Cisco Nexus 3000 Series NX-OS Interfaces Configuration Guide, Release 5.0(3)U5(1)

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Preface

This preface contains the following sections:

Audience

This publication is for experienced 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.

Convention	Description
[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.
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.

This document uses the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Related Documentation for Nexus 3000 Series NX-OS Software

The entire Cisco NX-OS 3000 Series documentation set is available at the following URL:

http://www.cisco.com/en/US/products/ps11541/tsd_products_support_series_home.html

Release Notes

The release notes are available at the following URL:

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Installation and Upgrade Guides

The installation and upgrade guides are available at the following URL:

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The documents in this category include:

- *Cisco Nexus 5000 Series, Cisco Nexus 3000 Series, and Cisco Nexus 2000 Series Safety Information and Documentation*
- *Regulatory, Compliance, and Safety Information for the Cisco Nexus 5000 Series, Cisco Nexus 3000 Series, and Cisco Nexus 2000 Series*
- *Cisco Nexus 3000 Series Hardware Installation Guide*

License Information

For information about feature licenses in NX-OS, see the *Cisco NX-OS Licensing Guide*, available at the following URL: http://www.cisco.com/en/US/docs/switches/datacenter/sw/nx-os/licensing/guide/b_Cisco_NX-OS_Licensing_Guide.html.

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Configuration Guides

The configuration guides are available at the following URL:

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The documents in this category include:

- *Fundamentals Configuration Guide*
- *Interfaces Configuration Guide*
- *Layer 2 Switching Configuration Guide*
- *Multicast Configuration Guide*
- *Quality of Service Configuration Guide*
- *Security Configuration Guide*
- *System Management Configuration Guide*
- *Unicast Routing Configuration Guide*
- *Verified Scalability Guide for Cisco NX-OS*

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The error and system message reference guides are available at the following URL:

http://www.cisco.com/en/US/products/ps11541/products_system_message_guides_list.html

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CHAPTER 1

New and Changed Information for this Release

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.

New and Changed Information in this Release

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.

Feature	Description	Added or Changed in Release	Where Documented
Port-channel load-balancing hash	Added support for port-channel load balancing resolution.	5.0(3)U5(1)	Configuring Port Channels, on page 37
SVI Autostate disable	Allows user to keep a SVI up even when no interfaces are up in the corresponding VLAN.	5.0(3)U5(1)	Configuring Layer 2 Interfaces, on page 3

CHAPTER 2

Configuring Layer 2 Interfaces

This chapter contains the following sections:

Information About Ethernet Interfaces

The Ethernet ports can operate as standard Ethernet interfaces connected to servers or to a LAN.

The Ethernet interfaces are enabled by default.

About the Interface Command

You can enable the various capabilities of the Ethernet interfaces on a per-interface basis using the **interface** command. When you enter the **interface** command, you specify the following information:

- Interface type—All physical Ethernet interfaces use the **ethernet** keyword.
- Slot number
  - Slot 1 includes all the fixed ports.
  - Slot 2 includes the ports on the upper expansion module (if populated).
  - Slot 3 includes the ports on the lower expansion module (if populated).
  - Slot 4 includes the ports on the lower expansion module (if populated).

Note Slot 4 is only available on the Cisco Nexus 5596T switch.

- Port number
  - Port number within the group.

The interface numbering convention is extended to support use with a Cisco Nexus 2000 Series Fabric Extender as follows:

switch(config)# **interface ethernet** [*chassis*/]*slot*/*port*

- Chassis ID is an optional entry to address the ports of a connected Fabric Extender. The chassis ID is configured on a physical Ethernet or EtherChannel interface on the switch to identify the Fabric Extender discovered via the interface. The chassis ID ranges from 100 to 199.

About the Unidirectional Link Detection Parameter

The Cisco-proprietary Unidirectional Link Detection (UDLD) protocol allows ports that are connected through fiber optics or copper (for example, Category 5 cabling) Ethernet cables to monitor the physical configuration of the cables and detect when a unidirectional link exists. When the switch detects a unidirectional link, UDLD shuts down the affected LAN port and alerts the user. Unidirectional links can cause a variety of problems, including spanning tree topology loops.

UDLD is a Layer 2 protocol that works with the Layer 1 protocols to determine the physical status of a link. At Layer 1, autonegotiation takes care of physical signaling and fault detection. UDLD performs tasks that autonegotiation cannot perform, such as detecting the identities of neighbors and shutting down misconnected LAN ports. When you enable both autonegotiation and UDLD, Layer 1 and Layer 2 detections work together to prevent physical and logical unidirectional connections and the malfunctioning of other protocols.

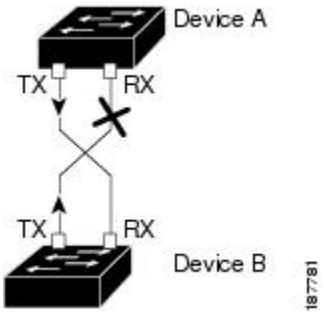
A unidirectional link occurs whenever traffic transmitted by the local device over a link is received by the neighbor but traffic transmitted from the neighbor is not received by the local device. If one of the fiber strands in a pair is disconnected, as long as autonegotiation is active, the link does not stay up. In this case, the logical link is undetermined, and UDLD does not take any action. If both fibers are working normally at Layer 1, then UDLD at Layer 2 determines whether those fibers are connected correctly and whether traffic is flowing bidirectionally between the correct neighbors. This check cannot be performed by autonegotiation, because autonegotiation operates at Layer 1.

A Cisco Nexus device periodically transmits UDLD frames to neighbor devices on LAN ports with UDLD enabled. If the frames are echoed back within a specific time frame and they lack a specific acknowledgment (echo), the link is flagged as unidirectional and the LAN port is shut down. Devices on both ends of the link must support UDLD in order for the protocol to successfully identify and disable unidirectional links.

Note By default, UDLD is locally disabled on copper LAN ports to avoid sending unnecessary control traffic on this type of media.

The following figure shows an example of a unidirectional link condition. Device B successfully receives traffic from Device A on the port. However, Device A does not receive traffic from Device B on the same port. UDLD detects the problem and disables the port.

Figure 1: Unidirectional Link



Default UDLD Configuration

The following table shows the default UDLD configuration.

Table 1: UDLD Default Configuration

Feature	Default Value
UDLD global enable state	Globally disabled
UDLD aggressive mode	Disabled
UDLD per-port enable state for fiber-optic media	Enabled on all Ethernet fiber-optic LAN ports
UDLD per-port enable state for twisted-pair (copper) media	Disabled on all Ethernet 10/100 and 1000BASE-TX LAN ports

UDLD Aggressive and Nonaggressive Modes

UDLD aggressive mode is disabled by default. You can configure UDLD aggressive mode only on point-to-point links between network devices that support UDLD aggressive mode. If UDLD aggressive mode is enabled, when a port on a bidirectional link that has a UDLD neighbor relationship established stops receiving UDLD frames, UDLD tries to reestablish the connection with the neighbor. After eight failed retries, the port is disabled.

To prevent spanning tree loops, nonaggressive UDLD with the default interval of 15 seconds is fast enough to shut down a unidirectional link before a blocking port transitions to the forwarding state (with default spanning tree parameters).

When you enable the UDLD aggressive mode, the following occurs:

- One side of a link has a port stuck (both transmission and receive)
- One side of a link remains up while the other side of the link is down

In these cases, the UDLD aggressive mode disables one of the ports on the link, which prevents traffic from being discarded.

Interface Speed

Cisco Nexus 3000 Series switches have a number of fixed 10-Gigabit ports, each equipped with SFP+ interface adapters.

SVI Autostate

The Switch Virtual Interface (SVI) represents a logical interface between the bridging function and the routing function of a VLAN in the device. By default, when a VLAN interface has multiple ports in the VLAN, the SVI goes to the down state when all the ports in the VLAN go down.

Autostate behavior is the operational state of an interface that is governed by the state of the various ports in its corresponding vlan. In other words a SVI interface on a VLAN comes up when there is at least one port in that vlan that is in STP forwarding state. Similarly, this interface goes down when the last STP forwarding port goes down or goes to another STP state.

By default, Autostate calculation is enabled. You can disable Autostate calculation for a SVI interface and change the default value.

About the Cisco Discovery Protocol

The Cisco Discovery Protocol (CDP) is a device discovery protocol that runs over Layer 2 (the data link layer) on all Cisco-manufactured devices (routers, bridges, access servers, and switches) and allows network management applications to discover Cisco devices that are neighbors of already known devices. With CDP, network management applications can learn the device type and the Simple Network Management Protocol (SNMP) agent address of neighboring devices running lower-layer, transparent protocols. This feature enables applications to send SNMP queries to neighboring devices.

CDP runs on all media that support Subnetwork Access Protocol (SNAP). Because CDP runs over the data-link layer only, two systems that support different network-layer protocols can learn about each other.

Each CDP-configured device sends periodic messages to a multicast address, advertising at least one address at which it can receive SNMP messages. The advertisements also contain time-to-live, or holdtime information, which is the length of time a receiving device holds CDP information before discarding it. Each device also listens to the messages sent by other devices to learn about neighboring devices.

The switch supports both CDP Version 1 and Version 2.

Default CDP Configuration

The following table shows the default CDP configuration.

Table 2: Default CDP Configuration

Feature	Default Setting
CDP interface state	Enabled

Feature	Default Setting
CDP timer (packet update frequency)	60 seconds
CDP holdtime (before discarding)	180 seconds
CDP Version-2 advertisements	Enabled

About the Error-Disabled State

An interface is in the error-disabled (err-disabled) state when the inteface is enabled administratively (using the **no shutdown** command) but disabled at runtime by any process. For example, if UDLD detects a unidirectional link, the interface is shut down at runtime. However, because the interface is administratively enabled, the interface status displays as err-disabled. Once an interface goes into the err-disabled state, you must manually reenable it or you can configure an automatic timeout recovery value. The err-disabled detection is enabled by default for all causes. The automatic recovery is not configured by default.

When an interface is in the err-disabled state, use the **errdisable detect cause** command to find information about the error.

You can configure the automatic err-disabled recovery timeout for a particular err-disabled cause by changing the time variable.

The **errdisable recovery cause** command provides automatic recovery after 300 seconds. To change the recovery period, use the **errdisable recovery interval** command to specify the timeout period. You can specify 30 to 65535 seconds.

If you do not enable the err-disabled recovery for the cause, the interface stays in the err-disabled state until you enter the **shutdown** and **no shutdown** commands. If the recovery is enabled for a cause, the interface is brought out of the err-disabled state and allowed to retry operation once all the causes have timed out. Use the **show interface status err-disabled** command to display the reason behind the error.

About MTU Configuration

The Cisco Nexus device switch does not fragment frames. As a result, the switch cannot have two ports in the same Layer 2 domain with different maximum transmission units (MTUs). A per-physical Ethernet interface MTU is not supported. Instead, the MTU is set according to the QoS classes. You modify the MTU by setting class and policy maps.

Note When you show the interface settings, a default MTU of 1500 is displayed for physical Ethernet interfaces.

Configuring Ethernet Interfaces

The section includes the following topics:

Configuring the UDLD Mode

You can configure normal or aggressive unidirectional link detection (UDLD) modes for Ethernet interfaces on devices configured to run UDLD. Before you can enable a UDLD mode for an interface, you must make sure that UDLD is already enabled on the device that includes the interface. UDLD must also be enabled on the other linked interface and its device.

To use the normal UDLD mode, you must configure one of the ports for normal mode and configure the other port for the normal or aggressive mode. To use the aggressive UDLD mode, you must configure both ports for the aggressive mode.

Note Before you begin, UDLD must be enabled for the other linked port and its device.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **feature udld**	Enables UDLD for the device.
Step 3	switch(config)# **no feature udld**	Disables UDLD for the device.
Step 4	switch(config)# **show udld global**	Displays the UDLD status for the device.
Step 5	switch(config)# **interface** *type slot/port*	Specifies an interface to configure, and enters interface configuration mode.
Step 6	switch(config-if)# **udld** {**enable** | **disable** | **aggressive**}	Enables the normal UDLD mode, disables UDLD, or enables the aggressive UDLD mode.
Step 7	switch(config-if)# **show udld** *interface*	Displays the UDLD status for the interface.

This example shows how to enable the UDLD for the switch:

```
switch# configure terminal
switch(config)# feature udld
```

This example shows how to enable the normal UDLD mode for an Ethernet port:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# udld enable
```

This example shows how to enable the aggressive UDLD mode for an Ethernet port:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# udld aggressive
```

This example shows how to disable UDLD for an Ethernet port:

```
switch# configure terminal
```

```
switch(config)# interface ethernet 1/4
switch(config-if)# udld disable
```

This example shows how to disable UDLD for the switch:

```
switch# configure terminal
switch(config)# no feature udld
```

Changing an Interface Port Mode

You can configure a Quad small form-factor pluggable (QSFP+) port by using the **hardware profile portmode** command. To restore the defaults, use the **no** form of this command.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **copy running-config bootflash**: *my-config.cfg*	Copies the running configuration to the bootflash. You can use this file to configure your device later.
Step 3	switch(config)# **write erase**	Removes all the interface configurations.
Step 4	switch(config)# **reload**	Reloads the Cisco NX-OS software.
Step 5	switch(config)# [**no**] **hardware profile portmode** *portmode*	Changes the interface port mode.
Step 6	switch(config)# **hardware profile portmode** *portmode* **2-tuple**	(Optional) Displays the port names in 2-tuple mode instead of the default 3-tuple convention mode.
Step 7	switch(config)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.
Step 8	switch(config)# **reload**	Reloads the Cisco NX-OS software. Manually apply all the interface configuration. You can refer to the configuration file that you saved earlier. **Note** The interface numbering changes if the ports are changed from 40G mode to 4x10G mode or vice versa.

This example shows how to change the port mode to 48x10g+4x40g for QSFP+ ports:

```
switch# configure terminal
switch(config) copy running-config bootflash:my-config.cfg
switch(config)# write erase
switch(config)# reload
WARNING: This command will reboot the system
Do you want to continue? (y/n) [n] y
switch(config)# hardware profile portmode 48x10g+4x40g
Warning: This command will take effect only after saving the configuration and reload!
```

```
Port configurations could get lost when port mode is changed!
switch(config)# copy running-config startup-config
switch(config)# reload
WARNING: This command will reboot the system
Do you want to continue? (y/n) [n] y
```

This example shows how to change the port mode to 48x10g+4x40g for QSFP+ ports and verify the changes:

```
switch# configure terminal
switch(config)# hardware profile portmode 48x10g+4x40g
Warning: This command will take effect only after saving the configuration and r
eload! Port configurations could get lost when port mode is changed!
switch(config)# show running-config
!Command: show running-config
!Time: Thu Aug 25 07:39:37 2011
version 5.0(3)U2(1)
feature telnet
no feature ssh
feature lldp
username admin password 5 $1$OOV4MdOM$BAB5RkD22YanT4empqqSM0 role network-admin
ip domain-lookup
switchname BLR-QG-5
ip access-list my-acl
10 deny ip any 10.0.0.1/32
20 deny ip 10.1.1.1/32 any
class-map type control-plane match-any copp-arp
class-map type control-plane match-any copp-bpdu
:
:
control-plane
service-policy input copp-system-policy
hardware profile tcam region arpacl 128
hardware profile tcam region ifacl 256
hardware profile tcam region racl 256
hardware profile tcam region vacl 512
hardware profile portmode 48x10G+4x40G
snmp-server user admin network-admin auth md5 0xdd1d21ee42e93106836cdefd1a60e062
<--Output truncated-->
switch#
```

This example shows how to restore the default port mode for QSFP+ ports:

```
switch# configure terminal
switch(config)# no hardware profile portmode
Warning: This command will take effect only after saving the configuration and r
eload! Port configurations could get lost when port mode is changed!
switch(config)#
```

Configuring Interface Speed

Note If the interface and transceiver speed is mismatched, the SFP validation failed message is displayed when you enter the **show interface ethernet** *slot*/*port* command. For example, if you insert a 1-Gigabit SFP transceiver into a port without configuring the speed 1000 command, you will get this error. By default, all ports are 10 Gigabits.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.

