



## Configuring Layer 2 Switching

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This chapter describes how to configure Layer 2 switching using Cisco NX-OS.

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## Finding Feature Information

Your software release might not support all the features documented in this module. For the latest caveats and feature information, see the Bug Search Tool at <https://tools.cisco.com/bugsearch/> and the release notes for your software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "New and Changed Information" chapter or the Feature History table in this chapter.

## Information About Layer 2 Switching



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**Note**

See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide* for information on creating interfaces.

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You can configure Layer 2 switching ports as access or trunk ports. Trunks carry the traffic of multiple VLANs over a single link and allow you to extend VLANs across an entire network. All Layer 2 switching ports maintain MAC address tables.

**Note**

See the *Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide* for complete information on high-availability features.

## Layer 2 Ethernet Switching Overview

The device supports simultaneous, parallel connections between Layer 2 Ethernet segments. Switched connections between Ethernet segments last only for the duration of the packet. New connections can be made between different segments for the next packet.

The device solves congestion problems caused by high-bandwidth devices and a large number of users by assigning each device (for example, a server) to its own domain. Because each LAN port connects to a separate Ethernet collision domain, servers in a switched environment achieve full access to the bandwidth.

Because collisions cause significant congestion in Ethernet networks, an effective solution is full-duplex communication. Typically, 10/100-Mbps Ethernet operates in half-duplex mode, which means that stations can either receive or transmit. In full-duplex mode, which is configurable on these interfaces, two stations can transmit and receive at the same time. When packets can flow in both directions simultaneously, the effective Ethernet bandwidth doubles. 1/10-Gigabit Ethernet operates in full duplex only.

## Switching Frames Between Segments

Each LAN port on a device can connect to a single workstation, server, or to another device through which workstations or servers connect to the network.

To reduce signal degradation, the device considers each LAN port to be an individual segment. When stations connected to different LAN ports need to communicate, the device forwards frames from one LAN port to the other at wire speed to ensure that each session receives full bandwidth.

To switch frames between LAN ports efficiently, the device maintains an address table. When a frame enters the device, it associates the media access control (MAC) address of the sending network device with the LAN port on which it was received.

## Building the Address Table and Address Table Changes

The device dynamically builds the address table by using the MAC source address of the frames received. When the device receives a frame for a MAC destination address not listed in its address table, it floods the frame to all LAN ports of the same VLAN except the port that received the frame. When the destination station replies, the device adds its relevant MAC source address and port ID to the address table. The device then forwards subsequent frames to a single LAN port without flooding all LAN ports.

You can configure MAC addresses, which are called static MAC addresses, to statically point to specified interfaces on the device. These static MAC addresses override any dynamically learned MAC addresses on those interfaces. You cannot configure broadcast addresses as static MAC addresses. Beginning with Cisco NX-OS Release 5.2(1), multicast MAC addresses can be configured as static MAC addresses. For further information, see the “Configuring IGMP Snooping” of the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*. The static MAC entries are retained across a reboot of the device.

Beginning with Cisco NX-OS Release 4.1(5), you must manually configure identical static MAC addresses on both devices connected by a virtual port channel (vPC) peer link. The MAC address table display is enhanced to display information on MAC addresses when you are using vPCs.

See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide* for information about vPCs.

The address table can store a number of MAC address entries depending on the hardware I/O module. The device uses an aging mechanism, defined by a configurable aging timer, so if an address remains inactive for a specified number of seconds, it is removed from the address table.

See the *Cisco Nexus 7000 Series NX-OS Security Command Reference* for information on MAC port security.

## Consistent MAC Address Tables on the Supervisor and on the Modules

Optimally, all the MAC address tables on each module exactly match the MAC address table on the supervisor. Beginning with Cisco NX-OS 4.1(2), when you enter the **show forwarding consistency l2** command, the device displays discrepant, missing, and extra MAC address entries.

## Layer 3 Static MAC Addresses

Beginning with Release 4.2, you can configure a static MAC address for all Layer 3 interfaces. The default MAC address for the Layer 3 interfaces is the VDC MAC address.

You can configure a static MAC address for the following Layer 3 interfaces:

- Layer 3 interfaces
- Layer 3 subinterfaces
- Layer 3 port channels
- VLAN network interface



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**Note** You cannot configure static MAC address on tunnel interfaces.

