

Configuring Ethernet Interfaces

This module describes the configuration of Ethernet interfaces.

Table 1: Feature History Table

Feature Name	Release	Description
OTN Support for NC55-MPA-12T-S MPA on Cisco NCS 5500 Series Routers.	Release 7.5.1	This release introduces support for Optical Network Transport (OTN) on NC55-MPA-12T-S Modular Port Adapter (MPA) on the following Cisco NCS 5500 Series Line cards: • NCS-55A2-MOD-S • NCS-55A2-MOD-SE-S • NCS-55A2-MOD-HX-S • NCS-55A2-MOD-SE-H-S • NCS-55A2-MOD-HD-S OTN is a superior technology that bridges the gap between next-generation IP and legacy time-division multiplexing (TDM) networks by acting as a converged transport layer for newer packet-based and existing TDM services. OTN provides robust transport services that leverage many benefits of SONET/SDH, such as resiliency and performance monitoring, while adding enhanced multi-rate capabilities in packet traffic. The Cisco NCS 5500 Series Routers support Ethernet, SONET/SDH, and OTN client interfaces with data rates from 1 to 10 Gigabits per second. To enable OTN, use the **pm otn report enable** command in the otu2e or odu2e mode.

The following distributed ethernet architecture delivers network scalability and performance, while enabling service providers to offer high-density, high-bandwidth networking solutions.

- 10-Gigabit
- 40-Gigabit
- 100-Gigabit

Tip You can programmatically configure and manage the Ethernet interfaces using `openconfig-ethernet-if.yang` and `openconfig-interfaces.yang` OpenConfig data models. To get started with using data models, see the *Programmability Configuration Guide for Cisco NCS 5500 Series Routers*.

These solutions are designed to interconnect the router with other systems in point-of-presence (POP)s, including core and edge routers and Layer 2 and Layer 3 switches.

Restrictions for Configuring Ethernet Interfaces

- Router does not support configuration of the static mac address.
- As per design, traffic logs for incoming CRC error packets don't display packets per second (PPS) and other packet-specific information, as highlighted below.

```
Router# show interface tenGigE 0/0/0/10 | include packets

5 minute input rate 541242000 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
   0 packets input, 7718374402816 bytes, 0 total input drops
   Received 0 broadcast packets, 0 multicast packets
   2952 packets output, 389664 bytes, 0 total output drops
   Output 0 broadcast packets, 2952 multicast packets
```

- To save power consumption, the router shuts down the ethernet interfaces with no configuration other than **no shutdown** after a graceful line card or system reload. To avoid ethernet interfaces going down in such scenarios, you must provide a description and the **no shutdown** configuration under the interface. You can use the **description (interface)** to add a description to an interface.
- The router doesn't support connecting a 1Gig copper cable to a 25GbE or higher speed QSFP ports.
- For 1Gig fibre cable, the router doesn't support auto-negotiation for 25GbE or higher speed QSFP ports.

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Configuring Gigabit Ethernet Interfaces

Restrictions and Important Guidelines

- NC55-MPA-12T-S supports 1G optics in eight ports. The ports are 0 to 3 and 8 to 11.
- NC55-MPA-12T-S supports 10G optics in ports 4 to 7.

Use this procedure to create a basic Ethernet interface configuration.

SUMMARY STEPS

1. **show version**
2. **show interfaces** [**GigE** | **TenGigE** | | | **HundredGigE**] *interface-path-id*
3. **configure**
4. **interface** [**GigE** | **TenGigE** | | | **HundredGigE**] *interface-path-id*
5. **ipv4 address** *ip-address mask*
6. **mtu** *bytes*
7. **no shutdown**
8. **end** or **commit**
9. **show interfaces** [**GigE TenGigE HundredGigE**] *interface-path-id*

DETAILED STEPS

Procedure

Step 1 **show version**

Example:

```
RP/0/RP0/CPU0:router# show version
```

(Optional) Displays the current software version, and can also be used to confirm that the router recognizes the line card.

Step 2 **show interfaces** [**GigE** | **TenGigE** | | | **HundredGigE**] *interface-path-id*

Example:

```
RP/0/RP0/CPU0:router# show interface HundredGigE 0/1/0/1
```

(Optional) Displays the configured interface and checks the status of each interface port.

Step 3 **configure**

Example:

```
RP/0/RP0/CPU0:router# configure terminal
```

Enters global configuration mode.

Step 4 **interface** [**GigE** | **TenGigE** | | | **HundredGigE**] *interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/1
```

Enters interface configuration mode and specifies the Ethernet interface name and notation *rack/slot/module/port*. Possible interface types for this procedure are:

- GigE

- 10GigE
- 100GigE

Note
- The example indicates a 100-Gigabit Ethernet interface in the line card in slot 1.

Step 5 **ipv4 address** *ip-address mask*

Example:

```
RP/0/RP0/CPU0:router(config-if)# ipv4 address 172.18.189.38 255.255.255.224
```

Assigns an IP address and subnet mask to the interface.

- Replace *ip-address* with the primary IPv4 address for the interface.
- Replace *mask* with the mask for the associated IP subnet. The network mask can be specified in either of two ways:
- The network mask can be a four-part dotted decimal address. For example, 255.0.0.0 indicates that each bit equal to 1 means that the corresponding address bit belongs to the network address.
- The network mask can be indicated as a slash (/) and number. For example, /8 indicates that the first 8 bits of the mask are ones, and the corresponding bits of the address are network address.

Step 6 **mtu** *bytes*

Example:

```
RP/0/RP0/CPU0:router(config-if)# mtu 2000
```

(Optional) Sets the MTU value for the interface.

- The configurable range for MTU values is 1514 bytes to 9646 bytes.
- The default is 1514 bytes for normal frames and 1518 bytes for 802.1Q tagged frames.

Step 7 **no shutdown**

Example:

```
RP/0/RP0/CPU0:router(config-if)# no shutdown
```

Removes the shutdown configuration, which forces an interface administratively down.

Step 8 **end** or **commit**

Example:

```
RP/0/RP0/CPU0:router(config-if)# end
```

or

```
RP/0/RP0/CPU0:router(config-if)# commit
```

Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

```
Uncommitted changes found, commit them before exiting(yes/no/cancel)?
[cancel]:
```

- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
- Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Step 9 **show interfaces** [**GigE TenGigE HundredGigE**] *interface-path-id*

Example:

```
RP/0/RP0/CPU0:router# show interfaces HundredGigE 0/1/0/1
```

(Optional) Displays statistics for interfaces on the router.

Example

This example shows how to configure an interface for a 100-Gigabit Ethernet line card:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/1
RP/0/RP0/CPU0:router(config-if)# ipv4 address 172.18.189.38 255.255.255.224

RP/0/RP0/CPU0:router(config-if)# mtu 2000

RP/0/RP0/CPU0:router(config-if)# no shutdown
RP/0/RP0/CPU0:router(config-if)# end
Uncommitted changes found, commit them? [yes]: yes


RP/0/RP0/CPU0:router# show interfaces HundredGigE 0/5/0/24
HundredGigE0/5/0/24 is up, line protocol is up
  Interface state transitions: 1
  Hardware is HundredGigE, address is 6219.8864.e330 (bia 6219.8864.e330)
  Internet address is 3.24.1.1/24
  MTU 9216 bytes, BW 100000000 Kbit (Max: 100000000 Kbit)
     reliability 255/255, txload 3/255, rxload 3/255
  Encapsulation ARPA,
  Full-duplex, 100000Mb/s, link type is force-up
  output flow control is off, input flow control is off
  Carrier delay (up) is 10 msec
  loopback not set,
  Last link flapped 10:05:07
  ARP type ARPA, ARP timeout 04:00:00
```

```
  Last input 00:08:56, output 00:00:00
  Last clearing of "show interface" counters never
  5 minute input rate 1258567000 bits/sec, 1484160 packets/sec
  5 minute output rate 1258584000 bits/sec, 1484160 packets/sec
     228290765840 packets input, 27293508436038 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 15 broadcast packets, 45 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     212467849449 packets output, 25733664696650 bytes, 0 total output drops
     Output 23 broadcast packets, 15732 multicast packets
     39 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

```
RP/0/RP0/CPU0:router# show running-config interface HundredGigE 0/5/0/24

interface HundredGigE 0/5/0/24
 mtu 9216
 service-policy input linerate
 service-policy output elinerate
 ipv4 address 3.24.1.1 255.255.255.0
 ipv6 address 3:24:1::1/64
 flow ipv4 monitor perfv4 sampler fsm ingress
!
```

Information About Configuring Ethernet

This section provides the following information sections:

Default Configuration Values for 100-Gigabit Ethernet

This table describes the default interface configuration parameters that are present when an interface is enabled on a 100-Gigabit Ethernet line card.



Note You must use the **shutdown** command to bring an interface administratively down. The interface default is **no shutdown**. When a line card is first inserted into the router, if there is no established preconfiguration for it, the configuration manager adds a shutdown item to its configuration. This shutdown can be removed only be entering the **no shutdown** command.

Table 2: 100-Gigabit Ethernet line card Default Configuration Values

Parameter	Configuration File Entry	Default Value
MTU	**mtu**	• 1514 bytes for normal frames • 1518 bytes for 802.1Q tagged frames. • 1522 bytes for Q-in-Q frames.
MAC address	**mac address**	Hardware burned-in address (BIA)

Network Interface Speed

1Gig interfaces connected through copper or fiber cable can have interface speed of either 100 Mbps or 1000 Mbps. This is applicable on 1Gig interface with a 1000Base-T module (GLC-TE). By default 1G interface has following capabilities:

- Speed—1000 Mbps for fiber cable and autonegotiate for copper cable
- Duplex—Full
- Pause—Receive Part (RX) and Transmit Part (TX)

The copper and fiber cables have same default values as mentioned above but autonegotiation is default for copper cable.

The speed can either configured or set to autonegotiate with remote end interface. When in autonegotiation mode, an interface is capable of negotiating the speed of 100 Mbps or 1000 Mbps depending on the speed at the remote end interface; and other parameters such as full duplex and pause are also autonegotiated.

Autonegotiation is an optional function of the Fast Ethernet standard that enables devices to automatically exchange information over a link about speed and duplex abilities. Autonegotiation is very useful for ports where devices with different capabilities are connected and disconnected on a regular basis.

Note Autonegotiation is disabled by default, but it's mandatory on QSFP-100G-CUxM link. You must enable autonegotiation manually when you use 100GBASE-CR4 DAC cable.

Note Starting with IOS-XR software release 24.1.1, the default value for Forward Error Correction (FEC) is set to disabled for 25G 1M and 2M copper optics.

Restrictions for internal loopback

On 1G fixed copper interfaces and interfaces that use GLC-TE copper SFPs, applying internal loopback with autonegotiation enabled can change the operational speed of the interface. The speed can also become unsynchronized between the Broadcom hardware and Cisco IOS XR software.

If this condition occurs, recover the interface by reloading the line card or, on a fixed router, by reloading the chassis. If the interface supports a different optic type, replace the copper SFP with a 10G SFP, and then reinstall the 1G copper SFP.

Because of these impacts, Cisco does not recommend using internal loopback on fixed copper ports or copper SFP ports. Use an external loopback for port verification instead.

Configuring Network Interface Speed

You can configure the network interface speed by using one of the following methods:

- Using the **speed** command
- Using the **negotiation auto** command
- Using both **speed** and **negotiation auto** command

Note Cisco recommends configuring network interface speed in autonegotiation mode.

Using the speed command

When you configure the speed of the network interface (1G) using the **speed** command, the interface speed is forced to the configured speed by limiting the speed value of the auto negotiated parameter to the configured speed.

This sample configuration forces the Gig interface speed to 100Mbps.

Note The interface speed at remote end is also set to 100Mbps.

```
#configuration
 (config)#interface GigabitEthernet 0/0/0/31
 (config-if)#speed 100
 (config-if)#commit
 (config-if)#end
```

Use the **show controller GigE** and **show interface GigE** commands to verify if the speed is configured to 100Mbps and autonegotiation is disabled:

```
#show controllers GigabitEthernet 0/0/0/31
Operational data for interface GigabitEthernet0/0/0/31:
State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
Phy:
    Media type: Four-pair Category 5 UTP PHY, full duplex
    Optics:
```

```
        Vendor: CISCO
        Part number: SBCU-5740ARZ-CS1
        Serial number: AVC194525HW
        Wavelength: 0 nm
    Digital Optical Monitoring:
        Transceiver Temp: 0.000 C
        Transceiver Voltage: 0.000 V

        Alarms key: (H) Alarm high, (h) Warning high
                    (L) Alarm low, (l) Warning low
           Wavelength    Tx Power          Rx Power      Laser Bias
        Lane  (nm)    (dBm)    (mW)     (dBm)     (mW)      (mA)
        --   -----   ------   ------    ------   ------    ------
        0     n/a     0.0   1.0000     0.0   1.0000     0.000

        DOM alarms:
            No alarms

        Alarm                     Alarm    Warning   Warning    Alarm
        Thresholds                High      High       Low       Low
                                 -------   -------   -------   -------
        Transceiver Temp (C):      0.000     0.000     0.000     0.000
        Transceiver Voltage (V):   0.000     0.000     0.000     0.000
        Laser Bias (mA):           0.000     0.000     0.000     0.000
        Transmit Power (mW):       1.000     1.000     1.000     1.000
        Transmit Power (dBm):      0.000     0.000     0.000     0.000
        Receive Power (mW):        1.000     1.000     1.000     1.000
        Receive Power (dBm):       0.000     0.000     0.000     0.000
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

MAC address information:
    Operational address: 0035.1a00.e67c
    Burnt-in address: 0035.1a00.e62c
Autonegotiation disabled.

