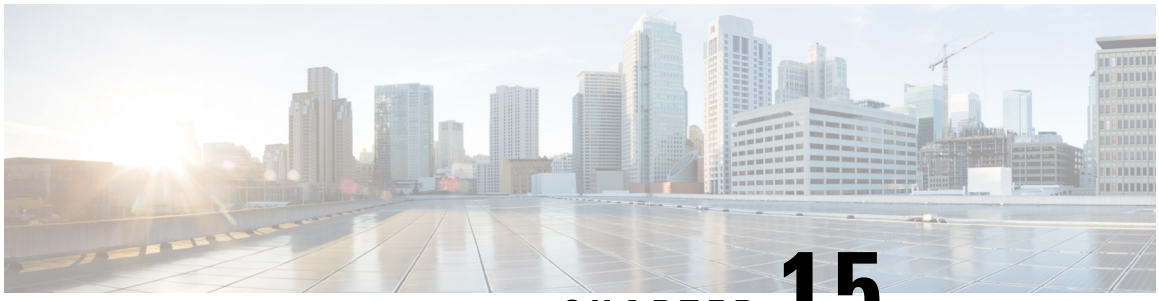
The following example shows how to configure an ERSPAN destination session:

```
switch# config t
switch(config)# interface e14/29
switch(config-if)# no shut
switch(config-if)# switchport
switch(config-if)# switchport monitor
switch(config-if)# exit
switch(config)# monitor session 2 type erspan-destination
switch(config-erspan-dst)# source ip 9.1.1.2
switch(config-erspan-dst)# destination interface e14/29
switch(config-erspan-src)# erspan-id 1
switch(config-erspan-dst)# no shut
switch(config-erspan-dst)# exit
switch(config)# show monitor session 2
```

Additional References

Related Documents

Related Topic	Document Title
ERSPAN commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Cisco Nexus NX-OS System Management Command Reference* for your platform.



CHAPTER 15

Configuring Warp SPAN

This chapter contains the following sections:

- Information About Warp SPAN, on page 169
- Guidelines and Limitations for Warp Span, on page 170
- Configuring Warp SPAN, on page 171
- Verifying Warp SPAN Mode Configuration, on page 172
- Feature History for Warp SPAN, on page 173

Information About Warp SPAN

Warp SPAN is AlgoBoost feature that spans the traffic coming into a dedicated port to a group of ports at very low latency. In Warp SPAN, traffic arriving at one dedicated ingress port is replicated to a user configurable group of egress ports. The packet replication happens without any filters or lookup mechanisms. Unlike normal or Warp mode traffic forwarding, the incoming traffic is replicated before any traffic classification or ACL processing occurs. Because traffic bypasses these processes, the latency for the replicated packets is as low as 50ns. The Warp SPAN functions independently and simultaneously to normal traffic forwarding. For example, the incoming source traffic can be switched, routed, multicast replicated, and so on, while at the same time this incoming traffic is warp spanned to multiple destination ports.

The original traffic ingressing the dedicated source port is forwarded normally with nominal switch latency, along with the Warp SPAN traffic at about 50ns to the configured destination ports. Warp SPAN can be enabled both in normal traffic forwarding mode and Warp mode.

The source can be monitored only in the ingress direction and is not configurable. The source port is configured automatically as soon as you configure the Warp SPAN session.

You configure the dedicated source Layer 2/Layer 3 port (must be Ethernet port 1/36) with standard configuration as required by the network.

You configure destination ports similar to any regular SPAN destination port. The destination ports cannot be used as regular Layer 2/Layer 3 ports. Destination ports must be configured in groups of four, so you can create a maximum of 12 groups with a total of 47 destination ports (one port—port 1/36—is the fixed source port). See the following table.

Table 30: Warp SPAN Groups

Group	Destination Ports
1	1-4

Group	Destination Ports
2	5-8
3	9-12
4	13-16
5	17-20
6	21-24
7	25-28
8	29-32
9	33-35 [1]
10	37-40
11	41-44
12	45-48

[1] Port 36 is the dedicated source port.

Guidelines and Limitations for Warp Span

Warp SPAN has the following configuration guidelines and limitations:

- Source and destination Warp SPAN ports must all be 10G.
- Configuring the source/destination interface as a port-channel member is not allowed.
- The source port is not configurable and is fixed as Ethernet port 1/36.
- You can create a maximum of 12 groups with a total of 47 destination ports. All of the groups have four ports, except for group 9, which has only three ports and excludes port 1/36 (the fixed source port).
- All four ports in a group must be configured with the **switchport monitor** command before they can be grouped in a SPAN destination group.
- Warp SPAN does not allow the destination group to be configured unless all of the ports are administratively up. After the group has been configured, you can bring up or down any of the ports in the SPAN destination group. If you copy a working warp configuration that has one or more ports in the administratively down state and paste that configuration back in the configuration file of the same switch, Warp SPAN logs the following error:

  ```
  ERROR: Cannot configure group with member interfaces in admin DOWN state
  ```

- The use of the same source interface on Warp SPAN and ERSPAN is not supported.

Configuring Warp SPAN

You configure Warp SPAN by enabling it and then configuring its destination groups.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config-monitor)# **interface ethernet** *port/slot*	Enters interface configuration mode for the specified interface. **Note** You can specify a range to configure multiple interfaces at once.
Step 3	switch(config-if)# **switchport monitor**	Sets the interface to monitor mode. Priority flow control (PFC) is disabled when the port is configured as a SPAN destination.
Step 4	switch(config-if)# **no shutdown**	Brings the interface administratively up.
Step 5	switch(config)# **monitor session warp**	Enables Warp SPAN on the interface.
Step 6	switch(config)# **no shutdown**	Brings the interface administratively up.
Step 7	switch(conifig-monitor)# **destination group** *group-number*	Configures the destination group. **Note** You can create a maximum of 12 groups with a total of 47 destination ports. All of the groups have four ports, except for group 9, which has only three ports and excludes port 1/36 (the fixed source port).
Step 8	(Optional) switch(config-if)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

The following example shows how to configure destination SPAN ports 1/1-4 for Warp SPAN:

```
switch# configure terminal
switch(config-monitor)# interface ethernet 1/1-4
switch(config-if-range)# switchport monitor
switch(config-if-range)# no shutdown
switch(config)# monitor session warp
switch(config)# no shutdown
switch(config-monitor)# destination group 1
switch(config-if-range)# copy running-config startup-config
```

Verifying Warp SPAN Mode Configuration

You can verify the Warp SPAN mode configuration.

Procedure

	Command or Action	Purpose
Step 1	switch(config)# **show monitor session** {*number* | **all** | *range*}	Displays information about a specific SPAN session, all SPAN sessions, or a range of SPAN sessions.
Step 2	switch(config)# **show monitor session warp**	Displays information about only the Warp SPAN sessions.

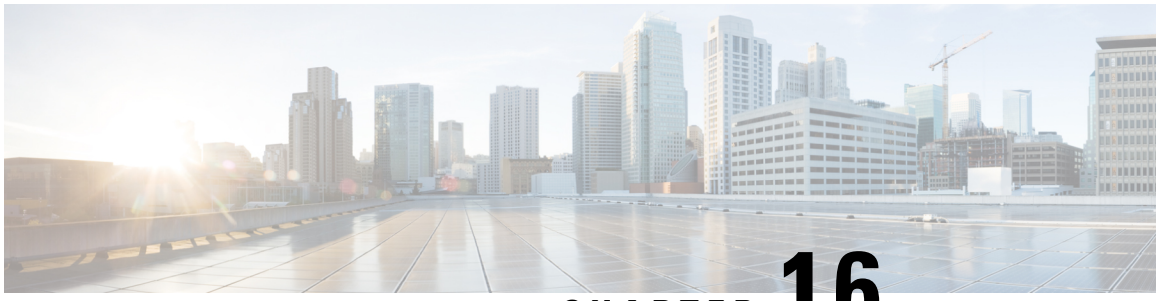
Example

This example shows how to display information about all SPAN sessions and only the Warp SPAN sessions:

```
switch(config)# show monitor session all
session warp
---------------
type : local
state : up
source intf :
rx : Eth1/36
tx :
both :
source VLANs :
rx :
destination ports : Eth1/1 Eth1/2 Eth1/3 Eth1/4

Legend: f = forwarding enabled, l = learning enabled


switch(config)# show monitor session warp
session warp
---------------
type : local
state : up
source intf :
rx : Eth1/36
tx :
both :
source VLANs :
rx :
destination ports : Eth1/1 Eth1/2 Eth1/3 Eth1/4

Legend: f = forwarding enabled, l = learning enabled
```

Feature History for Warp SPAN

Feature Name	Release	Feature Information
Warp SPAN	5.0(3)A1(2)	This feature was introduced.



CHAPTER 16

Configuring DNS

This chapter contains the following sections:

- Information About DNS Client , on page 175
- Prerequisites for DNS Clients, on page 176
- Licensing Requirements for DNS Clients, on page 176
- Default Settings for DNS Clients, on page 176
- Configuring DNS Clients, on page 176

Information About DNS Client

If your network devices require connectivity with devices in networks for which you do not control name assignment, you can assign device names that uniquely identify your devices within the entire internetwork using the domain name server (DNS). DNS uses a hierarchical scheme for establishing hostnames for network nodes, which allows local control of the segments of the network through a client-server scheme. The DNS system can locate a network device by translating the hostname of the device into its associated IP address.

On the Internet, a domain is a portion of the naming hierarchy tree that refers to general groupings of networks based on the organization type or geography. Domain names are pieced together with periods (.) as the delimiting characters. For example, Cisco is a commercial organization that the Internet identifies by a com domain, so its domain name is cisco.com. A specific hostname in this domain, the File Transfer Protocol (FTP) system, for example, is identified as ftp.cisco.com.

