CHAPTER 5

Configuring the Fast Ethernet and Gigabit Ethernet SPAs

This chapter provides information about configuring the Cisco 1-port 10 Gigabit Ethernet SPA, 5-Port Gigabit Ethernet SPA, 8-Port Gigabit Ethernet SPA, 8-Port Fast Ethernet SPA,and Cisco 10-port Gigabit Ethernet SPA on Cisco 12000 series routers. It includes the following sections:

For information about managing your system images and configuration files, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide, Release 12.0* and *Cisco IOS Configuration Fundamentals Command Reference, Release 12.0* publications.

For more information about the commands used in this chapter, first see Chapter 19, "SIP and SPA Command Reference," which documents new and modified commands. Also refer to the related Cisco IOS Release 12.0 software command reference and master index publications. For more information about accessing these publications, see the "Related Documentation" section on page xix.

Configuration Tasks

This section describes how to configure the Cisco 1-port 10 Gigabit Ethernet SPA, the 1-Port 10-Gigabit Ethernet DWDM SPA, the 2-Port Gigabit Ethernet SPA, the 5-Port Gigabit Ethernet SPA, the 8-Port Gigabit Ethernet SPA, the 8-Port Fast Ethernet SPA, and the Cisco 10-port Gigabit Ethernet SPA. This section also includes information about verifying the configuration.

This section includes the following topics:

Required Configuration Tasks

This section lists the required configuration steps to configure the Gigabit Ethernet SPAs. Some of the required configuration commands implement default values that might be appropriate for your network. If the default value is correct for your network, then you do not need to configure the command. These commands are indicated by "(As Required)" in the purpose column.

Required Configuration Tasks for the Fast Ethernet SPA

To configure the 8-Port Fast Ethernet SPA, complete the following steps:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface fastethernet** *slot/subslot/port*[**.***subinterface-number*]	Specifies the Fast Ethernet interface to configure, where: • *slot/subslot/port*—Specifies the location of the interface. See the "Specifying the Interface Address" section on page 5-4. • **.***subinterface-number*—(Optional) Specifies a secondary interface (subinterface) number.
Step 3	Router(config-if)# **ip address** *ip-address mask* [**secondary**]	Sets a primary or secondary IP address for an interface, where: • *ip-address*—Specifies the IP address for the interface. • *mask*—Specifies the mask for the associated IP subnet. • **secondary**—(Optional) Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 4	Router(config-if)# **duplex** {**full** | **half**}	(As Required) Configures the duplex operation on an interface. The default is **full**.
Step 5	Router(config-if)# **speed** {**10** | **100**}	(As Required) Configures the speed of an interface (Mbps).
Step 6	Router(config-if)# **mtu** *bytes*	(As Required) Specifies the maximum packet size for an interface, where: • *bytes*—Specifies the maximum number of bytes for a packet. The default is 1500 bytes.
Step 7	Router(config-if)# **no shutdown**	Enables the interface.

Required Configuration Tasks for the Gigabit Ethernet SPA

To configure the Cisco 1-port 10 Gigabit Ethernet SPA, the 1-Port 10-Gigabit Ethernet DWDM SPA, the 2-Port Gigabit Ethernet SPA, the 5-Port Gigabit Ethernet SPA, the 8-Port Gigabit Ethernet SPA, or the Cisco 10-port Gigabit Ethernet SPA, complete the following steps:

	Command	Purpose
Step 1	Router# **configure terminal**	Enters global configuration mode.
Step 2	Router(config)# **interface gigabitethernet** *slot*/*subslot*/*port*[**.***subinterface-number*] or Router(config)# **interface tengigabitethernet** *slot*/*subslot*/*port*[**.***subinterface-number*]	Specifies the Gigabit Ethernet or Ten Gigabit Ethernet interface to configure, where: • *slot*/*subslot*/*port*—Specifies the location of the interface. See the "Specifying the Interface Address" section on page 5-4. • **.***subinterface-number*—(Optional) Specifies a secondary interface (subinterface) number.
Step 3	Router(config-if)# **ip address** *ip-address mask* [**secondary**]	For IPv4: Sets a primary or secondary IP address for an interface that is using IPv4, where: • *ip-address*—Specifies the IP address for the interface. • *mask*—Specifies the mask for the associated IP subnet. • **secondary**—(Optional) Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.
Step 4	Router(config)# **ip accounting mac-address** {**input** | **output**}	(Optional) Enables MAC address accounting. MAC address accounting provides accounting information for IP traffic based on the source and destination MAC addresses of the LAN interfaces, where: • **input**—specifies MAC address accounting for traffic entering the interface. • **output**—specifies MAC address accounting for traffic leaving the interface.
Step 5	Router(config-if)# **mtu** *bytes*	(As Required) Specifies the maximum packet size for an interface, where: • *bytes*—Specifies the maximum number of bytes for a packet. The default is 1500 bytes.