Operational values:
    Speed: 100Mbps       /*Gig interface speed is set to 100Mbps */
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    MTU: 1514
    MRU: 1514
    Forward error correction: Disabled


#show interfaces GigabitEthernet 0/0/0/31
GigabitEthernet0/0/0/31 is up, line protocol is up
  Interface state transitions: 7
  Hardware is GigabitEthernet, address is 0035.1a00.e62c (bia 0035.1a00.e62c)
  Internet address is Unknown
  MTU 1514 bytes, BW 100000 Kbit (Max: 100000 Kbit)
     reliability 255/255, txload 0/255, rxload 0/255
  Encapsulation ARPA,
  Full-duplex, 100Mb/s, TFD, link type is force-up
  output flow control is off, input flow control is off
  Carrier delay (up) is 10 msec
  loopback not set,
  Last link flapped 00:00:30
  Last input 00:00:00, output 00:00:00
  Last clearing of "show interface" counters never
  30 second input rate 1000 bits/sec, 1 packets/sec
```

```
  30 second output rate 0 bits/sec, 1 packets/sec
     90943 packets input, 11680016 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 90943 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     61279 packets output, 4347618 bytes, 0 total output drops
     Output 0 broadcast packets, 8656 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
8 carrier transitions
```

In the above show output you will observe that the state of the GigabitEthernet0/0/0/31 is up, and line protocol is up. This is because the speed at both ends is 100Mbps.

Using the negotiation auto command

When you configure the network interface speed using **negotiation auto** command, the speed is autonegotiated with the remote end interface. This command enhances the speed capability to 100M or 1G to be negotiated with the peer.

This sample configuration sets the interface speed to autonegotiate:



Note The interface speed at remote end is set to 100Mbps.



Note Before Cisco IOS XR Software Release 7.3.2, the default setting for autonegotiation varied with different platforms under the NCS 5500 family. On NCS 540 and NCS 55A2, 100G autonegotiation was enabled by default.

From Cisco IOS XR Software Release 7.3.2 onwards, autonegotiation is not enabled by default. Use the **negotiation auto** command to enable autonegotiation.



Note Enabling the **negotiation auto** configuration is mandatory for the GLC-TE-specific ports to work properly on the NC57-48Q2D-S or NC57-48Q2D-SE-S line cards.

```
#configuration
 (config)#interface GigabitEthernet 0/0/0/31
 (config-if)#negotiation auto
 (config-if)#commit
 (config-if)#end
```

Use the **show controller GigE** and **show interface GigE** commands to verify if the speed is autonegotiated:

```
#show interfaces GigabitEthernet 0/0/0/31
GigabitEthernet0/0/0/31 is up, line protocol is up
  Interface state transitions: 10
  Hardware is GigabitEthernet, address is 0035.1a00.e62c (bia 0035.1a00.e62c)
  Internet address is Unknown
  MTU 1514 bytes, BW 100000 Kbit (Max: 100000 Kbit)
     reliability 255/255, txload 0/255, rxload 0/255
  Encapsulation ARPA,
```

```
  Full-duplex, 100Mb/s, TFD, link type is autonegotiation
  output flow control is off, input flow control is off
  Carrier delay (up) is 10 msec
  loopback not set,
  Last link flapped 00:00:01
  Last input 00:00:00, output 00:00:00
  Last clearing of "show interface" counters never
  30 second input rate 1000 bits/sec, 1 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     91005 packets input, 11687850 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 91005 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     61307 packets output, 4350024 bytes, 0 total output drops
     Output 0 broadcast packets, 8668 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     15 carrier transitions
```

In the above show output you see that GigabitEthernet0/0/0/31 is up, and line protocol is up.

```
 #show controllers GigabitEthernet 0/0/0/31
Operational data for interface GigabitEthernet0/0/0/31:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On

Phy:
    Media type: Four-pair Category 5 UTP PHY, full duplex
    Optics:
        Vendor: CISCO
        Part number: SBCU-5740ARZ-CS1
        Serial number: AVC194525HW
        Wavelength: 0 nm
    Digital Optical Monitoring:
        Transceiver Temp: 0.000 C
        Transceiver Voltage: 0.000 V

        Alarms key: (H) Alarm high, (h) Warning high
                    (L) Alarm low, (l) Warning low
           Wavelength    Tx Power          Rx Power      Laser Bias
        Lane  (nm)    (dBm)    (mW)     (dBm)     (mW)      (mA)
        --   -----   ------   ------    ------   ------    ------
        0     n/a     0.0   1.0000     0.0   1.0000     0.000

        DOM alarms:
            No alarms

        Alarm                    Alarm    Warning   Warning    Alarm
        Thresholds               High      High       Low       Low
                                -------   -------   -------   -------
        Transceiver Temp (C):     0.000     0.000     0.000     0.000
        Transceiver Voltage (V):  0.000     0.000     0.000     0.000
        Laser Bias (mA):          0.000     0.000     0.000     0.000
        Transmit Power (mW):      1.000     1.000     1.000     1.000
        Transmit Power (dBm):     0.000     0.000     0.000     0.000
        Receive Power (mW):       1.000     1.000     1.000     1.000
        Receive Power (dBm):      0.000     0.000     0.000     0.000
    Statistics:
        FEC:
            Corrected Codeword Count: 0
```

```
            Uncorrected Codeword Count: 0

MAC address information:
    Operational address: 0035.1a00.e67c
    Burnt-in address: 0035.1a00.e62c

Autonegotiation enabled:
    No restricted parameters

Operational values:
    Speed: 100Mbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    MTU: 1514
    MRU: 1514
    Forward error correction: Disabled
```

Using speed and negotiation auto command

When you configure the speed of the network interface (1G) using the **speed** and **negotiation auto** command, the interface autonegotiates all the paramets (full-duplex and pause) except speed. The speed is forced to the configured value.

This sample shows how to configures Gig interface speed to 100Mbps and autonegotiate other parameters:



Note The interface speed at remote end is set to 100Mbps.

```
#configuration
(config)#interface GigabitEthernet 0/0/0/31
(config-if)#negotiation auto
(config-if)#speed 100
(config-if)#end
```

Use the **show controller GigE** and **show interface GigE** command to verify if the link is up, speed is forced to 100Mbps and autonegotiation is enabled:

```
#show interfaces GigabitEthernet 0/0/0/31
GigabitEthernet0/0/0/31 is up, line protocol is up
  Interface state transitions: 9
  Hardware is GigabitEthernet, address is 0035.1a00.e62c (bia 0035.1a00.e62c)
  Internet address is Unknown
  MTU 1514 bytes, BW 100000 Kbit (Max: 100000 Kbit)
     reliability 255/255, txload 0/255, rxload 0/255
  Encapsulation ARPA,
  Full-duplex, 100Mb/s, TFD, link type is autonegotiation
  output flow control is off, input flow control is off
  Carrier delay (up) is 10 msec
  loopback not set,
  Last link flapped 00:00:03
  Last input 00:00:00, output 00:00:00
  Last clearing of "show interface" counters never
  30 second input rate 0 bits/sec, 1 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     90968 packets input, 11683189 bytes, 0 total input drops
     0 drops for unrecognized upper-level protocol
     Received 0 broadcast packets, 90968 multicast packets
              0 runts, 0 giants, 0 throttles, 0 parity
```

```
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     61287 packets output, 4348541 bytes, 0 total output drops
     Output 0 broadcast packets, 8664 multicast packets
     0 output errors, 0 underruns, 0 applique, 0 resets
     0 output buffer failures, 0 output buffers swapped out
     12 carrier transitions
```

In the above show output you will observe that the GigabitEthernet0/0/0/31 is up, and line protocol is up This is because the speed at both ends is 100Mbps.

```
#show controllers GigabitEthernet 0/0/0/31
Operational data for interface GigabitEthernet0/0/0/31:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On

Phy:
    Media type: Four-pair Category 5 UTP PHY, full duplex
    Optics:
        Vendor: CISCO
        Part number: SBCU-5740ARZ-CS1
        Serial number: AVC194525HW
        Wavelength: 0 nm
    Digital Optical Monitoring:
        Transceiver Temp: 0.000 C
        Transceiver Voltage: 0.000 V

        Alarms key: (H) Alarm high, (h) Warning high
                    (L) Alarm low, (l) Warning low
           Wavelength    Tx Power          Rx Power      Laser Bias
        Lane  (nm)     (dBm)     (mW)      (dBm)      (mW)       (mA)
        --   -----    ------    ------     ------    ------     ------
        0     n/a     0.0   1.0000     0.0   1.0000     0.000

        DOM alarms:
            No alarms

        Alarm                     Alarm    Warning   Warning    Alarm
        Thresholds                High      High       Low       Low
                                 -------   -------   -------   -------
        Transceiver Temp (C):      0.000     0.000     0.000     0.000
        Transceiver Voltage (V):   0.000     0.000     0.000     0.000
        Laser Bias (mA):           0.000     0.000     0.000     0.000
        Transmit Power (mW):       1.000     1.000     1.000     1.000
        Transmit Power (dBm):      0.000     0.000     0.000     0.000
        Receive Power (mW):        1.000     1.000     1.000     1.000
        Receive Power (dBm):       0.000     0.000     0.000     0.000
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

MAC address information:
    Operational address: 0035.1a00.e67c
    Burnt-in address: 0035.1a00.e62c

Autonegotiation enabled:
    Speed restricted to: 100Mbps  /* autonegotiation is enabled and speed is forced to
100Mbps*/
```

```
Operational values:
    Speed: 100Mbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    MTU: 1514
    MRU: 1514
    Forward error correction: Disabled
```

Ethernet MTU

The Ethernet maximum transmission unit (MTU) is the size of the largest frame, minus the 4-byte frame check sequence (FCS), that can be transmitted on the Ethernet network. Every physical network along the destination of a packet can have a different MTU.

Cisco IOS XR software supports two types of frame forwarding processes:

- Fragmentation for IPV4 packets–In this process, IPv4 packets are fragmented as necessary to fit within the MTU of the next-hop physical network.



Note IPv6 does not support fragmentation.

- MTU discovery process determines largest packet size–This process is available for all IPV6 devices, and for originating IPv4 devices. In this process, the originating IP device determines the size of the largest IPv6 or IPV4 packet that can be sent without being fragmented. The largest packet is equal to the smallest MTU of any network between the IP source and the IP destination devices. If a packet is larger than the smallest MTU of all the networks in its path, that packet will be fragmented as necessary. This process ensures that the originating device does not send an IP packet that is too large.



Note To enable hashing for L3 header only when the majority of traffic is fragmented, use the **hw-module profile load-balance algorithm L3-Only** command.

Jumbo frame support is automatically enable for frames that exceed the standard frame size. The default value is 1514 for standard frames and 1518 for 802.1Q tagged frames. These numbers exclude the 4-byte frame check sequence (FCS).

Following are the supported MTU properties on devices containing NC55 first generation line cards, NCS 5501, NCS5501-SE cards:

- Each physical port can have a different MTU.
- Main interface of each bundle can have one MTU value.
- L3 sub-interface (bundle or physical) shares MTU profiles and can have a maximum of 3 unique configured MTUs per NPU.



Note L2 sub-interface MTU is not supported.

Following are the supported MTU profiles on devices containing NC55 second generation line cards. Each profile has a limit of 7 configured MTUs per NPU.

- Port MTU profile: This is shared by bundle main interfaces and physical main interfaces.
- RIF MTU profile: This is used by the L3 sub-interface (bundle or physical) on the device.

Note L2 sub-interface MTU is not supported.

For more information about the architecture, refer to the NCS 5500 and NCS 5700 Fixed Platform Architecture white paper.

Independent MTUs for IPv4 and IPv6

Table 3: Feature History Table

Feature Name	Release Information	Description
Independent MTUs for IPv4 and IPv6	Release 7.11.1	Introduced in this release on: NCS 5700 line cards [Mode: Native] You can now ensure reduced fragmentation or packet drops by configuring separate IPv4 and IPv6 Maximum Transmission Units (MTUs). You can configure independent IPv4 and IPv6 MTUs on the physical interface and subinterface, bundle interface and subinterface, and Bridge-Group Virtual Interface (BVI). This feature introduces these changes: **CLI:** The following commands are extended to subinterface configuration mode: • **ipv4 mtu** • **ipv6 mtu** • **mtu**

Earlier, the MTU value could be configured for IP protocol only at the physical interface level. The same MTU value is considered for all subinterfaces associated with the main interface.

As IPv4 and IPv6 have different header sizes, packet overhead is correspondingly different. Therefore, a common MTU configuration for both IPv4 and IPv6 does not result in an optimum data transmission. This also results in higher fragmentation rate, further reducing the network efficiency.

You can now configure IPv4 and IPv6 MTUs separately and independent of each other for physical interface, physical sub-interface, bundle interface, bundle sub-interface, and BVI. When MTU is configured for the main interface, all sub-interfaces inherit that value as its MTU. If MTU is configured for both the main interface and the sub-interface, the minimum MTU value between the two is considered for the lower level. The possible range for MTU at all interface levels is 64 to 65535 bytes for both IPv4 and IPv6.

Following are the key benefits of using independent IPv4 and IPv6 MTU values:

- Optimal MTU configuration: By allowing independent MTU configurations, you can optimize the MTU settings for each protocol individually, considering the difference in packet overhead due to header size variation. This flexibility ensures efficient data transmission for both IPv4 and IPv6 traffic, maximizing network performance.
- Efficient MTU discovery process: MTU discovery process determines the maximum MTU size that can be transmitted without fragmentation along the entire path between source and destination. With separate MTU configurations, the process can operate independently for IPv4 and IPv6, enabling accurate discovery of the optimal MTU for each protocol. This helps reduce fragmentation and latency, and improves overall network efficiency.

Configure Independent MTUs for IPv4 and IPv6

IP MTU can be configured in different ways. The following is an example depicting separate IPv4 and IPv6 MTU configuration on specific interface.

In this example, IPv4 MTU of interface TenGigE 0/3/0/1/0 is configured to 4500. As this is lower than the common MTU of the interface (5000), 4500 is considered as the IPv4 MTU for the interface. However, IPv6 MTU of the interface is configured to 5500, which is more than the common MTU configured for the interface. Therefore, IPv6 MTU of this interface is considered as 5000, the lower of the two values.



Note NCS 5700 line cards [Mode: Native] support a maximum MTU size of 9646.

