

Configuring Dense Wavelength Division Multiplexing Controllers

This module describes the configuration of dense wavelength division multiplexing (DWDM) controllers.

DWDM is an optical technology that is used to increase bandwidth over existing fiber-optic backbones. DWDM can be configured on supported 10-Gigabit Ethernet (GE) or Packet-over-SONET/SDH physical layer interface modules (PLIMs). After you configure the DWDM controller, you can configure an associated 10-Gigabit Ethernet interface.

Feature History for Configuring DWDM Controller Interfaces

Release	Modification
Release 5.2.3	Support for OTN Termination was included.

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Prerequisites for Configuring DWDM Controller Interfaces

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Information About the DWDM Controllers

DWDM support in Cisco IOS XR software is based on the Optical Transport Network (OTN) protocol that is specified in ITU-T G.709. This standard combines the benefits of SONET/SDH technology with the multiwavelength networks of DWDM.

To enable multiservice transport, OTN uses the concept of a wrapped overhead (OH). To illustrate this structure:

- Optical channel payload unit (OPU) OH information is added to the information payload to form the OPU. The OPU OH includes information to support the adaptation of client signals.
- Optical channel (OCh) OH is added to form the OCh. The OCh provides the OTN management functionality and contains four subparts: the OPU, and frame alignment signal (FAS).

Figure 1: OTN Optical Channel Structure

TU		N
OPU	Payload	FEC
	-U DAO	면 Payload

These are the conditions for OTU Port configuration:

- OTU4 can be configured at slice level only.
- · Slice reset occurs immediately after commit.
- Interface is removed from the slice.
- Slice is powered back up in OTU4 mode.
- Two 100 GigE interfaces are created.

Information about IPoDWDM

Cisco IOS XR software includes the IP over Dense Wavelength Division Multiplexing (IPoDWDM) feature.

IPoDWDM currently provides the following software features:

Shared Risk Link Group (SRLG)

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The Shared Risk Link Group (SRLG) provides shared risk information between the DWDM optical layer (L0) and the router layer (L3), and the applications that use the shared risk information. An SRLG is a set of links that share a resource whose failure may affect all links in the set.

System administrators can configure the following IPoDWDM features:

Signal Logging

DWDM statistic data, such as EC, UC and alarms, are collected and stored in the log file on the DWDM line card.

How to Configure DWDM Controllers

The DWDM controllers are configured in the physical layer control element of the Cisco IOS XR software configuration space. This configuration is done using the **controller dwdm** command, and is described in the following task:

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Note All interface configuration tasks for Gigabit Ethernet interfaces still must be performed in interface configuration mode.

Configuring the Optical Parameters

This task describes how to configure the wavelength parameters for the DWDM controller to set the operational wavelength of a tunable SFP+ module. The DWDM controllers are configured in the physical layer control element of the Cisco IOS XR software configuration space.

SUMMARY STEPS

- 1. configure
- **2.** controller dwdm interface-path-id
- **3**. admin-state out-of-service
- 4. commit
- 5. wavelength channel-number
- 6. commit
- 7. admin-state in-service
- **8.** Do one of the following:
 - end
 - commit
- 9. show controllers dwdm interface-path-id optics

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure	Enter the XR Config mode.
	Example:	
	RP/0/RP0/CPU0:router# configure	
Step 2	controller dwdm interface-path-id	Specifies the DWDM controller name in the notation
	Example:	<i>rack/slot/module/port</i> and enters DWDM configuration mode.
	<pre>RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/0</pre>	

	Command or Action	Purpose	
	Example:		
	RP/0/RP0/CPU0:router(config-dwdm)#		
Step 3	admin-state out-of-service	Specifies the DWDM interface administrative state. You	
	Example:	must put the controller in out-of-service state before you can use the DWDM configuration commands.	
	<pre>RP/0/RP0/CPU0:router(config-dwdm) # admin-state out-of-service</pre>		
Step 4	commit	Saves configuration changes. This performs the shutdown	
	Example:	from the previous step. After the controller has been shut down, you can proceed with the wavelength configuration.	
	RP/0/RP0/CPU0:router(config-dwdm)# commit		
Step 5	wavelength channel-number	Configures the channel number corresponding to the first	
	Example:	wavelength. Values can range from 1 to 96. Use the show controller dwdm command with the wavelength-map	
	<pre>RP/0/RP0/CPU0:router(config-dwdm) # wavelength 1</pre>	keyword to determine which channels and wavelengths are supported on a specific controller.	
Step 6	commit	Saves configuration changes.	
	Example:		
	RP/0/RP0/CPU0:router(config-dwdm)# commit		
Step 7	admin-state in-service	Places the DWDM port in In-Service (IS) state, to support	
	Example:	all normal operation.	
	<pre>RP/0/RP0/CPU0:router(config-dwdm) # admin-state in-service</pre>		
Step 8	Do one of the following:	Saves configuration changes.	
	• end •	• When you issue the end command, the system prompts you to commit changes:	
	• commit		
	Example:	Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:	
	RP/0/RP0/CPU0:router(config-dwdm)# end	• Entering yes saves configuration changes to the running configuration file, exits the configuration	
	Example:	session, and returns the router to EXEC mode.	
	Example: RP/0/RP0/CPU0:router(config-dwdm)# commit	 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. 	
		• Entering cancel leaves the router in the configuration session without exiting committing the configuration change	