Name Servers

Name servers keep track of domain names and know the parts of the domain tree for which they have complete information. A name server may also store information about other parts of the domain tree. To map domain names to IP addresses in Cisco NX-OS, you must first identify the hostnames, then specify a name server, and enable the DNS service.

Cisco NX-OS allows you to statically map IP addresses to domain names. You can also configure Cisco NX-OS to use one or more domain name servers to find an IP address for a hostname.

DNS Operation

A name server handles client-issued queries to the DNS server for locally defined hosts within a particular zone as follows:

- An authoritative name server responds to DNS user queries for a domain name that is under its zone of authority by using the permanent and cached entries in its own host table. If the query is for a domain name that is under its zone of authority but for which it does not have any configuration information, the authoritative name server replies that no such information exists.
- A name server that is not configured as the authoritative name server responds to DNS user queries by using information that it has cached from previously received query responses. If no router is configured as the authoritative name server for a zone, queries to the DNS server for locally defined hosts receive nonauthoritative responses.

Name servers answer DNS queries (forward incoming DNS queries or resolve internally generated DNS queries) according to the forwarding and lookup parameters configured for the specific domain.

High Availability

Cisco NX-OS supports stateless restarts for the DNS client. After a reboot or supervisor switchover, Cisco NX-OS applies the running configuration.

Prerequisites for DNS Clients

The DNS client has the following prerequisites:

- You must have a DNS name server on your network.

Licensing Requirements for DNS Clients

The following table shows the licensing requirements for this feature:

Product	Licence Requirement
Cisco NX-OS	DNS requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For a complete explanation of the Cisco NX-OS licensing scheme, see the *Cisco NX-OS Licensing Guide*.

Default Settings for DNS Clients

The following table shows the default settings for DNS client parameters.

Parameter	Default
DNS client	Enabled

Configuring DNS Clients

You can configure the DNS client to use a DNS server on your network.

Before you begin

Ensure that you have a domain name server on your network.

Procedure

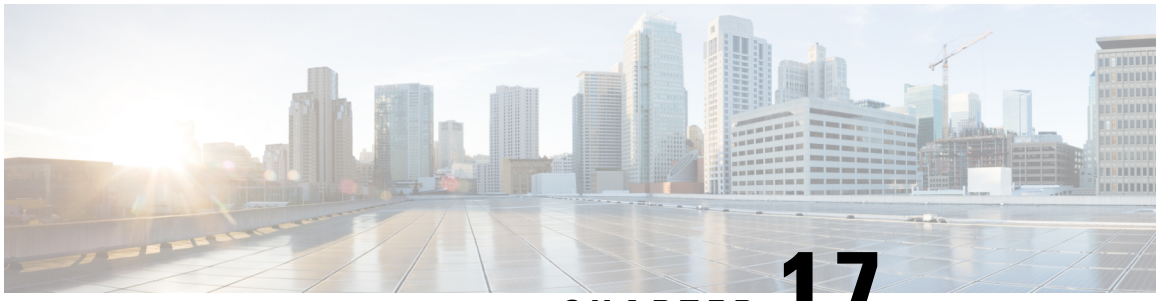
	Command or Action	Purpose
Step 1	switch# **configuration terminal**	Enters global configuration mode.
Step 2	switch(config)# vrf context managment	Specifies a configurable virtual and routing (VRF) name.
Step 3	switch(config)# **ip host** *name address1 [address2... address6]*	Defines up to six static hostname-to-address mappings in the host name cache.
Step 4	(Optional) switch(config)# **ip domain name** *name* [**use-vrf** *vrf-name*]	Defines the default domain name server that Cisco NX-OS uses to complete unqualified hostnames. You can optionally define a VRF that Cisco NX-OS uses to resolve this domain name server if it cannot be resolved in the VRF that you configured this domain name under. Cisco NX-OS appends the default domain name to any host name that does not contain a complete domain name before starting a domain-name lookup.
Step 5	(Optional) switch(config)# **ip domain-list** *name* [**use-vrf** *vrf-name*]	Defines additional domain name servers that Cisco NX-OS can use to complete unqualified hostnames. You can optionally define a VRF that Cisco NX-OS uses to resolve this domain name server if it cannot be resolved in the VRF that you configured this domain name under. Cisco NX-OS uses each entry in the domain list to append that domain name to any hostname that does not contain a complete domain name before starting a domain-name lookup. Cisco NX-OS continues this for each entry in the domain list until it finds a match.
Step 6	(Optional) switch(config)# **ip name-server** *server-address1 [server-address2... server-address6]* **[use-vrf** *vrf-name*]	Defines up to six name servers. The address can be either an IPv4 address or an IPv6 address. You can optionally define a VRF that Cisco NX-OS uses to reach this name server if it cannot be reached in the VRF that you configured this name server under.
Step 7	(Optional) switch(config)# **ip domain-lookup**	Enables DNS-based address translation. This feature is enabled by default.
Step 8	(Optional) switch(config)# **show hosts**	Displays information about DNS.

	Command or Action	Purpose
Step 9	switch(config)# **exit**	Exits configuration mode and returns to EXEC mode.
Step 10	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure a default domain name and enable DNS lookup:

```
switch# config t
switch(config)# vrf context management
switch(config)# ip domain-name mycompany.com
switch(config)# ip name-server 172.68.0.10
switch(config)# ip domain-lookup
```



CHAPTER 17

Configuring Traffic Forwarding Modes

This chapter contains the following sections:

- Information About Warp Mode, on page 179
- Guidelines and Limitations for Warp Mode, on page 179
- Enabling and Disabling Warp Mode, on page 180
- Verifying Warp Mode Status, on page 180
- Feature History for Warp Mode, on page 181

Information About Warp Mode

The Cisco Nexus device uses a hardware component called the Algorithm Boost Engine (Algo Boost Engine) to support a forwarding mechanism, called warp mode. In warp mode, the access path is shortened by consolidating the forwarding table into single table, resulting in faster processing of frames and packets. In warp mode, latency is reduced by up to 20 percent. For more information about the Algo Boost Engine, see Active Buffer Monitoring Overview, on page 183.

Guidelines and Limitations for Warp Mode

Warp mode has the following configuration guidelines and limitations:

- Warp mode provides up to 20 percent better switch latency than normal forwarding.
- In warp mode, unicast route tables are reduced. The route table is reduced from 24000 to 4000 entries. The host table and MAC table are reduced from 64000 to 8000 entries. (The multicast route table remains the same at 8000 entries.)
- In warp mode, the following features are not supported:
  - Egress Routed Access Control Lists (RACLs)
  - Port Access Control Lists (PACLs)
  - Equal-cost Multipathing (ECMP)
  - IP Redirect

Enabling and Disabling Warp Mode

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **hardware profile forwarding-mode warp**	Enables warp mode on the device. To disable warp mode, use the **no** form of this command. The default is warp mode disabled.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.
Step 4	Reload the switch.	—

Example

This example shows how to enable warp mode on the device:

```
switch# configuration terminal
switch(config)# hardware profile forwarding-mode warp
Warning: This command will take effect only after saving the configuration (copy r s)
switch(config)# copy running-config startup-config
switch(config)#
```

This example shows how to disable warp mode on the device:

```
switch# configuration terminal
switch(config)# no hardware profile forwarding-mode warp
Warning: This command will take effect only after saving the configuration (copy r s)
switch(config)# copy running-config startup-config
```

Verifying Warp Mode Status

Procedure

	Command or Action	Purpose
Step 1	switch# **show hardware profile forwarding-mode**	Displays information about warp mode and the host, unicast, multicast, and Layer 2 ternary content addressable memory (TCAM) sizes.

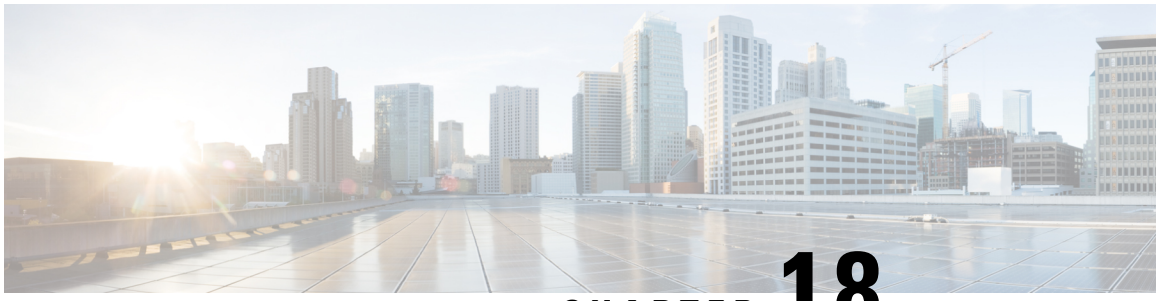
Example

This example shows how to display information about warp mode:

```
switch# show hardware profile forwarding-mode
==========================
 forwarding-mode : warp
==========================
 host      size  = 8192
 unicast   size  = 4096
 multicast size  = 8192
 l2        size  = 8192
switch#
```

Feature History for Warp Mode

Feature Name	Release	Feature Information
Warp Mode	5.0(3)A1(1)	This feature was introduced.



CHAPTER 18

Configuring Active Buffer Monitoring

This chapter contains the following sections:

- Information About Active Buffer Monitoring, on page 183
- Configuring Active Buffer Monitoring, on page 184
- Displaying Buffer Histogram Data, on page 185

Information About Active Buffer Monitoring

Active Buffer Monitoring Overview

The Active Buffer Monitoring feature provides detailed buffer occupancy data to help you detect network congestion, review past events to understand when and how network congestion is affecting network operations, understand historical trending, and identify patterns of application traffic flow.

A hardware component, called the Algorithm Boost Engine (Algo Boost Engine) supports buffer histogram counters for unicast buffer usage per individual port, total buffer usage per buffer block, and multicast buffer usage per buffer block. Each histogram counter has 18 buckets that span across the memory block. The Algo Boost Engine polls buffer usage data every hardware sampling interval (the default is every 4 milliseconds, but you can configure it to be as low as 10 nanoseconds). Based on the buffer utilization, the corresponding histogram counter is incremented. For example, if Ethernet port 1/4 is consuming 500 KB of the buffer, the bucket 2 counter (which represents 384 KB to 768 KB) for Ethernet 1/4 is incremented.