```
Router# configure terminal
Router(config)#interface TenGigE 0/3/0/1/0
Router(config-if)#mtu 5000 /* Main interface MTU */
Router(config-if)#ipv4 mtu 4500 /* Separate IPv4 MTU configuration for the interface */
Router(config-if)#ipv6 mtu 5500 /* Separate IPv6 MTU configuration for the interface */
Router(config-if)#commit
```

Running Configuration

The following example shows the running configuration:

```
Router#show running-config interface  tenGigE 0/3/0$
interface TenGigE0/3/0/1/0
 mtu 5000
 ipv4 mtu 4500
 ipv4 address 192.3.0.1 255.255.255.0
 ipv6 mtu 5500
 ipv6 address 192:3::1/64
 lldp
 !
 load-interval 30
!
Router#
```

Verification

The following example shows how to verify the separate configuration for IPv4 and IPv6 MTUs.

```
Router#show im database interface TenGigE 0/3/0/1/0
Wed Nov  8 16:04:20.443 UTC

View: OWN - Owner, L3P - Local 3rd Party, G3P - Global 3rd Party, LDP - Local Data Plane
      GDP - Global Data Plane, RED - Redundancy, UL - UL

Node 0/3/CPU0 (0x300)

Interface TenGigE0/3/0/1/0, ifh 0x06004048 (up, 5000)
  Interface flags:          0x000000000110049f (ROOT_IS_HW|IFCONNECTOR
                            |IFINDEX|BROADCAST|CONFIG|HW|VIS|DATA|CONTROL)
  Encapsulation:            ether
  Interface type:           IFT_TENGETHERNET
  Control parent:           None
  Data parent:              None
  Views:                    GDP|LDP|L3P|OWN

  Protocol        Caps (state, mtu)
  --------        -----------------
  None            hw_oor (up, 5000)
  None            spio (up, 5000)
  None            ether (up, 5000) /* configured L2 MTU */
  arp             arp (up, 4986)
  clns            clns (up, 4986)
  ipv4            ipv4 (up, 4500) /* configured IPv4 MTU, which is less than L2 MTU */
  ipv6            ipv6_preswitch (up, 4986)
  ipv6            ipv6 (up, 4986) /* Even though configured IPv6 MTU is 5500, minimum of
L2 and IPv6 MTUs is considered. In this case, it is L2 MTU (5000)*/
  ether_sock      ether_sock (up, 4986)
```

L3-only hash algorithm

An L3-only hash algorithm is a load balancing algorithm that

- makes decisions based exclusively on Layer 3 parameters, i.e source and destination IP addresses
- ensures packets in the same session traverse the same path by ignoring Layer 4 headers, and
- maintains path consistency for fragmented packets and certain anycast firewall scenarios.

Table 4: Feature History Table

Feature Name	Release Information	Feature Description
L3-only hash algorithm	Release 26.2.1	Introduced in this release on:NCS 5700 fixed port routers;NCS 5700 line cards [Mode: Compatibility; Native] This feature is extended to: • NCS 5700 fixed port routers • NCS 5700 line cards

Feature Name	Release Information	Feature Description
L3-only hash algorithm	Release 7.4.1	Introduced in this release on: NCS 5500 fixed port routers;NCS 5500 line cards You can now ensure path consistency for fragmented packets and IPSec sessions. This feature prevents traffic from traversing different firewalls, allowing IPSec sessions to establish successfully. The L3-only hash algorithm bases load balancing decisions exclusively on source and destination IP addresses. It ignores Layer 4 headers and IPv6 flow labels during hash calculations. You configure this hardware module profile to restrict hashing parameters to Layer 3 information only. CLI: • **hw-module profile load-balance algorithm L3-only**

Restrictions for L3-only hash algorithm

The algorithm explicitly excludes Layer 4 headers such as UDP, ICMP, and IP-in-IP and IPv6 flow labels from the hash calculation.

Guidelines for L3-only hash algorithm

Ensure you follow these guidelines while configuring the L3-only hash algorithm:

- Use the L3-only hash algorithm when most of the network traffic is fragmented or when it is important to ensure all packet fragments follow the same path through the network.
- Configure the L3-only hash algorithm only if you want the hashing calculation to consider only the Source IP (SIP) and Destination IP (DIP), excluding other header fields.
- Apply this configuration as a global change, understanding it affects load-balancing behavior for the entire system or supported line cards.
- Be aware that using only SIP and DIP for hashing may result in less optimal hash distribution if most of your traffic's entropy comes from other fields.

Configure L3-only hash algorithm

Configure the hardware module to utilize the l3-only load-balance algorithm, ensuring packets are distributed across interfaces based only on Layer 3 information.

The l3-only load-balance algorithm enables the router to make load-balancing decisions using only Layer 3 headers, which is useful in environments where Layer 4 information is not required or available.

Procedure

Configure the L3-only load-balance algorithm profile.

Example:

```
Router#configure
Router(config)#hw-module profile load-balance algorithm L3-only
Router(config)#commit
```

Link Layer Discovery Protocol (LLDP)

Cisco Discovery Protocol (CDP) is a device discovery protocol that runs over Layer 2. Layer 2 is also known as the data link layer that runs on all Cisco-manufactured devices, such as routers, bridges, access servers, and switches. CDP allows the network management applications to automatically discover and learn about other Cisco devices that connect to the network.

To support non-Cisco devices and to allow for interoperability between other devices, it also supports the IEEE 802.1AB LLDP. LLDP is also a neighbor discovery protocol that is used for network devices to advertise information about themselves to other devices on the network. This protocol runs over the data link layer, which allows two systems running different network layer protocols to learn about each other.

With LLDP, you can also access the information about a particular physical network connection. If you use a non-Cisco monitoring tool (via SNMP,) LLDP helps you identify the Object Identifiers (OIDs) that the system supports. The following are the supported OIDs:

- 1.0.8802.1.1.2.1.4.1.1.4
- 1.0.8802.1.1.2.1.4.1.1.5
- 1.0.8802.1.1.2.1.4.1.1.6
- 1.0.8802.1.1.2.1.4.1.1.7
- 1.0.8802.1.1.2.1.4.1.1.8
- 1.0.8802.1.1.2.1.4.1.1.9
- 1.0.8802.1.1.2.1.4.1.1.10
- 1.0.8802.1.1.2.1.4.1.1.11
- 1.0.8802.1.1.2.1.4.1.1.12

Specifying User-Defined LLDP TLV Values

It is possible to override the system default values for some of the mandatory LLDP Type-Length-Values (TLVs) that are advertised by routers to their directly connected neighboring devices. While advertising their identity and capabilities, routers can assign user-defined meaningful names instead of autogenerated values. Using the following CLIs you can specify these user-defined values:

- `Router(config)#lldp tlv-select`: Choose the wire-power management (Cisco 4-wire Power via MDI TLV or IEEE 802.3 DTE Power)
- `Router(config)#lldp system-name` *`system-name`*
- `Router(config)#lldp system-description` *`system-description`*
- `Router(config)#lldp chassis-id-type` *`chassis-type`*

- `Router(config)#lldp chassis-id` *`local-chassis-id`*

Note The **chassis-id** value is configurable only when the **chassis-id-type** is set as **Local**. If there is a mismatch, you encounter a configuration failed error message.

The configured values, such as the system name, system description, chassis-id, chassis-type become part of the TLV in the LLDP packets that are sent to its neighbors. Values are transmitted only to LLDP enabled interfaces to which the router is connected.

You can assign any of the following values for the `chassis-id-type`. The chassis-id-types are objects that are part of the management information base (MIB). Depending on the selected chassis-id-type, values are assigned to these objects, and they are advertised by the router to its neighboring devices.

chassis-id-type	Description
chassis-component	Chassis identifier based on the value of entPhysicalAlias object that is defined in IETF RFC 2737.
interface-alias	Chassis identifier based on the value of ifAlias object as defined in IETF RFC 2863.
interface-name	Chassis identifier based on the name of the interface.
local	Chassis identifier based on a locally defined value.
mac-address	Chassis identifier based on the value of a unicast source address.
network-address	Chassis identifier based on a network address that is associated with a particular chassis.
port-component	Chassis identifier based on the value of entPhysicalAlias object defined in IETF RFC 2737 for a port or backplane component.

Tip You can programmatically modify default values of LLDP TLVs by using the `openconfig-lldp` OpenConfig data model. To get started with using data models, see the *Programmability Configuration Guide for Cisco NCS 5500 Series Routers*.

Configuration Example

This example shows the configuration for the LLDP TLVs that will be advertised by routers to their directly connected neighboring devices.

```
Router(config)#lldp system-name cisco-xr
Router(config)#lldp system-description cisco-xr-edge-device
Router(config)#lldp chassis-id-type local
Router(config)#lldp chassis-id ce-device9
```

Running Configuration

```
Router#show lldp
Tue Sep 13 16:03:44.550 +0530
Global LLDP information:
Status: ACTIVE
LLDP Chassis ID: ce-device9
LLDP Chassis ID Subtype: Locally Assigned Chassis Subtype
LLDP System Name: cisco-xr
LLDP advertisements are sent every 30 seconds
LLDP hold time advertised is 120 seconds
LLDP interface reinitialisation delay is 2 seconds
```

Enabling LLDP Globally

To run LLDP on the router, you must enable it globally. When you enable LLDP globally, all interfaces that support LLDP are automatically enabled for both transmit and receive operations.

You can override this default operation at the interface to disable receive or transmit operations.

The following table describes the global attributes that you can configure:

Attribute	Default	Range	Description
Holdtime	120	0-65535	Specifies the holdtime (in sec) that are sent in packets
Reinit	2	2-5	Delay (in sec) for LLDP initialization on any interface
Timer	30	5-65534	Specifies the rate at which LLDP packets are sent (in sec)

To enable LLDP globally, complete the following steps:

1. `RP/0/RSP0/CPU0:router # configure`
2. `RP/0/RSP0/CPU0:router(config) #lldp`
3. `end or commit`

Running configuration

```
RP/0/RP0/CPU0:router-5#show run lldp
Fri Dec 15 20:36:49.132 UTC
lldp
!

RP/0/RP0/CPU0:router#show lldp neighbors
Fri Dec 15 20:29:53.763 UTC
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID       Local Intf          Hold-time  Capability     Port ID
SW-NOSTG-I11-PUB.cis Mg0/RP0/CPU0/0      120        N/A            Fa0/28
```

```
Total entries displayed: 1

RP/0/RP0/CPU0:router#show lldp neighbors mgmtEth 0/RP0/CPU0/0
Fri Dec 15 20:30:54.736 UTC
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID       Local Intf          Hold-time  Capability     Port ID
SW-NOSTG-I11-PUB.cis Mg0/RP0/CPU0/0      120        N/A             Fa0/28

Total entries displayed: 1
```

Enabling LLDP Per Interface

When you enable LLDP globally, all interfaces that support LLDP are automatically enabled for both transmit and receive operations. However, if you want to enable LLDP per interface, perform the following configuration steps:

1. `RP/0/RSP0/CPU0:router(config)# int gigabitEthernet 0/2/0/0`
2. `RP/0/RSP0/CPU0:router(config-if)# no sh`
3. `RP/0/RSP0/CPU0:router(config-if)#commit`
4. `RP/0/RSP0/CPU0:router(config-if)#lldp ?`
5. `RP/0/RSP0/CPU0:router(config-if)#lldp enable`
6. `RP/0/RSP0/CPU0:router(config-if)#commit`

Running configuration

```
RP/0/RSP0/CPU0:router#sh running-config
Wed Jun 27 12:40:21.274 IST
Building configuration...
!! IOS XR Configuration 0.0.0
!! Last configuration change at Wed Jun 27 00:59:29 2018 by UNKNOWN
!
interface GigabitEthernet0/1/0/0
 shutdown
!
interface GigabitEthernet0/1/0/1
 shutdown
!
interface GigabitEthernet0/1/0/2
 shutdown
!
interface GigabitEthernet0/2/0/0
 Shutdown
!
interface GigabitEthernet0/2/0/1
 shutdown
!
interface GigabitEthernet0/2/0/2
 shutdown
!
end
```

Verification

```
Verifying the config
==================
RP/0/RSP0/CPU0:router#sh lldp interface <===== LLDP enabled only on GigEth0/2/0/0
Wed Jun 27 12:43:26.252 IST


GigabitEthernet0/2/0/0:
        Tx: enabled
        Rx: enabled
        Tx state: IDLE
        Rx state: WAIT FOR FRAME
RP/0/RSP0/CPU0:router#

RP/0/RSP0/CPU0:router# show lldp neighbors
Wed Jun 27 12:44:38.977 IST
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID       Local Intf          Hold-time  Capability     Port ID
ios             Gi0/2/0/0           120        R              Gi0/2/0/0       <====== LLDP
 enabled only on GigEth0/2/0/0 and neighborship seen for the same.