	Command	Purpose
Step 6	Router(config-if)# **standby** [*group-number*] **ip** [*ip-address* [**secondary**]]	(Required for HSRP Configuration Only) Creates (or enables) the HSRP group using its number and virtual IP address. • (Optional) *group-number*—The group number on the interface for which HSRP is being enabled. The range is 0 to 255; the default is 0. If there is only one HSRP group, you do not need to enter a group number. • (Optional on all but one interface if configuring HSRP) *ip-address*—The virtual IP address of the hot standby router interface. You must enter the virtual IP address for at least one of the interfaces; it can be learned on the other interfaces. • (Optional) **secondary**—The IP address is a secondary hot standby router interface. If neither router is designated as a secondary or standby router and no priorities are set, the primary IP addresses are compared and the higher IP address is the active router, with the next highest as the standby router. This command enables HSRP but does not configure it further. For additional information on configuring HSRP, see the "*Configuring Hot Standby Routing Protocol*" section of the *Cisco IOS Release 12.2 IP Configuration Guide*.
Step 7	Router(config-if)# **no shutdown**	Enables the interface.

Specifying the Interface Address

The interface address format when using SPAs is *slot*/*subslot*/*port*:

- *slot*—Specifies the slot number in the Cisco 12000 series router in which the SIP that contains the SPA is installed.
- *subslot*—Specifies the secondary slot on the MSC where the SPA that you want to select is installed.
- *port*—Specifies the interface number that you want to select on the SPA:
  - For the Cisco 1-port 10 Gigabit Ethernet SPA, 0 is the only option.
  - For the 2-Port Gigabit Ethernet SPA, 0 or 1 are the options.
  - For the 5-Port Gigabit Ethernet SPA, 0 through 4 are the options.
  - For the 8-Port Fast Ethernet SPA, 0 through 7 are the options.
  - For the 8-Port Gigabit Ethernet SPA, 0 through 7 are the options.
  - For the Cisco 10-port Gigabit Ethernet SPA, 0 through 9 are the options.

Figure 5-1 shows the slot, subslot, and interface port locations of the Cisco 10-port Gigabit Ethernet SPA on a Cisco 12000 series router.

Figure 5-1 Slot, Subslot, and Port Locations for the Cisco 10-port Gigabit Ethernet SPA and the 1-Port 10-Gigabit Ethernet SPA.