To avoid a counter overflow, the Cisco NX-OS software collects the histogram data every polling interval and maintains it in the system memory. The software maintains the histogram data in the system memory for the last 60 minutes with 1-second granularity. Every hour, the software copies the buffer histogram data from the system memory to the bootflash as a backup.

The Active Buffer Monitoring feature has two modes of operation:

- Unicast mode—The Algo Boost Engine monitors and maintains a buffer histogram for total buffer utilization per buffer block and unicast buffer utilization for all 48 ports.
- Multicast mode—The Algo Boost Engine monitors and maintains buffer histogram data for total buffer utilization per buffer block and multicast buffer utilization per buffer block.

Buffer Histogram Data Access and Collection

After active buffer monitoring is enabled, the device maintains 70 minutes of data—the first 60 minutes (0 to 60 minutes) in the log and another 60 minutes (10 to 70 minutes) in memory.

You can access buffer histogram data using several methods:

- You can access it from the system memory using **show** commands.
- You can integrate the Active Buffer Monitoring feature with Cisco NX-OS Python scripting to collect historical data by copying the data to a server regularly.
- You can access the buffer histogram data using an XML interface.
- You can configure Cisco NX-OS to log a message in the syslog whenever the buffer occupancy exceeds the configured threshold.

Configuring Active Buffer Monitoring

Note If you use NX-API over the front panel port, you must increase the CoPP policy (for HTTP) to allow 3000 PPS traffic. Doing so prevents packet drops, and the CLIs, creating larger outputs, return within the expected time.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **hardware profile buffer monitor** {**unicast** | **multicast**}	Enables the hardware profile buffer for either unicast or multicast traffic.
Step 3	switch(config)# **hardware profile buffer monitor** {**unicast** | **multicast**} **threshold** *threshold-value*	Generates a syslog entry when the specified maximum buffer size is exceeded. The range is 384–6144 kilobytes with 384-kilobyte increments. The default is 90 percent of the total available shared buffer.
Step 4	switch(config)# **hardware profile buffer monitor** {**unicast** | **multicast**} **sampling** *sampling-value*	Specifies to sample data at the specified interval. Range is 10–20,000,000 nanoseconds. The default sampling value is 4 milliseconds.
Step 5	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure Active Buffer Monitoring for unicast traffic. A threshold value of 384 kilobytes and a sampling value of 5000 nanoseconds is used:

```
switch# configure terminal
switch(config)# hardware profile buffer monitor unicast
switch(config)# hardware profile buffer monitor unicast threshold 384
switch(config)# hardware profile buffer monitor unicast sampling 5000
switch(config)# copy running-config startup-config
```

The following example shows how to configure Active Buffer Monitoring for multicast traffic. A threshold value of 384 kilobytes and a sampling value of 5000 nanoseconds is used.

```
switch# configure terminal
switch(config)# hardware profile buffer monitor multicast
switch(config)# hardware profile buffer monitor multicast threshold 384
switch(config)# hardware profile buffer monitor multicast sampling 5000
switch(config)# copy running-config startup-config
```

Displaying Buffer Histogram Data

Procedure

	Command or Action	Purpose
Step 1	switch# **show hardware profile buffer monitor** [**interface ethernet** *slot/port*] {**brief** | **buffer-block** | **detail** | **multicast** | **summary**}	Displays data collected about the buffer. The keywords are defined as follows: • **brief**—Specifies to show limited information about each interface. • **buffer-block**—Specifies to display information about a specific buffer block. • **detail**—Specifies to display all information gathered for each interface. • **interface**—(Optional) Specifies to display information about a specific port. • **multicast**—Specifies to show buffer data for multicast traffic only. • **summary**—Specifies to display summary information about each buffer block. **Note** The show command option **interface** is only valid in unicast mode and the **multicast** option is only valid in multicast mode.

	Command or Action	Purpose
Step 2	(Optional) switch# **clear hardware profile buffer monitor**	Clears the collected buffer data.

Example

This example shows how to display summary information for each buffer block and for all of the buffers combined:

```
switch# show hardware profile buffer monitor summary
Summary CLI issued at: 09/18/2012 07:38:39

                   Maximum buffer utilization detected
                  1sec     5sec    60sec     5min      1hr
                 ------   ------   ------   ------   ------
Buffer Block 1       0KB      0KB      0KB      0KB      N/A

Total Shared Buffer Available = 5049 Kbytes
Class Threshold Limit = 4845 Kbytes
============================================================
Buffer Block 2       0KB      0KB      0KB      0KB      N/A

Total Shared Buffer Available = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
============================================================
Buffer Block 3       0KB      0KB   5376KB   5376KB      N/A

Total Shared Buffer Available = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
```

This example shows how to display the maximum buffer utilization of each buffer block and each interface for unicast mode:

```
switch# show hardware profile buffer monitor brief
Brief CLI issued at: 09/18/2012 07:38:29

                   Maximum buffer utilization detected
                  1sec     5sec    60sec     5min      1hr
                 ------   ------   ------   ------   ------
Buffer Block 1       0KB      0KB      0KB      0KB      N/A

Total Shared Buffer Avaliable = 5049 Kbytes
Class Threshold Limit = 4845 Kbytes
------------------------------------------------------------
Ethernet1/45         0KB      0KB      0KB      0KB      N/A
Ethernet1/46         0KB      0KB      0KB      0KB      N/A
Ethernet1/47         0KB      0KB      0KB      0KB      N/A
Ethernet1/48         0KB      0KB      0KB      0KB      N/A
Ethernet1/21         0KB      0KB      0KB      0KB      N/A
Ethernet1/22         0KB      0KB      0KB      0KB      N/A
Ethernet1/23         0KB      0KB      0KB      0KB      N/A
Ethernet1/24         0KB      0KB      0KB      0KB      N/A
Ethernet1/9          0KB      0KB      0KB      0KB      N/A
Ethernet1/10         0KB      0KB      0KB      0KB      N/A
Ethernet1/11         0KB      0KB      0KB      0KB      N/A
Ethernet1/12         0KB      0KB      0KB      0KB      N/A
Ethernet1/33         0KB      0KB      0KB      0KB      N/A
Ethernet1/34         0KB      0KB      0KB      0KB      N/A
```

```
Ethernet1/35          0KB       0KB       0KB       0KB       N/A
Ethernet1/36          0KB       0KB       0KB       0KB       N/A
------------------------------------------------------------------
Buffer Block 2        0KB       0KB       0KB       0KB       N/A

Total Shared Buffer Avaliable = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
------------------------------------------------------------------
Ethernet1/17          0KB       0KB       0KB       0KB       N/A
Ethernet1/18          0KB       0KB       0KB       0KB       N/A
Ethernet1/19          0KB       0KB       0KB       0KB       N/A
Ethernet1/20          0KB       0KB       0KB       0KB       N/A
Ethernet1/5           0KB       0KB       0KB       0KB       N/A
Ethernet1/6           0KB       0KB       0KB       0KB       N/A
Ethernet1/7           0KB       0KB       0KB       0KB       N/A
Ethernet1/8           0KB       0KB       0KB       0KB       N/A
Ethernet1/41          0KB       0KB       0KB       0KB       N/A
Ethernet1/42          0KB       0KB       0KB       0KB       N/A
Ethernet1/43          0KB       0KB       0KB       0KB       N/A
Ethernet1/44          0KB       0KB       0KB       0KB       N/A
Ethernet1/29          0KB       0KB       0KB       0KB       N/A
Ethernet1/30          0KB       0KB       0KB       0KB       N/A
Ethernet1/31          0KB       0KB       0KB       0KB       N/A
Ethernet1/32          0KB       0KB       0KB       0KB       N/A
------------------------------------------------------------------
Buffer Block 3        0KB       0KB    5376KB    5376KB       N/A

Total Shared Buffer Avaliable = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
------------------------------------------------------------------
Ethernet1/13          0KB       0KB       0KB       0KB       N/A
Ethernet1/14          0KB       0KB       0KB       0KB       N/A
Ethernet1/15          0KB       0KB       0KB       0KB       N/A
Ethernet1/16          0KB       0KB       0KB       0KB       N/A
Ethernet1/37          0KB       0KB       0KB       0KB       N/A
Ethernet1/38          0KB       0KB       0KB       0KB       N/A
Ethernet1/39          0KB       0KB       0KB       0KB       N/A
Ethernet1/40          0KB       0KB       0KB       0KB       N/A
Ethernet1/25          0KB       0KB       0KB       0KB       N/A
Ethernet1/26          0KB       0KB       0KB       0KB       N/A
Ethernet1/27          0KB       0KB       0KB       0KB       N/A
Ethernet1/28          0KB       0KB       0KB       0KB       N/A
Ethernet1/1           0KB       0KB       0KB       0KB       N/A
Ethernet1/2           0KB       0KB       0KB       0KB       N/A
Ethernet1/3           0KB       0KB       0KB       0KB       N/A
Ethernet1/4           0KB       0KB    5376KB    5376KB       N/A
```

This example shows how to display the maximum buffer utilization information of each buffer block for multicast mode:

```
switch# show hardware profile buffer monitor brief
Brief CLI issued at: 09/18/2012 08:30:08

                   Maximum buffer utilization detected
                 1sec     5sec    60sec     5min      1hr
                ------   ------   ------   ------   ------
Buffer Block 1        0KB       0KB       0KB       0KB       0KB

Total Shared Buffer Avaliable = 5049 Kbytes
Class Threshold Limit = 4845 Kbytes
Mcast Usage 1         0KB       0KB       0KB       0KB       0KB
------------------------------------------------------------------
```

```
Buffer Block 2       0KB      0KB      0KB      0KB      0KB

Total Shared Buffer Avaliable = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
Mcast Usage 2        0KB      0KB      0KB      0KB      0KB
============================================================
Buffer Block 3       0KB      0KB      0KB      0KB      0KB

Total Shared Buffer Avaliable = 5799 Kbytes
Class Threshold Limit = 5598 Kbytes
Mcast Usage 3        0KB      0KB      0KB      0KB      0KB
```