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See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide* for information on configuring Layer 3 interfaces.

## High Availability for Switching

You can upgrade or downgrade the software seamlessly, with respect to classical Ethernet switching. Beginning with Release 4.2(1), if you have configured static MAC addresses on Layer 3 interfaces, you must unconfigure those ports in order to downgrade the software.



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**Note** See the *Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide* for complete information on high availability features.

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## Virtualization Support for Layer 2 Switching

The device supports virtual device contexts (VDCs), and the configuration and operation of the MAC address table are local to the VDC.

**Note**

See the *Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide* for complete information on VDCs and assigning resources.

## Licensing Requirements for Layer 2 Switching

This table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	Layer 2 switching require 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 <i>Cisco NX-OS Licensing Guide</i> .

However, using VDCs requires an Advanced Services license.

## Prerequisites for Configuring MAC Addresses

MAC addresses have the following prerequisites:

- You must be logged onto the device.
- If necessary, install the Advanced Services license and enter the desired VDC.

## Guidelines and Limitations for Configuring MAC Addresses

MAC addresses have the following configuration guidelines and limitations:

MAC Address Table	Age Group
M1 Line Cards	128,000 entries
F1 Line Cards	16,000 to 256,000 entries
F2 and F2e Line Cards	16,000 to 192,000 entries

**Note**

The F2 and F2e modules synchronize the MAC address tables for a VLAN across all Switch on Chips (SoCs) present in a virtual device context (VDC) when a switch virtual interface (SVI) for the VLAN is configured. Synchronizing the MAC address tables can reduce the number of MAC addresses supported in a VDC to 16,000.

Beginning with NX-OS Release 6.0.1, the learning mode feature is supported. Learning mode has the following configuration guidelines and limitations:

Line Cards	Classic Ethernet (CE) Nonconversational Learning Supported	Classic Ethernet (CE) Conversational Learning Supported	Fabric Path Conversational Learning	Fabric Path Nonconversational Learning
M1	Yes	NA	NA	NA
F1	Yes	Yes	Yes	No
F2 and F2e	Yes	Yes	Yes	Yes, if the switch virtual interface (SVI) is configured.

**Note**

When you configure a static MAC address on a vPC switch, ensure to configure a corresponding static MAC address on the other vPC switch. If you configure the static MAC address only on one of the vPC switches, the other vPC switch will not learn the MAC address dynamically.

## Default Settings for Layer 2 Switching

This table lists the default setting for Layer 2 switching parameters.

**Table 1: Default Layer 2 Switching Parameters**

Parameters	Default
Aging time	1800 seconds

Beginning with NX-OS Release 6.0.1, the learning mode feature is supported. This table lists the default learning mode parameters.

**Table 2: Default Learning Mode Parameters**

Parameters	Default
Classic Ethernet (CE) VLAN	Nonconversational
Fabric Path VLANs	Conversational

## Configuring Layer 2 Switching

**Note**

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

## Configuring a Static MAC Address

You can configure MAC addresses, which are called static MAC addresses, to statically point to specified interfaces on the device. These static MAC addresses override any dynamically learned MAC addresses on those interfaces. You cannot configure broadcast addresses as static MAC addresses. Beginning with Cisco NX-OS Release 5.2(1), multicast MAC addresses can be configured as static MAC addresses. For further information, see the "Configuring IGMP Snooping" of the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*.

### Before you begin

Before you configure static MAC addresses, ensure that you are in the correct VDC (or enter the **switchto vdc** command).

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>config t</b>  <b>Example:</b>  switch# config t switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>mac address-table static mac-address vlan vlan-id</b> <b>{[drop   interface {type slot/port}   port-channel number]}</b>  <b>Example:</b>  switch(config)# mac address-table static 1.1.1.1 vlan 2 interface ethernet 1/2	Specifies a static MAC address to add to the Layer 2 MAC address table.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b>  switch(config)# exit switch#	Exits global configuration mode.
<b>Step 4</b>	(Optional) <b>show mac address-table static</b>  <b>Example:</b>  switch# show mac address-table static	Displays the static MAC addresses.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b>  switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

### Example

This example shows how to put a static entry in the Layer 2 MAC address table:

```
switch# config t
switch(config)# mac address-table static 1.1.1 vlan 2 interface ethernet 1/2
switch(config)#
```

## Configuring a Static MAC Address on a Layer 3 Interface

Beginning with Release 4.2(1), you can configure static MAC addresses on Layer 3 interfaces. You cannot configure broadcast addresses as static MAC addresses. Beginning with Cisco NX-OS Release 5.2(1), multicast MAC addresses can be configured as static MAC addresses. For further information, see the "Configuring IGMP Snooping" of the *Cisco Nexus 7000 Series NX-OS Multicast Routing Configuration Guide*.



