System Overview

The Cisco ONS 15530 is an optical transport platform that employs DWDM (dense wavelength division multiplexing) technology. With the Cisco ONS 15530, users can take advantage of the availability of dark fiber to build a common infrastructure that supports data networking and storage networking.

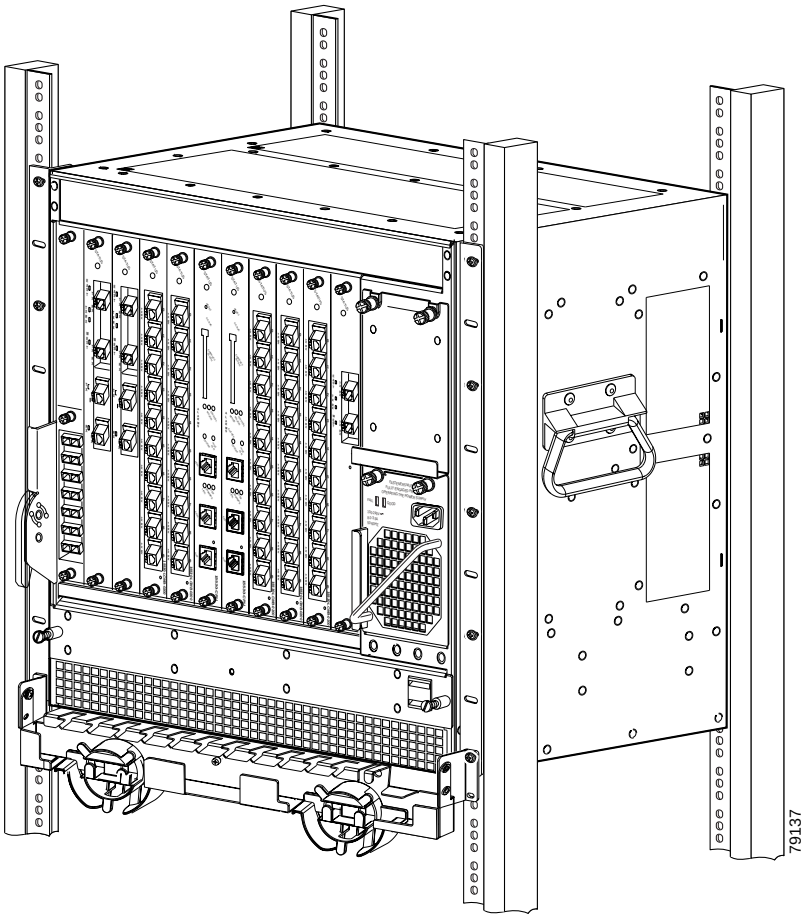
This chapter contains the following major sections:

Chassis Description

The Cisco ONS 15530 uses an 11-slot modular vertical chassis (see Figure 1-1). As you face the chassis, the leftmost slot (slot 0) holds up to two OADM (optical add/drop multiplexer/demultiplexer) modules. Slots 1 to 4 and 7 to 10 hold the line cards. Slots 5 and 6 hold the CPU switch modules. Air inlet, fan tray, and cable management are located beneath the modular slots. The system has an electrical backplane for system control and signal cross connection via the switch fabric.

The system receives power from two +12 volt redundant power supplies. Both 120V AC and –48V DC power supply options are supported.

Figure 1-1 Cisco ONS 15530 Shelf Layout



Chassis Configurations

There are two versions of the Cisco ONS 15530 chassis, each with different air flow and other mechanical design characteristics. The NEBS (Network Equipment Building System) version of the Cisco ONS 15530 chassis is designed for the North American and other markets. The mechanical design characteristics include the following:

- Handles located on the top of the chassis
- Air flow through the chassis from front to back

The other chassis is designed for ETSI (European Telecommunications Standards Institute), a standards organization for the European Union. The mechanical design characteristics include the following:

- Handles located on the sides of the chassis.
- Air flow through the chassis from bottom to top and equipped with baffles that bring the air from the front to the back.

For detailed specifications information on the Cisco ONS 15530 chassis, refer to the *Cisco ONS 15530 Hardware Installation Guide*.

System Functional Overview

The Cisco ONS 15530 connects to client equipment, to the DWDM trunk (transport network), to other Cisco ONS 15530 shelves, and to other DWDM equipment, such as the Cisco ONS 15540 ESP and Cisco ONS 15540 ESPx. Simply described, the Cisco ONS 15530 takes a client signal and converts it to an ITU-T G.692 compliant wavelength, then either optically multiplexes it with the other client signals for transmission over an optical fiber link or sends it through an uplink connection to a Cisco ONS 15540 ESP or Cisco ONS 15540 ESPx.

The Cisco ONS 15530 supports 1+1 path protection using both hardware mechanisms and software based on the APS (Automatic Protection Switching) standard. In a single shelf configuration, a Cisco ONS 15530 node can support up to four channels with facility (fiber) protection or with line card protection, or eight unprotected channels. In a multiple shelf configuration, a node can support up to 32 channels. The Cisco ONS 15530 can be deployed in point-to-point, hubbed ring, and mesh topologies.

The Cisco ONS 15530 is a duplex system with both light emitters and light detectors. For example, the client side interfaces both transmit and receive light. The same is true of the DWDM interface. Also, the OADM modules both multiplex the transmit signal and demultiplex the receive signal.

The Cisco ONS 15530 supports the following two types of transmission modes:

- Transparent mode using the transponder line cards
- Switched mode using the switch fabric on the CPU switch modules to cross connect the ESCON aggregation cards, 4-port 1-Gbps/2-Gbps FC aggregation card, or 8-port FC/GE aggregation line cards and 2.5-Gbps ITU trunk cards, 10-Gbps ITU tunable and non tunable trunk cards, or 10-Gbps uplink cards.

Figure 1-2 illustrates the principal functions involved in transparent transmission of the signal between the client and trunk networks using the transponder line card. Optical cross connections from the front panel of the transponder line card take the signal to the OADM module.