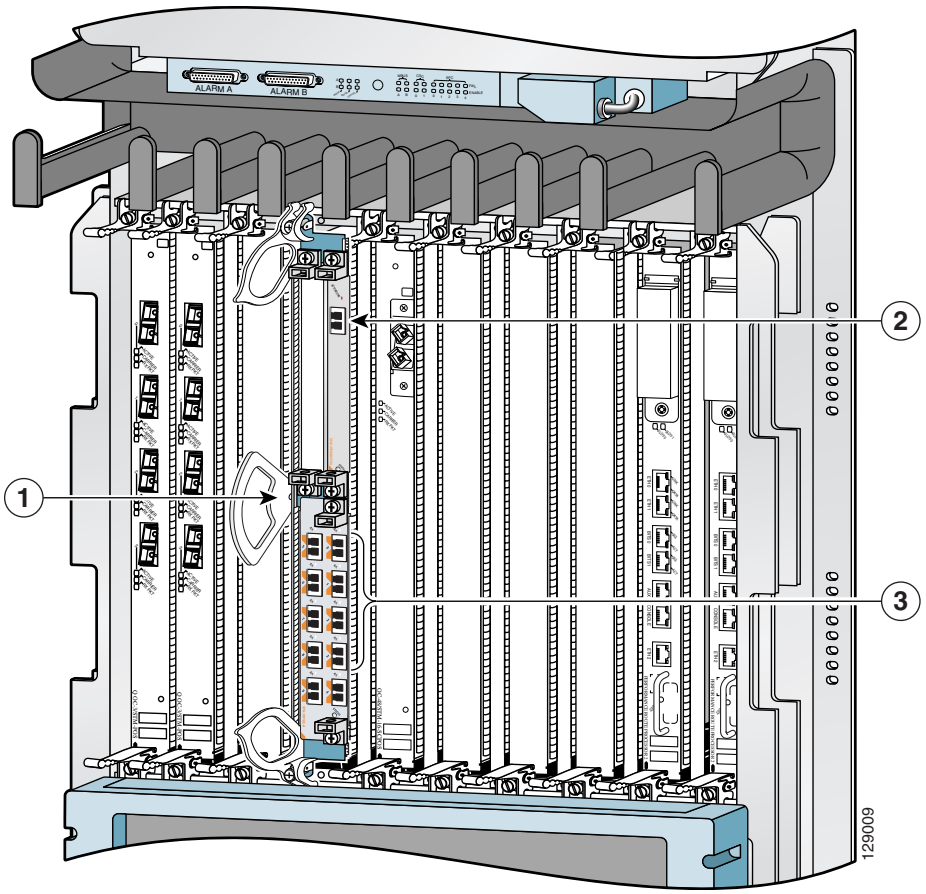

Table 5-1 Slot and Port Locations for the Gigabit Ethernet SPAs

Call Out Number	Description
1	Slot 3
2	Subslot 0, Port 3/0/0
3	Subslot 1, Ports 3/1/0 to 3/1/9

For more information about the installation of cards on the Cisco 12000 router, refer to the *Cisco 12000 SIP and SPA Hardware Installation Guide*.

Modifying the MAC Address on the Interface

The Fast Ethernet and Gigabit Ethernet SPAs use a default MAC address for each port that is derived from the base address that is stored in the electrically erasable programmable read-only memory (EEPROM) on the backplane of the Cisco 12000 series router.

To modify the default MAC address of an interface to some user-defined address, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **mac-address** *ieee-address*	Modifies the default MAC address of an interface to some user-defined address, where: • *ieee-address*—Specifies the 48-bit Institute of Electrical and Electronics Engineers (IEEE) MAC address written as a dotted triple of four-digit hexadecimal numbers (*xxxx.yyyy.zzzz*).

To return to the default MAC address on the interface, use the **no** form of the command.

Verifying the MAC Address

To verify the MAC address of an interface, use the **show interfaces gigabitethernet** privileged EXEC command and observe the value shown in the "address is" field.

The following example shows that the MAC address is 0008.7db3.8dfe for interface 0 on the SPA installed in slot 3 of the Cisco 12000 series router:

```
Router# show interfaces gigabitethernet 3/0/0
GigabitEthernet3/0/0 is up, line protocol is up
  Hardware is GigMac 1 Port 10 GigabitEthernet, address is 0008.7db3.8dfe (bia )
  Internet address is 10.0.0.2/24
  MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set
.
.
.
```

Gathering MAC Address Accounting Statistics

The **ip accounting mac-address** [**input** | **output**] command can be entered to enable MAC Address Accounting on an interface.

After enabling MAC Address Accounting, MAC address statistics can be gathered by entering the **show interface mac** command.

Configuring HSRP

Hot Standby Router Protocol (HSRP) is available for Fast Ethernet and Gigabit Ethernet SPAs. HSRP provides high network availability because it routes IP traffic from hosts without relying on the availability of any single router. HSRP is used in a group of routers for selecting an active router and a standby router. (An active router is the router of choice for routing packets; a standby router is a router that takes over the routing duties when an active router fails, or when preset conditions are met).

HSRP is enabled on an interface by entering the **standby** [*group-number*] **ip** [*ip-address* [**secondary**]] command. The **standby** command is also used to configure various HSRP elements. This document does not discuss more complex HSRP configurations. For additional information on configuring HSRP, see the *Configuring Hot Standby Routing Protocol* section of the *Cisco IOS Release 12.2 IP Configuration Guide*.

In the following HSRP configuration, standby group 2 on GigabitEthernet port 2/1/0 is configured at a priority of 110 and is also configured to have a preemptive delay should a switchover to this port occur.

```
Router(config)# interface GigabitEthernet 2/1/0
Router(config-if)# standby 2 ip 120.12.1.200
Router(config-if)# standby 2 priority 110
Router(config-if)# standby 2 preempt
```

Modifying the Interface MTU Size

The Cisco IOS software supports three different types of configurable maximum transmission unit (MTU) options at different levels of the protocol stack:

- Interface MTU—Checked by the SPA on traffic coming in from the network. Different interface types support different interface MTU sizes and defaults. The interface MTU defines the maximum packet size allowable (in bytes) for an interface before drops occur. If the frame is smaller than the interface MTU size, but is not smaller than the minimum frame size for the interface type (such as 64 bytes for Ethernet), then the frame continues to process.
- IP MTU—Can be configured on a subinterface and is used by the Cisco IOS software to determine whether fragmentation of a packet takes place. If an IP packet exceeds the IP MTU size, then the packet is fragmented.
- Tag or Multiprotocol Label Switching (MPLS) MTU—Can be configured on a subinterface and allows up to six different labels, or tag headers, to be attached to a packet. The maximum number of labels is dependent on your Cisco IOS software release.