The following example shows how to display detailed buffer utilization information of buffer block 3 for multicast mode:

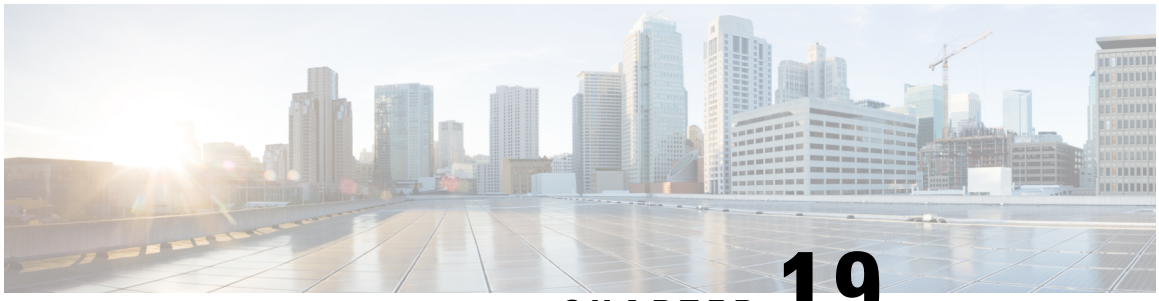
```
switch# show hardware profile buffer monitor multicast 3 detail
Detail CLI issued at: 09/18/2012 08:30:12

Legend -
384KB  - between   1 and 384KB of shared buffer consumed by port
768KB  - between 385 and 768KB of shared buffer consumed by port
307us  - estimated max time to drain the buffer at 10Gbps

Active Buffer Monitoring for Mcast Usage 3 is: Active
KBytes                384  768 1152 1536 1920 2304 2688 3072 3456 3840 4224 4608 4992 5376
 5760 6144
us @ 10Gbps           307  614  921 1228 1535 1842 2149 2456 2763 3070 3377 3684 3991 4298
 4605 4912
                     ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
 ---- ----
09/18/2012 08:30:12      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:11      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:10      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:09      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:08      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:07      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:06      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:05      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:04      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 08:30:03      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
```

The following example shows how to display detailed buffer data about Ethernet interface 1/4:

```
switch# show hardware profile buffer monitor interface ethernet 1/4 detail
Detail CLI issued at: 09/18/2012 07:38:43

Legend -
384KB  - between   1 and 384KB of shared buffer consumed by port
768KB  - between 385 and 768KB of shared buffer consumed by port
307us  - estimated max time to drain the buffer at 10Gbps

Active Buffer Monitoring for port Ethernet1/4 is: Active
KBytes                384  768 1152 1536 1920 2304 2688 3072 3456 3840 4224 4608 4992 5376
```

```
 5760 6144
us @ 10Gbps            307  614  921 1228 1535 1842 2149 2456 2763 3070 3377 3684 3991 4298
 4605 4912
                       ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
 ---- ----
09/18/2012 07:38:42      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:41      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:40      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:39      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:38      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:37      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:36      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:35      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:34      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:33      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:32      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:31      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:30      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:29      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:28      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:27      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:26      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:25      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:24      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:23      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:22      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:21      0    0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:20    177   36    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:19      0  143  107    0    0    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:18      0    0   72  178    3    0    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:17      0    0    0    0  176   74    0    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:16      0    0    0    0    0  105  145    0    0    0    0    0    0    0
0    0    0
09/18/2012 07:38:15      0    0    0    0    0    0   33  179   38    0    0    0    0    0
0    0    0
09/18/2012 07:38:14      0    0    0    0    0    0    0    0  140  113    0    0    0    0
0    0    0
09/18/2012 07:38:13      0    0    0    0    0    0    0    0    0   66  178    6    0    0
```

```
0    0    0
09/18/2012 07:38:12      0    0    0    0    0    0    0    0    0    0    0  173   77
0    0    0
09/18/2012 07:38:11      1    0    0    1    0    0    1    0    0    1    0    0  102
42    0    0
09/18/2012 07:38:10      0    0    0    0    0    0    0    0    0    0    0    0    0
0    0    0
```



CHAPTER 19

Performing Software Maintenance Upgrades (SMUs)

This chapter includes the following sections:

- About SMUs, on page 191
- Package Management, on page 192
- Prerequisites for SMUs, on page 192
- Guidelines and Limitations for SMUs, on page 193
- Performing a Software Maintenance Upgrade for Cisco NX-OS, on page 193
- Preparing for Package Installation, on page 193
- Copying the Package File to a Local Storage Device or Network Server, on page 194
- Adding and Activating Packages, on page 195
- Committing the Active Package Set, on page 196
- Deactivating and Removing Packages, on page 197
- Displaying Installation Log Information, on page 198

About SMUs

A software maintenance upgrade (SMU) is a package file that contains fixes for a specific defect. SMUs are created to respond to immediate issues and do not include new features. Typically, SMUs do not have a large impact on device operations. SMU versions are synchronized to the package major, minor, and maintenance versions they upgrade.

The effect of an SMU depends on its type:

- Process restart SMU-Causes a process or group of processes to restart on activation.
- Reload SMU-Causes a parallel reload of supervisors and line cards.

SMUs are not an alternative to maintenance releases. They provide a quick resolution of immediate issues. All defects fixed by SMUs are integrated into the maintenance releases.

For information on upgrading your device to a new feature or maintenance release, see the *Cisco Nexus 3500 Series NX-OS Software Upgrade and Downgrade Guide*.

Note Activating an SMU does not cause any earlier SMUs, or the package to which the SMU applies, to be automatically deactivated.

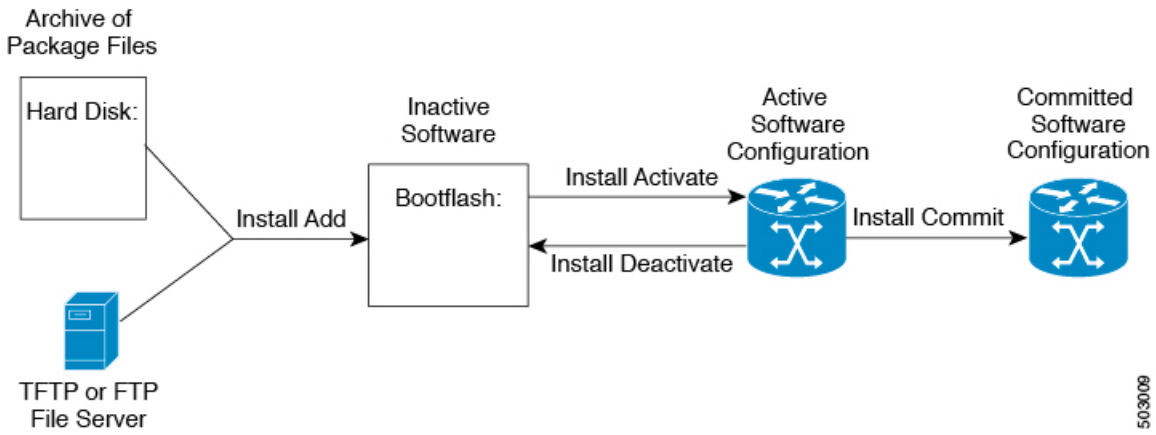
Package Management

The general procedure for adding and activating SMU packages on the device is as follows:

1. Copy the package file or files to a local storage device or file server.
2. Add the package or packages on the device using the **install add** command.
3. Activate the package or packages on the device using the **install activate** command.
4. Commit the current set of packages using the **install commit** command.
5. (Optional) Deactivate and remove the package, when desired.

The following figure illustrates the key steps in the package management process.

Figure 2: Process to Add, Activate, and Commit SMU Packages



Prerequisites for SMUs

These prerequisites must be met for a package to be activated or deactivated:

- You must be in a user group associated with a task group that includes the proper task IDs. If you suspect a user group assignment is preventing you from using a command, contact your AAA administrator for assistance.
- Verify that all line cards are installed and operating properly. For example, do not activate or deactivate packages while line cards are booting, while line cards are being upgraded or replaced, or when you anticipate an automatic switchover activity.

Guidelines and Limitations for SMUs

SMUs have the following guidelines and limitations:

- Some packages require the activation or deactivation of other packages. If the SMUs have dependencies on each other, you cannot activate them without first activating the previous ones.
- The package being activated must be compatible with the current active software set.
- You cannot activate multiple SMUs in one command.
- Activation is performed only after the package compatibility checks have been passed. If a conflict is found, an error message displays.
- While a software package is being activated, other requests are not allowed to run on any of the impacted nodes. Package activation is completed when a message similar to this one appears:

  ```
  Install operation 1 completed successfully at Thu Jan 9 01:19:24 2014
  ```

- Each CLI install request is assigned a request ID, which can be used later to review the events.
- If you perform a software maintenance upgrade and later upgrade your device to a new Cisco Nexus 3500 software release, the new image will overwrite both the previous Cisco Nexus 3500 release and the SMU package file.

Performing a Software Maintenance Upgrade for Cisco NX-OS

Preparing for Package Installation

You should use several **show** commands to gather information in preparation for the SMU package installation.

Before you begin

Determine if a software change is required.

Verify that the new package is supported on your system. Some software packages require that other packages or package versions be activated, and some packages support only specific line cards.

Review the release notes for important information related to that release and to help determine the package compatibility with your device configuration.

Verify that the system is stable and prepared for the software changes.