Figure 1-2 Simplified Data Flow Architecture For a Transponder Line Card

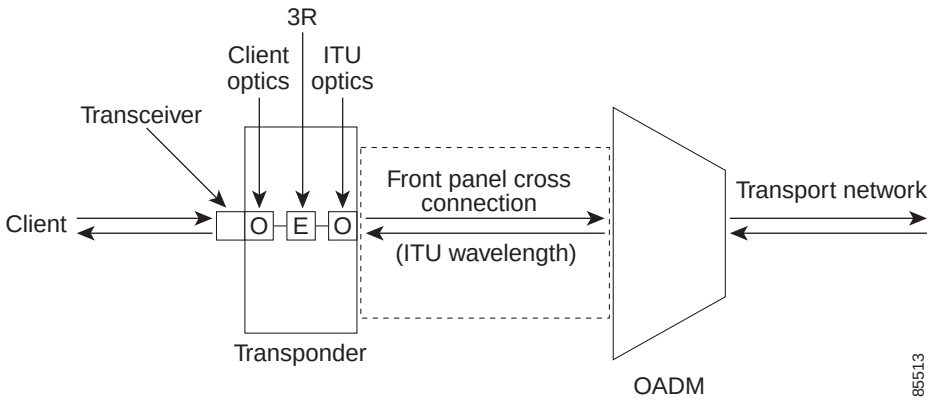
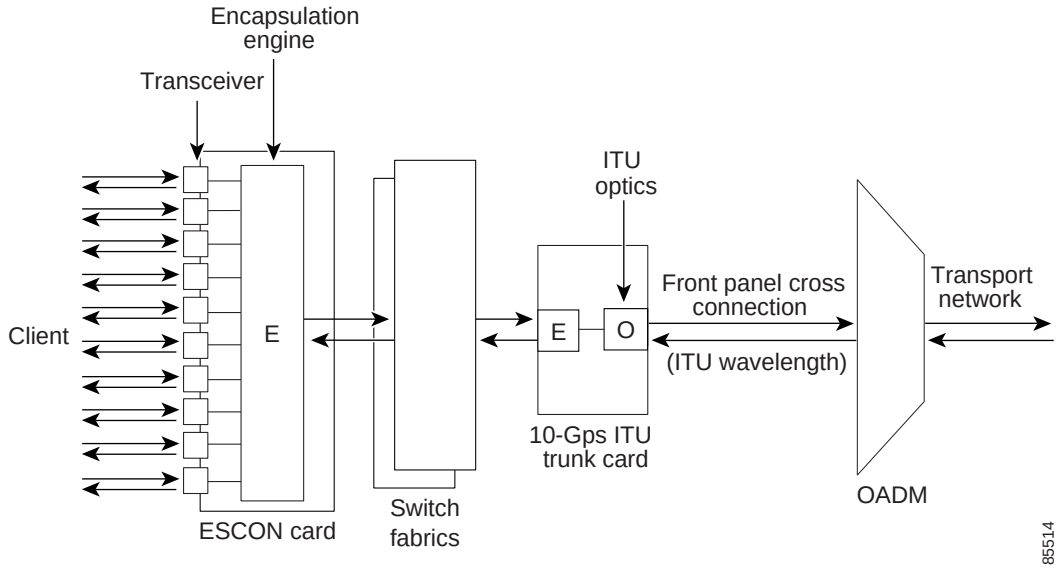


Figure 1-3 illustrates the principal functions involved in transmission of the signal between the client and trunk networks using the ESCON aggregation card and the 10-Gbps ITU trunk card. Electrical cross connections from the backplane side of the ESCON aggregation card take the signal through the switch fabrics on the CPU switch modules to the 10-Gbps ITU trunk card. Optical cross connections from the front panel of the 10-Gbps ITU trunk card take the signal to the OADM module.

Figure 1-3 Simplified Data Flow Architecture For an ESCON Aggregation Card and a 10-Gbps ITU Trunk Card



System Components

The Cisco ONS 15530 has a modular architecture that provides the flexibility to expand the system as the network grows. The Cisco ONS 15530 components are described in the following sections.

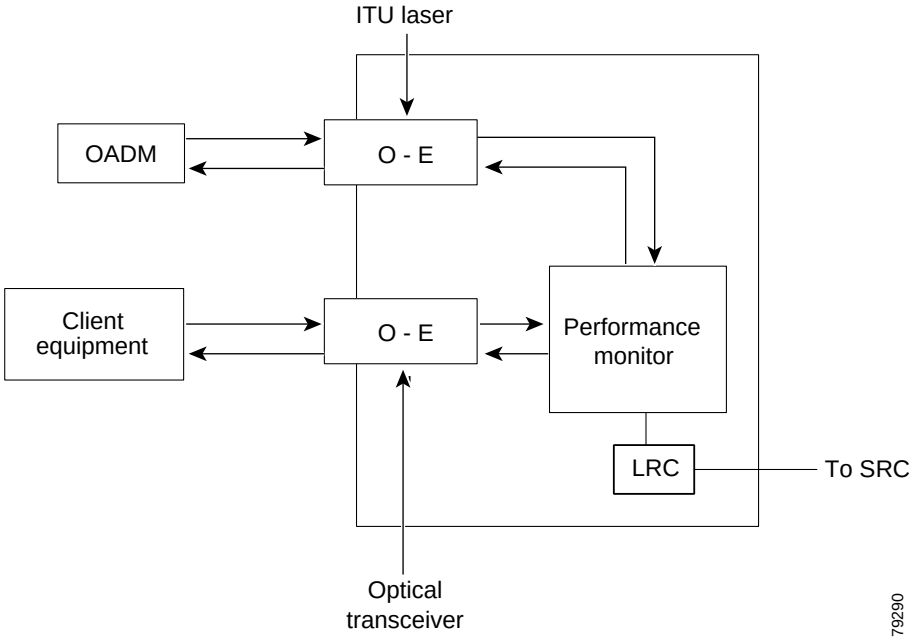
Transponder Line Cards

The Cisco ONS 15530 supports two types of transponder line cards: SM (single-mode) and MM (multimode). You can install the transponder line cards in any line card slot in the shelf (slots 1 to 4 and 7 to 10).

In the transponder line card, the client signal is regenerated, retimed, and retransmitted on an ITU-compliant wavelength. The ITU laser on each transponder line card is capable of generating one of two wavelengths on the trunk side. Thus, there are 16 different transponder line cards (for channels 1–2, 3–4,..., 31–32) to support the 32 channels; each module is available in SM and MM versions. The wavelength generated is configurable from the CLI (command-line interface).

Figure 1-4 shows the architecture of the transponder line card.

Figure 1-4 Transponder Line Card Architecture



A safety protocol, LSC (laser safety control), shuts the transmit laser down on the trunk side when a fiber break or removed connector is detected. The transponder line cards are hot pluggable, permitting in-service upgrades and replacement.

Client Side Interfaces

The client interfaces on the SM transponder line cards and MM transponder line cards are protocol transparent and bit-rate transparent, and accept either single-mode or multimode client signals on the 1310-nm wavelength through SC connectors. The multimode transponder supports 62.5 mMM, 50 mMM, and 9 or 10 mSM fiber; the single-mode transponder supports 50 mMM fiber and 9 or 10 m SM fiber.

The transponder interfaces support encapsulation of client signals in either 3R (reshape, retime, retransmit) enhanced mode, which allows some client protocol monitoring (such as code violations and data errors) or regular 3R mode, where the transponder is transparent to the client data stream. In either case, the content of the client data stream remains unmodified. Configurable failure and degrade thresholds for monitored protocols are also supported.

Table 1-1 shows the common client signal protocol encapsulations supported on the SM transponder line cards and MM transponders modules.