Different encapsulation methods and the number of MPLS MTU labels add additional overhead to a packet. For example, Subnetwork Access Protocol (SNAP) encapsulation adds an 8-byte header, dot1q encapsulation adds a 2-byte header, and each MPLS label adds a 4-byte header (*n* labels x 4 bytes).

For the Fast Ethernet and Gigabit Ethernet SPAs on the Cisco 12000 series router, the default MTU size is 1500 bytes. The maximum configurable MTU is 9216 bytes. The SPA automatically adds an additional 38 bytes to the configured MTU size to accommodate some of the additional overhead.

Interface MTU Configuration Guidelines

When configuring the interface MTU size on a Fast Ethernet or Gigabit Ethernet SPA on a Cisco 12000 series router, consider the following guidelines:

- The default interface MTU size accommodates a 1500-byte packet, plus 38 additional bytes to cover the following additional overhead:
  - Layer 2 header—14 bytes
  - SNAP header—8 bytes
  - Dot1q header—4 bytes
  - 2 MPLS labels—8 bytes
  - CRC—4 bytes

Note Depending on your Cisco IOS software release, a certain maximum number of MPLS labels are supported. If you need to support more than two MPLS labels, then you should increase the default interface MTU size on the SPA interface.

- If you are using MPLS, be sure that the **mpls mtu** command is configured for a value less than or equal to the interface MTU.
- If you are using MPLS labels, then you should increase the default interface MTU size to accommodate the number of MPLS labels. Each MPLS label adds 4 bytes of overhead to a packet.

Interface MTU Configuration Task

To modify the MTU size on an interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **mtu** *bytes*	Configures the maximum packet size for an interface, where: • *bytes*—Specifies the maximum number of bytes for a packet. The default is 1500 bytes.

To return to the default MTU size, use the **no** form of the command.

Verifying the MTU Size

To verify the MTU size for an interface, use the **show interfaces fastethernet** or **show interfaces gigabitethernet**, or **show interfaces tengigabitethernet** privileged EXEC command and observe the value shown in the "MTU" field.

The following example shows an MTU size of 1500 bytes for interface port 0 (the first port) on the Gigabit Ethernet SPA installed in the top subslot (0) of the MSC that is located in slot 3 of the Cisco 12000 series router:

```
Router# show interfaces gigabitethernet 3/0/0
GigabitEthernet3/0/0 is up, line protocol is up
  Hardware is GigMac 1 Port 10 GigabitEthernet, address is 0008.7db3.8dfe (bia )
  Internet address is 10.0.0.2/24
  MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full Duplex, 10000Mbps, link type is autonegotiation, media type is T
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:01, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
        Available Bandwidth 10000000 kilobits/sec
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     11 packets input, 1154 bytes, 0 no buffer
     Received 1 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     67 packets output, 20951 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

Configuring the Encapsulation Type

By default, the interfaces on the Cisco 1-port 10 Gigabit Ethernet SPA, 5-Port Gigabit Ethernet SPA,8-Port Fast Ethernet SPA, and Cisco 10-port Gigabit Ethernet SPA support Advanced Research Projects Agency (ARPA) encapsulation. They do not support configuration of service access point (SAP) or SNAP encapsulation for transmission of frames; however, the interfaces will properly receive frames that use SAP and SNAP encapsulation.

The only other encapsulation supported by the SPA interfaces is IEEE 802.1Q encapsulation for virtual LANs (VLANs).

Configuring Autonegotiation on an Interface

Ethernet interfaces use a connection-setup algorithm called *autonegotiation.* Autonegotiation allows the local and remote devices to configure compatible settings for communication over the link. Using autonegotiation, each device advertises its transmission capabilities and then agrees upon the settings to be used for the link.

For the Fast Ethernet and Gigabit Ethernet interfaces on the Cisco 12000 series router, flow control is autonegotiated when autonegotiation is enabled. For the 10 Gigabit Ethernet interfaces, autonegotiation is not an option.

The following guidelines should be followed regarding autonegotiation:

- If autonegotiation is disabled on one end of a link, it has to be disabled on the other end of the link. If one end of a link has autonegotiation disabled while the other end of the link does not, the link will not come up properly on both ends.
- Flow control is enabled by default.
- Flow control will be on if autonegotiation is disabled on both ends of the link.

Disabling Autonegotiation

Autonegotiation is automatically enabled. During autonegotiation, advertisement for flow control is advertised. If the Fast Ethernet or Gigabit Ethernet interface is connected to a link that has autonegotiation disabled, autonegotiation should either be re-enabled on the other end of the link or disabled on the Fast Ethernet or Gigabit Ethernet SPA. Both ends of the link will not come up properly if only one end of the link has disabled autonegotiation.

To disable autonegotiation on a Fast Ethernet or Gigabit Ethernet interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **no negotiation auto**	Disables autonegotiation on Gigabit Ethernet SPA interfaces. No advertisement of flow control occurs.

Enabling Autonegotiation

Autonegotiation is automatically enabled. During autonegotiation, advertisement and configuration of flow control occurs. To re-enable autonegotiation on a Fast Ethernet or Gigabit Ethernet interface, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **negotiation auto**	Enables autonegotiation on Gigabit Ethernet SPA interfaces. Advertisement of flow control occurs.

Configuring a Subinterface on a VLAN

You can configure subinterfaces on the Cisco 1-port 10 Gigabit Ethernet SPA, 5-Port Gigabit Ethernet SPA, 8-Port Fast Ethernet SPA, and Cisco 10-port Gigabit Ethernet SPA on a VLAN using IEEE 802.1Q encapsulation.

Note The Cisco 10-port Gigabit Ethernet SPA does not support Inter-Switch Link (ISL) encapsulation.

To configure a SPA subinterface on a VLAN, use the following commands beginning in interface configuration mode:

	Command	Purpose
Step 1	Router(config)# **interface fastethernet** *slot/subslot/port.subinterface-number* or Router(config)# **interface gigabitethernet** *slot/subslot/port.subinterface-number* or Router(config)# **interface tengigabitethernet** *slot/subslot/port.subinterface-number*	Specifies the Fast Ethernet, Gigabit Ethernet, or Ten Gigabit Ethernet interface to configure, where: • *slot/subslot/port*—Specifies the location of the interface. See the "Specifying the Interface Address" section on page 5-4. • *.subinterface-number*—Specifies a secondary interface (subinterface) number.
Step 2	Router(config-subif)# **encapsulation dot1q** *vlan-id*	Defines the encapsulation format as IEEE 802.1Q ("dot1q"), where *vlan-id* is the number of the VLAN (1–4095).
Step 3	Router(config-if)# **ip address** *ip-address mask* [**secondary**]	Sets a primary or secondary IP address for an interface, where: • *ip-address*—Specifies the IP address for the interface. • *mask*—Specifies the mask for the associated IP subnet. • **secondary**—(Optional) Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.

Verifying Subinterface Configuration on a VLAN

To verify the configuration of a subinterface and its status on the VLAN, use the **show vlans** privileged EXEC command.

The following example shows the status of subinterface number 1 on port 0 on the SPA in VLAN number 200:

```
Router# show vlans
VLAN ID:200 (IEEE 802.1Q Encapsulation)

Protocols Configured:         Received:       Transmitted:
          IP                  0                  14

VLAN trunk interfaces for VLAN ID 200:

GigabitEthernet4/1/0.1 (200)

      IP:12.200.21.21

      Total 0 packets, 0 bytes input
      Total 2 packets, 120 bytes output
```

Configuring Flow Control Support on the Link

Flow control is turned on or off based on the result of the autonegotiation. For information on this process, see "Configuring Autonegotiation on an Interface" section on page 5-9.

Verifying Flow Control Status

To verify flow control status on a Fast Ethernet or Gigabit Ethernet interface on a SPA, use the **show interfaces fastethernet**, **show interfaces gigabitethernet** ,or **show interfaces tengigabitethernet** privileged EXEC command and view the "output flow-control is" and " input flow-control is" output lines to see if input and output flow control is on or off. The "pause input" and "pause output" counters of the output of this command can be used to view the number of pause frames sent or received by the interface.

The following example shows that zero pause frames have been transmitted and received by the MAC device for interface port 3 (the fourth port) on the SPA located in subslot 0 of the MSC that is installed in slot 3 of the Cisco 12000 series router:

```
Router# show interfaces gigabitethernet 3/0/3
GigabitEthernet3/0/3 is up, line protocol is up
  Hardware is GigabitEthernet, address is 0008.7db3.8e01 (bia 0008.7db3.8e01)
  Internet address is 13.0.0.2/24
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full Duplex, 1000Mbps, link type is autonegotiation, media type is T
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:09, output 00:00:09, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
        Available Bandwidth 1000000 kilobits/sec
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     5 packets input, 520 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     26 packets output, 8286 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
```