Total entries displayed: 1

RP/0/RSP0/CPU0:router#
```

Transmission of VLAN-Tagged LLDP Packets

Table 5: Feature History Table

Feature Name	Release	Description
Transmission of VLAN-Tagged LLDP Packets	Release 7.9.1	With this release, transmitting VLAN-tagged LLDP packets on the subinterfaces is supported. Earlier, if LLDP is enabled on a subinterface, the LLDP packets are sent without a VLAN tag. VLAN-tagged LLDP packets help to identify unauthorized devices on the network and discover VLANs configured on the network devices. You can monitor and enforce VLAN segregation, ensuring that devices are connected to the correct VLANs and preventing unauthorized access to sensitive network segments. You can enable VLAN tagging for LLDP packets globally or on each subinterface using these commands: • Globally: **lldp subinterfaces-tagged** • Each subinterface: **lldp tagged**

You can now transmit VLAN-tagged LLDP packets on the subinterfaces. When VLAN-tagged LLDP transmission is enabled either globally or at subinterface level, VLAN information is added to the Ethernet header of the constructed LLDP packet. For VLAN tagging, LLDP packet includes a TLV called the "Port VLAN ID TLV" to convey VLAN information. This TLV contains the VLAN ID associated with the port or interface of the sending device. It provides the receiving device with information about the VLAN membership of the transmitting port. With this, the devices can exchange VLAN information during LLDP discovery and facilitate the configuration and management of VLANs across the network.

Global VLAN-tagged LLDP Processing

You can enable VLAN tagging of LLDP packets globally on all subinterfaces after enabling LLDP on all subinterfaces.

When you enable LLDP globally, all subinterfaces are automatically enabled for both transmit and receive operations. You can override this default operation at the subinterface to disable receive or transmit operation.

Subinterface-level VLAN-tagged LLDP Processing

Instead of enabling VLAN tagging of LLDP packets on all subinterfaces on the system, you can enable it only for specific subinterfaces. You can also disable either transmit or receive on the subinterface using **lldp transmit disable** or **lldp receive disable** commands.

Configuration

You can enable transmitting tagged LLDP packets globally or on each subinterface. LLDP should be enabled on the subinterfaces before enabling Tx for VLAN-tagged LLDP packets.

Run the command **subinterfaces enable** to enable LLDP on subinterfaces.

Enable Transmission of VLAN-tagged LLDP Packets (Global)

Perform the following tasks on the router to enable transmission of VLAN-tagged LLDP packets on all subinterfaces globally:

1. Enter global configuration mode.
2. Run **lldp subinterfaces enable** command to enable LLDP on all subinterfaces.
3. Run **lldp subinterfaces-tagged** command to enable VLAN tagging on all subinterfaces.

This example shows how to enable transmission of VLAN-tagged LLDP packets on all subinterfaces globally.

```
Router(config)# lldp subinterfaces
Router(config)# lldp subinterfaces-tagged
Router(config)#!
```

Enable Transmission of VLAN-tagged LLDP Packets (Subinterface)

Perform the following tasks on the router to enable transmission of VLAN-tagged LLDP packets on a specific subinterface:

1. Enter subinterface configuration mode.
2. Run **lldp enable** command to enable LLDP on the subinterface.
3. Run **lldp tagged** command to enable VLAN tagging on the subinterface.

This example shows how to enable transmission of VLAN-tagged LLDP packets on the subinterface GigabitEthernet 0/0/0/0.1.

```
Router(config)# interface GigabitEthernet 0/0/0/0.1
Router(config-subif)# lldp enable
Router(config-subif)# lldp tagged
Router(config-subif)#!
```



Note

- You may enable LLDP globally using the **lldp subinterfaces enable** command instead of step 2 above.
- If a subinterface has double VLAN encapsulation, LLDP packets are transmitted without the VLAN tag even with the configurations mentioned here.

Verification

The following command output for **show lldp interfaces** output shows the tagged state of a subinterface with the field `Tagged`. This field is displayed only for the subinterface.

```
Router(config-subif)do show lldp interface
Thu Feb 2 16:27:12.503 IST
GigabitEthernet0/0/0/0
Tx: disabled
Rx: enabled
Tx state: IDLE
Rx state: WAIT FOR FRAME
GigabitEthernet0/0/0/0.1:
Tx: disabled
rx: enabled
Tx state: IDLE
Rx state: WAIT FOR FRAME
Tagged: true
```

The following command output for **show lldp neighbors**, shows the tagged feature for a subinterface:

```
Router(config-subif)#do show lldp neighbors
Thu Nov 3 14:02:32.041 UTC
Capabilitv codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCS/S Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID  Local Intf                Hold-time  Capability  Port ID
R1-ASR9k   GigabitEthernet0/0/0/0.1    150        R         GigabitEthernet0/2/0/9.1

Total entries displayed: 1
```

Carrier Delay on Physical Interfaces

Table 6: Feature History Table

Feature Name	Release Information	Feature Description
Carrier Delay on Physical Interfaces on NCS 5700 fixed port routers	Release 24.2.11	Introduced in this release on: NCS 5700 fixed port routers This feature support is now extended to NCS 5700 fixed port routers.

Feature Name	Release Information	Feature Description
Carrier Delay on Physical Interfaces	Release 24.2.1	Introduced in this release on: NCS 5500 fixed port routers; NCS 5500 modular routers (NCS 5500 line cards; NCS 5700 line cards [Mode: Compatibility; Native]) With the carrier-delay timer functionality, the Ethernet interface state remains stable for the configured delay duration, even if the hardware link state fluctuates. This prevents interface flapping and improves network reliability. If you haven't configured the timer, the default carrier delay automatically delays the hardware link-up notifications by 200 ms. This time delay ensures that a stable hardware link state is established. If you want to change the delay of the interface state change notification, you can use the **carrier-delay** command to set a different value. The feature introduces these changes: **CLI:** • **carrier-delay** • The default value of **up** keyword is implemented as 200 ms in the **carrier-delay** command.

Hardware links take time to stabilize after a state change and may experience link flaps. Link flap is a condition where a physical interface frequently fluctuates between an up and a down state.

During link flaps, the network reestablishes and updates routing paths after a disruption, which leads to resource exhaustion on routers. To overcome the problem, we recommend waiting until the link state is stable before taking action.

The carrier delay introduces a delay in processing interface link-state notifications in the router to provide enough time for the interface link to stabilize.

When there is a change in the link state, the carrier-delay timer starts. If the link state goes up, the **carrier-delay up** timer starts. Similarly, when the link state goes down, the **carrier-delay down** timer starts. During this delay period, the Ethernet interface state remains unchanged even if the link is physically restored. Setting a delay timer ensures the link state is established before the interface becomes operational again and avoids unnecessary interface state changes and associated traffic rerouting.

Guidelines and Restrictions for Setting the Carrier Delay on Physical Interfaces

The following usage guidelines and restrictions are applicable for setting the carrier delay on physical interfaces:

- You can configure carrier-delay for only link-up, only link-down, or both link-up and link-down notifications.
- If the **carrier-delay down** *milliseconds* command is configured on a physical link that fails and cannot be recovered, link down detection time increases, and it may take longer for the routing protocols to reroute the traffic around the failed link.
- If not configured, the carrier-delay up parameter defaults to 200 ms and the carrier-delay down parameter to 0 ms. When carrier-delay down is not configured, the higher-layer protocols are notified immediately when a physical link state changes.
- The **carrier-delay** command overwrites the previous configuration every time you execute the command. If any of the optional keywords is not explicitly configured, its default value is considered.

  For example, you already configured 500 ms for up timer and 300 ms for down timer. Later, if you want to change the up timer to 600 ms, you need to run **carrier-delay up 600 down 300** command. If **down** keyword is not mentioned, the default value of down timer, 0 ms, would replace the previous configuration of 300 ms.
- Loss of Signal (LOS) is not supported on carrier delay.

Configure the Carrier Delay on Physical Interfaces

Default Configuration Example

In this example, one interface is brought up to check the default value of link-up notification delay.

```
Router#configure
Router(config)#interface HundredGigE 0/0/0/0
Router(config-if)#no shutdown
Router(config-if)#commit
```

Run the **show interfaces** command to check if the carrier-delay configuration for the interface defaults to 200 ms.

```
Router#show interfaces HundredGigE 0/0/0/0 | include Carrier
Fri Mar 31 07:25:05.273 UTC
Carrier delay (up) is 200 msec
```

Configuration Example

In this example, link-up and link-down notifications are configured to be delayed by 1000 ms and 150 ms using **carrier-delay** command.

```
Router#configure
Router(config)#interface HundredGigE 0/0/0/0
Router(config-if)#carrier-delay up 1000 down 150
Router(config-if)#commit
```

Running Configuration

```
 interface HundredGigE0/0/0/0
 carrier-delay up 1000 down 150
!
```

Verification

Run the **show interfaces** command to see the current state of the carrier-delay configuration for an interface.

```
Router#show interfaces HundredGigE 0/0/0/0 | include Carrier
Fri Mar 31 07:25:05.273 UTC
Carrier delay (up) is 1000 msec, Carrier delay (down) is 150 msec
```

Dense Wavelength Division Multiplexing tunable optics

Dense Wavelength-Division Multiplexing (DWDM) is an optical trasceiver module that

- enables transmission of multiple data signals simultaneously over a single fiber by assigning each signal a unique wavelength
- allows operators to flexibly select wavelengths as needed within the standardized ITU grid, and
- improves inventory management and operational integration across various optical transport platforms.

Dense Wavelength Division Multiplexing (DWDM) is an optical multiplexing technology that increases fiber capacity by transmitting multiple data signals simultaneously over a single fiber, with each signal carried on a different wavelength (frequency) of light. These wavelengths are standardized according to the ITU grid to ensure interoperability across optical networks.

Table 7: Feature History Table

Feature Name	Release Information	Feature Description
DWDM-SFP10G-E-I tunable optics for NCS-55A1-24Q6H-SS and NCS-57C1-48Q6-SYS routers	Release 26.2.1	Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers. This feature enables full DWDM channel tuning capability for the DWDM-SFP10G-E-I optics on NCS-55A1-24Q6H-SS and NCS-57C1-48Q6-SYS routers, allowing operation up to 196.3 THz and ensuring proper integration with your optical transport infrastructure.

DWDM-SFP10G-C tunable optics

A DWDM-SFP10G-C tunable optic is an optical module that

- supports dynamically selecting DWDM wavelengths
- allows interfaces to operate on ITU-defined chanlles within the DWDM spectrum, and
- ensures continuous traffic fowarding on the configured optiacal channel.

Administrators can configure the desired DWDM wavelength for a DWDM-SFP10G-C module on Cisco NCS 5500 routers using the **itu channel** command in interface configuration mode. This flexibility in wavelength assignment enables seamless integration of optical interfaces into DWDM networks.

The following table contains the wavelength mapping for the DWDM-SFP10G-C module:

Channel	Frequency (THz)	Wavelength (nm)
1	191.35	1566.723
2	191.40	1566.314
3	191.45	1565.905
4	191.50	1565.496
5	191.55	1565.087
6	191.60	1564.679
7	191.65	1564.271
8	191.70	1563.863
9	191.75	1563.455
10	191.80	1563.047
11	191.85	1562.640
12	191.90	1562.233
13	191.95	1561.826
14	192.00	1561.419
15	192.05	1561.013
16	192.10	1560.606
17	192.15	1560.200
18	192.20	1559.794
19	192.25	1559.389
20	192.30	1558.983
21	192.35	1558.578
22	192.40	1558.173

Channel	Frequency (THz)	Wavelength (nm)
23	192.45	1557.768
24	192.50	1557.363
25	192.55	1556.959
26	192.60	1556.555
27	192.65	1556.151
28	192.70	1555.747
29	192.75	1555.343
30	192.80	1554.940
31	192.85	1554.537
32	192.90	1554.134
33	192.95	1553.731
34	193.00	1553.329
35	193.05	1552.926
36	193.10	1552.524
37	193.15	1552.122
38	193.20	1551.721
39	193.25	1551.319
40	193.30	1550.918
41	193.35	1550.517
42	193.40	1550.116
43	193.45	1549.715
44	193.50	1549.315
45	193.55	1548.915
46	193.60	1548.515
47	193.65	1548.115
48	193.70	1547.715
49	193.75	1547.316
50	193.80	1546.917

Channel	Frequency (THz)	Wavelength (nm)
51	193.85	1546.518
52	193.90	1546.119
53	193.95	1545.720
54	194.00	1545.322
55	194.05	1544.924
56	194.10	1544.526
57	194.15	1544.128
58	194.20	1543.730
59	194.25	1543.333
60	194.30	1542.936
61	194.35	1542.539
62	194.40	1542.142
63	194.45	1541.746
64	194.50	1541.349
65	194.55	1540.953
66	194.60	1540.557
67	194.65	1540.162
68	194.70	1539.766
69	194.75	1539.371
70	194.80	1538.976
71	194.85	1538.581
72	194.90	1538.186
73	194.95	1537.792
74	195.00	1537.397
75	195.05	1537.003
76	195.10	1536.609
77	195.15	1536.216
78	195.20	1535.822

Channel	Frequency (THz)	Wavelength (nm)
79	195.25	1535.429
80	195.30	1535.036
81	195.35	1534.643
82	195.40	1534.250
83	195.45	1533.858
84	195.50	1533.465
85	195.55	1533.073
86	195.60	1532.681
87	195.65	1532.290
88	195.70	1531.898
89	195.75	1531.507
90	195.80	1531.116
91	195.85	1530.725
92	195.90	1530.334
93	195.95	1529.944
94	196.00	1529.553
95	196.05	1529.163
96	196.10	1528.773

For further information about the DWDM-SFP10G-C tunable optic, see the Cisco 10GBASE Dense Wavelength-Division Multiplexing SFP+ Modules Data Sheet.

Configure DWDM-SFP10G-C tunable optics on a 10-Gigabit Ethernet interface

Enable and customize DWDM-SFP10G-C tunable optics to meet specific network configuration requirements, including setting ITU channel, frequency, and wavelength values.

Follow these steps to configure the DWDM-SFP10G-C tunable optics:

The DWDM-SFP10G-C tunable optics module allows for flexible channel, frequency, and wavelength assignment, improving the adaptability of high-speed optical connections in DWDM networking environments.

Before you begin

- Ensure you have access to a router with DWDM-SFP10G-C tunable optics installed.
- Confirm you have administrative privileges to configure Ethernet interfaces.
- Have the required channel, frequency, or wavelength settings for your deployment.

Procedure

Step 1 Specify the 10-Gigabit Ethernet interface you want to configure.

Example:

```
Router(config)# interface tengigabitethernet 4/11
```

slot/port—Specifies the location of the interface.

Step 2 Set the ITU channel for the optics module.

Example:

```
Router(config-if)# itu channel 49
```

The channel number must between 1 and 96.

Step 3 Verify the ITU channel configuration.

Example:

```
Router# show controllers optics 0/0/0/16

Tue Sep  5 08:25:54.127 UTC


  Controller State: Up

  Transport Admin State: In Service


  Laser State: Off


  LED State: Off


  Optics Status


        Optics Type:  SFP+ 10G DWDM Tunable

        DWDM carrier Info: C BAND, MSA ITU Channel=49, Frequency=193.75THz,

        Wavelength=1547.316nm


        Alarm Status:

        -------------

        Detected Alarms:

                 LOW-RX0-PWR
```

```
        LOS/LOL/Fault Status:

        Laser Bias Current = 0.0 mA
        Actual TX Power = 0.00 dBm
        RX Power = 0.00 dBm

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.9      -30.9          -7.0        -26.9
        Tx Power Threshold(dBm)          5.9       -5.0           2.9         -1.0

        LBC Threshold(mA)              75.00      25.00         70.00        30.00
        Temp. Threshold(celsius)       75.00      -5.00         70.00         0.00
        Voltage Threshold(volt)         3.63       2.97          3.46         3.13

        Polarization parameters not supported by optics

        Temperature = 38.00 Celsius
        Voltage = 3.28 V

Transceiver Vendor Details

        Form Factor : SFP+
        Vendor Info
        -----------
        Optics type    : SFP+ 10G DWDM Tunable
        Name           : CISCO-OCLARO
```

```
        OUI Number     : 00.0b.40

        Part Number    : TRS7080FNCCA033

        Rev Number     : 0000

        Serial Number  : ONT2038009B

        PID            : DWDM-SFP10G-C

        VID            : V01
```

This displays the current controller and optics status, including channel, frequency, wavelength, alarm status, performance monitoring, and vendor details.

Step 4 Execute the **show controller optics** command to view the mapping of DWDM channels to frequencies or wavelengths.

Example:

```
Router# show controllers optics 0/0/0/16 dwdm-carrier-map
Tue Sep  5 08:26:31.175 UTC
DWDM Carrier Band:: (null)
MSA ITU channel range supported: 1~96

DWDM Carrier Map table
-----------------------------------------------------
ITU Ch   G.694.1         Frequency       Wavelength
 Num     Ch Num           (THz)            (nm)
-----------------------------------------------------
     1   -35             191.35          1566.723
-----------------------------------------------------
     2   -34             191.40          1566.314
-----------------------------------------------------
     3   -33             191.45          1565.905
-----------------------------------------------------
     4   -32             191.50          1565.496
-----------------------------------------------------
     5   -31             191.55          1565.087
-----------------------------------------------------
     6   -30             191.60          1564.679
-----------------------------------------------------
     7   -29             191.65          1564.271
-----------------------------------------------------
     8   -28             191.70          1563.863
-----------------------------------------------------
     9   -27             191.75          1563.455
-----------------------------------------------------
    10   -26             191.80          1563.047
-----------------------------------------------------
    11   -25             191.85          1562.640
-----------------------------------------------------
    12   -24             191.90          1562.233
-----------------------------------------------------
    13   -23             191.95          1561.826
-----------------------------------------------------
    14   -22             192.00          1561.419
-----------------------------------------------------
    15   -21             192.05          1561.013
-----------------------------------------------------
    16   -20             192.10          1560.606
-----------------------------------------------------
    17   -19             192.15          1560.200
-----------------------------------------------------
    18   -18             192.20          1559.794
-----------------------------------------------------
```

19	-17	192.25	1559.389
20	-16	192.30	1558.983
21	-15	192.35	1558.578
22	-14	192.40	1558.173
23	-13	192.45	1557.768
24	-12	192.50	1557.363
25	-11	192.55	1556.959
26	-10	192.60	1556.555
27	-9	192.65	1556.151
28	-8	192.70	1555.747
29	-7	192.75	1555.343
30	-6	192.80	1554.940
31	-5	192.85	1554.537
32	-4	192.90	1554.134
33	-3	192.95	1553.731
34	-2	193.00	1553.329
35	-1	193.05	1552.926
36	0	193.10	1552.524
37	1	193.15	1552.122
38	2	193.20	1551.721
39	3	193.25	1551.319
40	4	193.30	1550.918
41	5	193.35	1550.517
42	6	193.40	1550.116
43	7	193.45	1549.715
44	8	193.50	1549.315
45	9	193.55	1548.915
46	10	193.60	1548.515
47	11	193.65	1548.115
48	12	193.70	1547.715
49	13	193.75	1547.316
50	14	193.80	1546.917

51	15	193.85	1546.518
52	16	193.90	1546.119
53	17	193.95	1545.720
54	18	194.00	1545.322
55	19	194.05	1544.924
56	20	194.10	1544.526
57	21	194.15	1544.128
58	22	194.20	1543.730
59	23	194.25	1543.333
60	24	194.30	1542.936
61	25	194.35	1542.539
62	26	194.40	1542.142
63	27	194.45	1541.746
64	28	194.50	1541.349
65	29	194.55	1540.953
66	30	194.60	1540.557
67	31	194.65	1540.162
68	32	194.70	1539.766
69	33	194.75	1539.371
70	34	194.80	1538.976
71	35	194.85	1538.581
72	36	194.90	1538.186
73	37	194.95	1537.792
74	38	195.00	1537.397
75	39	195.05	1537.003
76	40	195.10	1536.609
77	41	195.15	1536.216
78	42	195.20	1535.822
79	43	195.25	1535.429
80	44	195.30	1535.036
81	45	195.35	1534.643
82	46	195.40	1534.250

```
    83    47             195.45          1533.858
-------------------------------------------------
    84    48             195.50          1533.465
-------------------------------------------------
    85    49             195.55          1533.073
-------------------------------------------------
    86    50             195.60          1532.681
-------------------------------------------------
    87    51             195.65          1532.290
-------------------------------------------------
    88    52             195.70          1531.898
-------------------------------------------------
    89    53             195.75          1531.507
-------------------------------------------------
    90    54             195.80          1531.116
-------------------------------------------------
    91    55             195.85          1530.725
-------------------------------------------------
    92    56             195.90          1530.334
-------------------------------------------------
    93    57             195.95          1529.944
-------------------------------------------------
    94    58             196.00          1529.553
-------------------------------------------------
    95    59             196.05          1529.163
-------------------------------------------------
    96    60             196.10          1528.773
```

This displayes a table of ITU channel numbers, corresponding frequencies (THz), and wavelengths (nm).

Step 5 Set the frequency for DWDM-SFP10G-C tunable optics module and commit the configuration.

Example:

```
Router(config)#controller optics 0/0/0/16
Router(config-Optics)#shutdown
Router(config-Optics)#dwdm-carrier 50GHz-grid frequency 19335
Router(config-Optics)#commit
Tue Sep  5 08:34:39.943 UTC
Router(config-Optics)#end
```

The frequency is set according to DWDM carrier grid standards.

Step 6 Verify the modified frequency.

Example:

```
Router# show controllers optics 0/0/0/16
Tue Sep  5 08:34:42.824 UTC

 Controller State: Administratively Down

 Transport Admin State: Out Of Service

 Laser State: Off

 LED State: Off

 Optics Status

         Optics Type:  SFP+ 10G DWDM Tunable
         DWDM carrier Info: C BAND, MSA ITU Channel=41, Frequency=193.35THz,
         Wavelength=1550.517nm

         Alarm Status:
         -------------
```

```
        Detected Alarms:
                LOW-RX0-PWR

        LOS/LOL/Fault Status:

        Laser Bias Current = 0.0 mA
        Actual TX Power = 0.00 dBm
        RX Power = 0.00 dBm

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.9      -30.9          -7.0        -26.9
        Tx Power Threshold(dBm)          5.9       -5.0           2.9         -1.0
        LBC Threshold(mA)              75.00      25.00         70.00        30.00
        Temp. Threshold(celsius)       75.00      -5.00         70.00         0.00
        Voltage Threshold(volt)         3.63       2.97          3.46         3.13

        Polarization parameters not supported by optics

        Temperature = 39.00 Celsius
        Voltage = 3.28 V

 Transceiver Vendor Details

       Form Factor : SFP+
       Vendor Info
       -----------
        Optics type    : SFP+ 10G DWDM Tunable
        Name           : CISCO-OCLARO
        OUI Number     : 00.0b.40
        Part Number    : TRS7080FNCCA033
        Rev Number     : 0000
        Serial Number  : ONT2038009B
        PID            : DWDM-SFP10G-C
        VID            : V01
```

Step 7 Change the wavelength or ITU channel as needed for your deployment and commit the configuration.

Example:

```
Router(config)# controller optics 0/0/0/16

Router(config-Optics)# shutdown
Router(config-Optics)# dwdm-carrier 50GHz-grid ?
frequency   Configure Frequency and Map to ITU Channel

itu-ch      Configure the ITU 50GHz Grid ITU Channel

wavelength  Configure Wavelength and Map to ITU Channel

Router(config-Optics)# dwdm-carrier 50GHz-grid itu-ch 84

Router(config-Optics)# commit
```

This sets the channel and wavelength based on the desired configuration.

Step 8 Execute the **show controller optics** command to verify the updated parameters.

Example:

```
Router# show controllers optics 0/0/0/16
Tue Sep  5 08:29:54.851 UTC


  Controller State: Administratively Down


  Transport Admin State: Out Of Service


  Laser State: Off


  LED State: Off


  Optics Status


          Optics Type:  SFP+ 10G DWDM Tunable
          DWDM carrier Info: C BAND, MSA ITU Channel=84, Frequency=195.50THz,
          Wavelength=1533.465nm

          Alarm Status:
          -------------
          Detected Alarms:
                    LOW-RX0-PWR


          LOS/LOL/Fault Status:


          Laser Bias Current = 0.0 mA
          Actual TX Power = 0.00 dBm
          RX Power = 0.00 dBm


          Performance Monitoring: Enable


          THRESHOLD VALUES
          ----------------
```

```
          Parameter                High Alarm  Low Alarm  High Warning  Low Warning
          -----------------------  ----------  ---------  ------------  -----------
          Rx Power Threshold(dBm)         -2.9      -30.9          -7.0        -26.9
          Tx Power Threshold(dBm)          5.9       -5.0           2.9         -1.0
          LBC Threshold(mA)              75.00      25.00         70.00        30.00
          Temp. Threshold(celsius)       75.00      -5.00         70.00         0.00
          Voltage Threshold(volt)         3.63       2.97          3.46         3.13