Table 1-1 Common Protocol Encapsulations Supported on SM Transponder Line Cards and MM Transponder Line Cards

Client Signal Encapsulation	Fiber Type	Wavelength (nm)		Transponder Type		Protocol Monitoring
		1310	850	SM	MM	
Gigabit Ethernet (1250 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes	No	Yes
	MM 62.5/125 m	Yes	No	No	No	—
Fast Ethernet (125 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	No
	MM 50/125 m	Yes	No	Yes	Yes	No
	MM 62.5/125 m	Yes	No	No	Yes	No
SONET STS-3/ SDH STM-1 (OC-3) (155 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	Yes
	MM 50/125 m	Yes	No	Yes	Yes	Yes
	MM 62.5/125 m	Yes	No	No	Yes	Yes
SONET STS-12/SDH STM-4 (OC-12) (622 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	Yes
	MM 50/125 m	Yes	No	Yes	Yes	Yes
	MM 62.5/125 m	Yes	No	No	Yes	Yes
SONET STS-48/ SDH STM-16 (OC-48) (2488 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes	No	Yes
	MM 62.5/125 m	Yes	No	No	No	—
ATM 155 (OC-3) (155 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	Yes
	MM 50/125 m	Yes	No	Yes	Yes	Yes
	MM 62.5/125 m	Yes	No	No	Yes	Yes
Fiber Channel (1062 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes	No	Yes
	MM 62.5/125 m	Yes	No	No	No	—
Fiber Channel (2125 Mbps)	SM 9 o r10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes	No	Yes
	MM 62.5/125 m	Yes	No	No	No	—
FDDI (125 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	No
	MM 50/125 m	Yes	No	Yes	Yes	No
	MM 62.5/125 m	Yes	No	No	Yes	No

Table 1-2 shows the IBM storage protocols on the SM transponder line cards and MM transponders modules.

Table 1-2 IBM Storage Protocols Supported on Single-Mode and Multimode Transponders

Client Signal Encapsulation	Fiber Type	Wavelength (nm)		Transponder Type		Protocol Monitoring
		1310	850	SM	MM	
ESCON (200 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	Yes
	MM 50/125 m	Yes	No	No	Yes	Yes
	MM 62.5/125 m	Yes	No	No	Yes	Yes
FICON (1062 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes[1]	No	Yes
	MM 62.5/125 m	Yes	No	Yes[1]	No	Yes
FICON (2125 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes[2]	No	Yes
	MM 62.5/125 m	Yes	No	Yes[1]	No	Yes
Coupling Facility, ISC-3 compatibility mode (1062 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	Yes	No	Yes[1]	No	Yes
	MM 62.5/125 m	No	No	—	—	—
Coupling Facility, ISC-3 peer mode (2125 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	No	No	—	—	—
	MM 62.5/125 m	No	No	—	—	—
Coupling Facility, ISC-3 peer mode (1062 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	Yes
	MM 50/125 m	No	No	—	—	—
	MM 62.5/125 m	No	No	—	—	—
Sysplex Timer (ETR and CLO) (8 Mbps[3])	SM 9 or 10/125 m	No	No	—	—	—
	MM 50/125 m	Yes	No	No	Yes	No
	MM 62.5/125 m	Yes	No	No	Yes	No

1. These protocols require the use of a special mode-conditioning patch cable (available from IBM) at each end of the connection.
2. These protocols require the use of a special mode-conditioning patch cable (available from IBM) at each end of the connection.
3. Sysplex Timer is the only protocol supported at a clock rate less than 16 Mbps.

Table 1-3 shows some other common protocols that are supported on the SM transponder line cards and MM transponders modules without protocol monitoring.

Table 1-3 Other Client Signal Encapsulations Supported on Single-Mode and Multimode Transponders

Client Signal Encapsulation	Fiber Type	Wavelength (nm)		Transponder Type		Protocol Monitoring
		1310	850	SM	MM	
DS3 (45 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	No
	MM 50/125 m	Yes	No	Yes	Yes	No
	MM 62.5/125 m	Yes	No	No	Yes	No
OC-1 (51.52 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	Yes	No
	MM 50/125 m	Yes	No	Yes	Yes	No
	MM 62.5/125 m	Yes	No	No	Yes	No
OC-24 (933.12 Mbps)	SM 9 or 10/125 m	Yes	No	Yes	No	No
	MM 50/125 m	Yes	No	Yes	No	No
	MM 62.5/125 m	Yes	No	No	No	No

Additional discrete rates are also supported in regular 3R mode. For SM transponder line cards, these rates fall between 16 Mbps and 2.5 Gbps; for MM transponder line cards, the rates are between 16 Mbps and 622 Mbps.

The system supports OFC (open fiber control) for Fibre Channel and ISC encapsulations. Alternatively, FLC (forward laser control) can be enabled to shut down the laser on the client or trunk side if a Loss of Light is detected on the other side.

The transponder line cards support autonegotiation for Gigabit Ethernet traffic.

Note The Cisco ONS 15530 transponder line cards do not support autonegotiation for 2-Gbps Fibre Channel. The transponder line cards only recognize the configured clock rate or protocol encapsulation.

For detailed information about client interface configuration, refer to the *Cisco ONS 15530 Configuration Guide*.

Protocol Monitoring

The transponder line cards can monitor protocol and signal performance. When monitoring is enabled, the system maintains statistics that are used to determine the quality of the signal.

The following protocols can be monitored:

- ESCON (Enterprise Systems Connection)
- FC (Fibre Channel) (1 Gbps and 2 Gbps)
- FICON (Fiber Connection) (1 Gbps and 2 Gbps)
- GE (Gigabit Ethernet)
- ISC-3 links compatibility mode
- ISC-3 links peer mode (1-Gbps and 2-Gbps)
- SDH (Synchronous Digital Hierarchy) (STM-1, STM-4, STM-16)
- SONET (OC-3, OC-12, OC-48)

For GE, FC, and FICON traffic, the Cisco ONS 15530 monitors the following conditions:

- CVRD (code violation running disparity) error counts
- Loss of Sync
- Loss of Lock
- Loss of Light

For SONET errors, the Cisco ONS 15530 monitors the SONET section overhead only, not the SONET line overhead. Specifically, the system monitors the B1 byte and the framing bytes. The system detects the following defect conditions:

- Loss of Light
- Loss of Lock (when the clock cannot be recovered from the received data stream)
- Severely errored frame
- Loss of Frame

For SONET performance, the system monitors the B1 byte, which is used to compute the four SONET section layer performance monitor parameters:

- SEFS-S (second severely errored framing seconds)
- CV-S (section code violations)
- ES-S (section errored seconds)
- SES-S (section severely errored seconds)

For ISC-3 traffic, the system monitors the following conditions:

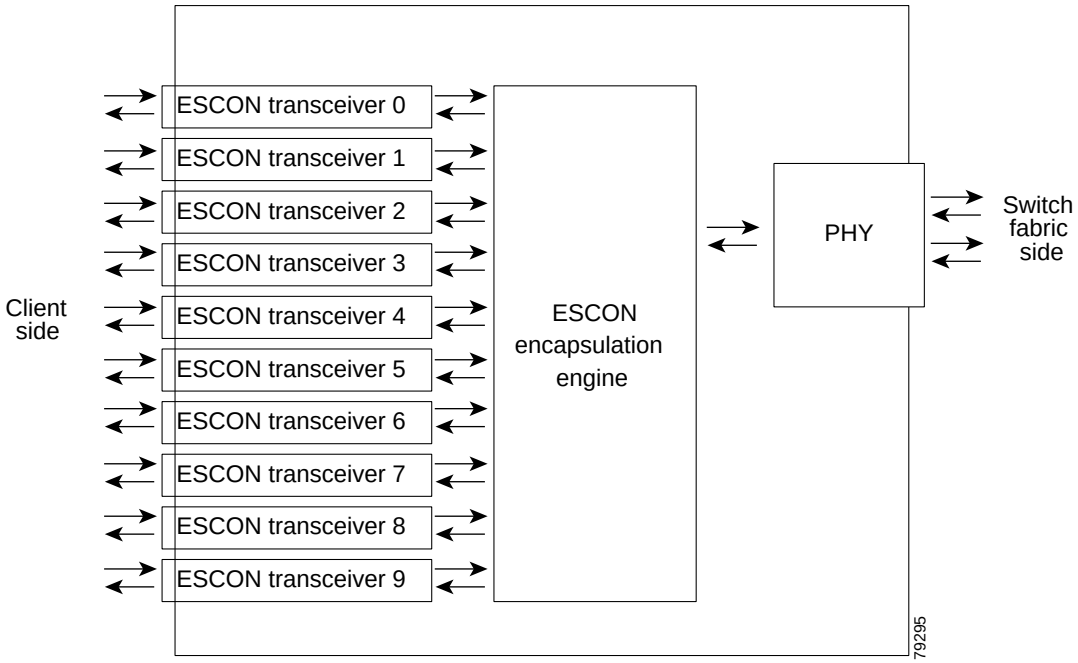
- CVRD error counts
- Loss of CDR (clock data recovery) Lock
- Loss of Light

ESCON Aggregation Cards

The Cisco ONS 15530 supports a line card specifically for ESCON traffic. The ESCON aggregation card accepts up to 10 SFP (small form-factor pluggable) optics for client traffic. The ESCON aggregation card converts the client signals from optical form to electrical and then aggregates them into a single signal. This aggregated signal passes through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, 10-Gbps ITU tunable or non tunable trunk card, or a 10-Gbps uplink card (see Figure 1-3). The cross connection between the two cards through the backplane and switch fabrics is configured using the CLI. The ESCON aggregation card has redundant connections over the backplane to the switch fabrics on the active and standby CPU switch modules.

Figure 1-5 shows the architecture of the ESCON aggregation card.

Figure 1-5 ESCON Aggregation Card Architecture



The ESCON aggregation card uses pluggable transceivers with MT-RJ connectors for the client signals. The Cisco ONS 15530 supports up to six ESCON aggregation cards for a total of 60 ESCON signals.

Table 1-4 lists features for the SFP optics supported by the ESCON aggregation cards.

Table 1-4 ESCON Aggregation Card SFP Optics Features

Part Number	Description	Fiber Type	Wavelength	Connector Type
15500-XVRA-01A2	Fixed rate	MM 50/125 m MM 62.5/125 m	1310 nm	MT-RJ
15500-XVRA-10A1	Low-band variable rate 16 Mbps to 200 Mbps	MM 50/125 m MM 62.5/125 m	1310 nm	LC
15500-XVRA-10B1	Low-band variable rate 16 Mbps to 200 Mbps	SM 9/125 m	1310 nm	LC

Note The Cisco IOS software only supports Cisco-certified SFP optics on the ESCON aggregation card.

4-Port 1-Gbps/2-Gbps FC Aggregation Cards

The Cisco ONS 15530 supports a line card specifically for 1-Gbps and 2-Gbps FC (Fibre Channel), FICON (Fibre Connection), and ISC (InterSystem Channel) links traffic. The 4-port 1-Gbps/2-Gbps FC aggregation card has the following features:

- Accepts up to four single-mode or multimode SFP (small form-factor pluggable) optics for client traffic. Each SFP optic supports 1-Gbps or 2 Gbps FC, FICON, or ISC traffic, depending on how the interface is configured in the CLI.
- Does not restriction how you can populated the card with SFPs. For example, you can mix a single-mode SFP optics with a multimode SFP optics in the same aggregated signal.
- Converts up to four client signals from optical form to electrical and transmits them over up to four 2.5-Gbps electric signals. These signals pass through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card. The cross connections between the two cards through the backplane and switch fabrics are configured using the CLI.
- Allows different traffic types on the same card and on the same aggregated signal.
- Allows two 1-Gbps protocol client signals to be aggregated on one 2.5-Gbps signal sent over the switch fabric. Only one 2-Gbps protocol client signal can be sent over a 2.5-Gbps signal over the switch fabric.
- Has redundant connections over the backplane to the switch fabrics on the active and standby CPU switch modules.
- Is compatible with the 8-port FC/GE aggregation card signals. Any 1-Gbps FC, FICON, or ISC signal can be transmitted between a 4-port 1-Gbps/2-Gbps FC aggregation card and an 8-port FC/GE aggregation card.

Note The 8-port FC/GE aggregation card does not support 1-Gbps ISC peer mode.

- Provides buffer credit functionality for Fibre Channel.

Figure 1-6 shows the architecture of the 4-port 1-Gbps/2-Gbps FC aggregation card.