```
0 babbles, 0 late collision, 0 deferred
0 lost carrier, 0 no carrier, 0 pause output
0 output buffer failures, 0 output buffers swapped out
```

Saving the Configuration

To save your running configuration to nonvolatile random-access memory (NVRAM), use the following command in privileged EXEC configuration mode:

Command	Purpose
Router# **copy running-config startup-config**	Writes the new configuration to NVRAM.

For more information about managing configuration files, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide, Release 12.0* and *Cisco IOS Configuration Fundamentals Command Reference, Release 12.0* publications.

Shutting Down and Restarting an Interface on a SPA

You can shut down and restart any of the interface ports on a SPA independently of each other. Shutting down an interface stops traffic and enters the interface into an "administratively down" state.

If you are preparing for an OIR of a SPA, it is not necessary to independently shut down each of the interfaces prior to deactivation of the SPA. The **hw-module subslot shutdown** command automatically stops traffic on the interfaces and deactivates them along with the SPA in preparation for OIR.

In similar fashion, you do not need to independently restart any interfaces on a SPA after OIR of a SPA or MSC.

To shut down an interface on a SPA, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **shutdown**	Disables an interface.

To restart an interface on a SPA, use the following command in interface configuration mode:

Command	Purpose
Router(config-if)# **no shutdown**	Restarts a disabled interface.

Verifying the Interface Configuration

Besides using the **show running-configuration** command to display your router configuration settings, you can use the **show interfaces gigabitethernet** command to get detailed information on a per-port basis for your Cisco 1-port 10 Gigabit Ethernet SPA, Cisco 1-Port 10-Gigabit Ethernet DWDM SPA, 5-Port Gigabit Ethernet SPA, and Cisco 10-port Gigabit Ethernet SPA. For the 8-Port Fast Ethernet SPA, **show interfaces fastethernet** can be entered to gather detailed per-port information.

Verifying Per-Port Interface Status

To find detailed interface information on a per-port basis for the Fast Ethernet or Gigabit Ethernet SPAs, use the **show interfaces fastethernet**, **show interfaces gigabitethernet** ,or **show interfaces tengigabitethernet** command. For a description of the command output, see Chapter 19, "SIP and SPA Command Reference."

The following example provides sample output for interface port 0 on the Gigabit Ethernet SPA located in the top subslot (0) of the MSC that is installed in slot 3 of the Cisco 12000 series router:

```
Router# show interfaces gigabitethernet 3/0/0
GigabitEthernet3/0/0 is up, line protocol is up
  Hardware is GigMac 1 Port 10 GigabitEthernet, address is 0008.7db3.8dfe (bia )
  Internet address is 10.0.0.2/24
  MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full Duplex, 10000Mbps, link type is autonegotiation, media type is T
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:01, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
        Available Bandwidth 10000000 kilobits/sec
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     11 packets input, 1154 bytes, 0 no buffer
     Received 1 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     67 packets output, 20951 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

The following example provides sample output for interface port 0 on the Fast Ethernet SPA located in the top subslot (0) of the SIP that is installed in slot 7 of the Cisco 12000 series router:

```
Router# show interfaces fastethernet 7/0/0
FastEthernet7/0/0 is administratively down, line protocol is down
  Hardware is FastEthernet, address is 0000.001c.a400 (bia 0000.001c.a400)
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full Duplex, 100Mbps, link type is autonegotiation, media type is 100BaseTx
  output flow-control is unsupported, input flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
        Available Bandwidth 100000 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     0 packets output, 0 bytes, 0 underruns
     Transmitted 0 broadcasts
     0 output errors, 0 collisions, 0 interface resets
```

```
0 babbles, 0 late collision, 0 deferred
0 lost carrier, 0 no carrier, 0 pause output
0 output buffer failures, 0 output buffers swapped out
```

Configuration Examples

This section includes the following configuration examples:

Basic Interface Configuration Example

The following example shows how to enter global configuration mode to specify the interface that you want to configure, configure an IP address for the interface, and save the configuration. This example configures interface port 1 on the SPA that is located in subslot 0 of the MSC, that is installed in slot 3 of the Cisco 12000 series router:

```
!Enter global configuration mode
!
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface gigabitethernet 3/0/1
!
! Configure an IP address
!
Router(config-if)# ip address 192.168.50.1 255.255.255.0
!
! Start the interface
!
Router(config-if)# no shut
!
! Save the configuration to NVRAM
!
Router(config-if)# exit
Router# copy running-config startup-config
```

The following example shows the same configuration on a port, but with an IPv6 address:

```
!Enter global configuration mode
!
Router# configure terminal
```

```
Enter configuration commands, one per line. End with CNTL/Z.
!
!Enable IPv6 Routing
!
Router(config)#
!
! Specify the interface address
!
Router(config)# interface gigabitethernet 3/0/1
!
! Configure an IP address
!
Router(config-if)# ipv6 address 2001:10::1/64
Router(config-if)# ipv6 address FEC0:11:1001:11::1/64
!
! Start the interface
!
Router(config-if)# no shut
!
! Save the configuration to NVRAM
!
Router(config-if)# exit
Router# copy running-config startup-config
```

MAC Address Configuration Example

The following example changes the default MAC address on the interface to 1111.2222.3333:

```
!Enter global configuration mode
!
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface gigabitethernet 3/0/1
!
! Modify the MAC address
!
Router(config-if)# mac-address 1111.2222.3333
```

