# Configuring Layer 2 Switching

## About Layer 2 Switching

**Note**    See the Cisco Nexus 3600 Series NX-OS Interfaces Configuration Guide, for information on creating interfaces.

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.

## 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 collision 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.

## 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. The static MAC entries are retained across a reboot of the device.

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 3600 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.

## 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. When you enter the **show forwarding consistency l2** command or the **show consistency-checker l2** command, the device displays discrepant, missing, and extra MAC address entries.

## Layer 3 Static MAC Addresses

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

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

See the Cisco Nexus 3600 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. If you have configured static MAC addresses on Layer 3 interfaces, you must unconfigure those ports in order to downgrade the software.

# 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.

# 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 |

# MAC Move Loop Detection

Cisco Nexus 3600 Series switches leverage L2FM for software MAC learning (and, subsequently, loop detection). If a host (MAC address) moves between two interfaces within the same VLAN, it would trigger a MAC move. If there are a large number of such MAC moves in a short duration of time, the control plane of the switch and the CPU performance could get impacted. L2FM protects the switch from such scenarios by disabling MAC learning on the specific VLAN once the number of MAC moves for the corresponding MAC address exceeds a threshold.

For Cisco Nexus 3600 switches, the MAC move learn disable threshold criteria is when a single MAC addresses moves 10 or more times in a duration of one second within the same VLAN. Once threshold limit is hit, all new MAC learning on the corresponding VLAN is disabled for a period between 120 seconds to 240 seconds within the same VLAN. After that, new MAC learning is re-enabled on that VLAN. There is no impact of this on rest of the VLANs on the switch.

**Note**    If Cisco Nexus 3600 Series switches is operated in N9K mode, the generated syslog messages will be similar to Cisco Nexus 9000 Series switches.

# Generating Syslog Error Messages

To see MAC move notifications in syslogs, follow the below steps:

## SUMMARY STEPS

1. **config t**
2. **logging level l2fm 5**
3. (Optional) **mac address-table notification mac-move**

## DETAILED STEPS

|  | **Command or Action** | **Purpose** |
|---|---|---|
| **Step 1** | **config t**<br><br>**Example:**<br><br>`switch# config t`<br>`switch(config)#` | Enters configuration mode. |
| **Step 2** | **logging level l2fm 5**<br><br>**Example:**<br><br>`switch(config)# logging level l2fm 5` | Enables logging of all L2FM events from level 5 up to the highest severity events. |
| **Step 3** | (Optional) **mac address-table notification mac-move**<br><br>**Example:**<br><br>`switch(config)# mac address-table notification mac-move` | Enables MAC move notification on the switch.<br><br>**Note**  • MAC move notification is enabled by default.<br><br>• This command ensures that the syslog for L2FM detect displays when there is a MAC address move. |

Following are the sample generated syslog messages:

• When MAC move is detected:

```
2018 Nov 14 16:04:23.881 N9K %L2FM-4-L2FM_MAC_MOVE2: Mac XXXX.XXXX.XXXX
in vlan 741 has moved between Po6 to Eth1/3
```

• When MAC learning on VLAN is disabled:

```
2016 Apr 11 18:00:18 %L2FM-2-L2FM_MAC_FLAP_DISABLE_LEARN_N3K: Loops detected in the
network for mac XXXX.XXXX.XXXX among ports Eth1/48 and Eth1/50/3 on vlan 4 - Disabling
 dynamic learning notifications for a period between 120 and 240 second
```

• When MAC learning on VLAN is re-enabled:

```
2023 Nov 29 21:23:19 N-3164Q-40G %L2FM-2-L2FM_MAC_FLAP_RE_ENABLE_LEARN:
Re-enabling learning in vlan 500
```

**Example**

In order to check if the MAC addresses move, enter the command:

```
switch# show mac address-table notification mac-move
MAC Move Notify Triggers: 1206
Number of MAC Addresses added: 944088
Number of MAC Addresses moved: 265
Number of MAC Addresses removed: 943920
```

**Note** The following are the possible causes for MAC moves:

- MAC addresses move because of server NIC teaming and moving between Active-Active, Active-Standby states, etc.

- MAC addresses move because the source of the data is physically moved across all switches while STP states are converged and in correct states.