**Note** You cannot configure static MAC addresses on tunnel interfaces.

See the *Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide* for information on configuring Layer 3 interfaces.

### Before you begin

Before you configure static MAC addresses, ensure that you are in the correct VDC (or enter the **switchto vdc** command).

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>config t</b>  <b>Example:</b> <pre>switch# config t switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	<b>interface [ethernet slot/port   ethernet slot/port.number   port-channel number   vlan vlan-id]</b>  <b>Example:</b> <pre>switch(config)# interface ethernet 7/3</pre>	Specifies the Layer 3 interface and enters interface configuration mode.  <b>Note</b> You must create the Layer 3 interface before you can assign the static MAC address.
<b>Step 3</b>	<b>mac-address mac-address</b>  <b>Example:</b> <pre>switch(config-if)# mac-address 22ab.47dd.ff89 switch(config-if)#</pre>	Specifies a static MAC address to add to the Layer 3 interface.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config-if)# exit switch(config)#</pre>	Exits interface configuration mode.

	Command or Action	Purpose
<b>Step 5</b>	(Optional) <b>show interface</b> [ <i>ethernet slot/port</i>   <i>ethernet slot/port.number</i>   <b>port-channel number</b>   <b>vlan vlan-id</b> ]  <b>Example:</b> switch# show interface ethernet 7/3	Displays information about the Layer 3 interface.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

### Example

This example shows how to configure the Layer 3 interface on slot 7, port 3 with a static MAC address:

```
switch# config t
switch(config)# interface ethernet 7/3
switch(config-if)# mac-address 22ab.47dd.ff89
switch(config-if)#
```

## Configuring the Aging Time for the MAC Address Table

You can configure the amount of time that a MAC address entry (the packet source MAC address and port on which that packet was learned) remains in the MAC address table, which contains the Layer 2 information.



### Note

You can also configure the MAC aging time in interface configuration mode or VLAN configuration mode.

### Before you begin

Before you configure the aging time for the MAC address table, ensure that you are in the correct VDC (or enter the **switchto vdc** command).

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>config t</b>  <b>Example:</b> switch# config t switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>mac address-table aging-time seconds</b> [ <i>vlan vlan_id</i> ]	Specifies the time before an entry ages out and is discarded from the Layer 2 MAC address table. The range is from 120 to 918000; the



	Command or Action	Purpose
	<b>Example:</b> <pre>switch(config)# mac address-table aging-time 600</pre>	default is 1800 seconds. Entering the value 0 disables the MAC aging.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.
<b>Step 4</b>	(Optional) <b>show mac address-table aging-time</b>  <b>Example:</b> <pre>switch# show mac address-table aging-time</pre>	Displays the aging time configuration for MAC address retention.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

### Example

This example shows how to set the ageout time for entries in the Layer 2 MAC address table to 600 seconds (10 minutes):

```
switch# config t
switch(config)# mac address-table aging-time 600
switch(config)#
```

## Configuring Learning Mode for VLANs

Beginning with NX-OS Release 6.0.1, configuring the learning mode for VLANs is supported. Based on the learning mode configured, the Cisco NX-OS software can install MAC addresses in hardware either conversationally or nonconversationally.

### Before you begin

Before you configure the learning mode for VLANs, ensure that you are in the correct VDC (or enter the **switchto vdc** command).

### Procedure

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

	Command or Action	Purpose
<b>Step 2</b>	<b>mac address-table learning-mode conversational</b> <i>vlan-range of CE-vlans</i>  <b>Example:</b> <pre>switch(config)# mac address-table learning-mode conversational vlan1</pre>	Specifies the learning mode for the Layer 2 MAC address table. The options are conversational learning and nonconversational learning.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits global configuration mode.