MTU Configuration Example

The following example sets the interface MTU to 9216 bytes:

Note The SPA automatically adds an additional 36 bytes to the configured interface MTU size.

```
!Enter global configuration mode
!
Router# configure terminal
```

```
Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface gigabitethernet 3/0/1
!
! Configure the interface MTU
!
Router(config-if)# mtu 9216
```

VLAN Configuration Example

The following example creates subinterface number 268 on SPA interface port 2 (the third port), and configures the subinterface on the VLAN with ID number 269 using IEEE 802.1Q encapsulation:

Note The SPA does not support ISL encapsulation.

```
!Enter global configuration mode
!
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface gigabitethernet 3/0/1.268
!
! Configure dot1q encapsulation and specify the VLAN ID
!
Router(config-subif)# encapsulation dot1q 268
```

Configuring Dense Wavelength Division Multiplexing Controllers on Cisco IOS Software

This module describes the configuration of dense wavelength division multiplexing (DWDM) controller on routers supporting Cisco IOS software. DWDM is an optical technology that is used to increase bandwidth over existing fiber-optic backbones. DWDM can be configured on 1-Port 10-Gigabit Ethernet DWDM SPA.

Feature History for Configuring DWDM Controller Interfaces

Release	Modification
Release 12.0(33)s	This feature was introduced on the Cisco 12000 Series Router.
	Support was added for the 1-Port 10-Gigabit Ethernet DWDM SPA (SPA-1X10GE-L-ITUC).

Contents

Prerequisites for Configuring DWDM Controller Interfaces

Before configuring a DWDM controller, be sure that the following tasks and conditions are met:

- You must be in a user group associated with a task group that includes the proper task IDs for DWDM commands.
- Your SPA must support DWDM. The 1-Port 10-Gigabit Ethernet DWDM SPA supports DWDM.

Information About the DWDM Controllers

DWDM support in Cisco IOS 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. It also provides for forward error correction (FEC) that can allow a reduction in network costs by reducing the number of regenerators used.

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 data unit (ODU) OH is added to the OPU to create the ODU. The ODU OH includes information for maintenance and operational functions to support optical channels.
- Optical channel transport unit (OTU) OH together with the FEC is added to form the OTU. The OTU OH includes information for operational functions to support the transport by way of one or more optical channel connections.
- Optical channel (OCh) OH is added to form the OCh. The OCh provides the OTN management functionality and contains four subparts: the OPU, ODU, OTU, and frame alignment signal (FAS). See Figure 5-2.

Figure 5-2 OTN Optical Channel Structure

How to Configure DWDM Controllers

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

- Configuring the Optical Parameters, page 5-18
- Configuring G.709 Parameters, page 5-20

Note All interface configuration tasks for the GE interfaces still must be performed in interface configuration mode. .

Configuring the Optical Parameters

This task describes how to configure the receive power threshold and the wavelength parameters for the DWDM controller. You should verify that the optical parameters are configured correctly for your DWDM installation and if necessary, perform this task.

Prerequisites

The **rx-threshold** and **wavelength** commands can be used only when the controller is in the shutdown state. Use the **shutdown** command.

SUMMARY STEPS

1. **configure**
2. **controller dwdm** <*slot*>/<*subslot*>/<*port*>
3. **shutdown**
4. **rx-threshold** *power-level*
5. **wavelength** *channel-number*
6. **g709 fec enhanced**
7. **no shutdown**
8. **show controller dwdm** <*slot*>/<*subslot*>/<*port*> [**g709 | optics | wavelegth-map**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure t** **Example:** `Router# configure t`	Enters global configuration mode.
Step 2	**controller dwdm** *<slot>/<subslot>/<port>* **Example:** `Router(config)# controller dwdm 3/0/0`	Specifies the DWDM controller name in the notation *slot/subslot/port* and enters DWDM configuration mode.
Step 3	**shutdown** **Example:** `Router(config-dwdm)# shutdown`	Disables the DWDM controller. You must disable the controller before you can use the DWDM configuration commands.
Step 4	**rx-threshold** *power-level* **Example:** `Router(config-dwdm)# rx-threshold -10`	Configures the transponder receive power threshold for the DWDM controllers. The range for the parameters are provided by the platform specific part of the software at the time of the init to the configuration utility. The all inclusive range of the values will be shown to the CLI options, however only the acceptable range is allowed to be configured on the specific controller.
Step 5	**wavelength** *channel-number* **Example:** `Router(config-dwdm)# wavelength 1`	Configures the channel number corresponding to the first wavelength. Values are selected between 1 to 80 and the platform supported will be checked before applying the configuration. The default channel selected is first channel on the transponder.
Step 6	**g709 fec enhanced** **Example:** `Router(config-dwdm)# g709 fec enhanced`	Configures the forward error correction (fec) mode for the DWDM controller to enhanced.
Step 7	**no shutdown** **Example:** `Router(config-dwdm)# no shutdown`	Removes the shutdown configuration. • The removal of the shutdown configuration removes the forced administrative down on the controller, enabling the controller to move to an up or down state.
Step 8	**show controllers dwdm** *<slot>/<subslot>/<port>* [**g709** | **optics** | **wavelegth-map**] **Example:** `Router# show controller dwdm 3/0/0 g709`	Displays the g709 OTN protocol alarms, output power level, input power level, wavelength, and laser bias current monitoring information.