Procedure

	Command or Action	Purpose
Step 1	**show install active** **Example:** `switch# show install active`	Displays the active software on the device. Use this command to determine what software should be added on the device and to compare

	Command or Action	Purpose
		to the active software report after installation operations are complete.
Step 2	**show module** **Example:** `switch# show module`	Confirms that all modules are in the stable state.
Step 3	**show clock** **Example:** `switch# show clock`	Verifies that the system clock is correct. Software operations use certificates based on device clock times.

Example

This example shows how to display the active packages for the entire system. Use this information to determine if a software change is required.

```
switch# show install active
Active Packages:
Active Packages on Module #3:

Active Packages on Module #6:

Active Packages on Module #7:
Active Packages on Module #22:

Active Packages on Module #30:
```

This example shows how to display the current system clock setting:

```
switch# show clock
02:14:51.474 PST Wed Jan 04 2014
```

Copying the Package File to a Local Storage Device or Network Server

You must copy the SMU package file to a local storage device or a network file server to which the device has access. After this task is done, the package can be added and activated on the device.

If you need to store package files on the device, we recommend that you store the files on the hard disk. The boot device is the local disk from which the package is added and activated. The default boot device is bootflash:.

Tip Before you copy package files to a local storage device, use the **dir** command to determine if the required package files are already on the device.

If the SMU package files are located on a remote TFTP, FTP, or SFTP server, you can copy the files to a local storage device. After the files are located on the local storage device, the package can be added and activated on the device from that storage device. The following server protocols are supported:

- Trivial File Transfer Protocol—TFTP allows files to be transferred from one computer to another over a network, usually without the use of client authentication (for example, username and password). It is a simplified version of FTP.

Note Some package files might be larger than 32 MB, and the TFTP services provided by some vendors might not support a file this large. If you do not have access to a TFTP server that supports files larger than 32 MB, download the file using FTP.

- File Transfer Protocol—FTP is part of the TCP/IP protocol stack and requires a username and password.
- SSH File Transfer Protocol—SFTP is part of the SSHv2 feature in the security package and provides for secure file transfers.

After the SMU package file has been transferred to a network file server or the local storage device, you are ready to add and activate the file.

Adding and Activating Packages

You can add SMU package files that are stored on a local storage device or on a remote TFTP, FTP, or SFTP server to your device.

Note The SMU package being activated must be compatible with the currently active software to operate. When an activation is attempted, the system runs an automatic compatibility check to ensure that the package is compatible with the other active software on the device. If a conflict is found, an error message displays. The activation is performed only after all compatibility checks have been passed.

Procedure

	Command or Action	Purpose
Step 1	**install add** *filename* [**activate**] **Example:** `switch# install add bootflash: n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin`	Unpacks the package software files from the local storage device or network server and adds them to the bootflash: and all active and standby supervisors installed on the device. The *filename* argument can take any of these formats: • **bootflash:***filename* • **tftp:**//*hostname-or-ipaddress/directory-path/filename* • **ftp:**//*username***:***password***@***hostname-or-ipaddress/directory-path/filename* • **sftp:**//*hostname-or-ipaddress/directory-path/filename*

	Command or Action	Purpose
Step 2	(Optional) **show install inactive** **Example:** `switch# show install inactive`	Displays the inactive packages on the device. Verify that the package added in the previous step appears in the display.

Step 3	Required: **install activate** *filename* [**test**]
	Example:
	`switch# install activate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin`
	Example:
	`switch# install activate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin Install operation 1 completed successfully at Thu Jan 9 01:27:56 2014`
	Example:
	`switch# install activate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin Install operation 2 !!WARNING!! This patch will get activated only after a reload of the switch. at Sun Mar 9 00:42:12 2014`
		Activates a package that was added to the device. SMU packages remain inactive until activated. (Skip this step if the package was activated earlier with the **install add activate** command.)
		Note
		Press **?** after a partial package name to display all possible matches available for activation. If there is only one match, press the **Tab** key to fill in the rest of the package name.

Step 4	Repeat Step 3 until all packages are activated.	Activates additional packages as required.
Step 5	(Optional) **show install active** **Example:** `switch# show install active`	Displays all active packages. Use this command to determine if the correct packages are active.

Committing the Active Package Set

When an SMU package is activated on the device, it becomes part of the current running configuration. To make the package activation persistent across system-wide reloads, you must commit the package on the device.

Procedure

	Command or Action	Purpose
Step 1	**install commit** *filename* **Example:** `switch# install commit n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin`	Commits the current set of packages so that these packages are used if the device is restarted.
Step 2	(Optional) **show install committed** **Example:**	Displays which packages are committed.

	Command or Action	Purpose
	`switch# show install committed`	

Deactivating and Removing Packages

When a package is deactivated, it is no longer active on the device, but the package files remain on the boot disk. The package files can be reactivated later, or they can be removed from the disk.

Procedure

	Command or Action	Purpose
Step 1	**install deactivate** *filename* **Example:** `switch# install deactivate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin`	Deactivates a package that was added to the device and turns off the package features for the line card. **Note** Press **?** after a partial package name to display all possible matches available for deactivation. If there is only one match, press the **Tab** key to fill in the rest of the package name.
Step 2	(Optional) **show install inactive** **Example:** `switch# show install inactive`	Displays the inactive packages on the device.
Step 3	(Optional) **install commit** **Example:** `switch# install commit`	Commits the current set of packages so that these packages are used if the device is restarted. **Note** Packages can be removed only if the deactivation operation is committed.

Step 4	(Optional) **install remove** {*filename* | **inactive**}
	Example:
	`switch# install remove n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin Proceed with removing n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin? (y/n)? [n] y`
	Example:
	`switch# install remove inactive Proceed with removing? (y/n)? [n] y`
		Removes the inactive package.
		• Only inactive packages can be removed.
		• Packages can be removed only if they are deactivated from all line cards in the device.
		• The package deactivation must be committed.
		• To remove a specific inactive package from a storage device, use the **install remove** command with the *filename* argument.
		• To remove all inactive packages from all nodes in the system, use the **install**

	Command or Action	Purpose
		remove command with the **inactive** keyword.

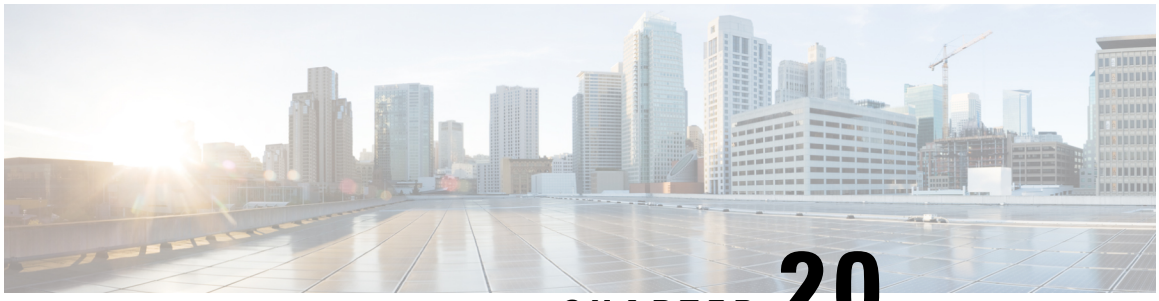
Displaying Installation Log Information

The installation log provides information on the history of the installation operations. Each time an installation operation is run, a number is assigned to that operation.

- Use the **show install log** command to display information about both successful and failed installation operations.
- Use the **show install log** command with no arguments to display a summary of all installation operations. Specify the *request-id* argument to display information specific to an operation. Use the **detail** keyword to display details for a specific operation, including file changes, nodes that could not be reloaded, and any impact to processes.

This example shows how to display information for all installation requests:

```
switch# show install log
Thu Jan 9 01:26:09 2014
Install operation 1 by user 'admin' at Thu Jan 9 01:19:19 2018
Install add bootflash: n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 1 completed successfully at Thu Jan 9 01:19:24 2014
---------------------------------------
Install operation 2 by user 'admin' at Thu Jan 9 01:19:29 2018
Install activate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 2 completed successfully at Thu Jan 9 01:19:45 2018
---------------------------------------
Install operation 3 by user 'admin' at Thu Jan 9 01:20:05 2018
Install commit n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 3 completed successfully at Thu Jan 9 01:20:08 2018
---------------------------------------
Install operation 4 by user 'admin' at Thu Jan 9 01:20:21 2018
Install deactivate n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 4 completed successfully at Thu Jan 9 01:20:36 2018
---------------------------------------
Install operation 5 by user 'admin' at Thu Jan 9 01:20:43 2018
Install commit n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 5 completed successfully at Thu Jan 9 01:20:46 2014
---------------------------------------
Install operation 6 by user 'admin' at Thu Jan 9 01:20:55 2018
Install remove n3500-uk9.6.0.2.U6.0.1.CSCab00001.bin
Install operation 6 completed successfully at Thu Jan 9 01:20:57 2018
```



CHAPTER 20

Monitoring Interface Statistics

This chapter contains the following sections:

- Monitoring Interface Statistics, on page 199
- Guidelines and Limitations for Monitoring Interface Statistics, on page 200

Monitoring Interface Statistics

Beginning Cisco NX-OS Release 7.0(3)I7(7) TCP based interface statistics streaming is supported on Cisco Nexus 3500 series switches. This feature, based on TCP request response model, provides more granular interface statistics information at 10–15 millisecond intervals.