### Example

This example shows how to set the learning mode to conversational for the VLANs:

```
switch# config t
switch(config)# mac address-table learning-mode conversational vlan1
switch(config)# end
switch(config)# show mac address-table learning-mode
```

## Checking the Consistency of MAC Address Tables

Beginning with Release 4.1(2), you can check the match between the MAC address table on the supervisor and all the modules.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>show forwarding consistency l2</b> <i>{module_number}</i>  <b>Example:</b> <pre>switch# show forwarding consistency l2 7 switch#</pre>	Displays the discrepant, missing, and extra MAC addresses between the supervisor and the specified module.

### Example

This example shows how to display discrepant, missing, and extra entries in the MAC address tables between the supervisor and the specified module:

```
switch# show forwarding consistency l2 7
switch#
```

## Clearing Dynamic Addresses from the MAC Address Table

You can clear all dynamic Layer 2 entries in the MAC address table.

### Before you begin

Before you clear the dynamic MAC address table, ensure that you are in the correct VDC (or enter the **switchto vdc** command).

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>clear mac address-table dynamic</b> {address <i>mac_addr</i> } {interface [ <i>ethernet slot/port</i>   <i>loopback number</i>   <i>port-channel channel-number</i> ]} { <i>vlan vlan_id</i> }  <b>Example:</b>  switch# clear mac address-table dynamic	Clears the dynamic address entries from the MAC address table in Layer 2.
<b>Step 2</b>	(Optional) <b>show mac address-table</b>  <b>Example:</b>  switch# show mac address-table	Displays the MAC address table.

### Example

This example shows how to clear the dynamic entries in the Layer 2 MAC address table:

```
switch# clear mac address-table dynamic
switch#
```

## Verifying the Layer 2 Switching Configuration

To display Layer 2 switching configuration information, perform one of the following tasks:

Command	Purpose
<b>show mac address-table</b>	Displays information about the MAC address table.
<b>show mac address-table aging-time</b>	Displays information about the aging time set for the MAC address entries.
<b>show mac address-table static</b>	Displays information about the static entries on the MAC address table.
<b>show interface [<i>interface</i>] mac-address</b>	Displays the MAC addresses and the burned in MAC addresses for the interfaces.

Command	Purpose
<b>show forwarding consistency l2 {module}</b>	Displays discrepant, missing, and extra MAC addresses between the tables on the module and the supervisor.

For information on the output of these commands, see the *Cisco Nexus 7000 Series NX-OS Layer 2 Switching Command Reference*.

## Configuration Example for Layer 2 Switching

The following example shows how to add a static MAC address and how to modify the default global aging time for MAC addresses:

```
switch# configure terminal
switch(config)# mac address-table static 0000.0000.1234 vlan 10 interface ethernet 2/15
switch(config)# mac address-table aging-time 120
```

## Additional References for Layer 2 Switching

### Related Documents

Related Topic	Document Title
Port security, static MAC addresses	<i>Cisco Nexus 7000 Series NX-OS Security Configuration Guide</i>
Interfaces	<i>Cisco Nexus 7000 Series NX-OS Interfaces Configuration Guide</i>
Command reference	<i>Cisco Nexus 7000 Series NX-OS Layer 2 Switching Command Reference</i>
High availability	<i>Cisco Nexus 7000 Series NX-OS High Availability and Redundancy Guide</i>
VDCs	<i>Cisco Nexus 7000 Series NX-OS Virtual Device Context Configuration Guide</i>
System management	<i>Cisco Nexus 7000 Series NX-OS System Management Configuration Guide</i>
Licensing	<i>Cisco NX-OS Licensing Guide</i>
Release Notes	<i>Cisco Nexus 7000 Series NX-OS Release Notes</i>

### Standards

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

# Feature History for Configuring Layer 2 Switching

This table lists the release history for this feature.

*Table 3: Feature History for Configuring Layer 2 Switching*

Feature Name	Releases	Feature Information	
Learning mode for VLANs	6.0(1)	You can configure conversational or nonconversational learning mode for VLANs.	
Layer 3 interface static MAC addresses	4.2(1)	You can configure a Layer 3 interface with a static MAC address.	
<b>show mac address-table</b>	4.1(2)	This display provides additional information when vPC is enabled and running.	
Layer 2 consistency	4.1(2)	The <b>show forwarding consistency 12</b> command displays inconsistent entries on the MAC address table between the modules.	