	Command or Action	Purpose
Step 2	switch(config)# **interface** *type slot/port*	Enters interface configuration mode for the specified interface. This interface must have a 1-Gigabit Ethernet SFP transceiver inserted into it.
Step 3	switch(config-if)# **speed** *speed*	Sets the speed on the interface. This command can only be applied to a physical Ethernet interface. The *speed* argument can be set to one of the following: • 10 Mbps • 100 Mbps • 1 Gbps • 10Gbps • automatic

This example shows how to set the speed for a 1-Gigabit Ethernet port:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# speed 1000
```

Disabling Link Negotiation

You can disable link negotiation using the **no negotiate auto** command. By default, auto-negotiation is enabled on 1-Gigabit ports and disabled on 10-Gigabit ports. By default, auto-negotiation is enabled on the Cisco Nexus 3064 and 3064-X switches and disabled on the Cisco Nexus 3048 switch.

This command is equivalent to the Cisco IOS **speed non-negotiate** command.

Note We do not recommend that you enable auto negotiation on 10-Gigabit ports. Enabling auto-negotiation on 10-Gigabit ports brings the link down. By default, link negotiation is disabled on 10-Gigabit ports.

Procedure

	Command or Action	Purpose
Step 1	switch# configure terminal	Enters configuration mode.
Step 2	switch(config)# interface ethernet slot/port	Selects the interface and enters interface mode.
Step 3	switch(config-if)# no negotiate auto	Disables link negotiation on the selected Ethernet interface (1-Gigabit port).

	Command or Action	Purpose
Step 4	switch(config-if)# negotiate auto	(Optional) Enables link negotiation on the selected Ethernet interface. The default for 1-Gigabit ports is enabled. **Note** This command is not applicable for 10GBase-T ports. It should not be used on 10GBase-T ports.

This example shows how to disable auto negotiation on a specified Ethernet interface (1-Gigabit port):

```
switch# configure terminal
switch(config)# interface ethernet 1/1
switch(config-if)# no negotiate auto
switch(config-if)#
```

This example shows how to enable auto negotiation on a specified Ethernet interface (1-Gigabit port):

```
switch# configure terminal
switch(config)# interface ethernet 1/5
switch(config-if)# negotiate auto
switch(config-if)#
```

Disabling SVI Autostate

You can configure a SVI to remain active even if no interfaces are up in the corresponding VLAN. This enhancement is called Autostate Disable.

When you enable or disable autostate behavior it is applied to all the SVIs in the switch unless you configure autostate per SVI .

Note Autostate behavior is enabled by default.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **feature interface-vlan**	Enables the interface-vlan feature.
Step 3	switch(config)# **system default interface-vlan** [**no**] **autostate**	Configures the system to enable or disable the Autostate default behavior.
Step 4	switch(config)# **interface vlan** *interface-vlan-number*	(Optional) Creates a VLAN interface. The number range is from 1 to 4094.
Step 5	switch(config-if)# [**no**] **autostate**	(Optional) Enables or disables Autostate behavior per SVI.

	Command or Action	Purpose
Step 6	switch(config)# **show interface-vlan** *interface-vlan*	(Optional) Displays the enabled or disabled Autostate behavior of the SVI.
Step 7	switch(config)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to disable the systems Autostate default for all the SVIs on the switch:

```
switch# configure terminal
switch(config)# feature interface-vlan
switch(config)# system default interface-vlan no autostate
switch(config)# interface vlan 50
switch(config-if)# no autostate
switch(config)# copy running-config startup-config
```

This example shows enabled autostate configuration:

```
switch(config)# show interface-vlan 2
Vlan2 is down, line protocol is down, autostate enabled
Hardware is EtherSVI, address is 547f.ee40.a17c
MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec
```

Configuring the CDP Characteristics

You can configure the frequency of Cisco Discovery Protocol (CDP) updates, the amount of time to hold the information before discarding it, and whether or not to send Version-2 advertisements.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# [**no**] **cdp advertise** {**v1** | **v2** }	(Optional) Configures the version to use to send CDP advertisements. Version-2 is the default state. Use the **no** form of the command to return to its default setting.
Step 3	switch(config)# [**no**] **cdp format device-id** {**mac-address** | **serial-number** | **system-name**}	(Optional) Configures the format of the CDP device ID. The default is the system name, which can be expressed as a fully qualified domain name. Use the **no** form of the command to return to its default setting.

	Command or Action	Purpose
Step 4	switch(config)# [**no**] **cdp holdtime** *seconds*	(Optional) Specifies the amount of time a receiving device should hold the information sent by your device before discarding it. The range is 10 to 255 seconds; the default is 180 seconds. Use the **no** form of the command to return to its default setting.
Step 5	switch(config)# [**no**] **cdp timer** *seconds*	(Optional) Sets the transmission frequency of CDP updates in seconds. The range is 5 to 254; the default is 60 seconds. Use the **no** form of the command to return to its default setting.

This example shows how to configure CDP characteristics:

```
switch# configure terminal
switch(config)# cdp timer 50
switch(config)# cdp holdtime 120
switch(config)# cdp advertise v2
```

Enabling or Disabling CDP

You can enable or disable CDP for Ethernet interfaces. This protocol works only when you have it enabled on both interfaces on the same link.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Enters interface configuration mode for the specified interface.
Step 3	switch(config-if)# **cdp enable**	Enables CDP for the interface. To work correctly, this parameter must be enabled for both interfaces on the same link.
Step 4	switch(config-if)# **no cdp enable**	Disables CDP for the interface.

This example shows how to enable CDP for an Ethernet port:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# cdp enable
```

This command can only be applied to a physical Ethernet interface.

Enabling the Error-Disabled Detection

You can enable error-disable (err-disabled) detection in an application. As a result, when a cause is detected on an interface, the interface is placed in an err-disabled state, which is an operational state that is similar to the link-down state.

Procedure

	Command or Action	Purpose

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

Step 2	**errdisable detect cause** {*all* | *link-flap* | *loopback*}
	
	Example:
	`switch(config)# errdisable detect cause all`
	`switch(config)#`
		Specifies a condition under which to place the interface in an err-disabled state. The default is enabled.

Step 3	**shutdown**
	
	Example:
	`switch(config)# shutdown`
	`switch(config)#`
		Brings the interface down administratively. To manually recover the interface from the err-disabled state, enter this command first.

Step 4	**no shutdown**
	
	Example:
	`switch(config)# no shutdown`
	`switch(config)#`
		Brings the interface up administratively and enables the interface to recover manually from the err-disabled state.

Step 5	**show interface status err-disabled** **Example:** `switch(config)# show interface status err-disabled`	Displays information about err-disabled interfaces.
Step 6	**copy running-config startup-config** **Example:** `switch(config)# copy running-config startup-config`	(Optional) Copies the running configuration to the startup configuration.

This example shows how to enable the err-disabled detection in all cases:

```
switch(config)#errdisable detect cause all
switch(config)#
```

Enabling the Error-Disabled Recovery

You can specify the application to bring the interface out of the error-disabled (err-disabled) state and retry coming up. It retries after 300 seconds, unless you configure the recovery timer (see the **errdisable recovery interval** command).

Procedure

	Command or Action	Purpose

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

Step 2	**errdisable recovery cause** {*all* | *udld* | *bpduguard* | *link-flap* | *failed-port-state* | *pause-rate-limit*}
	
	Example:
	`switch(config)#errdisable recovery cause all`
	`switch(config-if)#`
		Specifies a condition under which the interface automatically recovers from the err-disabled state, and the device retries bringing the interface up. The device waits 300 seconds to retry. The default is disabled.

Step 3	**show interface status err-disabled** **Example:** `switch(config)#show interface status err-disabled`	Displays information about err-disabled interfaces.
Step 4	**copy running-config startup-config** **Example:** `switch(config)#copy running-config startup-config`	(Optional) Copies the running configuration to the startup configuration.

This example shows how to enable err-disabled recovery under all conditions:

```
switch(config)#errdisable recovery cause all
switch(config)#
```

Configuring the Error-Disabled Recovery Interval

You can use this procedure to configure the err-disabled recovery timer value. The range is from 30 to 65535 seconds. The default is 300 seconds.

Procedure

	Command or Action	Purpose

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

Step 2	**errdisable recovery interval** *interval*
	
	Example:
	`switch(config)#errdisable recovery interval 32`
	`switch(config-if)#`
		Specifies the interval for the interface to recover from the err-disabled state. The range is from 30 to 65535 seconds. The default is 300 seconds.

Step 3	**show interface status err-disabled** **Example:** `switch(config)#show interface status err-disabled`	Displays information about err-disabled interfaces.
Step 4	**copy running-config startup-config** **Example:** `switch(config)#copy running-config startup-config`	(Optional) Copies the running configuration to the startup configuration.

This example shows how to enable err-disabled recovery under all conditions:

```
switch(config)#errdisable recovery cause all
switch(config)#
```

Configuring the Description Parameter

You can provide textual interface descriptions for the Ethernet ports.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Enters interface configuration mode for the specified interface.
Step 3	switch(config-if)# **description** *test*	Specifies the description for the interface.

This example shows how to set the interface description to Server 3 Interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/3
switch(config-if)# description Server 3 Interface
```

Disabling and Restarting Ethernet Interfaces

You can shut down and restart an Ethernet interface. This action disables all of the interface functions and marks the interface as being down on all monitoring displays. This information is communicated to other network servers through all dynamic routing protocols. When shut down, the interface is not included in any routing updates.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Enters interface configuration mode for the specified interface.
Step 3	switch(config-if)# **shutdown**	Disables the interface.
Step 4	switch(config-if)# **no shutdown**	Restarts the interface.

This example shows how to disable an Ethernet port:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# shutdown
```

This example shows how to restart an Ethernet interface:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# no shutdown
```

Displaying Interface Information

To view configuration information about the defined interfaces, perform one of these tasks:

Command	Purpose
switch# **show interface** *type slot/port*	Displays the detailed configuration of the specified interface.
switch# **show interface** *type slot/port* **capabilities**	Displays detailed information about the capabilities of the specified interface. This option is only available for physical interfaces

Command	Purpose
switch# **show interface** *type slot/port* **transceiver**	Displays detailed information about the transceiver connected to the specified interface. This option is only available for physical interfaces.
switch# **show interface brief**	Displays the status of all interfaces.
switch# **show interface flowcontrol**	Displays the detailed listing of the flow control settings on all interfaces.

The **show interface** command is invoked from EXEC mode and displays the interface configurations. Without any arguments, this command displays the information for all the configured interfaces in the switch.

This example shows how to display the physical Ethernet interface:

```
switch# show interface ethernet 1/1
  Ethernet1/1 is up
  Hardware is 1000/10000 Ethernet, address is 000d.eca3.5f08 (bia 000d.eca3.5f08)
  MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec,
     reliability 255/255, txload 190/255, rxload 192/255
  Encapsulation ARPA
  Port mode is trunk
  full-duplex, 10 Gb/s, media type is 1/10g
  Input flow-control is off, output flow-control is off
  Auto-mdix is turned on
  Rate mode is dedicated
  Switchport monitor is off
  Last clearing of "show interface" counters never
  5 minute input rate 942201806 bytes/sec, 14721892 packets/sec
  5 minute output rate 935840313 bytes/sec, 14622492 packets/sec
  Rx
    129141483840 input packets 0 unicast packets 129141483847 multicast packets
    0 broadcast packets 0 jumbo packets 0 storm suppression packets
    8265054965824 bytes
    0 No buffer 0 runt 0 Overrun
    0 crc 0 Ignored 0 Bad etype drop
    0 Bad proto drop
  Tx
    119038487241 output packets 119038487245 multicast packets
   0 broadcast packets 0 jumbo packets
    7618463256471 bytes
    0 output CRC 0 ecc
    0 underrun 0 if down drop     0 output error 0 collision 0 deferred
    0 late collision 0 lost carrier 0 no carrier
    0 babble
    0 Rx pause 8031547972 Tx pause 0 reset
```

This example shows how to display the physical Ethernet capabilities:

```
switch# show interface ethernet 1/1 capabilities
Ethernet1/1
  Model:                 734510033
  Type:                  10Gbase-(unknown)
  Speed:                 1000,10000
  Duplex:                full
  Trunk encap. type:     802.1Q
  Channel:               yes
  Broadcast suppression: percentage(0-100)
  Flowcontrol:           rx-(off/on),tx-(off/on)
  Rate mode:             none
  QOS scheduling:        rx-(6q1t),tx-(1p6q0t)
  CoS rewrite:           no
  ToS rewrite:           no
  SPAN:                  yes
  UDLD:                  yes
```

```
  MDIX:                  no
  FEX Fabric:            yes
```

This example shows how to display the physical Ethernet transceiver:

```
switch# show interface ethernet 1/1 transceiver
Ethernet1/1
    sfp is present
    name is CISCO-EXCELIGHT
    part number is SPP5101SR-C1
    revision is A
    serial number is ECL120901AV
    nominal bitrate is 10300 MBits/sec
    Link length supported for 50/125mm fiber is 82 m(s)
    Link length supported for 62.5/125mm fiber is 26 m(s)
    cisco id is --
    cisco extended id number is 4
```

This example shows how to display a brief interface status (some of the output has been removed for brevity):

```
switch# show interface brief

--------------------------------------------------------------------------------
Ethernet      VLAN   Type Mode   Status  Reason                   Speed     Port
Interface                                                                    Ch #
--------------------------------------------------------------------------------
Eth1/1        200    eth  trunk  up      none                       10G(D) --
Eth1/2        1      eth  trunk  up      none                       10G(D) --
Eth1/3        300    eth  access down    SFP not inserted           10G(D) --
Eth1/4        300    eth  access down    SFP not inserted           10G(D) --
Eth1/5        300    eth  access down    Link not connected        1000(D) --
Eth1/6        20     eth  access down    Link not connected         10G(D) --
Eth1/7        300    eth  access down    SFP not inserted           10G(D) --
...
```

This example shows how to display the CDP neighbors:

```
switch# show cdp neighbors
Capability Codes: R - Router, T - Trans-Bridge, B - Source-Route-Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater,
                  V - VoIP-Phone, D - Remotely-Managed-Device,
                  s - Supports-STP-Dispute
Device ID              Local Intrfce   Hldtme  Capability  Platform      Port ID
d13-dist-1               mgmt0           148     S I      WS-C2960-24TC  Fas0/9
n5k(FLC12080012)         Eth1/5          8       S I s    N5K-C5020P-BA  Eth1/5
```

Displaying Input Packet Discard Information

Beginning with Cisco NX-OS Release 5.0(3)U2(1), you can get detailed information on what specific condition led to an input discard on a given interface. Use the **show hardware internal interface indiscard-stats front-port** *x* command to determine the condition that could be potentially responsible for the input discards that are seen on port eth1/x. The switch output shows the discards for IPv4, STP, input policy, ACL specific discard, generic receive drop, and VLAN related discards.

This example shows how to determine the condition that could be potentially responsible for the input discards:

```
switch# show hardware internal interface indiscard-stats front-port 1

+----------------------------------------+-----------------+----------------+
|       Counter Description              |     Count       |                |
+----------------------------------------+-----------------+----------------+
        IPv4 Discards                            0
        STP Discards                             0
        Policy Discards                          100
        ACL Drops                                0
        Receive Drops                            0
        Vlan Discards                            33
+----------------------------------------+-----------------+----------------+
```

Counter Information:

- IPv4 Discards--- IPv4 Discards represent errors at the IP layer, for example the IP checksum error.
- STP Discards--- STP Discards are incremented when the receive interface STP state is not forwarding the packets received.
- Policy Discards--- Policy Discards are incremented when there are discards because of input policy on the interface.
- ACL Drops---ACL drops indicate that incoming packets match an ACL entry with a drop action.
- Receive Drops--- This drop increment represents a condition when no output port is determined for an ingress packet. Receive drops happen because of variety of reasons including IPv4, STP and policy discards. The drop counter increments in conjunction with one of the above counters or separately.
- Vlan Discard--- Vlan Discard indicates vlan-based discards. For example, a vlan tagged packet ingressing on a port which is not a member of the vlan.

This example shows how to clear all the input discard counters which is useful for debugging purposes:

```
Switch# show hardware internal interface indiscard-stats front-port 1 clear

+--------------------------------------+----------------+----------------+-----------------------------------+
|        Counter Description                |      Count        | Last Increment |    Last
Increment Time              |
+--------------------------------------+----------------+----------------+-----------------------------------+

 Discard Stats have been reset
+--------------------------------------+----------------+----------------+-----------------------------------+
```

Default Physical Ethernet Settings

The following table lists the default settings for all physical Ethernet interfaces:

Parameter	Default Setting
Duplex	Auto (full-duplex)
Encapsulation	ARPA
MTU[1]	1500 bytes
Port Mode	Access
Speed	Auto (10000)

1 MTU cannot be changed per-physical Ethernet interface. You modify MTU by selecting maps of QoS classes.

MIBs for Layer 2 Interfaces

MIB	MIB Link
IF-MIB	To locate and download MIBs, go to the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml
MAU-MIB Limited support includes only the following MIB Objects: • ifMauType (Read-only) GET • ifMauAutoNegSupported (Read-only) GET • ifMauTypeListBits (Read-only) GET • ifMauDefaultType (Read-write) GET-SET • ifMauAutoNegAdminStatus (Read-write) GET-SET • ifMauAutoNegCapabilityBits (Read-only) GET • ifMauAutoNegAdvertisedBits (Read-write) GET-SET	

CHAPTER 3

Configuring Layer 3 Interfaces

This chapter contains the following sections:

Information About Layer 3 Interfaces

Layer 3 interfaces forward packets to another device using static or dynamic routing protocols. You can use Layer 3 interfaces for IP routing and inter-VLAN routing of Layer 2 traffic.

Routed Interfaces

You can configure a port as a Layer 2 interface or a Layer 3 interface. A routed interface is a physical port that can route IP traffic to another device. A routed interface is a Layer 3 interface only and does not support Layer 2 protocols, such as the Spanning Tree Protocol (STP).

All Ethernet ports are Layer 2 (switchports) by default. You can change this default behavior using the **no switchport** command from interface configuration mode. To change multiple ports at one time, you can specify a range of interfaces and then apply the **no switchport** command.

You can assign an IP address to the port, enable routing, and assign routing protocol characteristics to this routed interface.

You can assign a static MAC address to a Layer 3 interface. For information on configuring MAC addresses, see the Layer 2 Switching Configuration Guide for your device.

You can also create a Layer 3 port channel from routed interfaces.

Routed interfaces and subinterfaces support exponentially decayed rate counters. Cisco NX-OS tracks the following statistics with these averaging counters:

- Input packets/sec
- Output packets/sec
- Input bytes/sec
- Output bytes/sec

Subinterfaces

You can create virtual subinterfaces on a parent interface configured as a Layer 3 interface. A parent interface can be a physical port or a port channel.

Subinterfaces divide the parent interface into two or more virtual interfaces on which you can assign unique Layer 3 parameters such as IP addresses and dynamic routing protocols. The IP address for each subinterface should be in a different subnet from any other subinterface on the parent interface.

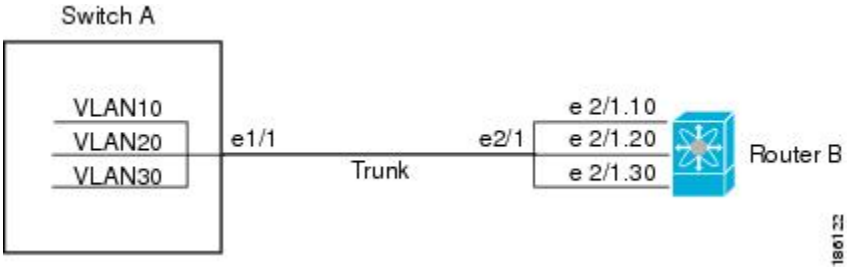
You create a subinterface with a name that consists of the parent interface name (for example, Ethernet 2/1) followed by a period and then by a number that is unique for that subinterface. For example, you could create a subinterface for Ethernet interface 2/1 named Ethernet 2/1.1 where .1 indicates the subinterface.

Cisco NX-OS enables subinterfaces when the parent interface is enabled. You can shut down a subinterface independent of shutting down the parent interface. If you shut down the parent interface, Cisco NX-OS shuts down all associated subinterfaces as well.

One use of subinterfaces is to provide unique Layer 3 interfaces to each VLAN that is supported by the parent interface. In this scenario, the parent interface connects to a Layer 2 trunking port on another device. You configure a subinterface and associate the subinterface to a VLAN ID using 802.1Q trunking.

The following figure shows a trunking port from a switch that connects to router B on interface E 2/1. This interface contains three subinterfaces that are associated with each of the three VLANs that are carried by the trunking port.

Figure 2: Subinterfaces for VLANs



VLAN Interfaces

A VLAN interface or a switch virtual interface (SVI) is a virtual routed interface that connects a VLAN on the device to the Layer 3 router engine on the same device. Only one VLAN interface can be associated with a VLAN, but you need to configure a VLAN interface for a VLAN only when you want to route between VLANs or to provide IP host connectivity to the device through a virtual routing and forwarding (VRF) instance that is not the management VRF. When you enable VLAN interface creation, Cisco NX-OS creates a VLAN interface for the default VLAN (VLAN 1) to permit remote switch administration.

You must enable the VLAN network interface feature before you can configure it. The system automatically takes a checkpoint prior to disabling the feature, and you can roll back to this checkpoint. For information about rollbacks and checkpoints, see the System Management Configuration Guide for your device.

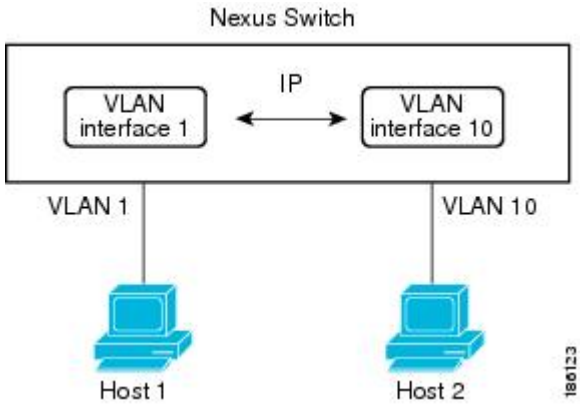
Note You cannot delete the VLAN interface for VLAN 1.

You can route across VLAN interfaces to provide Layer 3 inter-VLAN routing by configuring a VLAN interface for each VLAN that you want to route traffic to and assigning an IP address on the VLAN interface. For more information on IP addresses and IP routing, see the Unicast Routing Configuration Guide for your device.

The following figure shows two hosts connected to two VLANs on a device. You can configure VLAN interfaces for each VLAN that allows Host 1 to communicate with Host 2 using IP routing between the VLANs.

VLAN 1 communicates at Layer 3 over VLAN interface 1and VLAN 10 communicates at Layer 3 over VLAN interface 10.

Figure 3: Connecting Two VLANs with VLAN Interfaces



Loopback Interfaces

A loopback interface is a virtual interface with a single endpoint that is always up. Any packet that is transmitted over a loopback interface is immediately received by this interface. Loopback interfaces emulate a physical interface.

You can use loopback interfaces for performance analysis, testing, and local communications. Loopback interfaces can act as a termination address for routing protocol sessions. This loopback configuration allows routing protocol sessions to stay up even if some of the outbound interfaces are down.

Tunnel Interfaces

Cisco NX-OS supports tunnel interfaces as IP tunnels. IP tunnels can encapsulate a same- ayer or higher layer protocol and transport the result over IP through a tunnel that is created between two routers.

Licensing Requirements for Layer 3 Interfaces

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 Layer 3 Interfaces

Layer 3 interfaces have the following configuration guidelines and limitations:

- If you change a Layer 3 interface to a Layer 2 interface, Cisco NX-OS shuts down the interface, reenables the interface, and removes all configuration specific to Layer 3.

- If you change a Layer 2 interface to a Layer 3 interface, Cisco NX-OS shuts down the interface, reenables the interface, and deletes all configuration specific to Layer 2.

Default Settings for Layer 3 Interfaces

The default setting for the Layer 3 Admin state is Shut.

Configuring Layer 3 Interfaces

Configuring a Routed Interface

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.
Step 3	switch(conifg-if)# **no switchport**	Configures the interface as a Layer 3 interface and deletes any configuration specific to Layer 2 on this interface. **Note** To convert a Layer 3 interface back into a Layer 2 interface, use the **switchport** command.
Step 4	switch(config-if)# [**ip** | **ipv6**]*ip-address/length*	Configures an IP address for this interface.
Step 5	switch(config-if)# **medium** {**broadcast** | **p2p**}	(Optional) Configures the interface medium as either point to point or broadcast. **Note** The default setting is broadcast, and this setting does not appear in any of the **show** commands. However, if you do change the setting to **p2p**, you will see this setting when you enter the **show running-config** command.
Step 6	switch(config-if)# **show interfaces**	(Optional) Displays the Layer 3 interface statistics.
Step 7	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to configure an IPv4 routed Layer 3 interface:

```
switch# configure terminal
switch(config)# interface ethernet 2/1
switch(config-if)# no switchport
switch(config-if)# ip address 192.0.2.1/8
switch(config-if)# copy running-config startup-config
```

Configuring a Subinterface

Before You Begin

- Configure the parent interface as a routed interface.
- Create the port-channel interface if you want to create a subinterface on that port channel.

Procedure

	Command or Action	Purpose
Step 1	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.
Step 2	switch(config)# **interface ethernet** *slot/port***.***number*	Enters interface configuration mode. The range for the *slot* is from 1 to 255. The range for the *port* is from 1 to 128.
Step 3	switch(config-if)# [**ip** | **ipv6**] **address** *ip-address/length*	Configures IP address for this interface.
Step 4	switch(config-if)# **encapsulation dot1Q** *vlan-id*	Configures IEEE 802.1Q VLAN encapsulation on the subinterface. The range for the *vlan-id* is from 2 to 4093.
Step 5	switch(config-if)# **show interfaces**	(Optional) Displays the Layer 3 interface statistics.
Step 6	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create a subinterface:

```
switch# configure terminal
switch(config)# interface ethernet 2/1
switch(config-if)# ip address 192.0.2.1/8
switch(config-if)# encapsulation dot1Q 33
switch(config-if)# copy running-config startup-config
```

Configuring the Bandwidth on an Interface

You can configure the bandwidth for a routed interface, port channel, or subinterface.

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. The range for the *slot* is from 1 to 255. The range for the *port* is from 1 to 128.
Step 3	switch(conifg-if)# **bandwidth** [*value* | **inherit** [*value*]]	Configures the bandwidth parameter for a routed interface, port channel, or subinterface, as follows: • *value*—Size of the bandwidth in kilobytes. The range is from 1 to 10000000. • **inherit**—Indicates that all subinterfaces of this interface inherit either the bandwidth value (if a value is specified) or the bandwidth of the parent interface (if a value is not specified).
Step 4	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to configure Ethernet interface 2/1 with a bandwidth value of 80000:

```
switch# configure terminal
switch(config)# interface ethernet 2/1
switch(config-if)# bandwidth 80000
switch(config-if)# copy running-config startup-config
```

Configuring a VLAN Interface

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **feature interface-vlan**	Enables VLAN interface mode.
Step 3	switch(config)# **interface vlan** *number*	Creates a VLAN interface. The *number* range is from 1 to 4094.

	Command or Action	Purpose
Step 4	switch(config-if)# [**ip** | **ipv6**] **address** *ip-address/length*	Configures an IP address for this interface.
Step 5	switch(config-if)# **show interface vlan** *number*	(Optional) Displays the VLAN interface statistics. The *number* range is from 1 to 4094.
Step 6	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create a VLAN interface:

```
switch# configure terminal
switch(config)# feature interface-vlan
switch(config)# interface vlan 10
switch(config-if)# ip address 192.0.2.1/8
switch(config-if)# copy running-config startup-config
```

Configuring a Loopback Interface

Before You Begin

Ensure that the IP address of the loopback interface is unique across all routers on the network.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface loopback** *instance*	Creates a loopback interface. The *instance* range is from 0 to 1023.
Step 3	switch(config-if)# [**ip** | **ipv6**] **address** *ip-address/length*	Configures an IP address for this interface.
Step 4	switch(config-if)# **show interface loopback** *instance*	(Optional) Displays the loopback interface statistics. The *instance* range is from 0 to 1023.
Step 5	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create a loopback interface:

```
switch# configure terminal
switch(config)# interface loopback 0
switch(config-if)# ip address 192.0.2.100/8
switch(config-if)# copy running-config startup-config
```

Assigning an Interface to a VRF

Before You Begin

Assign the IP address for a tunnel interface after you have configured the interface for a VRF.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface** *interface-typenumber*	Enters interface configuration mode.
Step 3	switch(conifg-if)#**vrf member** *vrf-name*	Adds this interface to a VRF.
Step 4	switch(config-if)# [**ip** | **ipv6**]*ip-address/length*	Configures an IP address for this interface. You must do this step after you assign this interface to a VRF.
Step 5	switch(config-if)# **show vrf** [*vrf-name*] **interface** *interface-type number*	(Optional) Displays VRF information.
Step 6	switch(config-if)# **show interfaces**	(Optional) Displays the Layer 3 interface statistics.
Step 7	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to add a Layer 3 interface to the VRF:

```
switch# configure terminal
switch(config)# interface loopback 0
switch(config-if)# vrf member RemoteOfficeVRF
switch(config-if)# ip address 209.0.2.1/16
switch(config-if)# copy running-config startup-config
```

Verifying the Layer 3 Interfaces Configuration

Use one of the following commands to verify the configuration:

Command	Purpose
show interface ethernet *slot/port*	Displays the Layer 3 interface configuration, status, and counters (including the 5-minute exponentially decayed moving average of inbound and outbound packet and byte rates).
show interface ethernet *slot/port* **brief**	Displays the Layer 3 interface operational status.
show interface ethernet *slot/port* **capabilities**	Displays the Layer 3 interface capabilities, including port type, speed, and duplex.
show interface ethernet *slot/port* **description**	Displays the Layer 3 interface description.
show interface ethernet *slot/port* **status**	Displays the Layer 3 interface administrative status, port mode, speed, and duplex.
show interface ethernet *slot/port***.***number*	Displays the subinterface configuration, status, and counters (including the f-minute exponentially decayed moving average of inbound and outbound packet and byte rates).
show interface port-channel *channel-id***.***number*	Displays the port-channel subinterface configuration, status, and counters (including the 5-minute exponentially decayed moving average of inbound and outbound packet and byte rates).
show interface loopback *number*	Displays the loopback interface configuration, status, and counters.
show interface loopback *number* **brief**	Displays the loopback interface operational status.
show interface loopback *number* **description**	Displays the loopback interface description.
show interface loopback *number* **status**	Displays the loopback interface administrative status and protocol status.
show interface vlan *number*	Displays the VLAN interface configuration, status, and counters.
show interface vlan *number* **brief**	Displays the VLAN interface operational status.
show interface vlan *number* **description**	Displays the VLAN interface description.
show interface vlan *number* **private-vlan mapping**	Displays the VLAN interface private VLAN information.
show interface vlan *number* **status**	Displays the VLAN interface administrative status and protocol status.

Monitoring Layer 3 Interfaces

Use one of the following commands to display statistics about the feature:

Command	Purpose
show interface ethernet *slot*/*port* **counters**	Displays the Layer 3 interface statistics (unicast, multicast, and broadcast).
show interface ethernet *slot*/*port* **counters brief**	Displays the Layer 3 interface input and output counters.
show interface ethernet *slot*/*port* **counters detailed** [**all**]	Displays the Layer 3 interface statistics. You can optionally include all 32-bit and 64-bit packet and byte counters (including errors).
show interface ethernet *slot*/*port* **counters error**	Displays the Layer 3 interface input and output errors.
show interface ethernet *slot*/*port* **counters snmp**	Displays the Layer 3 interface counters reported by SNMP MIBs. You cannot clear these counters.
show interface ethernet *slot*/*port*.*number* **counters**	Displays the subinterface statistics (unicast, multicast, and broadcast).
show interface port-channel *channel-id*.*number* **counters**	Displays the port-channel subinterface statistics (unicast, multicast, and broadcast).
show interface loopback *number* **counters**	Displays the loopback interface input and output counters (unicast, multicast, and broadcast).
show interface loopback *number* **counters detailed** [**all**]	Displays the loopback interface statistics. You can optionally include all 32-bit and 64-bit packet and byte counters (including errors).
show interface loopback *number* **counters errors**	Displays the loopback interface input and output errors.
show interface vlan *number* **counters**	Displays the VLAN interface input and output counters (unicast, multicast, and broadcast).
show interface vlan *number* **counters detailed** [*all*]	Displays the VLAN interface statistics. You can optionally include all Layer 3 packet and byte counters (unicast and multicast).
show interface vlan *counters* **snmp**	Displays the VLAN interface counters reported by SNMP MIBs. You cannot clear these counters.

Configuration Examples for Layer 3 Interfaces

This example shows how to configure Ethernet subinterfaces:

```
switch# configuration terminal
switch(config)# interface ethernet 2/1.10
switch(config-if)# no switchport
switch(config-if)# description Layer 3 for VLAN 10
switch(config-if)# encapsulation dot1q 10
switch(config-if)# ip address 192.0.2.1/8
switch(config-if)# copy running-config startup-config
```

This example shows how to configure a VLAN interface:

```
switch# configuration terminal
switch(config)# interface vlan 100
switch(config-if)# no switchport

switch(config-if)# ipv6 address 33:0DB::2/8
switch(config-if)# copy running-config startup-config
```

This example shows how to configure a loopback interface:

```
switch# configuration terminal
switch(config)# interface loopback 3
switch(config-if)# no switchport
switch(config-if)# ip address 192.0.2.2/32
switch(config-if)# copy running-config startup-config
```

Related Documents for Layer 3 Interfaces

Related Topics	Document Title
Command syntax	*Cisco Nexus 3000 Series Command Reference*
IP	"Configuring IP" chapter in the *Cisco Nexus 3000 Series NX-OS Unicast Routing Configuration Guide*
VLAN	"Configuring VLANs" chapter in the *Cisco Nexus 3000 Series NX-OS Layer 2 Switching Configuration Guide*

MIBs for Layer 3 Interfaces

MIB	MIB Link
CISCO-IF-EXTENSION-MIB	To locate and download MIBs, go to the following URL: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml
ETHERLIKE-MIB	

Standards for Layer 3 Interfaces

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 Layer 3 Interfaces

Feature Name	Release	Feature Information
show interface vlan *vlan-id* **counters** command	5.0(3)U3(1)	The **show interface vlan** *vlan-id* **counters** command has been enhanced to correctly show input and output packet counts.

CHAPTER 4

Configuring Port Channels

This chapter contains the following sections:

Information About Port Channels

A port channel bundles individual interfaces into a group to provide increased bandwidth and redundancy. Port channeling also load balances traffic across these physical interfaces. The port channel stays operational as long as at least one physical interface within the port channel is operational.

You create an port channel by bundling compatible interfaces. You can configure and run either static port channels or port channels running the Link Aggregation Control Protocol (LACP).

Any configuration changes that you apply to the port channel are applied to each member interface of that port channel. For example, if you configure Spanning Tree Protocol (STP) parameters on the port channel, Cisco NX-OS applies those parameters to each interface in the port channel.

You can use static port channels, with no associated protocol, for a simplified configuration. For more efficient use of the port channel, you can use the Link Aggregation Control Protocol (LACP), which is defined in IEEE 802.3ad. When you use LACP, the link passes protocol packets.

Related Topics

LACP Overview, on page 41

Understanding Port Channels

Using port channels, Cisco NX-OS provides wider bandwidth, redundancy, and load balancing across the channels.

You can collect ports into a static port channel or you can enable the Link Aggregation Control Protocol (LACP). Configuring port channels with LACP requires slightly different steps than configuring static port channels. For information on port channel configuration limits, see the *Verified Scalability* document for your platform. For more information about load balancing, see Load Balancing Using Port Channels, on page 40.

Note Cisco NX-OS does not support Port Aggregation Protocol (PAgP) for port channels.

A port channel bundles individual links into a channel group to create a single logical link that provides the aggregate bandwidth of several physical links. If a member port within a port channel fails, traffic previously carried over the failed link switches to the remaining member ports within the port channel.

Each port can be in only one port channel. All the ports in an port channel must be compatible; they must use the same speed and operate in full-duplex mode. When you are running static port channels, without LACP, the individual links are all in the on channel mode; you cannot change this mode without enabling LACP.

Note You cannot change the mode from ON to Active or from ON to Passive.

You can create a port channel directly by creating the port-channel interface, or you can create a channel group that acts to aggregate individual ports into a bundle. When you associate an interface with a channel group, Cisco NX-OS creates a matching port channel automatically if the port channel does not already exist. You can also create the port channel first. In this instance, Cisco NX-OS creates an empty channel group with the same channel number as the port channel and takes the default configuration.

Note A port channel is operationally up when at least one of the member ports is up and that port's status is channeling. The port channel is operationally down when all member ports are operationally down.

Compatibility Requirements

When you add an interface to a port channel group, Cisco NX-OS checks certain interface attributes to ensure that the interface is compatible with the channel group. Cisco NX-OS also checks a number of operational attributes for an interface before allowing that interface to participate in the port-channel aggregation.

The compatibility check includes the following operational attributes:

- Port mode
- Access VLAN
- Trunk native VLAN
- Allowed VLAN list
- Speed
- 802.3x flow control setting
- MTU
- Broadcast/Unicast/Multicast Storm Control setting

- Priority-Flow-Control
- Untagged CoS

Use the **show port-channel compatibility-parameters** command to see the full list of compatibility checks that Cisco NX-OS uses.

You can only add interfaces configured with the channel mode set to on to static port channels. You can also only add interfaces configured with the channel mode as active or passive to port channels that are running LACP. You can configure these attributes on an individual member port.

When the interface joins a port channel, the following individual parameters are replaced with the values on the port channel:

- Bandwidth
- MAC address
- Spanning Tree Protocol

The following interface parameters remain unaffected when the interface joins a port channel:

- Description
- CDP
- LACP port priority
- Debounce

After you enable forcing a port to be added to a channel group by entering the **channel-group force** command, the following two conditions occur:

- When an interface joins a port channel the following parameters are removed and they are operationally replaced with the values on the port channel; however, this change will not be reflected in the running-configuration for the interface:
  - QoS
  - Bandwidth
  - Delay
  - STP
  - Service policy
  - ACLs
- When an interface joins or leaves a port channel, the following parameters remain unaffected:
  - Beacon
  - Description
  - CDP
  - LACP port priority
  - Debounce
  - UDLD

- Shutdown
- SNMP traps

Load Balancing Using Port Channels

Cisco NX-OS load balances traffic across all operational interfaces in a port channel by reducing part of the binary pattern formed from the addresses in the frame to a numerical value that selects one of the links in the channel. Port channels provide load balancing by default.

The basic configuration uses the following criteria to select the link:

- For a Layer 2 frame, it uses the source and destination MAC addresses.
- For a Layer 3 frame, it uses the source and destination MAC addresses and the source and destination IP addresses.
- For a Layer 4 frame, it uses the source and destination MAC addresses and the source and destination IP addresses.

Note You have the option to include the source and destination port number for the Layer 4 frame.

You can configure the switch to use one of the following methods (see the following table for more details) to load balance across the port channel:

- Destination MAC address
- Source MAC address
- Source and destination MAC address
- Destination IP address
- Source IP address
- Source and destination IP address
- Destination TCP/UDP port number
- Source TCP/UDP port number
- Source and destination TCP/UDP port number

Table 3: Port Channel Load-Balancing Criteria

Configuration	Layer 2 Criteria	Layer 3 Criteria	Layer 4 Criteria
Destination MAC	Destination MAC	Destination MAC	Destination MAC
Source MAC	Source MAC	Source MAC	Source MAC

Configuration	Layer 2 Criteria	Layer 3 Criteria	Layer 4 Criteria
Source and destination MAC	Source and destination MAC	Source and destination MAC	Source and destination MAC
Destination IP	Destination MAC	Destination MAC, destination IP	Destination MAC, destination IP
Source IP	Source MAC	Source MAC, source IP	Source MAC, source IP
Source and destination IP	Source and destination MAC	Source and destination MAC, source and destination IP	Source and destination MAC, source and destination IP
Destination TCP/UDP port	Destination MAC	Destination MAC, destination IP	Destination MAC, destination IP, destination port
Source TCP/UDP port	Source MAC	Source MAC, source IP	Source MAC, source IP, source port
Source and destination TCP/UDP port	Source and destination MAC	Source and destination MAC, source and destination IP	Source and destination MAC, source and destination IP, source and destination port

Use the option that provides the balance criteria with the greatest variety in your configuration. For example, if the traffic on a port channel is going only to a single MAC address and you use the destination MAC address as the basis of port-channel load balancing, the port channel always chooses the same link in that port channel; using source addresses or IP addresses might result in better load balancing.

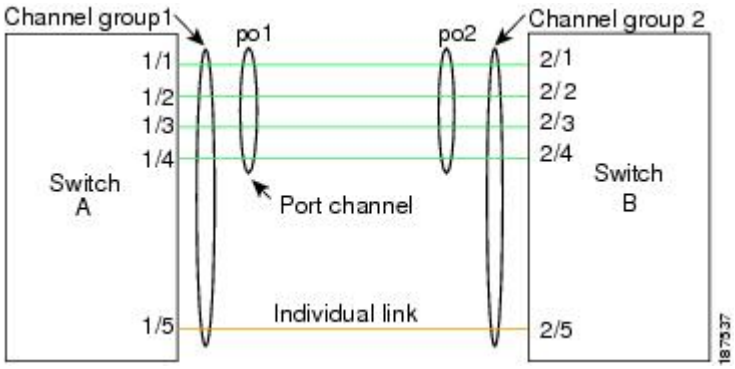
Understanding LACP

LACP Overview

Note You must enable the LACP feature before you can configure and use LACP functions.

The following figure shows how individual links can be combined into LACP port channels and channel groups as well as function as individual links.

Figure 4: Individual Links Combined into a Port channel



With LACP, just like with static port-channels, you can bundle up to 16 interfaces in a channel group.

Note When you delete the port channel, Cisco NX-OS automatically deletes the associated channel group. All member interfaces revert to their previous configuration.

You cannot disable LACP while any LACP configurations are present.

LACP ID Parameters

LACP uses the following parameters:

- LACP system priority—Each system that runs LACP has an LACP system priority value. You can accept the default value of 32768 for this parameter, or you can configure a value between 1 and 65535. LACP uses the system priority with the MAC address to form the system ID and also uses the system priority during negotiation with other devices. A higher system priority value means a lower priority.

Note The LACP system ID is the combination of the LACP system priority value and the MAC address.

- LACP port priority—Each port configured to use LACP has an LACP port priority. You can accept the default value of 32768 for the LACP port priority, or you can configure a value between 1 and 65535. LACP uses the port priority with the port number to form the port identifier. LACP uses the port priority to decide which ports should be put in standby mode when there is a limitation that prevents all compatible ports from aggregating and which ports should be put into active mode. A higher port priority value means a lower priority for LACP. You can configure the port priority so that specified ports have a lower priority for LACP and are most likely to be chosen as active links, rather than hot-standby links.
- LACP administrative key—LACP automatically configures an administrative key value equal to the channel-group number on each port configured to use LACP. The administrative key defines the ability of a port to aggregate with other ports. A port's ability to aggregate with other ports is determined by these factors:

- Port physical characteristics, such as the data rate, the duplex capability, and the point-to-point or shared medium state
- Configuration restrictions that you establish

Channel Modes

Individual interfaces in port channels are configured with channel modes. When you run static port channels, with no protocol, the channel mode is always set to on. After you enable LACP globally on the device, you enable LACP for each channel by setting the channel mode for each interface to active or passive. You can configure either channel mode for individual links in the LACP channel group.

Note You must enable LACP globally before you can configure an interface in either the active or passive channel mode.

The following table describes the channel modes.

Table 4: Channel Modes for Individual Links in a Port channel

Channel Mode	Description
passive	LACP mode that places a port into a passive negotiating state, in which the port responds to LACP packets that it receives but does not initiate LACP negotiation.
active	LACP mode that places a port into an active negotiating state, in which the port initiates negotiations with other ports by sending LACP packets.
on	All static port channels, that is, that are not running LACP, remain in this mode. If you attempt to change the channel mode to active or passive before enabling LACP, the device returns an error message. You enable LACP on each channel by configuring the interface in that channel for the channel mode as either active or passive. When an LACP attempts to negotiate with an interface in the on state, it does not receive any LACP packets and becomes an individual link with that interface; it does not join the LACP channel group.

Both the passive and active modes allow LACP to negotiate between ports to determine if they can form a port channel, based on criteria such as the port speed and the trunking state. The passive mode is useful when you do not know whether the remote system, or partner, supports LACP.

Ports can form an LACP port channel when they are in different LACP modes as long as the modes are compatible as in the following examples:

- A port in active mode can form a port channel successfully with another port that is in active mode.
- A port in active mode can form a port channel with another port in passive mode.
- A port in passive mode cannot form a port channel with another port that is also in passive mode because neither port will initiate negotiation.
- A port in on mode is not running LACP.

LACP Marker Responders

Using port channels, data traffic may be dynamically redistributed due to either a link failure or load balancing. LACP uses the Marker Protocol to ensure that frames are not duplicated or reordered because of this redistribution. Cisco NX-OS supports only Marker Responders.

LACP-Enabled and Static Port Channel Differences

The following table provides a brief summary of major differences between port channels with LACP enabled and static port channels. For information about the maximum configuration limits, see the *Verified Scalability* document for your device.

Table 5: Port channels with LACP Enabled and Static Port channels

Configurations	Port Channels with LACP Enabled	Static Port Channels
Protocol applied	Enable globally.	Not applicable.
Channel mode of links	Can be either: • Active • Passive	Can only be On.

LACP Port Channel MinLinks

A port channel aggregates similar ports to provide increased bandwidth in a single manageable interface. The MinLinks feature allows you to define the minimum number of interfaces from a LACP bundle that must fail before the port channel goes down.

The LACP port channel MinLinks feature does the following:

- Configures the minimum number of port channel interfaces that must be linked and bundled in the LACP port channel.
- Prevents a low-bandwidth LACP port channel from becoming active.
- Causes the LACP port channel to become inactive if only a few active members ports supply the required minimum bandwidth.

Note The MinLinks feature works only with LACP port channels. The device allows you to configure this feature in non-LACP port channels, but the feature is not operational.

Configuring Port Channels

Creating a Port Channel

You can create a port channel before creating a channel group. Cisco NX-OS automatically creates the associated channel group.

Note If you want LACP-based port channels, you need to enable LACP.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface port-channel** *channel-number*	Specifies the port-channel interface to configure, and enters the interface configuration mode. The range is from 1 to 4096. Cisco NX-OS automatically creates the channel group if it does not already exist.
Step 3	switch(config)# **no interface port-channel** *channel-number*	Removes the port channel and deletes the associated channel group.

This example shows how to create a port channel:

```
switch# configure terminal
switch (config)# interface port-channel 1
```

Adding a Port to a Port Channel

You can add a port to a new channel group or to a channel group that already contains ports. Cisco NX-OS creates the port channel associated with this channel group if the port channel does not already exist.

Note If you want LACP-based port channels, you need to enable LACP.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface that you want to add to a channel group and enters the interface configuration mode.
Step 3	switch(config-if)# **switchport mode trunk**	(Optional) Configures the interface as a trunk port.
Step 4	switch(config-if)# **switchport trunk** {**allowed vlan** *vlan-id* | **native vlan** *vlan-id*}	(Optional) Configures necessary parameters for a trunk port.
Step 5	switch(config-if)# **channel-group** *channel-number*	Configures the port in a channel group and sets the mode. The channel-number range is from 1 to 4096. Cisco NX-OS creates the port channel associated with this channel group if the port channel does not already exist. This is called implicit port channel creation.
Step 6	switch(config-if)# **no channel-group**	(Optional) Removes the port from the channel group. The port reverts to its original configuration.

This example shows how to add an Ethernet interface 1/4 to channel group 1:

```
switch# configure terminal
switch (config)# interface ethernet 1/4
switch(config-if)# switchport mode trunk
switch(config-if)# channel-group 1
```

Configuring Load Balancing Using Port Channels

You can configure the load-balancing algorithm for port channels that applies to the entire device.

Note If you want LACP-based port channels, you need to enable LACP.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.

	Command or Action	Purpose
Step 2	switch(config)# **port-channel load-balance ethernet** {[**destination-ip** | **destination-mac** | **destination-port** | **source-dest-ip** | **source-dest-mac** | **source-dest-port** | **source-ip** | **source-mac** | **source-port**] crc-poly}	Specifies the load-balancing algorithm for the device. The range depends on the device. The default is source-dest-mac.
Step 3	switch(config)# **no port-channel load-balance ethernet**	(Optional) Restores the default load-balancing algorithm of source-dest-mac.
Step 4	switch# **show port-channel load-balance**	(Optional) Displays the port-channel load-balancing algorithm.

This example shows how to configure source IP load balancing for port channels:

```
switch# configure terminal
switch (config)# port-channel load-balance ethernet source-ip
```

Configuring Hardware Hashing for Multicast Traffic

By default, ingress multicast traffic on any port in the switch selects a particular port channel member to egress the traffic. You can configure hardware hashing for multicast traffic to reduce potential bandwidth issues and to provide effective load balancing of the ingress multicast traffic. Use the **hardware multicast hw-hash** command to enable hardware hashing. To restore the default, use the **no hardware multicast hw-hash** command.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface port-channel** *channel-number*	Selects the port channel and enters the interface configuration mode.
Step 3	switch(config-if)# **hardware multicast hw-hash**	Configures hardware hashing for the specified port channel.

This example shows how to configure hardware hashing on a port channel:

```
switch# configure terminal
switch (config)# interface port-channel 21
switch(config-if)# hardware multicast hw-hash
```

This example shows how to remove hardware hashing from a port channel:

```
switch# configure terminal
switch (config)# interface port-channel 21
switch(config-if)# no hardware multicast hw-hash
```

Enabling LACP

LACP is disabled by default; you must enable LACP before you begin LACP configuration. You cannot disable LACP while any LACP configuration is present.

LACP learns the capabilities of LAN port groups dynamically and informs the other LAN ports. Once LACP identifies correctly matched Ethernet links, it facilitates grouping the links into an port channel. The port channel is then added to the spanning tree as a single bridge port.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **feature lacp**	Enables LACP on the switch.
Step 3	switch(config)# **show feature**	(Optional) Displays enabled features.

This example shows how to enable LACP:

```
switch# configure terminal
switch(config)# feature lacp
```

Configuring the Channel Mode for a Port

You can configure the channel mode for each individual link in the LACP port channel as active or passive. This channel configuration mode allows the link to operate with LACP.

When you configure port channels with no associated protocol, all interfaces on both sides of the link remain in the on channel mode.

Before You Begin

Ensure that you have enabled the LACP feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface to configure, and enters the interface configuration mode.
Step 3	switch(config-if)# **channel-group** *channel-number* [**force**] [**mode** {**on** | **active** | **passive**}]	Specifies the port mode for the link in a port channel. After LACP is enabled, you configure each link or the entire channel as active or passive.

	Command or Action	Purpose
		force—Specifies that the LAN port be forcefully added to the channel group. This option is available in Cisco NX-OS Release 5.0(2)N2(1). mode—Specifies the port channel mode of the interface. active—Specifies that when you enable LACP, this command enables LACP on the specified interface. The interface is in an active negotiating state in which the port initiates negotiations with other ports by sending LACP packets. on—(Default mode) Specifies that all port channels that are not running LACP remain in this mode. passive—Enables LACP only if an LACP device is detected. The interface is in a passive negotiation state in which the port responds to LACP packets that it receives but does not initiate LACP negotiation. When you run port channels with no associated protocol, the channel mode is always on.
Step 4	switch(config-if)# **no channel-group** *number* **mode**	Returns the port mode to on for the specified interface.

This example shows how to set the LACP-enabled interface to active port-channel mode for Ethernet interface 1/4 in channel group 5:

```
switch# configure terminal
switch (config)# interface ethernet 1/4
switch(config-if)# channel-group 5 mode active
```

This example shows how to forcefully add an interface to the channel group 5:

```
switch(config)# interface ethernet 1/1
switch(config-if)# channel-group 5 force
switch(config-if)#
```

Configuring LACP Port Channel MinLinks

The MinLink feature works only with LACP port channels. The device allows you to configure this feature in non-LACP port channels, but the feature is not operational.

Important Cisco recommends that you only configure the MinLink feature on one end of your port channel. Configuring the **lacp min-links** command on both ends of the port channel might result in link flapping.

Procedure

	Command or Action	Purpose

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

Step 2	**interface port-channel** *number*
	
	Example:
	`switch(config) # interface port-channel 3`
	`switch(config-if) #`
		Specifies the interface to configure and enters interface configuration mode.

Step 3	[**no**] **lacp min-links** *number* **Example:** `switch(config-if) # lacp min-links 3`	Specifies the port channel interface to configure the number of minimum links and enters the interface configuration mode. The default value for *number* is 1. The range is from 1 to 16. Use the **no** form of this command to disable this feature.

Step 4	**show running-config interface port-channel** *number*
	
	Example:
	`switch(config) # show running-config interface port-channel 3`
	`switch(config-if) #`
		(Optional)
		Displays the port channel MinLinks configuration.

This example shows how to configure the minimum number of port channel interfaces on module 3:

```
switch# configure terminal
switch(config) # interface port-channel 3
switch(config-if) # lacp min-links 3
switch(config-if) #
```

Configuring the LACP Fast Timer Rate

You can change the LACP timer rate to modify the duration of the LACP timeout. Use the **lacp rate** command to set the rate at which LACP control packets are sent to an LACP-supported interface. You can change the timeout rate from the default rate (30 seconds) to the fast rate (1 second). This command is supported only on LACP-enabled interfaces.

Before You Begin

Ensure that you have enabled the LACP feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface to configure and enters the interface configuration mode.
Step 3	switch(config-if)# **lacp rate fast**	Configures the fast rate (one second) at which LACP control packets are sent to an LACP-supported interface.

This example shows how to configure the LACP fast rate on Ethernet interface 1/4:

```
switch# configure terminal
switch (config)# interface ethernet 1/4

switch(config-if)# lacp rate fast
```

This example shows how to restore the LACP default rate (30 seconds) on Ethernet interface 1/4.

```
switch# configure terminal
switch (config)# interface ethernet 1/4
switch(config-if)# no lacp rate fast
```

Configuring the LACP System Priority and System ID

The LACP system ID is the combination of the LACP system priority value and the MAC address.

Before You Begin

Ensure that you have enabled the LACP feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **lacp system-priority** *priority*	Configures the system priority for use with LACP. Valid values are 1 through 65535, and higher numbers have lower priority. The default value is 32768.
Step 3	switch# **show lacp system-identifier**	(Optional) Displays the LACP system identifier.

This example shows how to set the LACP system priority to 2500:

```
switch# configure terminal
switch(config)# lacp system-priority 2500
```

Configuring the LACP Port Priority

You can configure each link in the LACP port channel for the port priority.

Before You Begin

Ensure that you have enabled the LACP feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface** *type slot/port*	Specifies the interface to configure, and enters the interface configuration mode.
Step 3	switch(config-if)# **lacp port-priority** *priority*	Configures the port priority for use with LACP. Valid values are 1 through 65535, and higher numbers have lower priority. The default value is 32768.

This example shows how to set the LACP port priority for Ethernet interface 1/4 to 40000:

```
switch# configure terminal
switch (config)# interface ethernet 1/4
switch(config-if)# lacp port priority 40000
```

Verifying Port Channel Configuration

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

Command	Purpose
switch# **show interface port-channel** *channel-number*	Displays the status of a port channel interface.
switch# **show feature**	Displays enabled features.
switch# **show resource**	Displays the number of resources currently available in the system.
switch# **show lacp** {**counters** | **interface** *type slot/port* | **neighbor** | **port-channel** | **system-identifier**}	Displays LACP information.

Command	Purpose
switch# **show port-channel compatibility-parameters**	Displays the parameters that must be the same among the member ports in order to join a port channel.
switch# **show port-channel database** [**interface port-channel** *channel-number*]	Displays the aggregation state for one or more port-channel interfaces.
switch# **show port-channel summary**	Displays a summary for the port channel interfaces.
switch# **show port-channel traffic**	Displays the traffic statistics for port channels.
switch# **show port-channel usage**	Displays the range of used and unused channel numbers.
switch# **show port-channel database**	Displays information on current running of the port channel feature.
switch# **show port-channel load-balance**	Displays information about load-balancing using port channels.

Verifying the Load-Balancing Outgoing Port ID

Command Guidelines

The **show port-channel load-balance** command allows you to verify which ports a given frame is hashed to on a port channel. You need to specify the VLAN and the destination MAC in order to get accurate results.

Note Certain traffic flows are not subject to hashing, for example when there is a single port in a port-channel.

To display the load-balancing outgoing port ID, perform one of the tasks listed in the table below.

Command	Purpose
switch# **show port-channel load-balance forwarding-path interface port-channel** *port-channel-id* **vlan** vlan-id **dst-ip src-ip dst-mac src-mac l4-src-port** *port-id* **l4-dst-port** *port-id* **ether-type** *ether-type* **ip-proto** *ip-proto*	Displays the outgoing port ID.

Example

This example shows the output of the short **port-channel load-balance** command.

```
switch# show port-channel load-balance forwarding-path interface port-channel 10 vlan 1
dst-ip 1.225.225.225 src-ip 1.1.10.10 src-mac aa:bb:cc:dd:ee:ff
l4-src-port 0 l4-dst-port 1
Missing params will be substituted by 0's. Load-balance Algorithm on switch: source-dest-port
```

```
 crc8_hash:204 Outgoing port id: Ethernet 1/1 Param(s) used to calculate load balance:
dst-port: 0
src-port: 0
dst-ip: 1.225.225.225
src-ip: 1.1.10.10
dst-mac: 0000.0000.0000
src-mac: aabb.ccdd.eeff
```

Example

This example shows the output of the short **port-channel load-balance** command.

```
switch# show port-channel load-balance forwarding-path interface port-channel 10 vlan 1
dst-ip 1.225.225.225 src-ip 1.1.10.10 src-mac aa:bb:cc:dd:ee:ff ether-type 0x0800 ip-proto
 0x11
l4-src-port 0 l4-dst-port 1
Missing params will be substituted by 0's. Load-balance Algorithm on switch: source-dest-port
 crc8_hash:204 Outgoing port id: Ethernet 1/1 Param(s) used to calculate load balance:
dst-port: 0
src-port: 0
dst-ip: 1.225.225.225
src-ip: 1.1.10.10
dst-mac: 0000.0000.0000
src-mac: aabb.ccdd.eeff
ether-type: 0x0800
proto-type: 0x11
```

Feature History for Port Channels

Feature Name	Release	Feature Information
Minimum Links	5.0(3)U3(1)	Added information about setting up and using the Minimum Links feature.

CHAPTER 5

Configuring IP Tunnels

This chapter contains the following sections:

Information About IP Tunnels

IP tunnels can encapsulate a same-layer or higher-layer protocol and transport the result over IP through a tunnel created between two devices.

IP tunnels consists of the following three main components:

- Passenger protocol—The protocol that needs to be encapsulated. IPv4 is an example of a passenger protocol.
- Carrier protocol—The protocol that is used to encapsulate the passenger protocol. Cisco NX-OS supports generic routing encapsulation (GRE) as a carrier protocol.
- Transport protocol—The protocol that is used to carry the encapsulated protocol. IPv4 is an example of a transport protocol.

An IP tunnel takes a passenger protocol, such as IPv4, and encapsulates that protocol within a carrier protocol, such as GRE. The device then transmits this carrier protocol over a transport protocol, such as IPv4.

You configure a tunnel interface with matching characteristics on each end of the tunnel.

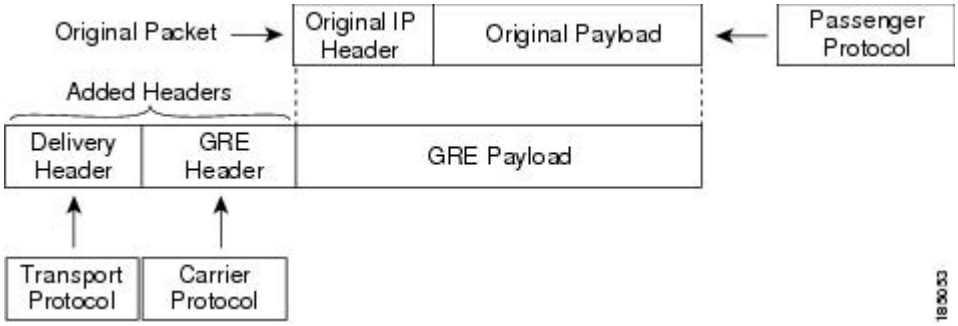
You must enable the tunnel feature before you can configure it.

GRE Tunnels

You can use GRE as the carrier protocol for a variety of passenger protocols.

The figure shows the IP tunnel components for a GRE tunnel. The original passenger protocol packet becomes the GRE payload and the device adds a GRE header to the packet. The device then adds the transport protocol header to the packet and transmits it.

Figure 5: GRE PDU



Licensing Requirements for IP Tunnels

Product	License Requirement
Cisco NX-OS	IP tunnels require an Enterprise Services license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the *Cisco NX-OS Licensing Guide*.

Prerequisites for IP Tunnels

IP tunnels have the following prerequisites:

- You must be familiar with TCP/IP fundamentals to configure IP tunnels.
- You are logged on to the switch.
- You have installed the Enterprise Services license for Cisco NX-OS.
- You must enable the tunneling feature in a device before you can configure and enable any IP tunnels.

Guidelines and Limitations for IP Tunnels

IP tunnels have the following configuration guidelines and limitations:

- Cisco NX-OS software supports the GRE header defined in IETF RFC 2784. Cisco NX-OS software does not support tunnel keys and other options from IETF RFC 1701.
- The Cisco Nexus device supports a maximum of eight tunnels.
- The Cisco Nexus device does not support the following features:
  - Path maximum transmission unit (MTU) discovery
  - Statistics
  - Access control lists (ACLs)
  - Unicast reverse path forwarding (URPF)
  - Multicast traffic and associated multicast protocols such as Internet Group Management Protocol (IGMP) and Protocol Independent Multicast (PIM).
- Cisco NX-OS software does not support the Web Cache Control Protocol (WCCP) on tunnel interfaces.

Default Settings for IP Tunneling

The following table lists the default settings for IP tunnel parameters.

Table 6: Default IP Tunnel Parameters

Parameters	Default
Tunnel feature	Disabled

Configuring IP Tunnels

Enabling Tunneling

Before You Begin

You must enable the tunneling feature before you can configure any IP tunnels.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **feature tunnel**	Enables the tunnel feature on the switch.
Step 3	switch(config)# **exit**	Returns to configuration mode.
Step 4	switch(config)# **show feature tunnel**	Displays the tunnel feature on the switch.
Step 5	switch# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to enable the tunnel feature:

```
switch# configure terminal
switch(config)# feature tunnel
switch(config)# exit
switch(config)# copy running-config startup-config
```

Creating a Tunnel Interface

You can create a tunnel interface and then configure this logical interface for your IP tunnel.

Before You Begin

Both the tunnel source and the tunnel destination must exist within the same virtual routing and forwarding (VRF) instance.

Ensure that you have enabled the tunneling feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# [**no**] **interface tunnel** *number*	Creates a new tunnel interface.
Step 3	switch(config)#**tunnel source** {*ip address* | *interface-name*}	Configures the source address for this IP tunnel.
Step 4	switch(config)#**tunnel destination** {*ip address* | *host-name*}	Configures the destination address for this IP tunnel.

	Command or Action	Purpose
Step 5	switch(config)#**tunnel use-vrf** *vrf-name*	(Optional) Uses the configured VRF to look up the tunnel IP destination address.
Step 6	switch(config)#**show interface tunnel** *number*	(Optional) Displays the tunnel interface statistics.
Step 7	switch# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create a tunnel interface:

```
switch# configure terminal
switch(config)# interface tunnel 1
switch(config)# tunnel source ethernet 1/2
switch(config)# tunnel destination 192.0.2.1
switch(config)# copy running-config startup-config
```

Creating a GRE Tunnel

You can set a tunnel interface to GRE tunnel mode.

Before You Begin

Ensure that you have enabled the tunneling feature.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface tunnel** *number*	Enters a tunnel interface configuration mode.
Step 3	switch(config)#**tunnel mode gre ip**	Sets this tunnel mode to GRE.
Step 4	switch(config)#**show interface tunnel** *number*	(Optional) Displays the tunnel interface statistics.
Step 5	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create the tunnel interface to GRE and set the GRE tunnel keepalives:

```
switch# configure terminal
switch(config)# interface tunnel 1
```

```
switch(config)# tunnel mode gre ip
switch(config)# copy running-config startup-config
```

Assigning VRF Membership to a Tunnel Interface

You can add a tunnel interface to a VRF.

Before You Begin

Ensure that you have enabled the tunneling feature.

Assign the IP address for a tunnel interface after you have configured the interface for a VRF.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface tunnel** *number*	Enters interface configuration mode.
Step 3	switch(config)# **vrf member** *vrf-name*	Adds this interface to a VRF.
Step 4	switch(config)# **ip address** *ip-prefix/length*	Configures an IP address for this interface. You must do this step after you assign this interface to a VRF.
Step 5	switch(config)# **show vrf** [*vrf-name*] **interface** *interface-type number*	(Optional) Displays VRF information.
Step 6	switch(config-if)# **copy running-config startup-config**	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to add a tunnel interface to the VRF:

```
switch# configure terminal
switch(config)# interface tunnel 0
switch(config-if)# vrf member RemoteOfficeVRF
switch(config-if)# ip address 209.0.2.1/16
switch(config-if)# copy running-config startup-config
```

Verifying the IP Tunnel Configuration

To verify IP tunnel configuration information, perform one of the following tasks:

Command	Purpose
show interface tunnel *number*	Displays the configuration for the tunnel interface (MTU, protocol, transport, and VRF). Displays input and output packets, bytes, and packet rates.

Command	Purpose
show interface tunnel *number* **brief**	Displays the operational status, IP address, encapsulation type, and MTU of the tunnel interface.
show interface tunnel *number* **description**	Displays the configured description of the tunnel interface.
show interface tunnel *number* **status**	Displays the operational status of the tunnel interface.
show interface tunnel *number* **status err-disabled**	Displays the error disabled status of the tunnel interface.

Configuration Examples for IP Tunneling

This example shows a simple GRE tunnel. Ethernet 1/2 is the tunnel source for router A and the tunnel destination for router B. Ethernet interface 1/3 is the tunnel source for router B and the tunnel destination for router A.

```
router A:
feature tunnel
interface tunnel 0
  ip address 209.165.20.2/8
  tunnel source ethernet 1/2
  tunnel destination 192.0.2.2
  tunnel mode gre ip
interface ethernet1/2
  ip address 192.0.2.55/8

router B:
feature tunnel
interface tunnel 0
  ip address 209.165.20.1/8
  tunnel source ethernet 1/3
  tunnel destination 192.0.2.55
  tunnel mode gre ip
interface ethernet 1/3
ip address 192.0.2.2/8
```

Related Documents for IP Tunnels

Related Topics	Document Title
IP Tunnel commands	*Cisco Nexus 3000 Series Interfaces Command Reference*

Standards for IP Tunnels

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 IP Tunnels

Table 7: Feature History for Configuring IP Tunnels

Feature Name	Release	Feature Information
IP tunnels	5.0(3)U4(1)	This feature was introduced.

CHAPTER 6

Configuring Virtual Port Channels

This chapter contains the following sections:

Information About vPCs

vPC Overview

A virtual port channel (vPC) allows links that are physically connected to two different Cisco Nexus 3000 Series switches to appear as a single port channel by a third device (see the following figure). The third device can be a switch, server, or any other networking device. A vPC can provide multipathing, which allows you to create redundancy by enabling multiple parallel paths between nodes and load balancing traffic where alternative paths exist.

You configure the EtherChannels by using one of the following:

- No protocol
- Link Aggregation Control Protocol (LACP)

When you configure the EtherChannels in a vPC—including the vPC peer link channel—each switch can have up to 16 active links in a single EtherChannel.

Note You must enable the vPC feature before you can configure or run the vPC functionality.

To enable the vPC functionality, you must create a peer-keepalive link and a peer-link under the vPC domain for the two vPC peer switches to provide the vPC functionality.

To create a vPC peer link you configure an EtherChannel on one Cisco Nexus 3000 Series switch by using two or more Ethernet ports. On the other switch, you configure another EtherChannel again using two or more Ethernet ports. Connecting these two EtherChannels together creates a vPC peer link.

Note We recommend that you configure the vPC peer-link EtherChannels as trunks.

The vPC domain includes both vPC peer devices, the vPC peer-keepalive link, the vPC peer link, and all of the EtherChannels in the vPC domain connected to the downstream device. You can have only one vPC domain ID on each vPC peer device.

Note Always attach all vPC devices using EtherChannels to both vPC peer devices.

A vPC provides the following benefits:

- Allows a single device to use an EtherChannel across two upstream devices
- Eliminates Spanning Tree Protocol (STP) blocked ports
- Provides a loop-free topology
- Uses all available uplink bandwidth
- Provides fast convergence if either the link or a switch fails
- Provides link-level resiliency
- Assures high availability

Terminology

vPC Terminology

The terminology used in vPCs is as follows:

- vPC—The combined EtherChannel between the vPC peer devices and the downstream device.
- vPC peer device—One of a pair of devices that are connected with the special EtherChannel known as the vPC peer link.
- vPC peer link—The link used to synchronize states between the vPC peer devices.
- vPC member port—Interfaces that belong to the vPCs.
- vPC domain—This domain includes both vPC peer devices, the vPC peer-keepalive link, and all of the port channels in the vPC connected to the downstream devices. It is also associated to the configuration mode that you must use to assign vPC global parameters. The vPC domain ID must be the same on both switches.
- vPC peer-keepalive link—The peer-keepalive link monitors the vitality of a vPC peer Cisco Nexus 3000 Series device. The peer-keepalive link sends configurable, periodic keepalive messages between vPC peer devices.

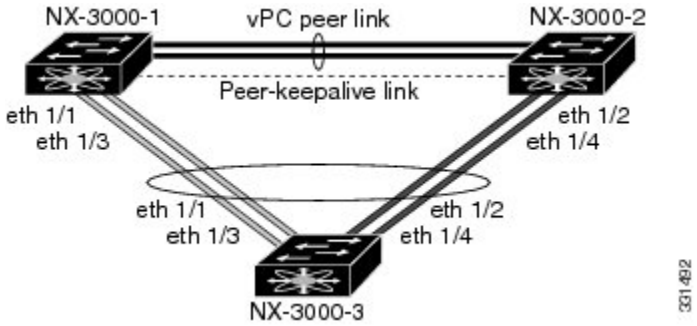
No data or synchronization traffic moves over the vPC peer-keepalive link; the only traffic on this link is a message that indicates that the originating switch is operating and running vPCs.

Supported vPC Topologies

Cisco Nexus 3000 Series Switch vPC Topology

You can connect a pair of Cisco Nexus 3000 Series switches in a vPC directly to another switch or to a server. Up to 8 interfaces could be connected to each Cisco Nexus 3000 Series switch providing 16 interfaces bundled for the vPC pair. The topology that is shown in the following figure provides the vPC functionality to dual connected switches or servers with 10-Gigabit or 1-Gigabit Ethernet uplink interfaces.

Figure 6: Switch-to-Switch vPC Topology



The switch connected to the pair of Cisco Nexus 3000 Series switches can be any standards-based Ethernet switch. Common environments to use this configuration include Blade Chassis with dual switches connected to the pair of Cisco Nexus 3000 Series switches through vPC or Unified Computing Systems connected to the pair of Cisco Nexus 3000 Series switches.

vPC Domain

To create a vPC domain, you must first create a vPC domain ID on each vPC peer switch using a number from 1 to 1000. This ID must be the same on a set of vPC peer devices.

You can configure the EtherChannels and vPC peer links by using LACP or no protocol. When possible, we recommend that you use LACP on the peer-link, because LACP provides configuration checks against a configuration mismatch on the EtherChannel.

The vPC peer switches use the vPC domain ID that you configure to automatically assign a unique vPC system MAC address. Each vPC domain has a unique MAC address that is used as a unique identifier for the specific vPC-related operations, although the switches use the vPC system MAC addresses only for link-scope operations, such as LACP. We recommend that you create each vPC domain within the contiguous network with a unique domain ID. You can also configure a specific MAC address for the vPC domain, rather than having the Cisco NX-OS software assign the address.

The vPC peer switches use the vPC domain ID that you configure to automatically assign a unique vPC system MAC address. The switches use the vPC system MAC addresses only for link-scope operations, such as LACP or BPDUs. You can also configure a specific MAC address for the vPC domain.

Cisco recommends that you configure the same VPC domain ID on both peers and, the domain ID should be unique in the network. For example, if there are two different VPCs (one in access and one in aggregation) then each vPC should have a unique domain ID.

After you create a vPC domain, the Cisco NX-OS software automatically creates a system priority for the vPC domain. You can also manually configure a specific system priority for the vPC domain.

Note If you manually configure the system priority, you must ensure that you assign the same priority value on both vPC peer switches. If the vPC peer switches have different system priority values, the vPC will not come up.

Peer-Keepalive Link and Messages

The Cisco NX-OS software uses a peer-keepalive link between the vPC peers to transmit periodic, configurable keepalive messages. You must have Layer 3 connectivity between the peer switches to transmit these messages; the system cannot bring up the vPC peer link unless a peer-keepalive link is already up and running.

If one of the vPC peer switches fails, the vPC peer switch on the other side of the vPC peer link senses the failure when it does not receive any peer-keepalive messages. The default interval time for the vPC peer-keepalive message is 1 second. You can configure the interval between 400 milliseconds and 10 seconds. You can also configure a timeout value with a range of 3 to 20 seconds; the default timeout value is 5 seconds. The peer-keepalive status is checked only when the peer-link goes down.

The vPC peer-keepalive can be carried either in the management or default VRF on the Cisco Nexus 3000 Series switch. When you configure the switches to use the management VRF, the source and destination for the keepalive messages are the mgmt 0 interface IP addresses. When you configure the switches to use the default VRF, an SVI must be created to act as the source and destination addresses for the vPC peer-keepalive messages. Ensure that both the source and destination IP addresses used for the peer-keepalive messages are unique in your network and these IP addresses are reachable from the VRF associated with the vPC peer-keepalive link.

Note We recommend that you configure the vPC peer-keepalive link on the Cisco Nexus 3000 Series switch to run in the management VRF using the mgmt 0 interfaces. If you configure the default VRF, ensure that the vPC peer link is not used to carry the vPC peer-keepalive messages.

Compatibility Parameters for vPC Peer Links

Many configuration and operational parameters must be identical on all interfaces in the vPC. After you enable the vPC feature and configure the peer link on both vPC peer switches, Cisco Fabric Services (CFS) messages provide a copy of the configuration on the local vPC peer switch configuration to the remote vPC peer switch. The system then determines whether any of the crucial configuration parameters differ on the two switches.

Enter the **show vpc consistency-parameters** command to display the configured values on all interfaces in the vPC. The displayed configurations are only those configurations that would limit the vPC peer link and vPC from coming up.

The compatibility check process for vPCs differs from the compatibility check for regular EtherChannels.

Configuration Parameters That Must Be Identical

The configuration parameters in this section must be configured identically on both switches at either end of the vPC peer link.

Note You must ensure that all interfaces in the vPC have the identical operational and configuration parameters listed in this section.

Enter the **show vpc consistency-parameters** command to display the configured values on all interfaces in the vPC. The displayed configurations are only those configurations that would limit the vPC peer link and vPC from coming up.

The switch automatically check for compatibility of these parameters on the vPC interfaces. The per-interface parameters must be consistent per interface, and the global parameters must be consistent globally.

- Port-channel mode: on, off, or active
- Link speed per channel
- Duplex mode per channel
- Trunk mode per channel:
  - Native VLAN
  - VLANs allowed on trunk
  - Tagging of native VLAN traffic
- Spanning Tree Protocol (STP) mode
- STP region configuration for Multiple Spanning Tree (MST)
- Enable or disable state per VLAN
- STP global settings:
  - Bridge Assurance setting
  - Port type setting—We recommend that you set all vPC interfaces as normal ports
  - Loop Guard settings
- STP interface settings:
  - Port type setting
  - Loop Guard
  - Root Guard

If any of these parameters are not enabled or defined on either switch, the vPC consistency check ignores those parameters.

Note To ensure that none of the vPC interfaces are in the suspend mode, enter the **show vpc brief** and **show vpc consistency-parameters** commands and check the syslog messages.

Configuration Parameters That Should Be Identical

When any of the following parameters are not configured identically on both vPC peer switches, a misconfiguration may cause undesirable behavior in the traffic flow:

- MAC aging timers
- Static MAC entries
- VLAN interface—Each switch on the end of the vPC peer link must have a VLAN interface configured for the same VLAN on both ends and they must be in the same administrative and operational mode. Those VLANs configured on only one switch of the peer link do not pass traffic using the vPC or peer link. You must create all VLANs on both the primary and secondary vPC switches, or the VLAN will be suspended.
- Private VLAN configuration
- All ACL configurations and parameters
- Quality of service (QoS) configuration and parameters—Local parameters; global parameters must be identical
- STP interface settings:
  - BPDU Filter
  - BPDU Guard
  - Cost
  - Link type
  - Priority
  - VLANs (Rapid PVST+)

To ensure that all the configuration parameters are compatible, we recommend that you display the configurations for each vPC peer switch once you configure the vPC.

Graceful Type-1 Check

When a consistency check fails, vPCs are brought down only on the secondary vPC switch. The VLANs remain up on the primary switch and Type-1 configurations can be performed without traffic disruption. This feature is used both in the case of global as well as interface-specific Type-1 inconsistencies.

Per-VLAN Consistency Check

Some Type-1 consistency checks are performed on a per-VLAN basis when spanning tree is enabled or disabled on a VLAN. VLANs that do not pass the consistency check are brought down on both the primary and secondary switches while other VLANs are not affected.

vPC Auto-Recovery

The vPC auto-recovery feature re-enables vPC links in the following scenarios:

When both vPC peer switches reload and only one switch reboots, auto-recovery allows that switch to assume the role of the primary switch and the vPC links will be allowed to come up after a predetermined period of time. The reload delay period in this scenario can range from 240-3600 seconds.

When vPCs are disabled on a secondary vPC switch due to a peer-link failure and then the primary vPC switch fails or is unable to forward traffic, the secondary switch re-enables the vPCs. In this scenario, the vPC waits for three consecutive keep-alive failures to recover the vPC links.

The vPC auto-recovery feature is disabled by default.

vPC Peer Links

A vPC peer link is the link that is used to synchronize the states between the vPC peer devices.

Note You must configure the peer-keepalive link before you configure the vPC peer link or the peer link will not come up.

vPC Peer Link Overview

You can have only two switches as vPC peers; each switch can serve as a vPC peer to only one other vPC peer. The vPC peer switches can also have non-vPC links to other switches.

To make a valid configuration, you configure an EtherChannel on each switch and then configure the vPC domain. You assign the EtherChannel on each switch as a peer link. For redundancy, we recommend that you should configure at least two dedicated ports into the EtherChannel; if one of the interfaces in the vPC peer link fails, the switch automatically falls back to use another interface in the peer link.

Note We recommend that you configure the EtherChannels in trunk mode.

Many operational parameters and configuration parameters must be the same in each switch connected by a vPC peer link. Because each switch is completely independent on the management plane, you must ensure that the switches are compatible on the critical parameters. vPC peer switches have separate control planes. After configuring the vPC peer link, you should display the configuration on each vPC peer switch to ensure that the configurations are compatible.

Note You must ensure that the two switches connected by the vPC peer link have certain identical operational and configuration parameters.

When you configure the vPC peer link, the vPC peer switches negotiate that one of the connected switches is the primary switch and the other connected switch is the secondary switch. By default, the Cisco NX-OS software uses the lowest MAC address to elect the primary switch. The software takes different actions on each switch—that is, the primary and secondary—only in certain failover conditions. If the primary switch fails, the secondary switch becomes the operational primary switch when the system recovers, and the previously primary switch is now the secondary switch.

You can also configure which of the vPC switches is the primary switch. If you want to configure the role priority again to make one vPC switch the primary switch, configure the role priority on both the primary and secondary vPC switches with the appropriate values, shut down the EtherChannel that is the vPC peer link on both switches by entering the **shutdown** command, and reenable the EtherChannel on both switches by entering the **no shutdown** command.

MAC addresses that are learned over vPC links are also synchronized between the peers.

Configuration information flows across the vPC peer links using the Cisco Fabric Services over Ethernet (CFSoE) protocol. All MAC addresses for those VLANs configured on both switches are synchronized between vPC peer switches. The software uses CFSoE for this synchronization.

If the vPC peer link fails, the software checks the status of the remote vPC peer switch using the peer-keepalive link, which is a link between vPC peer switches, to ensure that both switches are up. If the vPC peer switch is up, the secondary vPC switch disables all vPC ports on its switch. The data then forwards down the remaining active links of the EtherChannel.

The software learns of a vPC peer switch failure when the keepalive messages are not returned over the peer-keepalive link.

Use a separate link (vPC peer-keepalive link) to send configurable keepalive messages between the vPC peer switches. The keepalive messages on the vPC peer-keepalive link determines whether a failure is on the vPC peer link only or on the vPC peer switch. The keepalive messages are used only when all the links in the peer link fail.

vPC Number

Once you have created the vPC domain ID and the vPC peer link, you can create EtherChannels to attach the downstream switch to each vPC peer switch. That is, you create one single EtherChannel on the downstream switch with half of the ports to the primary vPC peer switch and the other half of the ports to the secondary peer switch.

On each vPC peer switch, you assign the same vPC number to the EtherChannel that connects to the downstream switch. You will experience minimal traffic disruption when you are creating vPCs. To simplify the configuration, you can assign the vPC ID number for each EtherChannel to be the same as the EtherChannel itself (that is, vPC ID 10 for EtherChannel 10).

Note The vPC number that you assign to the EtherChannel connecting to the downstream switch from the vPC peer switch must be identical on both vPC peer switches.

vPC Interactions with Other Features

vPC and LACP

The Link Aggregation Control Protocol (LACP) uses the system MAC address of the vPC domain to form the LACP Aggregation Group (LAG) ID for the vPC.

You can use LACP on all the vPC EtherChannels, including those channels from the downstream switch. We recommend that you configure LACP with active mode on the interfaces on each EtherChannel on the vPC peer switches. This configuration allows you to more easily detect compatibility between switches, unidirectional links, and multihop connections, and provides dynamic reaction to run-time changes and link failures.

The vPC peer link supports 16 EtherChannel interfaces.

Note When manually configuring the system priority, you must ensure that you assign the same priority value on both vPC peer switches. If the vPC peer switches have different system priority values, vPC will not come up.

vPC Peer Links and STP

When you first bring up the vPC functionality, STP reconverges. STP treats the vPC peer link as a special link and always includes the vPC peer link in the STP active topology.

We recommend that you set all the vPC peer link interfaces to the STP network port type so that Bridge Assurance is automatically enabled on all vPC peer links. We also recommend that you do not enable any of the STP enhancement features on VPC peer links.

You must configure a list of parameters to be identical on the vPC peer switches on both sides of the vPC peer link.

STP is distributed; that is, the protocol continues running on both vPC peer switches. However, the configuration on the vPC peer switch elected as the primary switch controls the STP process for the vPC interfaces on the secondary vPC peer switch.

The primary vPC switch synchronizes the STP state on the vPC secondary peer switch using Cisco Fabric Services over Ethernet (CFSoE).

The vPC manager performs a proposal/handshake agreement between the vPC peer switches that sets the primary and secondary switches and coordinates the two switches for STP. The primary vPC peer switch then controls the STP protocol for vPC interfaces on both the primary and secondary switches.

The Bridge Protocol Data Units (BPDUs) use the MAC address set for the vPC for the STP bridge ID in the designated bridge ID field. The vPC primary switch sends these BPDUs on the vPC interfaces.

Note Display the configuration on both sides of the vPC peer link to ensure that the settings are identical. Use the **show spanning-tree** command to display information about the vPC.

CFSoE

The Cisco Fabric Services over Ethernet (CFSoE) is a reliable state transport mechanism that you can use to synchronize the actions of the vPC peer devices. CFSoE carries messages and packets for many features linked with vPC, such as STP and IGMP. Information is carried in CFS/CFSoE protocol data units (PDUs).

When you enable the vPC feature, the device automatically enables CFSoE, and you do not have to configure anything. CFSoE distributions for vPCs do not need the capabilities to distribute over IP or the CFS regions. You do not need to configure anything for the CFSoE feature to work correctly on vPCs.

You can use the **show mac address-table** command to display the MAC addresses that CFSoE synchronizes for the vPC peer link.

Note Do not enter the **no cfs eth distribute** or the **no cfs distribute** command. CFSoE must be enabled for vPC functionality. If you do enter either of these commands when vPC is enabled, the system displays an error message.

When you enter the **show cfs application** command, the output displays "Physical-eth," which shows the applications that are using CFSoE.

Guidelines and Limitations for vPCs

vPC has the following configuration guidelines and limitations:

- vPC is not qualified with IPv6.
- You must enable the vPC feature before you can configure vPC peer-link and vPC interfaces.
- You must configure the peer-keepalive link before the system can form the vPC peer link.
- The vPC peer-link needs to be formed using a minimum of two 10-Gigabit Ethernet interfaces.
- Cisco recommends that you configure the same vPC domain ID on both peers and, the domain ID should be unique in the network. For example, if there are two different vPCs (one in access and one in aggregation) then each vPC should have a unique domain ID.
- Only Port Channels can be in vPCs. A vPC can be configured on a normal Port Channel (switch-to-switch vPC topology) and on an Port Channel host interface (host interface vPC topology).
- You must configure both vPC peer switches; the configuration is not automatically synchronized between the vPC peer devices.
- Check that the necessary configuration parameters are compatible on both sides of the vPC peer link.
- You might experience minimal traffic disruption while configuring vPCs.
- You should configure all the Port Channels in the vPC using LACP with the interfaces in active mode.
- You might experience traffic disruption when the first member of a vPC is brought up.

Configuring vPCs

Enabling vPCs

You must enable the vPC feature before you can configure and use vPCs.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **feature vpc**	Enables vPCs on the switch.
Step 3	switch# **show feature**	(Optional) Displays which features are enabled on the switch.
Step 4	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to enable the vPC feature:

```
switch# configure terminal
switch(config)# feature vpc
```

Disabling vPCs

You can disable the vPC feature.

Note When you disable the vPC feature, the Cisco Nexus 3000 Series switch clears all the vPC configurations.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **no feature vpc**	Disables vPCs on the switch.
Step 3	switch# **show feature**	(Optional) Displays which features are enabled on the switch.

	Command or Action	Purpose
Step 4	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to disable the vPC feature:

```
switch# configure terminal
switch(config)# no feature vpc
```

Creating a vPC Domain

You must create identical vPC domain IDs on both the vPC peer devices. This domain ID is used to automatically form the vPC system MAC address.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Creates a vPC domain on the switch, and enters the vpc-domain configuration mode. There is no default *domain-id* ; the range is from 1 to 1000. **Note** You can also use the **vpc domain** command to enter the vpc-domain configuration mode for an existing vPC domain.
Step 3	switch# **show vpc brief**	(Optional) Displays brief information about each vPC domain.
Step 4	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to create a vPC domain:

```
switch# configure terminal
switch(config)# vpc domain 5
```

Configuring a vPC Keepalive Link and Messages

You can configure the destination IP for the peer-keepalive link that carries the keepalive messages. Optionally, you can configure other parameters for the keepalive messages.

The Cisco NX-OS software uses the peer-keepalive link between the vPC peers to transmit periodic, configurable keepalive messages. You must have Layer 3 connectivity between the peer devices to transmit these messages. The system cannot bring up the vPC peer link unless the peer-keepalive link is already up and running.

Ensure that both the source and destination IP addresses used for the peer-keepalive message are unique in your network and these IP addresses are reachable from the Virtual Routing and Forwarding (VRF) associated with the vPC peer-keepalive link.

Note We recommend that you configure a separate VRF instance and put a Layer 3 port from each vPC peer switch into that VRF for the vPC peer-keepalive link. Do not use the peer link itself to send vPC peer-keepalive messages.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure the vPC peer-keepalive link before the system can form the vPC peer link.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Creates a vPC domain on the switch if it does not already exist, and enters the vpc-domain configuration mode.
Step 3	switch(config-vpc-domain)# **peer-keepalive destination** *ipaddress* [**hold-timeout** *secs* | **interval** *msecs* {**timeout** *secs*} | **precedence** {*prec-value* | **network** | **internet** | **critical** | **flash-override** | **flash** | **immediate priority** | **routine**} | **tos** {*tos-value* | **max-reliability** | **max-throughput** | **min-delay** | **min-monetary-cost** | **normal**} | **tos-byte** *tos-byte-value*} | **source** *ipaddress* | **vrf** {*name* | **management vpc-keepalive**}]	Configures the IPv4 address for the remote end of the vPC peer-keepalive link. **Note** The system does not form the vPC peer link until you configure a vPC peer-keepalive link. The management ports and VRF are the defaults
Step 4	switch(config-vpc-domain)# **vpc peer-keepalive destination** *ipaddress* **source** *ipaddress*	(Optional) Configures a separate VRF instance and puts a Layer 3 port from each vPC peer device into that VRF for the vPC peer-keepalive link.

	Command or Action	Purpose
Step 5	switch# **show vpc peer-keepalive**	(Optional) Displays information about the configuration for the keepalive messages.
Step 6	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure the destination IP address for the vPC-peer-keepalive link:

```
switch# configure terminal
switch(config)# vpc domain 5
switch(config-vpc-domain)# peer-keepalive destination 10.10.10.42
```

This example shows how to set up the peer keepalive link connection between the primary and secondary vPC device:

```
switch(config)# vpc domain 100
switch(config-vpc-domain)# peer-keepalive destination 192.168.2.2 source 192.168.2.1
Note:--------:: Management VRF will be used as the default VRF ::--------
switch(config-vpc-domain)#
```

This example shows how to create a separate VRF named vpc_keepalive for the vPC keepalive link and how to verify the new VRF:

This example shows how to create a separate VRF named vpc_keepalive for the vPC keepalive link and how to verify the new VRF:

```
vrf context vpc_keepalive
interface Ethernet1/31
  switchport access vlan 123
interface Vlan123
  vrf member vpc_keepalive
  ip address 123.1.1.2/30
  no shutdown
vpc domain 1
  peer-keepalive destination 123.1.1.1 source 123.1.1.2 vrf
vpc_keepalive

L3-NEXUS-2# sh vpc peer-keepalive

vPC keep-alive status           : peer is alive
--Peer is alive for             : (154477) seconds, (908) msec
--Send status                   : Success
--Last send at                  : 2011.01.14 19:02:50 100 ms
--Sent on interface             : Vlan123
--Receive status                : Success
--Last receive at               : 2011.01.14 19:02:50 103 ms
--Received on interface         : Vlan123
--Last update from peer         : (0) seconds, (524) msec

vPC Keep-alive parameters
--Destination                   : 123.1.1.1
--Keepalive interval            : 1000 msec
--Keepalive timeout             : 5 seconds
--Keepalive hold timeout        : 3 seconds
--Keepalive vrf                 : vpc_keepalive
--Keepalive udp port            : 3200
--Keepalive tos                 : 192

The services provided by the switch , such as ping, ssh, telnet,
```

```
radius, are VRF aware. The VRF name need to be configured or
specified in order for the correct routing table to be used.
L3-NEXUS-2# ping 123.1.1.1 vrf vpc_keepalive
PING 123.1.1.1 (123.1.1.1): 56 data bytes
64 bytes from 123.1.1.1: icmp_seq=0 ttl=254 time=3.234 ms
64 bytes from 123.1.1.1: icmp_seq=1 ttl=254 time=4.931 ms
64 bytes from 123.1.1.1: icmp_seq=2 ttl=254 time=4.965 ms
64 bytes from 123.1.1.1: icmp_seq=3 ttl=254 time=4.971 ms
64 bytes from 123.1.1.1: icmp_seq=4 ttl=254 time=4.915 ms

--- 123.1.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 3.234/4.603/4.971 ms
```

Creating a vPC Peer Link

You can create a vPC peer link by designating the EtherChannel that you want on each switch as the peer link for the specified vPC domain. We recommend that you configure the EtherChannels that you are designating as the vPC peer link in trunk mode and that you use two ports on separate modules on each vPC peer switch for redundancy.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedures

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface port-channel** *channel-number*	Selects the EtherChannel that you want to use as the vPC peer link for this switch, and enters the interface configuration mode.
Step 3	switch(config-if)# **vpc peer-link**	Configures the selected EtherChannel as the vPC peer link, and enters the vpc-domain configuration mode.
Step 4	switch# **show vpc brief**	(Optional) Displays information about each vPC, including information about the vPC peer link.
Step 5	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure a vPC peer link:

```
switch# configure terminal
switch(config)# interface port-channel 20
switch(config-if)# vpc peer-link
```

Checking the Configuration Compatibility

After you have configured the vPC peer link on both vPC peer switches, check that the configurations are consistent on all vPC interfaces.

Note The following QoS parameters support Type 2 consistency checks:

- Network QoS—MTU and Pause
- Input Queuing —Bandwidth and Absolute Priority
- Output Queuing—Bandwidth and Absolute Priority

In the case of a Type 2 mismatch, the vPC is not suspended. Type 1 mismatches suspend the vPC.

Parameter	Default Setting
switch# **show vpc consistency-parameters** {**global** | **interface port-channel** *channel-number*}	Displays the status of those parameters that must be consistent across all vPC interfaces.

This example shows how to check that the required configurations are compatible across all the vPC interfaces:

```
switch# show vpc consistency-parameters global
     Legend:
         Type 1 : vPC will be suspended in case of mismatch
Name                        Type  Local Value            Peer Value

------------- ----  ---------------------- -----------------------
QoS                         2     ([], [], [], [], [],   ([], [], [], [], [],
                                   [])                     [])

Network QoS (MTU)           2     (1538, 0, 0, 0, 0, 0)  (1538, 0, 0, 0, 0, 0)
Network Qos (Pause)         2     (F, F, F, F, F, F)     (1538, 0, 0, 0, 0, 0)
Input Queuing (Bandwidth)   2     (100, 0, 0, 0, 0, 0)   (100, 0, 0, 0, 0, 0)
Input Queuing (Absolute     2     (F, F, F, F, F, F)     (100, 0, 0, 0, 0, 0)
Priority)
Output Queuing (Bandwidth)  2     (100, 0, 0, 0, 0, 0)   (100, 0, 0, 0, 0, 0)
Output Queuing (Absolute    2     (F, F, F, F, F, F)     (100, 0, 0, 0, 0, 0)
Priority)
STP Mode                    1     Rapid-PVST             Rapid-PVST
STP Disabled                1     None                   None
STP MST Region Name         1     ""                     ""
STP MST Region Revision     1     0                      0
STP MST Region Instance to  1
  VLAN Mapping

STP Loopguard               1     Disabled               Disabled
STP Bridge Assurance        1     Enabled                Enabled
STP Port Type, Edge         1     Normal, Disabled,      Normal, Disabled,
BPDUFilter, Edge BPDUGuard        Disabled               Disabled
STP MST Simulate PVST       1     Enabled                Enabled
Allowed VLANs               -     1,624                  1
Local suspended VLANs       -     624                    -
switch#
```

Enabling vPC Auto-Recovery

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Enters vpc-domain configuration mode for an existing vPC domain.
Step 3	switch(config-vpc-domain)# **auto-recovery reload-delay** *delay*	Enables the auto-recovery feature and sets the reload delay period. The default is disabled.

This example shows how to enable the auto-recovery feature in vPC domain 10 and set the delay period for 240 seconds.