	Command or Action	Purpose
		• Use the commit command to save the configuration changes to the running configuration file and remain within the configuration session.
Step 9	show controllers dwdm interface-path-id optics Example:	Displays the output power level, input power level, and wavelength information.
	RP/0/RP0/CPU0:router# show controller dwdm 0/1/0/0 optics	

Configuring G.709 Parameters

This task describes how to customize the alarm display and the thresholds for alerts and forward error correction (FEC). You need to use this task only if the default values are not correct for your installation.

Before you begin

The **g709 disable**, **loopback**, and **g709 fec** commands can be used only when the controller is in the shutdown state. Use the **admin-state** command.

SUMMARY STEPS

- 1. configure
- 2. controller dwdm interface-path-id
- **3.** Do one of the following:
 - admin-state maintenance
 - •
 - admin-state out-of-service
- 4. commit
- 5. g709 disable
- 6. g709 fec {disable | standard}
- 7. g709 report *alarm* disable
- **8.** Do one of the following:
 - end

•

- commit
- 9. admin-state in-service
- 10. show controllers dwdm interface-path-id g709

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.
	Example:	

	Command or Action	Purpose	
	RP/0/RP0/CPU0:router# configure		
Step 2	controller dwdm interface-path-id Example:	Specifies the DWDM controller name in the notation <i>rack/slot/module/port</i> and enters DWDM configuration mode.	
	<pre>RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/0</pre>		
Step 3	Do one of the following:	Disables the DWDM controller. You must disable the	
	admin-state maintenance	controller before you can use the DwDM configuration commands.	
	admin-state out-of-service		
	Example:		
	<pre>RP/0/RP0/CPU0:router(config-dwdm)# admin-state out-of-service</pre>		
Step 4	commit	Saves configuration changes. This performs the shutdown	
	Example:	down, you can proceed with the configuration.	
	RP/0/RP0/CPU0:router(config-dwdm)# commit		
Step 5	g709 disable	(Optional) Disables the G.709 wrapper. The wrapper is	
	Example:	Note The $g709$ disable command is available on the	
	RP/0/RP0/CPU0:router(config-dwdm)# g709 disable	Cisco 4-Port 10-Gigabit Ethernet DWDM PLIM only.	
Step 6	g709 fec {disable standard}	(Optional) Configures the forward error correction mode	
	Example:	FEC is enabled.	
	RP/0/RP0/CPU0:router(config-dwdm)# g709 fec disable		
Step 7	g709 report alarm disable	(Optional) Disables the logging of selected optical channel	
	Example:	all alarms are logged to the console.	
	<pre>RP/0/RP0/CPU0:router(config-dwdm)# g709 odu bdi disable</pre>		
Step 8	Do one of the following:	Saves configuration changes.	
	• end •	• When you issue the end command, the system prompts you to commit changes:	
	• commit	Uncommitted changes found, commit them before	
	Example:	<pre>exiting(yes/no/cancel)? [cancel]:</pre>	
	RP/0/RP0/CPU0:router(config-dwdm)# end		

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	Command or Action	Purpose
	Example:	• • Entering yes saves configuration changes to the
	Example:	running configuration file, exits the configuration session, and returns the router to EXEC mode.
	RP/0/RP0/CPU0:router(config-dwdm)# commit	 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	admin-state in-service	Places the DWDM port in In Service (IS) state, to support
	Example:	all normal operation.
	<pre>RP/0/RP0/CPU0:router(config-dwdm)# admin-state in-service</pre>	
Step 10	show controllers dwdm interface-path-id g709	Displays the G.709 Optical Transport Network (OTN)
	Example:	protocol alarms and counters for Bit Errors, along with the FEC statistics and threshold-based alerts.
	RP/0/RP0/CPU0:router# show controller dwdm 0/1/0/0 optics	

What to Do Next

All interface configuration tasks for the Gigabit Ethernet interfaces still must be performed in interface configuration mode. Refer to the corresponding modules in this book for more information.