The TCP service listens to port 7891, over localhost interface allowing applications that run on the switch to capture statistics. The TCP server responds with statistics data to requests that the client initiates. Any custom TCP client application can make a connection and request for statistics. The feature provides the following per port statistical information:

- Tx Pkts
- Tx Bytes
- Rx Pkts
- Rx Bytes

The statistical information is displayed in the following format:

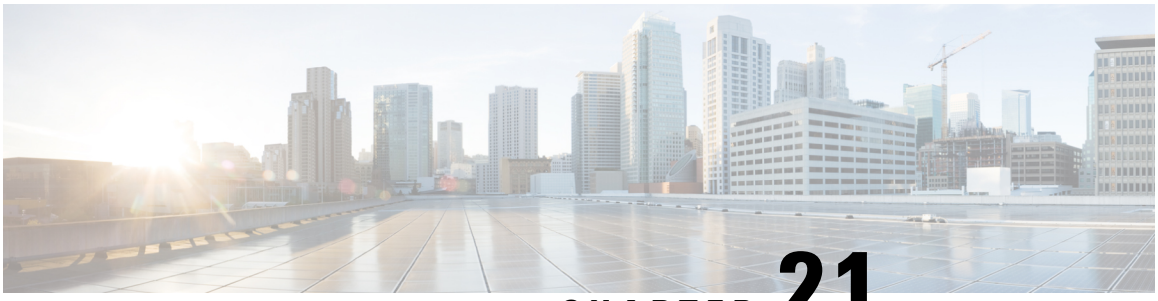
```
-----------------------------------------------
| timestamp             |           |          |
| ----------------------| num_ports | counters |
| tv_sec | tv_nsec      |           |          |
| ----------|-----------|-----------|----------|
| 8 - bytes | 8 - bytes | 4 - bytes |       || |
-------------------------------------------||--
                                           ||
                                           \/
-------------------------------------------------------------
| interface_name | Tx Pkts | Tx Octets | Rx Pkts | Rx Octets |
|-------------------------------------------------------------
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
|-------------------------------------------------------------
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
|-------------------------------------------------------------
```

```
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
-------------------------------------------------------------
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
-------------------------------------------------------------
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
-------------------------------------------------------------
.............................................................
.............................................................

-------------------------------------------------------------
| 24-bytes       | 8-bytes | 8-bytes   | 8-bytes | 8-bytes   |
-------------------------------------------------------------
```

Guidelines and Limitations for Monitoring Interface Statistics

TCP based interface statistics monitoring has the following configuration guidelines and limitations:

- TCP based interface statistics polling works with CLI/SNMP polling.
- TCP based interface statistics monitoring feature is enabled by default.
- The TCP server listens to port 7891 and it does not accept TCP connections from outside the switch.
- TCP clients that are running within the switch can only leverage the advantages of this feature.
- Only one TCP session is allowed at a time.
- Client applications can poll statistics at 5ms to 10ms intervals. USD process utilization goes above 40% for poll requests below 5ms intervals.



CHAPTER 21

Configuring Rollback

This chapter contains the following sections:

- Information About Rollbacks, on page 201
- Guidelines and Limitations for Rollbacks, on page 201
- Creating a Checkpoint, on page 202
- Implementing a Rollback, on page 203
- Verifying the Rollback Configuration, on page 203

Information About Rollbacks

The rollback feature allows you to take a snapshot, or user checkpoint, of the Cisco NX-OS configuration and then reapply that configuration to your switch at any point without having to reload the switch. A rollback allows any authorized administrator to apply this checkpoint configuration without requiring expert knowledge of the features configured in the checkpoint.

You can create a checkpoint copy of the current running configuration at any time. Cisco NX-OS saves this checkpoint as an ASCII file which you can use to roll back the running configuration to the checkpoint configuration at a future time. You can create multiple checkpoints to save different versions of your running configuration.

When you roll back the running configuration, you can trigger an atomic rollback. An atomic rollback implements a rollback only if no errors occur.

Guidelines and Limitations for Rollbacks

A rollback has the following configuration guidelines and limitations:

- You can create up to ten checkpoint copies.
- You cannot apply the checkpoint file of one switch into another switch.
- Your checkpoint file names must be 75 characters or less.
- You cannot start a checkpoint filename with the word system.
- You can start a checkpoint filename with the word auto.
- You can name a checkpoint file summary or any abbreviation of the word summary.

- Only one user can perform a checkpoint, rollback, or copy the running configuration to the startup configuration at the same time.
- After you enter the **write erase** and **reload** command, checkpoints are deleted. You can use the clear checkpoint database command to clear out all checkpoint files.
- When checkpoints are created on bootflash, differences with the running-system configuration cannot be performed before performing the rollback, and the system reports “No Changes.”
- Checkpoints are local to a switch.
- Checkpoints that are created using the **checkpoint** and **checkpoint** *checkpoint_name* commands are present upon a switchover for all switches.
- A rollback to files on bootflash is supported only on files that are created using the **checkpoint** *checkpoint_name* command and not on any other type of ASCII file.
- Checkpoint names must be unique. You cannot overwrite previously saved checkpoints with the same name.
- The Cisco NX-OS commands may differ from the Cisco IOS commands.

Creating a Checkpoint

You can create up to ten checkpoints of your configuration per switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **checkpoint** { [*cp-name*] [**description** *descr*] |**file** *file-name* **Example:** `switch# checkpoint stable`	Creates a checkpoint of the running configuration to either a user checkpoint name or a file. The checkpoint name can be any alphanumeric string up to 80 characters but cannot contain spaces. If you do not provide a name, Cisco NX-OS sets the checkpoint name to user-checkpoint-<number> where number is from 1 to 10. The description can contain up to 80 alphanumeric characters, including spaces.
Step 2	(Optional) switch# **no checkpoint***cp-name* **Example:** `switch# no checkpoint stable`	You can use the **no** form of the **checkpoint** command to remove a checkpoint name. Use the **delete** command to remove a checkpoint file.
Step 3	(Optional) switch# **show checkpoint***cp-name* **Example:** [**all**] `switch# show checkpoint stable`	Displays the contents of the checkpoint name.

Implementing a Rollback

You can implement a rollback to a checkpoint name or file. Before you implement a rollback, you can view the differences between source and destination checkpoints that reference current or saved configurations.

Note If you make a configuration change during an atomic rollback, the rollback will fail.

Procedure

	Command or Action	Purpose
Step 1	**show diff rollback-patch** {**checkpoint** *src-cp-name* | **running-config** | **startup-config** | **file** *source-file*} {**checkpoint** *dest-cp-name* | **running-config** | **startup-config** | **file** *dest-file*} **Example:** `switch# show diff rollback-patch checkpoint stable running-config`	Displays the differences between the source and destination checkpoint selections.
Step 2	**rollback running-config** {**checkpoint** *cp-name* | **file** *cp-file*} **atomic** **Example:** `switch# rollback running-config checkpoint stable`	Creates an atomic rollback to the specified checkpoint name or file if no errors occur.

Example

The following example shows how to create a checkpoint file and then implement an atomic rollback to a user checkpoint name:

```
switch# checkpoint stable
switch# rollback running-config checkpoint stable atomic
```

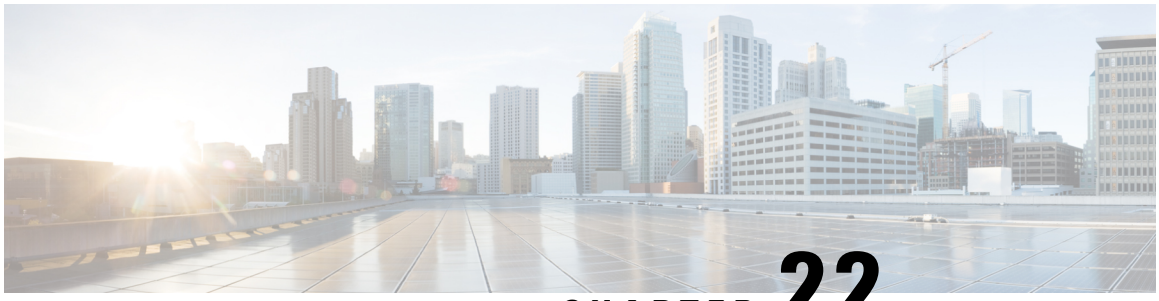
Verifying the Rollback Configuration

Use the following commands to verify the rollback configuration:

Command	Purpose
show checkpoint *name* [**all**]	Displays the contents of the checkpoint name.
show checkpoint all [**user** | **system**]	Displays the contents of all checkpoints in the current switch. You can limit the displayed checkpoints to user or system-generated checkpoints.

Command	Purpose
show checkpoint summary [**user** | **system**]	Displays a list of all checkpoints in the current switch. You can limit the displayed checkpoints to user or system-generated checkpoints.
show diff rollback-patch {**checkpoint** *src-cp-name* | **running-config** | **startup-config** | **file** *source-file*} {**checkpoint** *dest-cp-name* | **running-config** | **startup-config** | **file** *dest-file*}	Displays the differences between the source and destination checkpoint selections.
show rollback log [**exec** | **verify**]	Displays the contents of the rollback log.

Note Use the **clear checkpoint database** command to delete all checkpoint files.



CHAPTER 22

Configuring User Accounts and RBAC

This chapter contains the following sections:

- Information About User Accounts and RBAC, on page 205
- Guidelines and Limitations for User Accounts, on page 208
- Configuring User Accounts, on page 209
- Configuring RBAC, on page 210
- Verifying the User Accounts and RBAC Configuration, on page 213
- Configuring User Accounts Default Settings for the User Accounts and RBAC, on page 213

Information About User Accounts and RBAC

Cisco Nexus Series switches use role-based access control (RBAC) to define the amount of access that each user has when the user logs into the switch.

With RBAC, you define one or more user roles and then specify which management operations each user role is allowed to perform. When you create a user account for the switch, you associate that account with a user role, which then determines what the individual user is allowed to do on the switch.

User Roles

User roles contain rules that define the operations allowed for the user who is assigned the role. Each user role can contain multiple rules and each user can have multiple roles. For example, if role1 allows access only to configuration operations, and role2 allows access only to debug operations, users who belong to both role1 and role2 can access configuration and debug operations. You can also limit access to specific VLANs, and interfaces.

The switch provides the following default user roles:

network-admin (superuser)

Complete read and write access to the entire switch.

network-operator

Complete read access to the switch. However, the network-operator role cannot run the **show running-config** and **show startup-config** commands.