          Polarization parameters not supported by optics

          Temperature = 38.00 Celsius
          Voltage = 3.28 V

Transceiver Vendor Details

        Form Factor : SFP+
        Vendor Info
        -----------
        Optics type    : SFP+ 10G DWDM Tunable
        Name           : CISCO-OCLARO
        OUI Number     : 00.0b.40
        Part Number    : TRS7080FNCCA033
        Rev Number     : 0000
        Serial Number  : ONT2038009B
        PID            : DWDM-SFP10G-C
        VID            : V01
```

The DWDM-SFP10G-C tunable optics module is configured to your specified interface, ITU channel, frequency, and wavelength. The hardware status and operational parameters are updated and can be verified using the provided commands.

DWDM-SFP10G-E-I tunable optics for NCS-55A1-24Q6H-SS and NCS-57C1 routers

A DWDM-SFP10G-E-I tunable optic is an industrial-temperature 10GBASE DWDM tunable SFP+ optical transceiver that

- supports 100 tunable ITU-T 50GHz spaced channels across the C-band
- enables flexible wavelength selection for 10-Gigabit Ethernet connectivity, and
- simplifies inventory management through channel tunability and integration with optical transport systems.

Starting with Cisco IOS XR Release 26.2.1, DWDM-SFP10G-E-I optic is supported on the NCS-55A1-24Q6H-SS and NCS-57C1 routers. The support enables full DWDM channel tuning capability up to 196.3 THz, ensuring seamless integration with optical transport infrastructure.

The following table contains the wavelength mapping for the DWDM-SFP10G-E-I module:

Channel	Frequency (THz)	Wavelength (nm)
1	191.35	1566.723
2	191.40	1566.314
3	191.45	1565.905
4	191.50	1565.496
5	191.55	1565.087
6	191.60	1564.679
7	191.65	1564.271
8	191.70	1563.863
9	191.75	1563.455
10	191.80	1563.047
11	191.85	1562.640
12	191.90	1562.233
13	191.95	1561.826
14	192.00	1561.419
15	192.05	1561.013
16	192.10	1560.606
17	192.15	1560.200
18	192.20	1559.794
19	192.25	1559.389

Channel	Frequency (THz)	Wavelength (nm)
20	192.30	1558.983
21	192.35	1558.578
22	192.40	1558.173
23	192.45	1557.768
24	192.50	1557.363
25	192.55	1556.959
26	192.60	1556.555
27	192.65	1556.151
28	192.70	1555.747
29	192.75	1555.343
30	192.80	1554.940
31	192.85	1554.537
32	192.90	1554.134
33	192.95	1553.731
34	193.00	1553.329
35	193.05	1552.926
36	193.10	1552.524
37	193.15	1552.122
38	193.20	1551.721
39	193.25	1551.319
40	193.30	1550.918
41	193.35	1550.517
42	193.40	1550.116
43	193.45	1549.715
44	193.50	1549.315
45	193.55	1548.915
46	193.60	1548.515
47	193.65	1548.115

Channel	Frequency (THz)	Wavelength (nm)
48	193.70	1547.715
49	193.75	1547.316
50	193.80	1546.917
51	193.85	1546.518
52	193.90	1546.119
53	193.95	1545.720
54	194.00	1545.322
55	194.05	1544.924
56	194.10	1544.526
57	194.15	1544.128
58	194.20	1543.730
59	194.25	1543.333
60	194.30	1542.936
61	194.35	1542.539
62	194.40	1542.142
63	194.45	1541.746
64	194.50	1541.349
65	194.55	1540.953
66	194.60	1540.557
67	194.65	1540.162
68	194.70	1539.766
69	194.75	1539.371
70	194.80	1538.976
71	194.85	1538.581
72	194.90	1538.186
73	194.95	1537.792
74	195.00	1537.397
75	195.05	1537.003

Channel	Frequency (THz)	Wavelength (nm)
76	195.10	1536.609
77	195.15	1536.216
78	195.20	1535.822
79	195.25	1535.429
80	195.30	1535.036
81	195.35	1534.643
82	195.40	1534.250
83	195.45	1533.858
84	195.50	1533.465
85	195.55	1533.073
86	195.60	1532.681
87	195.65	1532.290
88	195.70	1531.898
89	195.75	1531.507
90	195.80	1531.116
91	195.85	1530.725
92	195.90	1530.334
93	195.95	1529.944
94	196.00	1529.553
95	196.05	1529.163
96	196.10	1528.773
97	196.15	1528.384
98	196.20	1527.994
99	196.25	1527.605
100	196.30	1527.216

For further information about the DWDM-SFP10G-E-I tunable optics, including benefits and optical parameters, see the Cisco Industrial Temp 10GBASE Dense Wavelength-Division Multiplexing SFP+ Modules Data Sheet.

Configure DWDM-SFP10G-E-I tunable optics on a 10-Gigabit Ethernet interface

Enable and customize DWDM-SFP10G-E-I tunable optics to meet specific network configuration requirements, including setting ITU channel, frequency, and wavelength values.

Follow these steps to configure the DWDM-SFP10G-E-I tunable optics:

The DWDM-SFP10G-E-I tunable optics module allows for flexible channel, frequency, and wavelength assignment, improving the adaptability of high-speed optical connections in DWDM networking environments.

Before you begin

- Ensure you have access to a router with DWDM-SFP10G-E-I tunable optics installed.
- Confirm you have administrative privileges to configure Ethernet interfaces.
- Have the required channel, frequency, or wavelength settings for your deployment.

Procedure

Step 1 Specify the 10-Gigabit Ethernet interface you want to configure.

Example:

```
Router(config)# interface tengigabitethernet 4/11
```

slot/port—Specifies the location of the interface.

Step 2 Set the ITU channel for the optics module.

Example:

```
Router(config-if)# itu channel 100
```

The channel number must between 1 and 100.

Step 3 Verify the ITU channel configuration.

Example:

```
Router# show controllers optics 0/0/0/16
Wed Jan 14 13:07:17.449 UTC

 Controller State: Up

 Transport Admin State: In Service

 Laser State: On

 Host Squelch Status: Enable

 Media linkdown preFEC degrade : Disabled

 LED State: Green

 Last link flapped: 00:32:39

 Optics Status

         Optics Type:  SFP+ 10G DWDM Tunable
         DWDM carrier Info: C+S BAND, MSA ITU Channel=100, Frequency=196.30THz,
         Wavelength=1527.216nm
```

```
          Loopback Host : None
          Loopback Media : None

          Alarm Status:
          -------------
          Detected Alarms: None


          LOS/LOL/Fault Status:

          Laser Bias Current = 50.0 mA
          Actual TX Power = 0.79 dBm
          RX Power = -15.37 dBm

          Performance Monitoring: Disable

          THRESHOLD VALUES
          ----------------

          Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
          ------------------------  ----------  ---------  ------------  -----------
          Rx Power Threshold(dBm)         -3.0      -28.8          -7.0        -26.9
1.0
          LBC Threshold(mA)              75.00      25.00         70.00        30.00
          Temp. Threshold(celsius)       97.00     -45.00         92.00       -40.00
          Voltage Threshold(volt)         3.63       2.96          3.46         3.13

          Polarization parameters not supported by optics

          Temperature = 27.00 Celsius
          Voltage = 3.31 V

 Transceiver Vendor Details

          Form Factor            : SFP+
          Optics type            : SFP+ 10G DWDM Tunable
          Name                   : CISCO-CISCO
          OUI Number             : 00.00.0c
          Part Number            : TRS7081FHCPA034
          Rev Number             : 00
          Serial Number          : LNQ29290006
          PID                    : DWDM-SFP10G-E-I
          VID                    : V02
          Hardware Version       : 0.0
          Date Code(yy/mm/dd)    : 25/07/14
```

This displays the current controller and optics status, including channel, frequency, wavelength, alarm status, performance monitoring, and vendor details.

Step 4 Execute the **show controller optics** command to view the mapping of DWDM channels to frequencies or wavelengths.

Example:

```
Router# show controllers optics 0/0/0/16 dwdm-carrier-map
Wed Jan 14 12:59:20.818 UTC
DWDM Carrier Band:: OPTICS_C_PLUS_S_BAND
MSA ITU channel range supported: 1~100

DWDM Carrier Map table
-----------------------------------------------------
ITU Ch      G.694.1     Frequency     Wavelength
 Num        Ch Num        (THz)          (nm)
-----------------------------------------------------
     1       -35           191.35      1566.723
-----------------------------------------------------
```

2	-34	191.40	1566.314
3	-33	191.45	1565.905
4	-32	191.50	1565.496
5	-31	191.55	1565.087
6	-30	191.60	1564.679
7	-29	191.65	1564.271
8	-28	191.70	1563.863
9	-27	191.75	1563.455
10	-26	191.80	1563.047
11	-25	191.85	1562.640
12	-24	191.90	1562.233
13	-23	191.95	1561.826
14	-22	192.00	1561.419
15	-21	192.05	1561.013
16	-20	192.10	1560.606
17	-19	192.15	1560.200
18	-18	192.20	1559.794
19	-17	192.25	1559.389
20	-16	192.30	1558.983
21	-15	192.35	1558.578
22	-14	192.40	1558.173
23	-13	192.45	1557.768
24	-12	192.50	1557.363
25	-11	192.55	1556.959
26	-10	192.60	1556.555
27	-9	192.65	1556.151
28	-8	192.70	1555.747
29	-7	192.75	1555.343
30	-6	192.80	1554.940
31	-5	192.85	1554.537
32	-4	192.90	1554.134
33	-3	192.95	1553.731

34	-2	193.00	1553.329
35	-1	193.05	1552.926
36	0	193.10	1552.524
37	1	193.15	1552.122
38	2	193.20	1551.721
39	3	193.25	1551.319
40	4	193.30	1550.918
41	5	193.35	1550.517
42	6	193.40	1550.116
43	7	193.45	1549.715
44	8	193.50	1549.315
45	9	193.55	1548.915
46	10	193.60	1548.515
47	11	193.65	1548.115
48	12	193.70	1547.715
49	13	193.75	1547.316
50	14	193.80	1546.917
51	15	193.85	1546.518
52	16	193.90	1546.119
53	17	193.95	1545.720
54	18	194.00	1545.322
55	19	194.05	1544.924
56	20	194.10	1544.526
57	21	194.15	1544.128
58	22	194.20	1543.730
59	23	194.25	1543.333
60	24	194.30	1542.936
61	25	194.35	1542.539
62	26	194.40	1542.142
63	27	194.45	1541.746
64	28	194.50	1541.349
65	29	194.55	1540.953

66	30	194.60	1540.557
67	31	194.65	1540.162
68	32	194.70	1539.766
69	33	194.75	1539.371
70	34	194.80	1538.976
71	35	194.85	1538.581
72	36	194.90	1538.186
73	37	194.95	1537.792
74	38	195.00	1537.397
75	39	195.05	1537.003
76	40	195.10	1536.609
77	41	195.15	1536.216
78	42	195.20	1535.822
79	43	195.25	1535.429
80	44	195.30	1535.036
81	45	195.35	1534.643
82	46	195.40	1534.250
83	47	195.45	1533.858
84	48	195.50	1533.465
85	49	195.55	1533.073
86	50	195.60	1532.681
87	51	195.65	1532.290
88	52	195.70	1531.898
89	53	195.75	1531.507
90	54	195.80	1531.116
91	55	195.85	1530.725
92	56	195.90	1530.334
93	57	195.95	1529.944
94	58	196.00	1529.553
95	59	196.05	1529.163
96	60	196.10	1528.773
97	61	196.15	1528.384

```
    98        62          196.20      1527.994
-------------------------------------------------
    99        63          196.25      1527.605
-------------------------------------------------
   100        64          196.30      1527.216
-------------------------------------------------
```

This displayes a table of ITU channel numbers, corresponding frequencies (THz), and wavelengths (nm).

Step 5 Set the frequency for DWDM-SFP10G-E-I tunable optics module and commit the configuration.

Example:

```
Router(config)#controller optics 0/0/0/16
Router(config-Optics)#shutdown
Router(config-Optics)#dwdm-carrier 50GHz-grid frequency 19375
Router(config-Optics)#commit
Tue Sep  5 08:34:39.943 UTC
RP/0/RP0/CPU0:ios(config-Optics)#end
```

The frequency is set according to DWDM carrier grid standards.

Step 6 Verify the modified frequency.

Example:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/16
Controller State: Up

 Transport Admin State: In Service

 Laser State: Off

 Host Squelch Status: Enable

 Media linkdown preFEC degrade : Disabled

 LED State: Off

 Last link flapped: 00:21:50

 Optics Status

         Optics Type:  SFP+ 10G DWDM Tunable
         DWDM carrier Info: C+S BAND, MSA ITU Channel=49, Frequency=193.75THz,
         Wavelength=1547.316nm
         Loopback Host : None
         Loopback Media : None

         Alarm Status:
         -------------
         Detected Alarms:
                 LOW-RX1-PWR

         LOS/LOL/Fault Status:
         Detected LOS/LOL/FAULT: RX-LOS   TX-FAULT


         Laser Bias Current = 0.0 mA
         Actual TX Power = -40.00 dBm
         RX Power = -40.00 dBm

         Performance Monitoring: Disable

         THRESHOLD VALUES
```

```
        ----------------

        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------

        Tx Power Threshold(dBm)          5.9       -5.0           2.9         -1.0
        LBC Threshold(mA)              75.00      25.00         70.00        30.00
        Temp. Threshold(celsius)       97.00     -45.00         92.00       -40.00
        Voltage Threshold(volt)         3.63       2.96          3.46         3.13

        Polarization parameters not supported by optics

        Temperature = 26.00 Celsius
        Voltage = 3.31 V

 Transceiver Vendor Details

        Form Factor             : SFP+
        Optics type             : SFP+ 10G DWDM Tunable
        Name                    : CISCO-CISCO
        OUI Number              : 00.00.0c
        Part Number             : TRS7081FHCPA034
        Rev Number              : 00
        Serial Number           : LNQ29290006
        PID                     : DWDM-SFP10G-E-I
        VID                     : V02
        Hardware Version        : 0.0
        Date Code(yy/mm/dd)     : 25/07/14
```

Step 7 Change the wavelength or ITU channel as needed for your deployment and commit the configuration.