Forward Error Correction (FEC)

FEC feature allows you to enable or disable RS-FEC (Reed-Solomon Codec for Ethernet IEEE 802.3 Clause 91) for 100G optics. The 100G optics can operate in both FEC and non-FEC mode. In FEC mode, these optics can cover an extended range. In non-FEC mode, 100G optics can interoperate with other optics.

FEC is a mechanism to recover lost packets on a link by sending extra "parity" packets for every group (N) of packets. As long as the receiver receives a subset of packets in the group (N-1) and the parity packet, up to a single lost packet in the group can be recovered.

FEC is supported on these optics:

- QSFP-100G-ER4L-S
- CPAK-100G-ER4F

Configuring FEC on an Interface

By default the interfaces operate in non-FEC mode. To enable FEC on an interface, use the **fec standard** command in the interface configuration mode.



Note The standard FEC refers to RS-FEC. The RS-FEC stands for Reed Solomon Forward Error Correction.

The RS-FEC is only supported on these 100G optic interfaces:

- QSFP-100G-ER4L-S
- CPAK-100G-ER4F

RP/0/RP0/CPU0:ios#(config)# interface HundredGigE 0/6/0/8
RP/0/RP0/CPU0:ios#(config-if)# fec standard
RP/0/RP0/CPU0:ios#(config)# commit

Verification

Use the **show controllers** command to verify the FEC configuration:

RP/0/RP0/CPU0:ios# show controllers hundredGigE 0/6/0/8

Thu Jul 25 05:58:38.162 UTC Operational data for interface HundredGigE0/6/0/8: State: Administrative state: enabled Operational state: Down (Reason: Link loss or low light, no loopback) LED state: Yellow On Phy:

```
Media type: fiber over 4 lane optics (25km reach) (lite)
Optics:
Vendor: CISCO
Part number: CISxxxx/101
Serial number: xxxxxx
Digital Optical Monitoring:
Transceiver Temp: 45.996 C
```

```
DOM alarms:
Not available
Statistics:
FEC:
Corrected Codeword Count: 0
Uncorrected Codeword Count: 0
```

```
MAC address information:
Operational address: e41f.0fae.7865
```

```
Burnt-in address: e41f.0fae.7865
No unicast addresses in filter
Operating in multicast promiscuous mode
Autonegotiation disabled.
Operational values:
Speed: 100Gbps
Duplex: Full Duplex
Flowcontrol: None
Loopback: None (or external)
MTU: 1514
MRU: 1514
Inter-packet gap: standard (12)
BER monitoring:
Signal Degrade: 1e-255 (no-alarm)
Signal Fail: 1e-0 (report-alarm)
Forward error correction: Standard (Reed-Solomon)
```

The show command confirms that RS-FEC is enabled on the HundredGigE0/6/0/8 interface.

Configuring IPoDWDM

This section provides the following configuration procedures:

Configuring the Optical Layer DWDM Ports

Use the following procedure to configure the Optical Layer DWDM ports.

SUMMARY STEPS

- 1. configure
- 2. controller dwdm interface-path-id
- 3. network port id *id-number*
- 4. network connection id *id-number*
- **5.** Do one of the following:
 - end
 - •
 - commit

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.
	Example:	
	RP/0/RP0/CPU0:router# config	
Step 2	2 controller dwdm interface-path-id Example:	Specifies the DWDM controller and enters DWDM
		controller mode.

	Command or Action	Purpose
	RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1	
Step 3	network port id <i>id-number</i> Example:	Assigns an identifier number to a port for the Multi Service Transport Protocol (MSTP).
	<pre>RP/0/RP0/CPU0:router(config-dwdm) # network port id 1/0/1/1</pre>	
Step 4	network connection id <i>id-number</i> Example:	Configures a connection identifier for the Multi Service Transport Protocol (MSTP).
	<pre>RP/0/RP0/CPU0:router(config-dwdm) # network connection id 1/1/1/1</pre>	
Step 5	Do one of the following:	Saves configuration changes.
	• end •	• When you issue the end command, the system prompts you to commit changes:
	• commit	
	Example:	<pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre>
	RP/0/RP0/CPU0:router(config-dwdm)# end	• • Entering yes saves configuration changes to the
	Example:	session, and returns the router to EXEC mode.
	Example:	• Entering no exits the configuration session and returns the router to EXEC mode without
	RP/0/RP0/CP00:router(coniig-awam)# commit	 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.