Note If you belong to multiple roles, you can execute a combination of all the commands permitted by these roles. Access to a command takes priority over being denied access to a command. For example, suppose a user has RoleA, which denied access to the configuration commands. However, the user also has RoleB, which has access to the configuration commands. In this case, the user has access to the configuration commands.

Note Only network-admin user can perform a Checkpoint or Rollback in the RBAC roles. Though other users have these commands as a permit rule in their role, the user access is denied when you try to execute these commands.

Rules

The rule is the basic element of a role. A rule defines what operations the role allows the user to perform. You can apply rules for the following parameters:

Command

A command or group of commands defined in a regular expression.

Feature

Commands that apply to a function provided by the Cisco Nexus device. Enter the **show role feature** command to display the feature names available for this parameter.

Feature group

Default or user-defined group of features. Enter the **show role feature-group** command to display the default feature groups available for this parameter.

OID

An SNMP object identifier (OID).

These parameters create a hierarchical relationship. The most basic control parameter is the command. The next control parameter is the feature, which represents all commands associated with the feature. The last control parameter is the feature group. The feature group combines related features and allows you to easily manage the rules.

SNMP OID is supported for RBAC. You can configure a read-only or read-and-write rule for an SNMP OID.

You can configure up to 256 rules for each role. The user-specified rule number determines the order in which the rules are applied. Rules are applied in descending order. For example, if a role has three rules, rule 3 is applied before rule 2, which is applied before rule 1.

User Role Policies

You can define user role policies to limit the switch resources that the user can access, or to limit access to interfaces, VLANs, and VSANs.

User role policies are constrained by the rules defined for the role. For example, if you define an interface policy to permit access to specific interfaces, the user does not have access to the interfaces unless you configure a command rule for the role to permit the **interface** command.

If a command rule permits access to specific resources (interfaces, VLANs), the user is permitted to access these resources, even if the user is not listed in the user role policies associated with that user.

User Account Configuration Restrictions

The following words are reserved and cannot be used to configure users:

- adm
- bin
- daemon
- ftp
- ftpuser
- games
- gdm
- gopher
- halt
- lp
- mail
- mailnull
- man
- mtsuser
- news
- nobody
- san-admin
- shutdown
- sync
- sys
- uucp
- xfs

User Password Requirements

Cisco Nexus device passwords are case sensitive and can contain alphanumeric characters. Special characters, such as the dollar sign ($) or the percent sign (%), are not allowed.

Note Beginning with Cisco NX-OS Release 7.2(0)N1(1), special characters, such as the dollar sign ($) or the percent sign (%), can be used in Cisco Nexus device passwords.

If a password is trivial (such as a short, easy-to-decipher password), the Cisco Nexus device rejects the password. Be sure to configure a strong password for each user account. A strong password has the following characteristics:

- At least eight characters long
- Does not contain many consecutive characters (such as "abcd")
- Does not contain many repeating characters (such as "aaabbb")
- Does not contain dictionary words
- Does not contain proper names
- Contains both uppercase and lowercase characters
- Contains numbers

The following are examples of strong passwords:

- If2CoM18
- 2009AsdfLkj30
- Cb1955S21

Note For security reasons, user passwords do not display in the configuration files.

Guidelines and Limitations for User Accounts

User accounts have the following guidelines and limitations when configuring user accounts and RBAC:

- Regardless of the read-write rule configured for a user role, some commands can be executed only through the predefined network-admin role.
- Up to 256 rules can be added to a user role.
- A maximum of 64 user roles can be assigned to a user account.
- You can assign a user role to more that one user account.
- Predefined roles such as network-admin, network-operator, and san-admin are not editable.
- Add, delete, and editing of rules is not supported for the SAN admin user role.
- The interface, VLAN, and/or VSAN scope cannot be changed for the SAN admin user role.

Note A user account must have at least one user role.

Configuring User Accounts

Note Changes to user account attributes do not take effect until the user logs in and creates a new session.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	(Optional) switch(config)# **show role**	Displays the user roles available. You can configure other user roles, if necessary.
Step 3	switch(config) # **username** *user-id* [**password** *password*] [**expire** *date*] [**role** *role-name*]	Configures a user account. The *user-id* is a case-sensitive, alphanumeric character string with a maximum of 28 characters. The default *password* is undefined. **Note** If you do not specify a password, the user might not be able to log into the switch. The **expire** *date* option format is YYYY-MM-DD. The default is no expiry date.
Step 4	switch(config) # **exit**	Exists global configuration mode.
Step 5	(Optional) switch# **show user-account**	Displays the role configuration.
Step 6	(Optional) switch# **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to configure a user account:

```
switch# configure terminal
switch(config)# username NewUser password 4Ty18Rnt
switch(config)# exit
switch# show user-account
```

Configuring RBAC

Creating User Roles and Rules

The rule number that you specify determines the order in which the rules are applied. Rules are applied in descending order. For example, if a role has three rules, rule 3 is applied before rule 2, which is applied before rule 1.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **role name** *role-name*	Specifies a user role and enters role configuration mode. The *role-name* argument is a case-sensitive, alphanumeric character string with a maximum of 16 characters.
Step 3	switch(config-role) # **rule** *number* {**deny** | **permit**} **command** *command-string*	Configures a command rule. The *command-string* can contain spaces and regular expressions. For example, interface ethernet * includes all Ethernet interfaces. Repeat this command for as many rules as needed.
Step 4	switch(config-role)# **rule** *number* {**deny** | **permit**} {**read** | **read-write**}	Configures a read-only or read-and-write rule for all operations.
Step 5	switch(config-role)# **rule** *number* {**deny** | **permit**} {**read** | **read-write**} **feature** *feature-name*	Configures a read-only or read-and-write rule for a feature. Use the **show role feature** command to display a list of features. Repeat this command for as many rules as needed.
Step 6	switch(config-role)# **rule** *number* {**deny** | **permit**} {**read** | **read-write**} **feature-group** *group-name*	Configures a read-only or read-and-write rule for a feature group. Use the **show role feature-group** command to display a list of feature groups. Repeat this command for as many rules as needed.
Step 7	(Optional) switch(config-role)# **description** *text*	Configures the role description. You can include spaces in the description.

	Command or Action	Purpose
Step 8	switch(config-role)# **end**	Exits role configuration mode.
Step 9	(Optional) switch# **show role**	Displays the user role configuration.
Step 10	(Optional) switch# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to create user roles and specify rules:

```
switch# configure terminal
switch(config)# role name UserA
switch(config-role)# rule deny command clear users
switch(config-role)# rule deny read-write
switch(config-role)# description This role does not allow users to use clear commands
switch(config-role)# end
switch(config)# show role
```

Creating Feature Groups

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **role feature-group** *group-name*	Specifies a user role feature group and enters role feature group configuration mode. The *group-name* is a case-sensitive, alphanumeric character string with a maximum of 32 characters.
Step 3	switch(config) # **exit**	Exits global configuration mode.
Step 4	(Optional) switch# **show role feature-group**	Displays the role feature group configuration.
Step 5	(Optional) switch# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to create a feature group:

```
switch# configure terminal
switch(config) # role feature-group group1
switch(config) # exit
```

```
switch# show role feature-group
switch# copy running-config startup-config
switch#
```

Changing User Role Interface Policies

You can change a user role interface policy to limit the interfaces that the user can access. Specify a list of interfaces that the role can access. You can specify it for as many interfaces as needed.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **role name** *role-name*	Specifies a user role and enters role configuration mode.
Step 3	switch(config-role) # **interface policy deny**	Enters role interface policy configuration mode.
Step 4	switch(config-role-interface) # **permit interface** *interface-list*	Specifies a list of interfaces that the role can access. Repeat this command for as many interfaces as needed. For this command, you can specify Ethernet interfaces.
Step 5	switch(config-role-interface) # **exit**	Exits role interface policy configuration mode.
Step 6	(Optional) switch(config-role) # **show role**	Displays the role configuration.
Step 7	(Optional) switch(config-role) # **copy running-config startup-config**	Copies the running configuration to the startup configuration.

Example

The following example shows how to change a user role interface policy to limit the interfaces that the user can access:

```
switch# configure terminal
switch(config)# role name UserB
switch(config-role)# interface policy deny
switch(config-role-interface)# permit interface ethernet 2/1
switch(config-role-interface)# permit interface fc 3/1
switch(config-role-interface)# permit interface vfc 30/1
```

Changing User Role VLAN Policies

You can change a user role VLAN policy to limit the VLANs that the user can access.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config) # **role name** *role-name*	Specifies a user role and enters role configuration mode.
Step 3	switch(config-role)# **vlan policy deny**	Enters role VLAN policy configuration mode.
Step 4	switch(config-role-vlan # **permit vlan** *vlan-list*	Specifies a range of VLANs that the role can access. Repeat this command for as many VLANs as needed.
Step 5	switch(config-role-vlan) # **exit**	Exits role VLAN policy configuration mode.
Step 6	(Optional) switch# **show role**	Displays the role configuration.
Step 7	(Optional) switch# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Verifying the User Accounts and RBAC Configuration

Use one of the following commands to verify the configuration:

Command	Purpose
show role [*role-name*]	Displays the user role configuration
show role feature	Displays the feature list.
show role feature-group	Displays the feature group configuration.
show startup-config security	Displays the user account configuration in the startup configuration.
show running-config security [**all**]	Displays the user account configuration in the running configuration. The **all** keyword displays the default values for the user accounts.
show user-account	Displays user account information.

Configuring User Accounts Default Settings for the User Accounts and RBAC

The following table lists the default settings for user accounts and RBAC parameters.

Table 31: Default User Accounts and RBAC Parameters

Parameters	Default
User account password	Undefined.
User account expiry date	None.
Interface policy	All interfaces are accessible.
VLAN policy	All VLANs are accessible.
VFC policy	All VFCs are accessible.
VETH policy	All VETHs are accessible.