- Due to loops in the network.

# Configuring Layer 2 Switching by Steps

**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 or multicast addresses as static MAC addresses.

**SUMMARY STEPS**

1. **config t**
2. **mac address-table static** *mac-address* **vlan** *vlan-id* {[**drop** | **interface** {*type slot/port*} | **port-channel** *number*]}
3. **exit**
4. (Optional) **show mac address-table static**
5. (Optional) **copy running-config startup-config**

**DETAILED STEPS**

|  | **Command or Action** | **Purpose** |
|---|---|---|
| **Step 1** | **config t**<br><br>**Example:**<br><br>`switch# config t`<br>`switch(config)#` | Enters configuration mode. |
| **Step 2** | **mac address-table static** *mac-address* **vlan** *vlan-id* {[**drop** \| **interface** {*type slot/port*} \| **port-channel** *number*]}<br><br>**Example:**<br><br>`switch(config)# mac address-table static 1.1.1 vlan`<br>` 2 interface ethernet 1/2` | Specifies a static MAC address to add to the Layer 2 MAC address table. |
| **Step 3** | **exit**<br><br>**Example:**<br><br>`switch(config)# exit`<br>`switch#` | Exits the configuration mode. |
| **Step 4** | (Optional) **show mac address-table static**<br><br>**Example:**<br><br>`switch# show mac address-table static` | Displays the static MAC addresses. |
| **Step 5** | (Optional) **copy running-config startup-config**<br><br>**Example:**<br><br>`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

You can configure static MAC addresses on Layer 3 interfaces. You cannot configure broadcast or multicast addresses as static MAC addresses.

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

> **Note** This configuration is limited to 16 VLAN interfaces. Applying the configuration to additional VLAN interfaces results in a down state for the interface with a `Hardware prog failed.` status.

See the Cisco Nexus 3600 Series NX-OS Interfaces Configuration Guide, for information on configuring Layer 3 interfaces.

## SUMMARY STEPS

1. **config t**
2. **interface** [**ethernet** *slot/port* | **ethernet** *slot/port.number* | **port-channel** *number* | **vlan** *vlan-id*]
3. **mac-address** *mac-address*
4. **exit**
5. (Optional) **show interface** [**ethernet** *slot/port* | **ethernet** *slot/port.number* | **port-channel** *number* | **vlan** *vlan-id*]
6. (Optional) **copy running-config startup-config**

## DETAILED STEPS

|  | Command or Action | Purpose |
|---|---|---|
| Step 1 | **config t**<br><br>**Example:**<br>`switch# config t`<br>`switch(config)#` | Enters configuration mode. |
| Step 2 | **interface** [**ethernet** *slot/port* | **ethernet** *slot/port.number* | **port-channel** *number* | **vlan** *vlan-id*]<br><br>**Example:**<br>`switch(config)# interface ethernet 7/3` | Specifies the Layer 3 interface and enters the interface configuration mode.<br><br>**Note** You must create the Layer 3 interface before you can assign the static MAC address. |
| Step 3 | **mac-address** *mac-address*<br><br>**Example:**<br>`switch(config-if)# mac-address 22ab.47dd.ff89`<br>`switch(config-if)#` | Specified a static MAC address to add to the Layer 3 interface. |
| Step 4 | **exit**<br><br>**Example:**<br>`switch(config-if)# exit`<br>`switch(config)#` | Exits the interface mode. |
| Step 5 | (Optional) **show interface** [**ethernet** *slot/port* | **ethernet** *slot/port.number* | **port-channel** *number* | **vlan** *vlan-id*]<br><br>**Example:**<br>`switch# show interface ethernet 7/3` | Displays information about the Layer 3 interface. |

| | Command or Action | Purpose |
|---|---|---|
| Step 6 | (Optional)  **copy running-config startup-config**<br><br>**Example:**<br><br>`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 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 table, which contains the Layer 2 information.