Figure 1-6 4-Port 1-Gbps/2-Gbps FC Aggregation Card Architecture

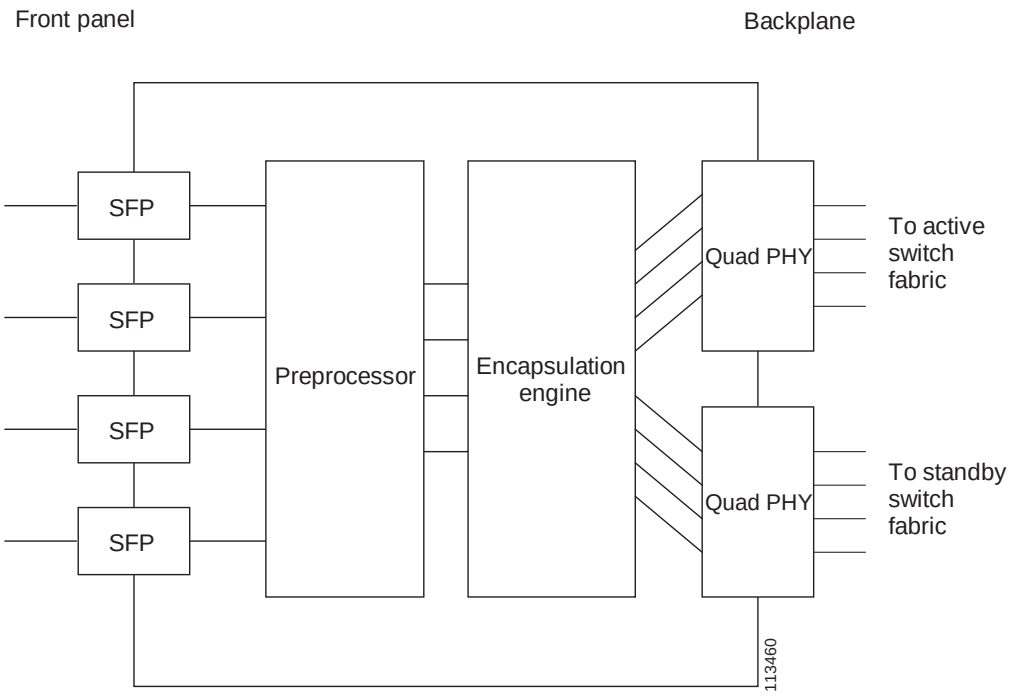


Table 1-5 lists features for the SFP optics supported by the 4-port 1-Gbps/2-Gbps FC aggregation cards.

Table 1-5 4-Port 1-Gbps/2-Gbps FC Aggregation Card SFP Optics Features

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-02C1	Fibre Channel (1 Gbps)[1], FICON (1 Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC
15500-SFP-GEFC-SX	Fibre Channel (1 Gbps and 2 Gbps)[2], Gigabit Ethernet	MM 50/125 m MM 62.5/125 m	850 nm	LC
15500-XVRA-03B1	Fibre Channel (1 Gbps)[3], FICON (1 Gbps), ISC links compatibility mode (1 Gbps)	SM 9/125 m	1310 nm	LC
15500-XVRA-03B2	Fibre Channel (1 Gbps[4] and 2 Gbps[5])	SM 9/125 m	1310 nm	LC
15500-XVRA-11B1	Mid-band variable rate 200 Mbps to 1.25 Gbps	SM 9/125 m	1310 nm	LC
15500-XVRA-12B1	High-band variable rate 1.062 Gbps to 2.488 Gbps	SM 9/125 m	1310 nm	LC

Table 1-5 4-Port 1-Gbps/2-Gbps FC Aggregation Card SFP Optics Features (continued)

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15454E-SFP-GEFC-S	Fibre Channel (1-Gbps and 2-Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC
15454-SFP-GEFC-SX	Fibre Channel (1-Gbps and 2-Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC

1. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
2. FC-0-200-M5-SN-S and FC-0-200-M6-SN-S standards
3. FC-0-100-SM-LC-S standard
4. FC-0-100-SM-LC-S standard
5. FC-0-200-SM-LC-S standard

Note The Cisco IOS software only supports Cisco-certified SFP optics on the 4-port 1-Gbps/2-Gbps FC aggregation card.

The Cisco ONS 15530 supports up to five 4-port 1-Gbps/2-Gbps FC aggregation cards for a total of 20 1-Gbps client signals.

Protocol Monitoring

For FC and FICON traffic, the system monitors the following conditions on the 4-port 1-Gbps/2-Gbps FC aggregation card:

- 8B/10B CVRD error counts
- Tx/Rx frame counts
- Tx/Rx byte counts
- Tx/Rx CRC errors
- Link failures
- Sequence protocol errors
- Invalid transmission words
- 5-minute input/output rates
- Loss of Sync
- Loss of Light

For ISC traffic, the system monitors the following conditions on the 4-port 1-Gbps/2-Gbps FC aggregation card:

- 8B/10B CVRD error counts
- Loss of Light

Support for FC Port Types

The 4-port 1-Gbps/2-Gbps FC aggregation card supports the following FC port types, with or without the buffer credit distance extension feature enabled:

- B_port—bridge port
- E_port—expansion port
- F_port—fabric port
- N_port—node port
- TE_port—trunking E_port (Cisco MDS 9000 Family systems only)

Note All of the above port topologies, except for TE_port, are point-to-point in the FC specifications.

Examples of valid topologies where you can place a Cisco ONS 15530 shelf, which has an 4-port 1-Gbps/2-Gbps FC aggregation card, in the middle to extend distance include the following:

- E_Port <--> E_Port
- F_Port <--> N_Port
- N_Port <--> N_Port
- B_Port <--> B_Port
- TE_Port <--> TE_Port

The arbitrated loop topology is not supported by the 4-port 1-Gbps/2-Gbps FC aggregation card. The arbitrated loop port types not supported include:

- NL_port—node loop port
- FL_port—fabric loop port
- EL_port—extension loop port

Note Any combination of these arbitrated port types are not supported.

8-Port FC/GE Aggregation Cards

The Cisco ONS 15530 supports a line card specifically for FC (Fibre Channel), FICON (Fibre Connection), GE (Gigabit Ethernet), ISC-1 (InterSystem Channel) links compatibility mode, and 1-Gbps ISC-3 peer mode traffic. The 8-port Fibre Channel/Gigabit Ethernet aggregation card accepts up to eight SFP (small form-factor pluggable) optics for client traffic. Each SFP optic supports FC, FICON, GE, or ISC, depending on how the interface is configured in the CLI.

The 8-port FC/GE aggregation card converts client signals from two adjacent port pairs (0–1, 2–3, 4–5, or 6–7) from optical form to electrical and then aggregates them into four 2.5-Gbps signals. These aggregated signals pass through the backplane and the switch fabric on the active CPU switch module to a 2.5-Gbps ITU trunk card, a 10-Gbps ITU trunk card, or a 10-Gbps uplink card. The cross connections between the two cards through the backplane and switch fabrics is configured using the CLI. The 8-port FC/GE aggregation card has redundant connections over the backplane to the switch fabrics on the active and standby CPU switch modules.

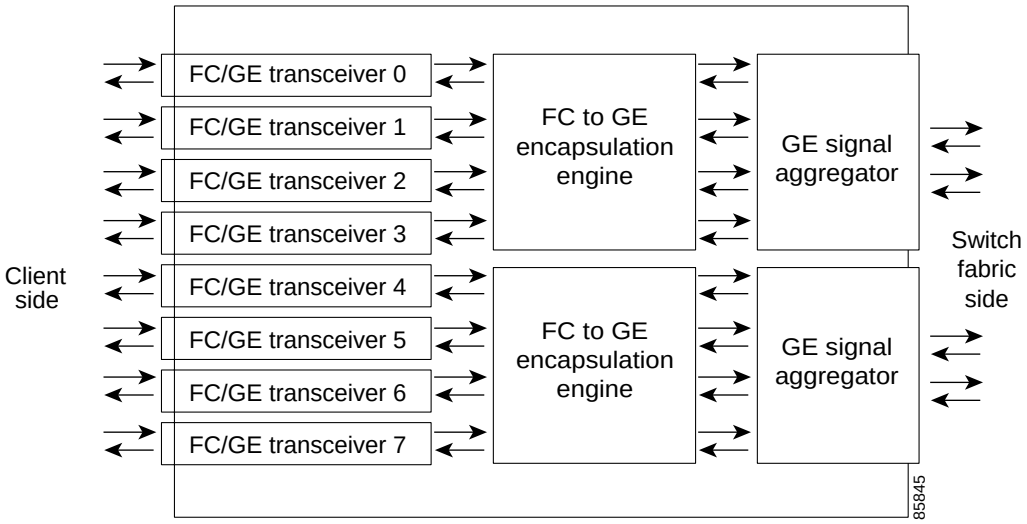
The 8-port FC/GE aggregation card provides buffer credit functionality for Fibre Channel traffic and end-to-end autonegotiation for Gigabit Ethernet traffic.