```
switch(config)# vpc domain 10
switch(config-vpc-domain)# auto-recovery reload-delay 240
Warning:
 Enables restoring of vPCs in a peer-detached state after reload, will wait for 240 seconds
 (by default) to determine if peer is un-reachable
```

This example shows how to view the status of the auto-recovery feature in vPC domain 10:

```
switch(config-vpc-domain)# show running-config vpc
!Command: show running-config vpc
!Time: Tue Dec  7 02:38:44 2010


version 5.0(3)U2(1)
feature vpc
vpc domain 10
  peer-keepalive destination 10.193.51.170
  auto-recovery
```

Configuring the Restore Time Delay

You can configure a restore timer that delays the vPC from coming back up until after the peer adjacency forms and the VLAN interfaces are back up. This feature avoids packet drops when the routing tables may not be converged before the vPC is once again passing traffic.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedures.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Creates a vPC domain on the switch if it does not already exist, and enters the vpc-domain configuration mode.
Step 3	switch(config-vpc-domain)# **delay restore** *time*	Configures the time delay before the vPC is restored. The restore time is the number of seconds to delay bringing up the restored vPC peer device. The range is from 1 to 3600. The default is 30 seconds.
Step 4	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure the delay reload time for a vPC link:

```
switch(config)# vpc domain 1
switch(config-vpc-domain)# delay restore 10
switch(config-vpc-domain)#
```

Excluding VLAN Interfaces From Shutdown When vPC Peer Link Fails

When a vPC peer-link is lost, the vPC secondary switch suspends its vPC member ports and its SVI interfaces. All Layer 3 forwarding is disabled for all VLANs on the vPC secondary switch. You can exclude specific SVI interfaces so that they are not suspended.

Before You Begin

Ensure that the VLAN interfaces have been configured.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Creates a vPC domain on the switch if it does not already exist, and enters the vpc-domain configuration mode.
Step 3	switch(config-vpc-domain))# **dual-active exclude interface-vlan** *range*	Specifies the VLAN interfaces that should remain up when a vPC peer-link is lost. range—Range of VLAN interfaces that you want to exclude from shutting down. The range is from 1 to 4094.

This example shows how to keep the interfaces on VLAN 10 up on the vPC peer switch if a peer link fails:

```
switch# configure terminal
switch(config)# vpc domain 5
switch(config-vpc-domain)# dual-active exclude interface-vlan 10
switch(config-vpc-domain)#
```

Configuring the VRF Name

The switch services, such as ping, ssh, telnet, radius, are VRF aware. The VRF name must be configured in order for the correct routing table to be used.

You can specify the VRF name.

Procedure

	Command or Action	Purpose
Step 1	switch# **ping** *ipaddress* **vrf** *vrf-name*	Specifies the virtual routing and forwarding (VRF) to use. The VRF name is case sensitive and can be a maximum of 32 characters..

This example shows how to specifiy the VRF named vpc_keepalive:

```
switch# ping 123.1.1.1 vrf vpc_keepalive
PING 123.1.1.1 (123.1.1.1): 56 data bytes
64 bytes from 123.1.1.1: icmp_seq=0 ttl=254 time=3.234 ms
64 bytes from 123.1.1.1: icmp_seq=1 ttl=254 time=4.931 ms
64 bytes from 123.1.1.1: icmp_seq=2 ttl=254 time=4.965 ms
64 bytes from 123.1.1.1: icmp_seq=3 ttl=254 time=4.971 ms
64 bytes from 123.1.1.1: icmp_seq=4 ttl=254 time=4.915 ms

--- 123.1.1.1 ping statistics ---
5 packets transmitted, 5 packets received, 0.00% packet loss
round-trip min/avg/max = 3.234/4.603/4.971 ms
```

Binding a VRF Instance to a vPC

You can bind a VRF instance to a vPC. One reserved VLAN is required for each VRF. Without this command, the receivers in a non-VPC VLAN and the receivers connected to a Layer 3 interface may not receive multicast traffic. The non-vPC VLANs are the VLANs that are not trunked over a peer-link.

Before You Begin

Use the **show interfaces brief** command to view the interfaces that are in use on a switch. To bind the VRF to the vPC, you must use a VLAN that is not already in use.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.

	Command or Action	Purpose
Step 2	switch(config)# **vpc bind-vrf** *vrf-name* **vlan** *vlan-id*	Binds a VRF instance to a vPC and specifies the VLAN to bind to the vPC. The VLAN ID range is from 1 to 3967, and 4049 to 4093.

This example shows how to bind a vPC to the default VRF using VLAN 2:

```
switch(config)# vpc bind-vrf default vlan vlan2
```

Moving Other Port Channels into a vPC

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **interface port-channel** *channel-number*	Selects the port channel that you want to put into the vPC to connect to the downstream switch, and enters the interface configuration mode. **Note** A vPC can be configured on a normal port channel (physical vPC topology) and on an port channel host interface (host interface vPC topology)
Step 3	switch(config-if)# **vpc** *number*	Configures the selected port channel into the vPC to connect to the downstream switch. The range is from 1 to 4096. The vPC *number* that you assign to the port channel connecting to the downstream switch from the vPC peer switch must be identical on both vPC peer switches.
Step 4	switch# **show vpc brief**	(Optional) Displays information about each vPC.
Step 5	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure a port channel that will connect to the downstream device:

```
switch# configure terminal
switch(config)# interface port-channel 20
switch(config-if)# vpc 5
```

Manually Configuring a vPC Domain MAC Address

Note Configuring the system-mac is an optional configuration step. This section explains how to configure it in case you want to.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Selects an existing vPC domain on the switch, or creates a new vPC domain, and enters the vpc-domain configuration mode. There is no default *domain-id* ; the range is from 1 to 1000.
Step 3	switch(config-vpc-domain)# **system-mac** *mac-address*	Enters the MAC address that you want for the specified vPC domain in the following format: aaaa.bbbb.cccc.
Step 4	switch# **show vpc role**	(Optional) Displays the vPC system MAC address.
Step 5	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure a vPC domain MAC address:

```
switch# configure terminal
switch(config)# vpc domain 5
switch(config-if)# system-mac 23fb.4ab5.4c4e
```

Manually Configuring the System Priority

When you create a vPC domain, the system automatically creates a vPC system priority. However, you can also manually configure a system priority for the vPC domain.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Selects an existing vPC domain on the switch, or creates a new vPC domain, and enters the vpc-domain configuration mode. There is no default *domain-id* ; the range is from 1 to 1000.
Step 3	switch(config-vpc-domain)# **system-priority** *priority*	Enters the system priority that you want for the specified vPC domain. The range of values is from 1 to 65535. The default value is 32667.
Step 4	switch# **show vpc brief**	(Optional) Displays information about each vPC, including information about the vPC peer link.
Step 5	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure a vPC peer link:

```
switch# configure terminal
switch(config)# vpc domain 5
switch(config-if)# system-priority 4000
```

Manually Configuring a vPC Peer Switch Role

By default, the Cisco NX-OS software elects a primary and secondary vPC peer switch after you configure the vPC domain and both sides of the vPC peer link. However, you may want to elect a specific vPC peer switch as the primary switch for the vPC. Then, you would manually configure the role value for the vPC peer switch that you want as the primary switch to be lower than the other vPC peer switch.

vPC does not support role preemption. If the primary vPC peer switch fails, the secondary vPC peer switch takes over to become operationally the vPC primary switch. However, the original operational roles are not restored when the formerly primary vPC comes up again.

Before You Begin

Ensure that you have enabled the vPC feature.

You must configure both switches on either side of the vPC peer link with the following procedure.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters configuration mode.
Step 2	switch(config)# **vpc domain** *domain-id*	Selects an existing vPC domain on the switch, or creates a new vPC domain, and enters the vpc-domain configuration mode. There is no default *domain-id* ; the range is from 1 to 1000.
Step 3	switch(config-vpc-domain)# **role priority** *priority*	Enters the role priority that you want for the vPC system priority. The range of values is from 1 to 65535. The default value is 32667.
Step 4	switch# **show vpc brief**	(Optional) Displays information about each vPC, including information about the vPC peer link.
Step 5	switch# **copy running-config startup-config**	(Optional) Copies the running configuration to the startup configuration.

This example shows how to configure a vPC peer link:

```
switch# configure terminal
switch(config)# vpc domain 5
switch(config-if)# role priority 4000
```

Verifying the vPC Configuration

Use the following commands to display vPC configuration information:

Command	Purpose
switch# **show feature**	Displays whether vPC is enabled or not.
switch# **show port-channel capacity**	Displays how many EtherChannels are configured and how many are still available on the switch.
switch# **show running-config vpc**	Displays running configuration information for vPCs.
switch# **show vpc brief**	Displays brief information on the vPCs.
switch# **show vpc consistency-parameters**	Displays the status of those parameters that must be consistent across all vPC interfaces.
switch# **show vpc peer-keepalive**	Displays information on the peer-keepalive messages.

Command	Purpose
switch# **show vpc role**	Displays the peer status, the role of the local switch, the vPC system MAC address and system priority, and the MAC address and priority for the local vPC switch.
switch# **show vpc statistics**	Displays statistics on the vPCs. **Note** This command displays the vPC statistics only for the vPC peer device that you are working on.

For information about the switch output, see the *Command Reference* for your Cisco Nexus Series switch.

Viewing The Graceful Type-1 Check Status

This example shows how to display the current status of the graceful Type-1 consistency check:

```
switch# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                   : 10
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
Configuration consistency status: success
Per-vlan consistency status     : success
Type-2 consistency status       : success
vPC role                        : secondary
Number of vPCs configured       : 34
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1
```

Viewing A Global Type-1 Inconsistency

When a global Type-1 inconsistency occurs, the vPCs on the secondary switch are brought down. The following example shows this type of inconsistency when there is a spanning-tree mode mismatch.

The example shows how to display the status of the suspended vPC VLANs on the secondary switch:

```
switch(config)# show vpc
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                   : 10
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
Configuration consistency status: failed
Per-vlan consistency status     : success
Configuration consistency reason: vPC type-1 configuration incompatible - STP
                                  Mode inconsistent
Type-2 consistency status       : success
```

```
vPC role                        : secondary
Number of vPCs configured       : 2
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1-10

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        down*  failed      Global compat check failed -
30     Po30        down*  failed      Global compat check failed -
```

The example shows how to display the inconsistent status (the VLANs on the primary vPC are not suspended) on the primary switch:

```
switch(config)# show vpc
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                   : 10
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
Configuration consistency status: failed
Per-vlan consistency status     : success
Configuration consistency reason: vPC type-1 configuration incompatible - STP Mo
de inconsistent
Type-2 consistency status       : success
vPC role                        : primary
Number of vPCs configured       : 2
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1-10

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     failed      Global compat check failed 1-10
30     Po30        up     failed      Global compat check failed 1-10
```

Viewing An Interface-Specific Type-1 Inconsistency

When an interface-specific Type-1 inconsistency occurs, the vPC port on the secondary switch is brought down while the primary switch vPC ports remain up.The following example shows this type of inconsistency when there is a switchport mode mismatch.

This example shows how to display the status of the suspended vPC VLAN on the secondary switch:

```
switch(config-if)# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                   : 10
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
```

```
Configuration consistency status: success
Per-vlan consistency status     : success
Type-2 consistency status       : success
vPC role                        : secondary
Number of vPCs configured       : 2
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     success     success                    1
30     Po30        down*  failed      Compatibility check failed -
                                       for port mode
```

This example shows how to display the inconsistent status (the VLANs on the primary vPC are not suspended) on the primary switch:

```
switch(config-if)# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                   : 10
Peer status                     : peer adjacency formed ok
vPC keep-alive status           : peer is alive
Configuration consistency status: success
Per-vlan consistency status     : success
Type-2 consistency status       : success
vPC role                        : primary
Number of vPCs configured       : 2
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     success     success                    1
30     Po30        up     failed      Compatibility check failed 1
                                       for port mode
```

Viewing a Per-VLAN Consistency Status

To view the per-VLAN consistency or inconsistency status, enter the **show vpc consistency-parameters vlans** command.

This example shows how to display the consistent status of the VLANs on the primary and the secondary switches.

```
switch(config-if)# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link
```

```
vPC domain id                     : 10
Peer status                       : peer adjacency formed ok
vPC keep-alive status             : peer is alive
Configuration consistency status: success
Per-vlan consistency status       : success
Type-2 consistency status         : success
vPC role                          : secondary
Number of vPCs configured         : 2
Peer Gateway                      : Disabled
Dual-active excluded VLANs        : -
Graceful Consistency Check        : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1-10

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     success     success                    1-10
30     Po30        up     success     success                    1-10
```

Entering **no spanning-tree vlan 5** command triggers the inconsistency on the primary and secondary VLANs:

```
switch(config)# no spanning-tree vlan 5
```

This example shows how to display the per-VLAN consistency status as Failed on the secondary switch.

```
switch(config)# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                     : 10
Peer status                       : peer adjacency formed ok
vPC keep-alive status             : peer is alive
Configuration consistency status: success
Per-vlan consistency status       : failed
Type-2 consistency status         : success
vPC role                          : secondary
Number of vPCs configured         : 2
Peer Gateway                      : Disabled
Dual-active excluded VLANs        : -
Graceful Consistency Check        : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1-4,6-10

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     success     success                    1-4,6-10
30     Po30        up     success     success                    1-4,6-10
```

This example shows how to display the per-VLAN consistency status as Failed on the primary switch.

```
switch(config)# show vpc brief
Legend:
                (*) - local vPC is down, forwarding via vPC peer-link

vPC domain id                     : 10
Peer status                       : peer adjacency formed ok
vPC keep-alive status             : peer is alive
Configuration consistency status: success
Per-vlan consistency status       : failed
Type-2 consistency status         : success
vPC role                          : primary
```

```
Number of vPCs configured       : 2
Peer Gateway                    : Disabled
Dual-active excluded VLANs      : -
Graceful Consistency Check      : Enabled

vPC Peer-link status
---------------------------------------------------------------------
id   Port   Status Active vlans
--   ----   ------ -------------------------------------------------
1    Po1    up     1-4,6-10

vPC status
----------------------------------------------------------------------------
id     Port        Status Consistency Reason                     Active vlans
------ ----------- ------ ----------- -------------------------- -----------
20     Po20        up     success     success                    1-4,6-10
30     Po30        up     success     success                    1-4,6-10
```

This example shows the inconsistency as STP Disabled:

```
switch(config)# show vpc consistency-parameters vlans

Name                        Type  Reason Code            Pass Vlans

-------------               ----  ---------------------- -----------------------
STP Mode                    1     success                0-4095
STP Disabled                1     vPC type-1             0-4,6-4095
                                  configuration
                                  incompatible - STP is
                                  enabled or disabled on
                                   some or all vlans
STP MST Region Name         1     success                0-4095
STP MST Region Revision     1     success                0-4095
STP MST Region Instance to  1     success                0-4095
 VLAN Mapping
STP Loopguard               1     success                0-4095
STP Bridge Assurance        1     success                0-4095
STP Port Type, Edge         1     success                0-4095
BPDUFilter, Edge BPDUGuard
STP MST Simulate PVST       1     success                0-4095
Pass Vlans                  -                            0-4,6-4095
```

vPC Default Settings

The following table lists the default settings for vPC parameters.

Table 8: Default vPC Parameters

Parameters	Default
vPC system priority	32667
vPC peer-keepalive message	Disabled
vPC peer-keepalive interval	1 second
vPC peer-keepalive timeout	5 seconds
vPC peer-keepalive UDP port	3200

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