**Note** MAC addresses are aged out up to two times the configured MAC address table aging timeout.

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

### SUMMARY STEPS

1. **config t**
2. **mac address-table aging-time** *seconds*
3. **exit**
4. (Optional) **show mac address-table aging-time**
5. (Optional) **copy running-config startup-config**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| Step 1 | **config t**<br><br>**Example:**<br><br>`switch# config t`<br>`switch(config)#` | Enters configuration mode. |
| Step 2 | **mac address-table aging-time** *seconds*<br><br>**Example:** | Specifies the time before an entry ages out and is discarded from the Layer 2 MAC address table. The range is from |

| | Command or Action | Purpose |
|---|---|---|
| | `switch(config)# mac address-table aging-time 600` | 120 to 918000; the default is 1800 seconds. Entering the value 0 disables the MAC aging. |
| **Step 3** | **exit**<br><br>**Example:**<br><br>`switch(config)# exit`<br>`switch#` | Exits the configuration mode. |
| **Step 4** | (Optional) **show mac address-table aging-time**<br><br>**Example:**<br><br>`switch# show mac address-table aging-time` | Displays the aging time configuration for MAC address retention. |
| **Step 5** | (Optional) **copy running-config startup-config**<br><br>**Example:**<br><br>`switch# copy running-config startup-config` | 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)#
```

# Checking Consistency of MAC Address Tables

You can check the match between the MAC address table on the supervisor and all the modules.

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**Note**    Alternatively, you can also use the **show consistency-checker l2** {*module_number*} command to check the consistency of the MAC address table.

Example:

```
switch# show consistency-checker l2 module 1
switch#
```

**SUMMARY STEPS**

    **1.** **show forwarding consistency l2** {*module_number*}

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **show forwarding consistency l2** {*module_number*}<br><br>**Example:** | Displays the discrepant, missing, and extra MAC addresses between the supervisor and the specified module. |

| Command or Action | Purpose |
|---|---|
| `switch# show forwarding consistency l2 7`<br>`switch#` | |

### 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 Table

You can clear all dynamic Layer 2 entries in the MAC address table. (You can also clear entries by designated interface or VLAN.)

### SUMMARY STEPS

1. **clear mac address-table dynamic** {**address** *mac_addr*} {**interface** [**ethernet** *slot/port* | **port-channel** *channel-number*]} {**vlan** *vlan_id*}
2. (Optional) **show mac address-table**

### DETAILED STEPS

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

# Configuring MAC Address Limits

**SUMMARY STEPS**

1. **config t**
2. **mac address-table limit vlan** *vlan-id limit -value*
3. **exit**
4. (Optional) **copy running-config startup-config**

**DETAILED STEPS**

|  | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **config t**<br><br>**Example:**<br>`switch# config t`<br>`switch(config)#` | Enters configuration mode. |
| **Step 2** | **mac address-table limit vlan** *vlan-id limit -value*<br><br>**Example:**<br>`switch(config)# mac address-table limit vlan 40`<br>`108` | Specifies the VLAN to which the MAC address limits should be applied. |
| **Step 3** | **exit**<br><br>**Example:**<br>`switch(config)# exit`<br>`switch#` | Exits the configuration mode. |
| **Step 4** | (Optional) **copy running-config startup-config**<br><br>**Example:**<br>`switch# copy running-config startup-config` | Copies the running configuration to the startup configuration. |

# Verifying the Layer 2 Switching Configuration

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

| Command | Purpose |
|---|---|
| **show mac address-table** | Displays information about the MAC address table. |
| **show mac address-table limit** | Displays information about the limits set for the MAC address table. |
| **show mac address-table aging-time** | Displays information about the aging time set for the MAC address entries. |

| Command | Purpose |
|---|---|
| **show mac address-table static** | Displays information about the static entries on the MAC address table. |
| **show interface** [*interface*] **mac-address** | Displays the MAC addresses and the burn-in MAC address for the interfaces. |
| **show forwarding consistency l2** {*module*} | Displays discrepant, missing, and extra MAC addresses between the tables on the module and the supervisor. |

# 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 -- CLI Version

**Related Documents**

| Related Topic | Document Title |
|---|---|
| Static MAC addresses | *Cisco Nexus 3600 Series NX-OS Security Configuration Guide* |
| Interfaces | *Cisco Nexus 3600 Series NX-OS Interfaces Configuration Guide* |
| System management | *Cisco Nexus 3600 Series NX-OS System Management Configuration Guide* |

**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. | — |