Note The 8-port FC/GE aggregation card supports end-to-end passthrough of the autonegotiation parameters only for hardware versions earlier than 8.0 updated with functional image A.2-30 or later, or hardware version 8.0, or later, updated with functional image B.2-30 or later. For information on updating functional images, refer to the *Cisco 15530 Software Upgrade Guide*.

Note We strongly recommend configuring port pairs as FC only or GE only. Mixing FC and GE in a port pair increases the FC signal latency between nodes.

Figure 1-7 shows the architecture of the 8-port FC/GE aggregation card.

Figure 1-7 8-port FC/GE Aggregation Card Architecture



The 8-port FC/GE aggregation card uses single-mode and multimode SFP optics for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP optic with a multimode SFP optic in the same port pair. Table 1-6 lists features for the SFP optics supported by the 8-port FC/GE aggregation cards.

Table 1-6 8-Port FC/GE Aggregation Card SFP Optics Features

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-02C1	Gigabit Ethernet[1], Fibre Channel (1 Gbps)[2], FICON (1 Gbps), ISC-3 links compatibility and peer mode (1 Gbps)	MM 50/125 m MM 62.5/125 m	850 nm	LC
15500-XVRA-03B1	Gigabit Ethernet[3], Fibre Channel (1 Gbps)[4], FICON (1 Gbps), ISC-3 links compatibility and peer mode (1 Gbps)	SM 9/125 m	1310 nm	LC

Table 1-6 8-Port FC/GE Aggregation Card SFP Optics Features (continued)

Part Number	Protocols or Clock Rate Range Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-11B1	Mid-band variable rate 200 Mbps to 1.25 Gbps	SM 9/125 m	1310 nm	LC
15500-XVRA-12B1	High-band variable rate 1.062 Gbps to 2.488 Gbps	SM 9/125 m	1310 nm	LC

1. 1000BASE-SX
2. FC-0-100-M5-SN-S and FC-0-100-M6-SN-S standards
3. 1000BASE-LX
4. FC-0-100-SM-LC-S standard

Note The Cisco IOS software only supports Cisco-certified SFP optics on the 8-port FC/GE aggregation card.

Note The MTU (maximum transmission unit) size for GE on the 8-port FC/GE aggregation card is 10232 bytes.

The Cisco ONS 15530 supports up to four 8-port FC/GE aggregation cards for a total of 32 client signals.

Protocol Monitoring

For GE traffic, the Cisco ONS 15530 monitors the following conditions on the 8-port FC/GE aggregation card:

- CVRD error counts
- Tx/Rx frame counts
- Tx/Rx byte counts
- Tx/Rx CRC errors
- Giant packet counts
- Runt packet counts
- 5 minute input/output rates

For FC and FICON traffic, the system monitors the following conditions on the 8-port FC/GE aggregation card:

- 8B/10B CVRD error counts
- Tx/Rx frame counts
- Tx/Rx byte counts
- Tx/Rx CRC errors
- Link failures
- Sequence protocol errors
- Invalid transmission words

- 5 minute input/output rates
- Loss of Sync
- Loss of Light

For ISC-3 links traffic, the system monitors the following conditions on the 8-port FC/GE aggregation card:

- 8B/10B CVRD error counts
- Loss of Light

Support for FC Port Types

The 8-port FC/GE aggregation card supports the following FC port types, with or without the buffer credit distance extension feature enabled:

- B_port—bridge port
- E_port—expansion port
- F_port—fabric port
- N_port—node port
- TE_port—trunking E_port (Cisco MDS 9000 Family systems only)

Note All of the above port topologies, except for TE_port, are point-to-point in the FC specifications.

Examples of valid topologies where you can place a Cisco ONS 15530 shelf, which has an 8-port FC/GE aggregation card, in the middle to extend distance include the following:

- E_Port <--> E_Port
- F_Port <--> N_Port
- N_Port <--> N_Port
- B_Port <--> B_Port
- TE_Port <--> TE_Port

The arbitrated loop topology is not supported by the 8-port FC/GE aggregation card. The arbitrated loop port types not supported include:

- NL_port—node loop port
- FL_port—fabric loop port
- EL_port—extension loop port

Note Any combination of these arbitrated port types are not supported.

8-Port Multi-Service Muxponders

The 8-port multi-service muxponder accepts up to eight SFPs for client traffic. The eight client signals are mapped into the right size STS-n payloads and multiplexed into a 2.5-Gbps ITU signal. The ITU signal is then multiplexed onto the trunk by an OADM.

Note The 8-port multi-service muxponder does not use the switch fabric, an ITU trunk card, or an 10-Gbps uplink card.

The 8-port multi-service muxponder supports the following protocols:

- Gigabit Ethernet (1.25 Gbps), copper and optical
- Fiber Channel (1.062 Gbps), optical
- FICON (1.062 Gbps), optical
- DVB-ASI (Digital Video Broadcast-Asynchronous Serial Interface) (270 Mbps), copper and optical
- SDI (Serial Digital Interface) (270 Mbps)
- ESCON (200 MHz), optical
- SONET OC-3 (155 Mbps), optical
- SDH STM-1 (155 Mbps), optical
- ITS (Integrated Trading System) (196.608 Mbps), optical
- Fast Ethernet (125 Mbps), copper and optical
- T1 (1.544 Mbps), copper
- E1 (2.048 Mbps), copper

Other features on the 8-port multi-service muxponder include:

- 2.5-Gbps ITU trunk signal that is tunable across two wavelengths
- DCC (Data Communications Channel) for in-band management
- Splitter protection