Configuring the Administrative State of DWDM Optical Ports

Use the following procedure to configure the administrative state and optionally set the maintenance embargo flag.

SUMMARY STEPS

- 1. configure
- 2. controller dwdm interface-path-id
- **3.** admin-state {in-service | maintenance | out-of-service}
- 4. exit
- **5.** Do one of the following:

- interface pos interface-path-id
- •
- interface tengige *interface-path-id*

6. maintenance disable

- **7.** Do one of the following:
 - end
 - • commit

DETAILED STEPS

Step 1 configure Enters global configuration mode.	
Evenne	
RP/0/RP0/CPU0:router# config	
Step 2controller dwdm interface-path-idSpecifies the DWDM controller and enter	Specifies the DWDM controller and enters DWDM controller mode.
Example: controller mode.	
RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1	
Step 3 admin-state {in-service maintenance out-of-service} Specifies the transport administration state	ate.
Example:	
RP/0/RP0/CPU0:router(config-dwdm)# admin-state maintenance	
Step 4 exit Exits to the previous mode.	
Example:	
RP/0/RP0/CPU0:router(config-dwdm)# exit	
Step 5Do one of the following:Specifies the interface and enters interface	ce configuration
• interface pos interface-path-id mode.	mode.
• • interface tengige interface-path-id	
Fxample	
RP/0/RP0/CPU0:router(config) # interface pos 1/0/1/1	
Evenule	
Example.	

	Command or Action	Purpose
	<pre>RP/0/RP0/CPU0:router(config)# interface tengige 1/0/1/1</pre>	
Step 6	maintenance disable Example:	Provisions the maintenance embargo flag, which prevents maintenance activities from being performed on an interface.
	<pre>RP/0/RP0/CPU0:router(config-if)# maintenance disable</pre>	
Step 7	Do one of the following:	Saves configuration changes.
	• end •	• When you issue the end command, the system prompts you to commit changes:
	• commit	
	Example:	Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:
	RP/0/RP0/CPU0:router(config-dwdm)# end	• Entering yes saves configuration changes to the running configuration file, exits the configuration
	Example:	session, and returns the router to EXEC mode.
	Example:	• Entering no exits the configuration session and returns the router to EXEC mode without
	RP/0/RP0/CPU0:router(config-dwdm)# commit	 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.

Configuration Examples

This section includes the following examples:

Turning On the Laser: Example

Note This is a required configuration. The DWDM cards will not operate without this configuration.

The following example shows how to turn on the laser and place a DWDM port in In Service (IS) state:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:Router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:Router(config-dwdm)# admin-state in-service
RP/0/RP0/CPU0:Router(config-dwdm)# commit
```

Turning Off the Laser: Example

The following example shows how to turn off the laser, stop all traffic and place a DWDM port in Out of Service (OOS) state:

RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:Router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:Router(config-dwdm)# admin-state out-of-service
RP/0/RP0/CPU0:Router(config-dwdm)# commit

IPoDWDM Configuration: Examples

This section includes the following examples:

Optical Layer DWDM Port Configuration: Examples

The following example shows how to configure Optical Layer DWDM ports.

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:router(config-dwdm)# network port id 1/0/1/1
```

RP/0/RP0/CPU0:router(config-dwdm) # network connection id 1/1/1/1

Administrative State of DWDM Optical Ports Configuration: Examples

The following examples show how to configure the administrative state and optionally set the maintenance embargo flag:

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller dwdm 0/1/0/1
RP/0/RP0/CPU0:router(config-dwdm)# admin-state in-service
RP/0/RP0/CPU0:router(config-dwdm)# exit
RP/0/RP0/CPU0:router(config)# interface tengige 1/0/1/1
RP/0/RP0/CPU0:router(config-if)# maintenance disable
RP/0/RP0/CPU0:router(config-if)# commit
```

Additional References

These sections provide references related to DWDM controller configuration.

Related Documents

Related Topic	Document Title
Cisco IOS XR interface configuration commands	Cisco IOS XR Interface and Hardware Component Command Reference

Related Topic	Document Title
Initial system bootup and configuration information for a router using Cisco IOS XR software	Cisco IOS XR Getting Started Guide
Cisco IOS XR AAA services configuration information	Cisco IOS XR System Security Configuration Guide andCisco IOS XR System Security Command Reference

Standards

Standards	Title
ITU-T G.709/Y.1331	Interfaces for the optical transport network (OTN)

MIBs

MIBs	MIBs Link
	To locate and download MIBs for selected platforms using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL:
	http://www.cisco.com/go/mibs
OTN-MIB	IPoDWDM MIB

RFCs

Title
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Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/support