Example:

```
Router(config)# controller optics 0/0/0/16

Router(config-Optics)# dwdm-carrier 50GHz-grid ?
frequency   Configure Frequency and Map to ITU Channel

itu-ch      Configure the ITU 50GHz Grid ITU Channel

wavelength  Configure Wavelength and Map to ITU Channel

Router(config-Optics)# dwdm-carrier 50GHz-grid itu-ch 100
Router(config-Optics)# commit
```

This sets the channel and wavelength based on the desired configuration.

Step 8 Execute the **show controller optics** command to verify the updated parameters.

Example:

```
Router# show controllers optics 0/0/0/16
Wed Jan 14 13:07:17.449 UTC

 Controller State: Up

 Transport Admin State: In Service

 Laser State: On

 Host Squelch Status: Enable
```

```
Media linkdown preFEC degrade : Disabled

LED State: Green

Last link flapped: 00:32:39

Optics Status

        Optics Type:  SFP+ 10G DWDM Tunable
        DWDM carrier Info: C+S BAND, MSA ITU Channel=100, Frequency=196.30THz,
        Wavelength=1527.216nm
        Loopback Host : None
        Loopback Media : None

        Alarm Status:
        -------------
        Detected Alarms: None


        LOS/LOL/Fault Status:

        Laser Bias Current = 50.0 mA
        Actual TX Power = 0.79 dBm
        RX Power = -15.37 dBm

        Performance Monitoring: Disable

        THRESHOLD VALUES
        ----------------

        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -3.0      -28.8          -7.0        -26.9

        LBC Threshold(mA)              75.00      25.00         70.00        30.00
        Temp. Threshold(celsius)       97.00     -45.00         92.00       -40.00
        Voltage Threshold(volt)         3.63       2.96          3.46         3.13

        Polarization parameters not supported by optics

        Temperature = 27.00 Celsius
        Voltage = 3.31 V

Transceiver Vendor Details

        Form Factor            : SFP+
        Optics type            : SFP+ 10G DWDM Tunable
        Name                   : CISCO-CISCO
        OUI Number             : 00.00.0c
        Part Number            : TRS7081FHCPA034
        Rev Number             : 00
        Serial Number          : LNQ29290006
        PID                    : DWDM-SFP10G-E-I
        VID                    : V02
        Hardware Version       : 0.0
        Date Code(yy/mm/dd)    : 25/07/14
```

The DWDM-SFP10G-E-I tunable optics module is configured to your specified interface, ITU channel, frequency, and wavelength. The hardware status and operational parameters are updated and can be verified using the provided commands.

Priority Flow Control (PFC)

Priority flow control (PFC; IEEE 802.1Qbb), which is also referred to as Class-based Flow Control (CBFC) or Per Priority Pause (PPP), is a mechanism that prevents frame loss that is due to congestion. PFC is similar to 802.3x Flow Control (pause frames) or link-level flow control (LLFC). However, PFC functions on a per class-of-service (CoS) basis.

During congestion, PFC sends a pause frame that indicates which CoS value needs to be paused. A PFC pause frame contains a 2-octet timer value for each CoS that indicates the length of time that the traffic needs to be paused. The unit of time for the timer is specified in pause quanta. A quanta is the time that is required for transmitting 512 bits at the speed of the port. The range is from 0 to 65535.

Note The router sends out the required amount of pause frames or pause-threshold (x-off) messages to achieve lossless queues. It also sends out resume-threshold (x-on) messages.

PFC asks the peer to stop sending frames of a particular CoS value by sending a pause frame to a well-known multicast address. This pause frame is a one-hop frame that is not forwarded when received by the peer. When the congestion is mitigated, the router stops sending the PFC frames to the upstream node.

Note

- PFC Rx traffic processing is enabled only if `hw-module profile priority-flow-control` command is enabled on the line card.
- `CISCO-PFC-EXT-MIB` is supported.

The PFC feature is only supported on the following line card or fixed chassis PIDs of the NCS5500 Series:

- NC55-36X100G
- NC55-18H18F
- NC55-24X100G-SE
- NC55-36X100G-S
- NC55-24H12F-SE
- NC55-36X100G-A-SE
- NCS-55A1-36H-SE-S
- NCS-55A1-36H-S
- NCS-55A1-24H
- NCS-55A1-48Q6H

Restrictions for PFC

PFC has the following restrictions:

- PFC for transmit is not supported for internal traffic (recycle / loopback) and non-unicast traffic (broadcast / multicast).
- PFC for receive impacts all traffic meant to go out of the port. This may cause unintended drops to both unicast and non-unicast traffic because non-unicast traffic may consume buffer descriptors, thus starving unicast traffic. Hence, PFC is incompatible with sustained high rate non-unicast traffic in the system.
- PFC configuration will enable or disable both PFC transmit and receive functionalities. There is no support to enable only transmit or receive functions.
- PFC is only supported in the non-HQoS profile. For more details on this QoS prerequisite and configuration examples, please refer to *Modular QoS Configuration Guide for Cisco NCS 5500 Series Routers*.
- Link level flow control and PFC are not supported on the same interface simultaneously.
- PFC is only qualified on 40G and 100G physical interface types. PFC is not supported on breakout ports for these interface types and is not qualified on other interface types.
- Being an Ethernet feature, PFC has to be individually configured on the member interfaces of a bundle instead of the bundle interface. The user is expected to either enable or disable PFC on all members of the bundle, as a mix isn't supported.
- Pause frames are not counted in the interface's statistical information, and the **show interfaces** command displays this counter as 0. Use the **show controllers** *Ethernet-interface-type interface-path-id* command to retrieve the PFC statistics.

Configuring Priority Flow Control

Use the following steps to configure Priority Flow Control:

Configuration:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(configure)#interface HundredGigE0/0/0/0
RP/0/RP0/CPU0:router(config)# priority-flow-control mode on
```

Running configuration:

```
*Interface Level*
interface HundredGigE0/0/0/0
priority-flow-control mode on
```

Verification:

Sample output for `show controllers hundredGigE 0/0/0/0 priority-flow-control` command is:

```
RP/0/RP1/CPU0:router#show controllers hundredGigE 0/0/0/0 priority-flow-control
Mon Oct 12 12:20:53.520 UTC

Priority flow control information for interface HundredGigE0/0/0/0:

Priority Flow Control:
    Total Rx PFC Frames: 0
    Total Tx PFC Frames: 1764273
    Rx Data Frames Dropped: 0
    CoS  Status  Rx Frames   Tx Frames
    ---  ------  ----------  ----------
      0  off              0           0
      1  off              0           0
      2  off              0           0
```

```
      3  on               0      882032
      4  on               0      882241
      5  off              0           0
      6  off              0           0
      7  off              0           0


Priority flow control watchdog configuration:
(D) : Default value
U : Unconfigured
------------------------------------------------------------------------------
       Configuration Item           Global  Interface Effective
------------------------------------------------------------------------------
    PFC watchdog state           :        U        U  Enabled(D)
    Poll interval                :        U        U      100(D)
    Shutdown multiplier          :        U        U        1(D)
    Auto-restore multiplier      :        U        U       10(D)


Priority flow control watchdog statistics:
SAR: Auto restore and shutdown
-------------------------------------------------------------------------------------------------------
Traffic Class            :       0        1        2        3        4        5        6
      7
-------------------------------------------------------------------------------------------------------
Watchdog Events          :       0        0        0        0        0        0        0
      0
Shutdown Events          :       0        0        0        0        0        0        0
      0
Auto Restore Events      :       0        0        0        0        0        0        0
      0
SAR Events               :       0        0        0        0        0        0        0
      0
SAR Instantaneous Events :       0        0        0        0        0        0        0
      0
Total Dropped Packets    :       0        0        0        0        0        0        0
      0
Dropped Packets          :       0        0        0        0        0        0        0
      0


Priority flow control watchdog state machine state:
D - Disabled
M - Monitoring
S - Waiting For Shutdown
R - Waiting to Restore
---------------------------------------------------------------
PFC Watchdog      : Enabled
Watchdog SM state :  Traffic Class
                     7 6 5 4 3 2 1 0
                     - - - D D - - -
RP/0/RP1/CPU0:router#
```

Sample output for `show controllers hundredGigE 0/0/0/0 priority-flow-control statistics` command is:

```
RP/0/RP1/CPU0:router#show controllers hundredGigE 0/0/0/0 priority-flow-control statistics

Mon Oct 12 12:22:39.362 UTC

Priority flow control information for interface HundredGigE0/0/0/0:

Priority Flow Control:
    Total Rx PFC Frames: 0
    Total Tx PFC Frames: 1764273
```

```
    Rx Data Frames Dropped: 0
    CoS  Status  Rx Frames   Tx Frames
    ---  ------  ----------  ----------
      0  off              0           0
      1  off              0           0
      2  off              0           0
      3  on               0      882032
      4  on               0      882241
      5  off              0           0
      6  off              0           0
      7  off              0           0
```

Sample output for `clear controller hundredGigE 0/0/0/0 priority-flow-control statistics [traffic-class <0-7>]` is:

```
RP/0/RP1/CPU0:router#clear controller hundredGigE 0/0/0/0 priority-flow-control statistics
 traffic-class 3
Mon Oct 12 12:22:48.778 UTC
RP/0/RP1/CPU0:router#show controllers hundredGigE 0/0/0/0  priority-flow-control statistics

Mon Oct 12 12:22:51.097 UTC

Priority flow control information for interface HundredGigE0/0/0/0:

Priority Flow Control:
    Total Rx PFC Frames: 0
    Total Tx PFC Frames: 882241
    Rx Data Frames Dropped: 0
    CoS  Status  Rx Frames   Tx Frames
    ---  ------  ----------  ----------
      0  off              0           0
      1  off              0           0
      2  off              0           0
      3  on               0           0
      4  on               0      882241
      5  off              0           0
      6  off              0           0
      7  off              0           0
RP/0/RP1/CPU0:router#
```

Optical Transport Networks

Optical Transport Network (OTN) encapsulates frames of data that allows the system to send multiple data sources on the same channel.

OTN can carry any kind of traffic and removes the restriction of the different physical network dependencies. These physical networks offer different types of services, such as Ethernet, SDH, SONET, Fiber Channel, and so on.

OTN comprises of the following switching layers:

- Time Division Multiplexing (TDM)
- Wavelength Switched Optical Network (WSON)

OTN uses the following information structures to encapsulate data:

- OTUk – where k=1/2/2e/3/3e2/4, is an information structure into which the system maps another information structure called ODUk (k=1/2/2e/3/3e2/4). The ODUk signal is the server layer signal for client signals.

- OTU2e (Data rate 11.09Gb/s) transports a 10 Gigabit Ethernet LAN PHY coming from IP/Ethernet switches and routers at full line rate (10.3 Gbit/s), as specified in G.Sup43

Restrictions and Important Guidelines

The following are some of the important guidelines and restrictions related to OTN:

- OTN is only supported on the NC55-MPA-12T-S line card.
- NC55-MPA-12T-S is supported on the following 2RU Cisco NCS 5500 Series Routers:
  - NCS-55A2-MOD-S
  - NCS-55A2-MOD-SE-S
  - NCS-55A2-MOD-HX-S
  - NCS-55A2-MOD-SE-H-S
  - NCS-55A2-MOD-HD-S
- NC55-MPA-12T-S is supported in the following Modular Line cards:
  - NC55-MOD-A-S
  - NC55-MOD-A-SE-S
- OTN isn't supported on SF_BER and SD_BER.
- OTN converts 10GE LAN PHY signal (host side) into OTU1e/OTU2e signal (line side).
- Supports 10G mapping modes
- OTU2e signal operates at 11.096 Gbps, which carries 10GE LAN PHY signal. Also known as the BMP mapping
- OTU1e signal operates at 11.049 Gbps, which carries 10GE LAN PHY signal. Also known as the BMP mapping
- Supports FEC functionality in the following modes:
  - GFEC = ITU-T G.709 / G.975, OH 7%
  - EFEC = ITU-T G.975.1 (1.4), OH 7%
  - UFEC = ITU-T G.975.1 (1.7), OH 7%
- FEC EC/UNC alarms aren't reported on NC55-MPA-12T-S.

OTN Architecture

Figure 1: OTN Architecture

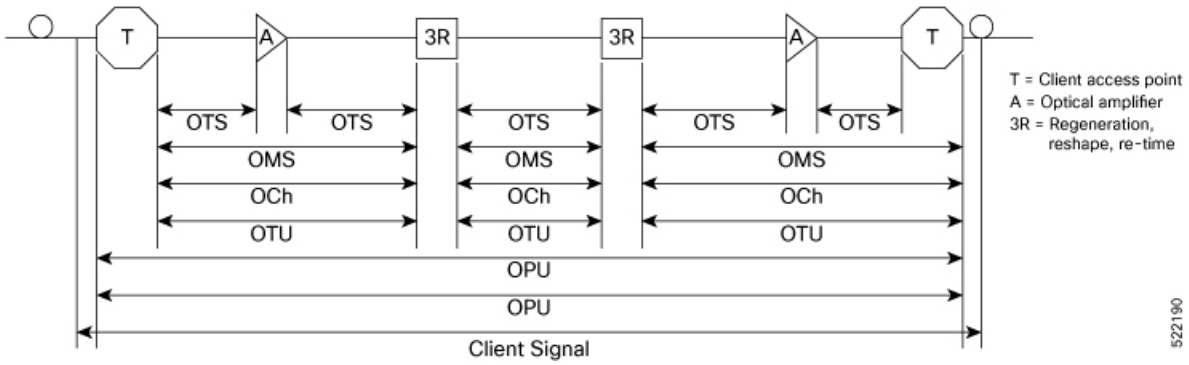
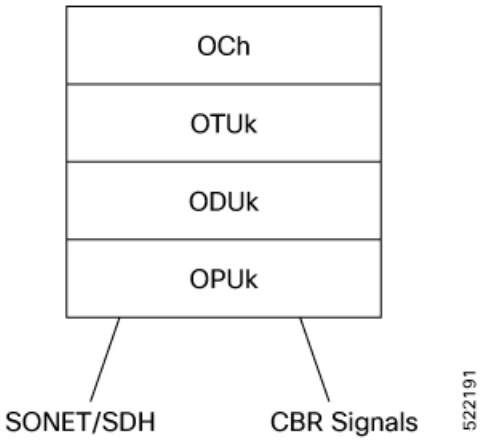


Figure 2: OTN Layers



OTN Layers and their Functions

Layer	Function	Ternimated On
Optical Transport Section (OTS)	Optical transmission. Includes fiber and optical amplifier.	Optical Amplifier
Optical Multiplex Section (OMS)	Optical multiplexing. Lambda multiplexing.	MUX/DEMUX
Optical Channel (OCh)	Client Optical Adaptation	Regenators
Optical Transport Unit (OTU)	Section Monitoring, FEC	Regenerators, Client Access Point, OTN Switch
Optical Data Unit (ODU)	Path Monitoring, Tandem Connection Monitoring	Client Access Point
Optical Channel Payload Unit (OPU)	Client Signal Adaptation	Client Access Point

Configuring OTN Interface

This section describes how you can configure OTN on an interface.