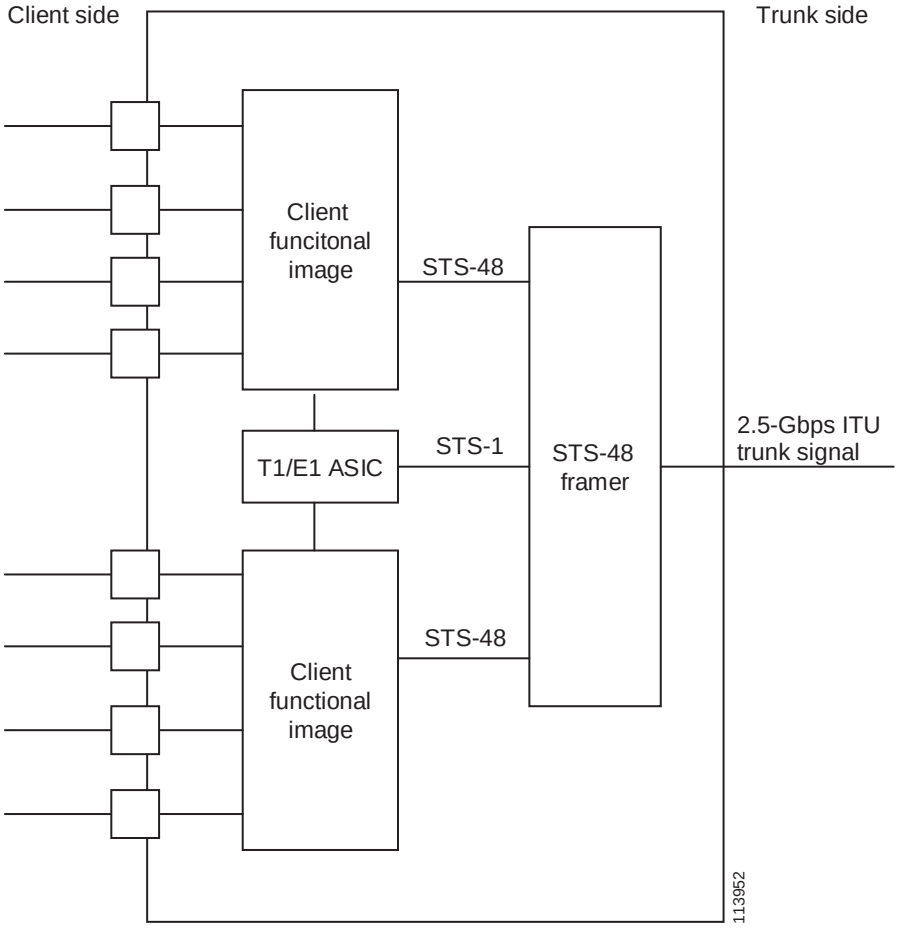
The following features are not supported on the 8-port multi-service muxponder:

- Oversubscription
- Y-cable line card protection
- FICON bridge
- OFC safety protocol

Note Although the 8-port multi-service muxponder uses a SONET-like framing structure to aggregate multiple client data streams, it is not SONET compliant on the optical trunk output. The muxponder ITU compliant optical trunk output must be used in an end-to-end configuration and cannot be connected to a SONET/SDH OADM.

Figure 1-8 shows the architecture of the 8-port multi-service muxponder.

Figure 1-8 8-Port Multi-Service Muxponder Architecture



The 8-port multi-service muxponder uses optical single-mode, optical multimode, and copper SFPs for the client signals. There are no restrictions on populating the line card with SFPs. For example, you can mix a single-mode SFP, a multimode SFP, and a copper SFP in the same muxponder. Table 1-7 lists features for the SFPs supported by the 8-port multi-service muxponders.

Table 1-7 8-port Multi-Service Muxponder SFP Features

Part Number	Protocols Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-10A2	Low band 8 Mbps to 200 Mbps	MM 50/125 m MM 62.5/125 m	1310 nm	LC
15500-XVRA-10B2	Low band 8 Mbps to 200 Mbps	SM 9/125 m	1310 nm	LC
15500-XVRA-11A2	Mid-band 200 Mbps to 622 Mbps	MM 62.5/125 m	1310 nm	LC
15500-XVRA-11B2	Mid-band 200 Mbps to 1.25 Gbps	SM 9/125 m	1310 nm	LC

Table 1-7 8-port Multi-Service Muxponder SFP Features (continued)

Part Number	Protocols Supported	Fiber Type	Wavelength	Connector Type
15500-XVRA-12B1	High-band 1.062 Gbps to 2.488 Gbps	SM 9/125 m	1310 nm	LC
15500-XVRA-08D1	T1 1.544 Mbps	Copper T1	–	RJ-45
15500-XVRA-09D1	E1 2.044 Mbps	Copper E1	–	RJ-45
15500-XVRA-10E1	SDI and DVB-ASI Video	Copper Digital Video	–	Mini SMB Coax
15500-XVRA-11D1	GE 1.25 Gbps, FE 1.25 Mbps	Copper GE/FE	–	RJ-45

Note The Cisco IOS software only supports Cisco-certified SFP optics on the 8-port multi-service muxponder.

The Cisco ONS 15530 supports up to four 8-port multi-service muxponders for a total of 32 client signals in a protected configuration and up to eight 8-port multi-service muxponders for a total of 64 client signals in an unprotected configuration.

Protocol Monitoring

The 8-port multi-service muxponder only monitors 8B/10B CVRD errors for GE (optical only), FC, FICON, ESCON, ITS, and ASI traffic.

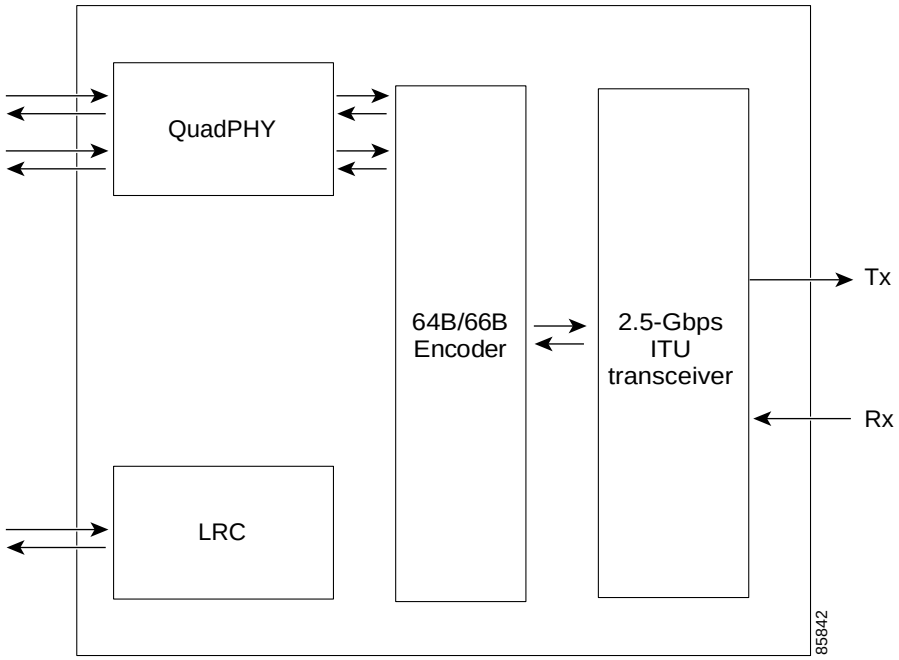
2.5-Gbps ITU Trunk Cards

The 2.5-Gbps ITU trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts a 2.5-Gbps (3.125-Gbps line rate) electrical signal from an ESCON aggregation card, an 8-port FC/GE aggregation card, or a 4-port FC aggregation card, which is converted to the ITU grid wavelength, or channel. The 2.5-Gbps ITU trunk card has redundant interfaces to the backplane, connecting to the switch fabrics on the active and standby CPU switch modules.You can turn the ITU laser to one of two channel frequencies. There are 16 different 2.5-Gbps ITU trunk cards (for channels 1–2, 3–4,..., 31–32) to support the 32 channels.