Troubleshooting Tips

You must shut down the controller before you can use the DWDM configuration commands.

Configuring G.709 Parameters

This task describes how to customize the alarm display and the thresholds for alerts and forward error correction (Refer ITU standards for STD FEC=ITU G.975 and Enhanced FEC=ITU G.975.1). You need to use this task only if the default values are not correct for your installation.

Prerequisites

The **g709 disable**, **loopback**, and **g709 fec** commands can be used only when the controller is in the shutdown state. Use the **no shutdown** command after configurating the parameters to remove the controller from shutdown state and enabling the controller to move to up or down state.

SUMMARY STEPS

1. **configure**
2. **controller dwdm** <*slot*>/<*subslot*>/<*port*>
3. **shutdown**
4. **g709 disable**
5. **loopback internal**
6. **g709 fec** {**enhanced** | **standard**}
7. **g709** {**odu** | **otu**} *alarm* **disable**
8. **no shutdown**
9. **show controllers dwdm** <*slot*>/<*subslot*>/<*port*> **g709**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `Router# configure`	Enters global configuration mode.
Step 2	**controller dwdm** *<slot>/<subslot>/<port>* **Example:** `Router(config)# controller dwdm 3/0/0`	Specifies the DWDM controller name in the notation <*slot*>/<*subslot*>/<*port*> and enters DWDM configuration mode.
Step 3	**shutdown** **Example:** `Router(config-dwdm)# shutdown`	Disables the DWDM controller. You must disable the controller before you can use the DWDM configuration commands.
Step 4	**g709 disable** **Example:** `Router(config-dwdm)# g709 disable`	(Optional) Disables the G.709 wrapper. The wrapper is enabled by default.

	Command or Action	Purpose
Step 5	**loopback** {**internal** | **line**} **Example:** `Router(config-dwdm)# loopback internal`	(Optional) Configures the DWDM controller for loopback mode.
Step 6	**g709 fec** {**enhanced** | **standard**} **Example:** `Router(config-dwdm)# g709 fec enhanced`	(Optional) Configures the forward error correction mode (FEC) for the DWDM controller. By default, enhanced FEC is enabled.
Step 7	**g709** {**odu** | **otu**} *alarm* **disable** **Example:** `Router(config-dwdm)# g709 odu bdi disable`	(Optional) Disables the logging of selected optical channel data unit (ODU) alarms or optical channel transport unit (OTU) alarms to the console for a DWDM controller. By default, all alarms are logged to the console.
Step 8	**no shutdown** **Example:** `Router(config-dwdm)# no shutdown`	Removes the shutdown configuration. • The removal of the shutdown configuration removes the forced administrative down on the controller, enabling the controller to move to an up or down state.
Step 9	**show controllers dwdm** *<slot>/<subslot>/<port>* **g709** **Example:** `Router# show controller dwdm 3/0/0 g709`	Displays detailed information about G.709 OTN protocol alarms and counters for Bit Errors, along with the FEC statistics and threshold based alerts.

Examples

The following example shows how to bring the DWDM controller down before using the configuration commands:

```
Router# configure
Router(config)# controller dwdm 3/0/0
Router(config-dwdm)# shutdown
Router(config-dwdm)# rx-threshold 0
Router(config-dwdm)# wavelength 1
Router(config-dwdm)# no shutdown
```

The following example shows how to customize the alarm display and the thresholds for alerts and forward error correction (FEC):

```
Router# configure
Router(config)# controller dwdm 3/0/0
Router(config-dwdm)# shutdown
Router(config-dwdm)# no g709 disable
Router(config-dwdm)# loopback internal
Router(config-dwdm)# g709 fec standard
Router(config-dwdm)# g709 odu bdi disable
Router(config-dwdm)# no shutdown
```

Additional References

The following sections provide references related to DWDM controller configuration.

Standards

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

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature	To locate and download MIBs for selected platforms using Cisco IOS software, use the Cisco MIB Locator found at the following URL: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

RFCs

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

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/techsupport