```
/* Configure “port-mode Otn framing opu2e” under controller optics of the interface. */

controller Optics0/2/1/0
port-mode Otn framing opu2e
!
```

Running Configuration

```
controller Optics0/2/1/0
port-mode Otn framing opu2e
!
```

Verification

```
RP/0/RP1/CPU0:ios#show portmode all
Sat Nov 20 21:37:01.717 UTC
Portmode Information
-------------------------------------------------
Port Name Portmode Type Framing Mapping PT type
Rate
Optics0_2_1_0 OTN OPU2e framing type None mapping type NA
None
Optics0_2_1_11 OTN OPU2e framing type None mapping type NA
None
RP/0/RP1/CPU0:ios#
```

```
RP/0/RP1/CPU0:ios#show controllers otu2e 0/2/1/0
Sat Nov 20 21:38:17.853 UTC
Port : OTU2E 0/2/1/0
Controller State : Up
Inherited Secondary State : Normal
Configured Secondary State : Normal
Derived State : In Service
Loopback mode : None
BER Thresholds : SF = 1.0E-6 SD = 1.0E-7
Performance Monitoring : Enable
Alarm Information:
LOS = 0 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 1 BIAE = 0 SF_BER = 0
SD_BER = 0 BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0 FLEXO_GIDM = 0
FLEXO-MM = 0 FLEXO-LOM = 0 FLEXO-RDI = 0
FLEXO-LOF = 0
Detected Alarms : None
OTU TTI Received
FEC mode : STANDARD
```

```
RP/0/RP1/CPU0:ios#show controllers odu2e 0/2/1/0
Sat Nov 20 21:39:06.792 UTC
Port : ODU2E 0/2/1/0
Controller State : Up
Inherited Secondary state : Normal
Configured Secondary state : Maintenance
Derived State : Maintenance
Loopback mode : None
BER Thresholds : SF = 1.0E-6 SD = 1.0E-7
Performance Monitoring : Enable
Path Monitoring Mode : Non-Intrusive Monitor
PM TIM-CA state : Disable
```

```
Alarm Information:
AIS = 0 IAE = 0 BIAE = 0
SF_BER = 0 SD_BER = 0 BDI = 0
OCI = 0 LCK = 0 PTIM = 0
TIM = 0 CSF = 0 GFP LFD = 0
GFP LOCS = 0 GFP LOCCS = 0 GFP UPM = 0
Detected Alarms : None
ODU TTI Sent
ODU TTI Received
ODU TTI Expected
Owner : All
Resource State : ODU Resource Free
Private Line Emulation(PLE) supported : No
```

Supported Alarms

This table lists the supported OTN alarms:

ODU Alarms	OUT Alarms
AIS	OOF
OCI	AIS
LCK	LOF
BDI	LOM
	OOM
	BDI
	BIAE
	IAE

The following are the supported OTN PM counters:

- BIP
- BEI

How to Configure Interfaces in Breakout Mode

Table 8: Feature History Table

Feature name	Release Information	Feature Description
2x50GbE Breakout Ports on Cisco NCS-55A1-24H Routers	Release 7.5.2	You can now configure 2x50GbE breakout ports on all QSFP28 ports of the Cisco NCS-55A1-24H fixed port router.

Information About Breakout

The router supports transmission of traffic in the breakout mode. The breakout mode enables a 40GbE, 100GbE, or 400GbE port to be split into multiple GbE ports.

Breakout Mode options:

- 4x10GbE
- 4x25GbE
- 2x50GbE
- 8x50GbE
- 4x100GbE
- 3x100GbE
- 2x100GbE
- 1x100GbE



Note

- The supported breakout mode is dependent on the port and optic transceiver.
- A configuration inconsistency alarm may occur during router reload when breakout interfaces are created with ETM mode. The system automatically clears this alarm by retrying the configuration.

Configure Breakout in a Port



Note For the N540-24Q8L2DD-SYS router , before proceeding with the breakout configuration, ensure that you configure the port mode speed under the optics controller. This step is crucial to ensure that the optics controller operates at the desired speed and can properly handle the breakout settings.

For port mode speed configuration steps, refer to Configure Port Mode Speed.

This example shows how to configuring a 4x10GbE breakout in a port:

```
RP/0/RP0/CPU0:Router# configure
RP/0/RP0/CPU0:Router(config)# controller optics 0/1/0/28
RP/0/RP0/CPU0:Router(config-Optics)# breakout 4x10
RP/0/RP0/CPU0:Router(config-Optics)# commit
RP/0/RP0/CPU0:Router(config-Optics)# end
RP/0/RP0/CPU0:Router#
```

Remove the Breakout Configuration

Removing the breakout configuration:

```
RP/0/RP0/CPU0:Router# configure
RP/0/RP0/CPU0:Router(config)# controller optics 0/1/0/28
```

```
RP/0/RP0/CPU0:Router(config-Optics)# no breakout 4x10
RP/0/RP0/CPU0:Router(config-Optics)# commit
RP/0/RP0/CPU0:uut(config-Optics)# end
```

Verify a Breakout Configuration

Verifying a breakout configuration:

```
RP/0/RP0/CPU0:Router# show running-config controller optics 0/1/0/28
controller Optics0/1/0/28
breakout 4x10
!

RP/0/RP0/CPU0:Router# show int br location 0/1/CPU0 | i Te0/1/0/28
       Te0/1/0/27/0          up          up               ARPA 10000   10000000
       Te0/1/0/27/1          up          up               ARPA 10000   10000000
       Te0/1/0/27/2          up          up               ARPA 10000   10000000
       Te0/1/0/27/3          up          up               ARPA 10000   10000000
       Te0/1/0/28/0          up          up               ARPA 10000   10000000
       Te0/1/0/28/1          up          up               ARPA 10000   10000000
       Te0/1/0/28/2          up          up               ARPA 10000   10000000
       Te0/1/0/28/3          up          up               ARPA 10000   10000000
```

1x100GbE Auto-Breakout

Table 9: Feature History Table

Feature name	Release Information	Feature Description
1x100GbE Auto-Breakout	Release 24.4.1	Introduced in this release on: NCS 5700 fixed port routers You can seamlessly switch between interface speeds with the 1x100GbE auto-breakout feature. When QDD-400G-ZRP-S optics are inserted into specified ports, 1x100GbE breakout interfaces are automatically created without manual configuration. This feature provides you the flexibility to switch between different interface speeds without manual reconfiguration. 1x100GbE auto-breakout feature is supported on the following Cisco router variant: • NCS-57B1-6D24H-S • NCS-57B1-5D24-SE

The 1x100GbE auto-breakout feature lets you seamlessly create 1x100GbE breakout interfaces using the QDD-400G-ZRP-S optical module, giving you the flexibility to switch between interface speeds without

manual configuration. When you remove the QDD-400G-ZRP-S optic, the speed stays at 1x100GbE and adjusts based on the next optics you insert.

Supported Routers

1x100GbE auto-breakout feature is supported on the following Cisco router variant:

- NCS-57B1-6D24H-S
- NCS-57B1-5D24-SE

Supported Auto-Breakout Ports

The following QSFP ports on the NCS-57B1-6D24H-S and NCS-57B1-5D24-SE platform support 1x100GbE auto-breakout:

- Even-numbered QSFP Ports: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22.

Creating Auto-Breakout Configurations

When a QDD-400G-ZRP-S module is inserted into even QSFP ports, the router automatically creates 1x100GbE breakout interfaces. The process involves:

- Inserting the optical module into the designated ports.
- System recognizing the module and creating the appropriate interfaces.
- Removing the optical module reverts the interfaces to 100GbE.

Restrictions and Usage Guidelines for Auto-breakout

- The ports are divided into six quads (0-5). Each quad consists of the following ports:
  - Quad 0 - Ports 0-3
  - Quad 1 - Ports 4-7
  - Quad 2 - Ports 8-11
  - Quad 3 - Ports 12-15
  - Quad 4 - Ports 16-19
  - Quad 5 - Ports 20-23
- 4x25GbE configuration cannot coexist with a 40G or 4x10GbE configuration in any quad.
- Different speeds cannot be configured on Quad0 simultaneously.

How to Configure Interfaces in Breakout Mode

Information About Breakout

The router supports transmission of traffic in the breakout mode. The breakout mode enables a 40GbE, 100GbE, or 400GbE port to be split into multiple GbE ports.

Breakout Mode options:

- 4x10GbE
- 4x25GbE
- 2x50GbE
- 8x50GbE
- 4x100GbE
- 3x100GbE
- 2x100GbE
- 1x100GbE

Note

- The supported breakout mode is dependent on the port and optic transceiver.
- A configuration inconsistency alarm may occur during router reload when breakout interfaces are created with ETM mode. The system automatically clears this alarm by retrying the configuration.

Configure Breakout in a Port

Note For the N540-24Q8L2DD-SYS router , before proceeding with the breakout configuration, ensure that you configure the port mode speed under the optics controller. This step is crucial to ensure that the optics controller operates at the desired speed and can properly handle the breakout settings.

For port mode speed configuration steps, refer to Configure Port Mode Speed.

This example shows how to configuring a 4x10GbE breakout in a port:

```
RP/0/RP0/CPU0:Router# configure
RP/0/RP0/CPU0:Router(config)# controller optics 0/1/0/28
RP/0/RP0/CPU0:Router(config-Optics)# breakout 4x10
RP/0/RP0/CPU0:Router(config-Optics)# commit
RP/0/RP0/CPU0:Router(config-Optics)# end
RP/0/RP0/CPU0:Router#
```

Remove the Breakout Configuration

Removing the breakout configuration:

```
RP/0/RP0/CPU0:Router# configure
RP/0/RP0/CPU0:Router(config)# controller optics 0/1/0/28
RP/0/RP0/CPU0:Router(config-Optics)# no breakout 4x10
RP/0/RP0/CPU0:Router(config-Optics)# commit
RP/0/RP0/CPU0:uut(config-Optics)# end
```

Verify a Breakout Configuration

Verifying a breakout configuration:

```
RP/0/RP0/CPU0:Router# show running-config controller optics 0/1/0/28
controller Optics0/1/0/28
breakout 4x10
!

RP/0/RP0/CPU0:Router# show int br location 0/1/CPU0 | i Te0/1/0/28
       Te0/1/0/27/0          up          up               ARPA 10000   10000000
       Te0/1/0/27/1          up          up               ARPA 10000   10000000
       Te0/1/0/27/2          up          up               ARPA 10000   10000000
       Te0/1/0/27/3          up          up               ARPA 10000   10000000
       Te0/1/0/28/0          up          up               ARPA 10000   10000000
       Te0/1/0/28/1          up          up               ARPA 10000   10000000
       Te0/1/0/28/2          up          up               ARPA 10000   10000000
       Te0/1/0/28/3          up          up               ARPA 10000   10000000
```