INDEX

A

access restriction, configuring 29
  ntp 29
action statements 123
  EEM 123
action statements, configuring 129
  EEM 129
activating sessions 143
  SPAN 143
Active Buffer Monitoring 183–184
  configuring 184
  overview 183
adding show commands, alert groups 67
  smart call home 67
alert groups 55
  smart call home 55
associating alert groups 67
  smart call home 67

B

buffer histogram data 184–185
  accessing 184
  buffer histogram data 184
    collecting 184
  displaying 185
buffer monitoring 184
  configuring 184

C

call home notifications 73
  full-text format for syslog 73
  XML format for syslog 73
changed information 1
  description 1
clock manager 24
  ntp 24
commiting changes 32
  ntp configuration 32
configuration example 166–167
  ERSPAN 166–167
    destination 167
    source 166
configuration examples 35
  ntp 35
configuration, verifying 89
  scheduler 89
contact information, configuring 62
  smart call home 62
creating, deleting sessions 139
  SPAN 139

D

default ntp settings 25
default parameters 154
  ERSPAN 154
default settings 61, 80, 83, 124
  EEM 124
  rollback 80
  scheduler 83
  smart call home 61
default SNMP settings 97
defining EEM policies 131
  VSH script 131
description, configuring 142
  SPAN 142
destination ports, characteristics 137
  SPAN 137
destination profile, creating 64
  smart call home 64
destination profile, modifying 65
  smart call home 65
destination profiles 54
  smart call home 54
destinations 136
  SPAN 136
device IDs 57
  call home format 57
diagnostics 117–118, 120
  configuring 118
  default settings 120
  expansion modules 118
  health monitoring 118
  runtime 117
disabling 50, 89
  DOM logging 50
  scheduler 89

displaying information 147
SPAN 147
displaying installation log information 198
duplicate message throttling, disabling 70–71
smart call home 70–71

E

e-mail details, configuring 68
smart call home 68
e-mail notifications 53
smart call home 53
EEM 122–126, 129, 131–133
action statements 123
action statements, configuring 129
default settings 124
defining environment variables 124
event statements 122
event statements, configuring 126
licensing 124
policies 122
prerequisites 124
syslog script 133
system policies,overriding 132
user policy, defining 125
VSH script 131
registering and activating 131
VSH script policies 124
embedded event manager 121
overview 121
enabling 50, 83
DOM logging 50
scheduler 83
environment variables, defining 124
EEM 124
ERSPAN 149–152, 154, 157, 166–167
configuring destination sessions 157
configuring source sessions 154
default parameters 154
destination 167
configuration example 167
destination sessions 157
configuring for ERSPAN 157
destinations 150
high availability 151
information about 149
licensing requirements 151
prerequisites 152
related documents 167
sessions 151
multiple 151
source 166
configuration example 166
source sessions 154
configuring for ERSPAN 154
ERSPAN *(continued)*
sources 149
types 149
Ethernet destination port, configuring 140
SPAN 140
event statements 122
EEM 122
event statements, configuring 126
EEM 126
example 90
job schedule, displaying 90
scheduler job, creating 90
scheduler job, scheduling 90
scheduler jobs, displaying results 90
executing a session 79

F

facility messages logging 42
configuring 42
feature groups, creating 211
RBAC 211
feature history 36
ntp 36
filtering SNMP requests 99

G

GOLD diagnostics 117–118
configuring 118
expansion modules 118
health monitoring 118
runtime 117
guidelines 25
ntp 25
guidelines and limitations 38, 61, 82, 97, 208
scheduler 82
smart call home 61
SNMP 97
system message logging 38
user accounts 208
guidelines and limitations for configuration rollback 201

H

health monitoring diagnostics 118
information 118
high availability 9
PTP 9
high availability 9

I

IDs 57
serial IDs 57

information 23
ntp 23
information about 81
scheduler 81
interfaces, configuring 14
PTP 14

J

job schedule, displaying 90
example 90
job, deleting 86
scheduler 86

L

licensing 10, 24, 82, 97, 124
EEM 124
ntp 24
PTP 10
licensing 10
scheduler 82
SNMP 97
licensing requirements 151
ERSPAN 151
linkDown notifications 106
linkUp notifications 106
log file size, defining 84
scheduler 84
log file, clearing 88
scheduler 88
log files 82
scheduler 82
logging 42
facility messages 42
module messages 42

M

message encryption 99
SNMP 99
module messages logging 42
configuring 42

N

new information 1
description 1
notification receivers 100
SNMP 100
ntp 23–25, 29, 35–36
access restriction, configuring 29
clock manager 24
configuration examples 35
default settings 25
ntp *(continued)*
feature history 36
guidelines 25
information 23
licensing 24
related documents 36
time server 24
using cfs 24
virtualization 24
ntp configuration 32
commiting changes 32
ntp using cfs 24

O

overview 121
embedded event manager 121

P

password requirements 207
periodic inventory notifications, configuring 69
smart call home 69
policies 122
EEM 122
prerequisites 124, 152
EEM 124
ERSPAN 152
PTP 7–9, 11, 14
configuring globally 11
default settings 11
device types 8
interface, configuring 14
overview 7
process 9

R

RBAC 205–207, 209–213
feature groups, creating 211
rules 206
user account restrictions 207
user accounts, configuring 209
user role interface policies, changing 212
user role VLAN policies, changing 212
user roles 205
user roles and rules, configuring 210
verifying 213
registering 62
smart call home 62
related documents 36, 167
ERSPAN 167
ntp 36
remote user authentication 82
scheduler 82

remote user authentication, configuring 84–85
scheduler 84–85
requirements 207
user passwords 207
roles 205
authentication 205
rollback 77, 80
checkpoint copy 77
creating a checkpoint copy 77
default settings 80
deleting a checkpoint file 77
description 77
example configuration 77
guidelines 77
high availability 77
implementing a rollback 77
limitations 77
reverting to checkpoint file 77
verifying configuration 80
rules 206
RBAC 206
runtime diagnostics 117
information 117

S

scheduler 81–86, 88–89, 91
configuration, verifying 89
default settings 83
disabling 89
enabling 83
guidelines and limitations 82
information about 81
job, deleting 86
licensing 82
log file size, defining 84
log file, clearing 88
log files 82
remote user authentication 82
remote user authentication, configuring 84–85
standards 91
timetable, defining 86
scheduler job, creating 90
example 90
scheduler job, scheduling 90
example 90
scheduler jobs, displaying results 90
example 90
serial IDs 57
description 57
server IDs 57
description 57
session manager 77, 79–80
committing a session 79
configuring an ACL session (example) 79
session manager *(continued)*
description 77
discarding a session 79
guidelines 77
limitations 77
saving a session 79
verifying configuration 80
verifying the session 79
smart call home 53–55, 61–62, 64–65, 67–72
adding show commands, alert groups 67
alert groups 55
associating alert groups 67
contact information, configuring 62
default settings 61
description 53
destination profile, creating 64
destination profile, modifying 65
destination profiles 54
duplicate message throttling, disabling 70–71
e-mail details, configuring 68
guidelines and limitations 61
message format options 54
periodic inventory notifications 69
prerequisites 61
registering 62
testing the configuration 71
verifying 72
smart call home messages 54, 56
configuring levels 56
format options 54
SMUs 191–193, 195–198
activating packages 195
adding packages 195
committing the active package set 196
deactivating packages 197
described 191
guidelines 193
limitations 193
package management 192
preparing for package installation 193
prerequisites 192
removing packages 197
SNMP 93–100, 103, 108
access groups 97
configuring users 98
default settings 97
disabling 108
filtering requests 99
functional overview 93
group-based access 97
guidelines and limitations 97
inband access 103
licensing 97
message encryption 99
notification receivers 100
security model 95

SNMP *(continued)*
trap notifications 94
user synchronization with CLI 96
user-based security 95
SNMP 95
version 3 security features 94
SNMP (Simple Network Management Protocol) 94
versions 94
SNMP notification receivers 101
configuring with VRFs 101
SNMP notifications 102
filtering based on a VRF 102
SNMPv3 94, 99
assigning multiple roles 99
security features 94
source IDs 57
call home event format 57
source ports, characteristics 136
SPAN 136
source ports, configuring 141
SPAN 141
SPAN 135–137, 139–143, 147
activating sessions 143
characteristics, source ports 136
creating, deleting sessions 139
description, configuring 142
destination ports, characteristics 137
destinations 136
displaying information 147
egress sources 136
Ethernet destination port, configuring 140
ingress sources 136
source port channels, configuring 142
source ports, configuring 141
sources for monitoring 135
VLANs, configuring 142
SPAN sources 136
egress 136
ingress 136
standards 91
scheduler 91
Switched Port Analyzer 135
syslog 45, 133
configuring 45
EEM 133
system message logging 37–38
guidelines and limitations 38
information about 37
system message logging settings 38
defaults 38
system policies, overriding 132
EEM 132

T

testing the configuration 71
smart call home 71
time server 24
ntp 24
timetable, defining 86
scheduler 86
trap notifications 94

U

user account restrictions 207
RBAC 207
user accounts 207–208, 213
guidelines and limitations 208
passwords 207
verifying 213
user policies, defining 125
EEM 125
user role interface policies, changing 212
RBAC 212
user role VLAN policies, changing 212
RBAC 212
user roles 205
RBAC 205
user roles and rules, creating 210
RBAC 210
users 205
description 205

V

verifying 50, 72, 213
DOM logging configuration 50
RBAC 213
smart call home 72
user accounts 213
virtualization 24
ntp 24
VRFs 101–102
configuring SNMP notification receivers with 101
filtering SNMP notifications 102
VSH script 131
defining EEM policies 131
VSH script policies 124, 131
EEM 124
registering and activating 131

W

warp mode 179–180
disabling 180
enabling 180
guidelines and limitations 179

warp mode *(continued)*
overview 179
verifying the status of 180
warp SPAN 179
guidelines and limitations 179