Note When designing your network, consider designs with 10-Gbps ITU tunable and non tunable trunk cards as well as designs with 2.5-Gbps ITU trunk cards. The type of ITU trunk card used affects the design parameters, such as dispersion compensation, amplification, and available wavelengths.

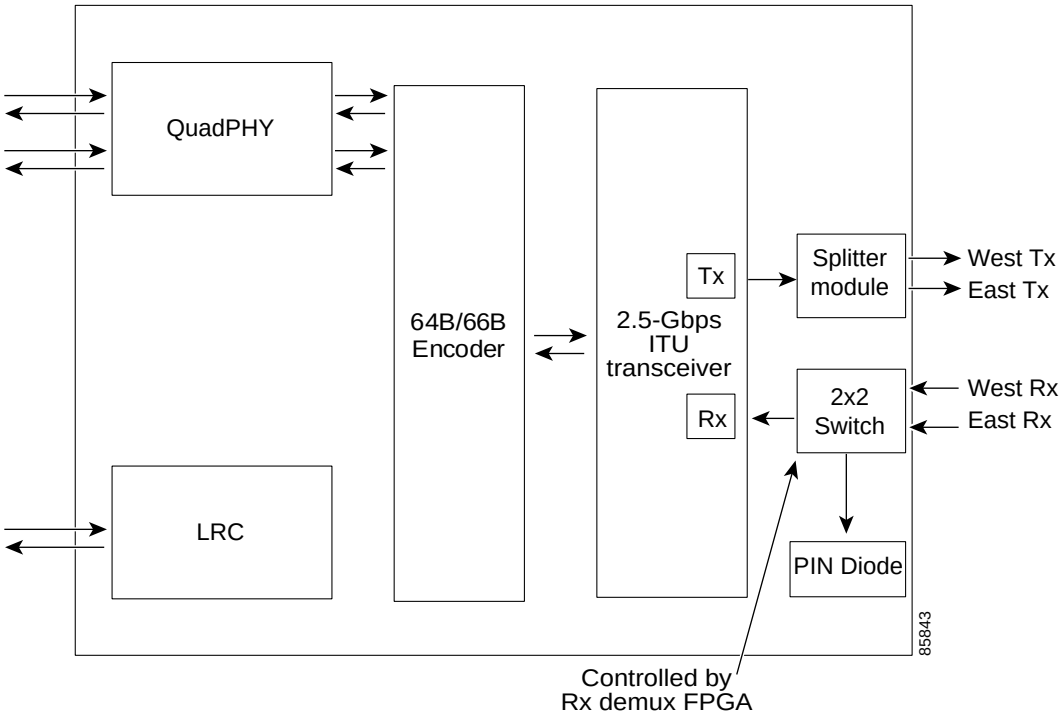
The 2.5-Gbps ITU trunk card has two versions: nonsplitter and splitter. The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications (see Figure 1-9).

Figure 1-9 Nonsplitter 2.5-Gbps ITU Trunk Card Architecture



The splitter version of the 2.5-Gbps ITU trunk card has two pairs of optical connectors on the front panel, which connect to the east and west OADM modules, and is designed for splitter protected applications (see Figure 1-10).

Figure 1-10 Splitter 2.5-Gbps ITU Trunk Card Architecture



The Cisco ONS 15530 supports up to four 2.5-Gbps ITU trunk cards for a total of four channels.

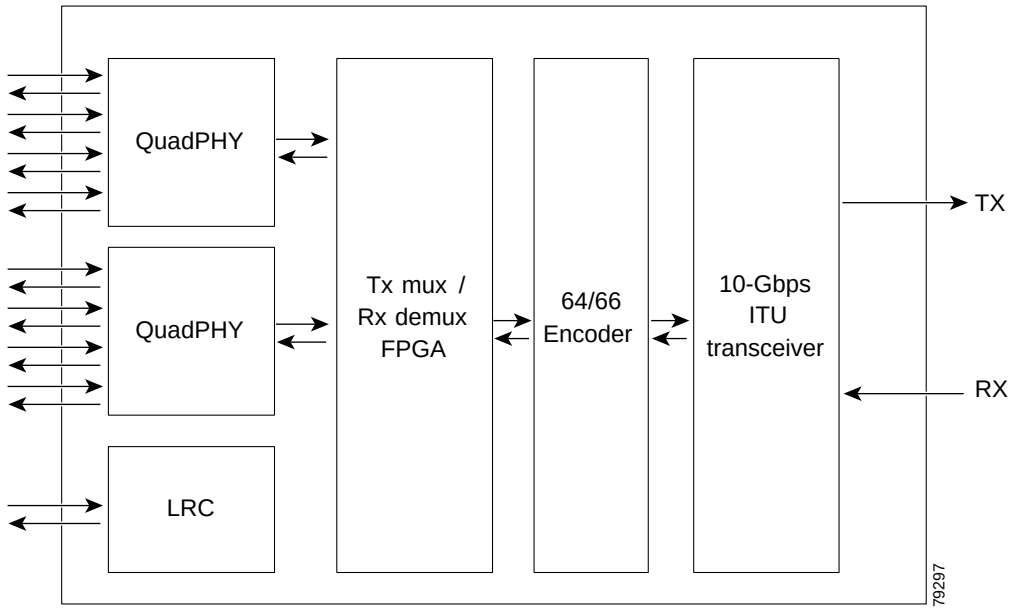
10-Gbps ITU Trunk Cards

The 10-Gbps ITU trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts up to four 2.5-Gbps (3.125-Gbps line rate) electrical signals from the ESCON aggregation cards, 8-port FC/GE aggregation cards, or a 4-port FC aggregation card, and combines them into one 10-Gbps signal, which is converted to the ITU grid wavelength, or channel. The 10-Gbps ITU trunk card has four separate redundant interfaces to the backplane, each connecting to the switch fabrics on the active and standby CPU switch modules.

Note When designing your network, consider designs with 10-Gbps ITU trunk cards as well as designs with 2.5-Gbps ITU trunk cards. The type of ITU trunk card used affects the design parameters, such as dispersion compensation, amplification, and available wavelengths.

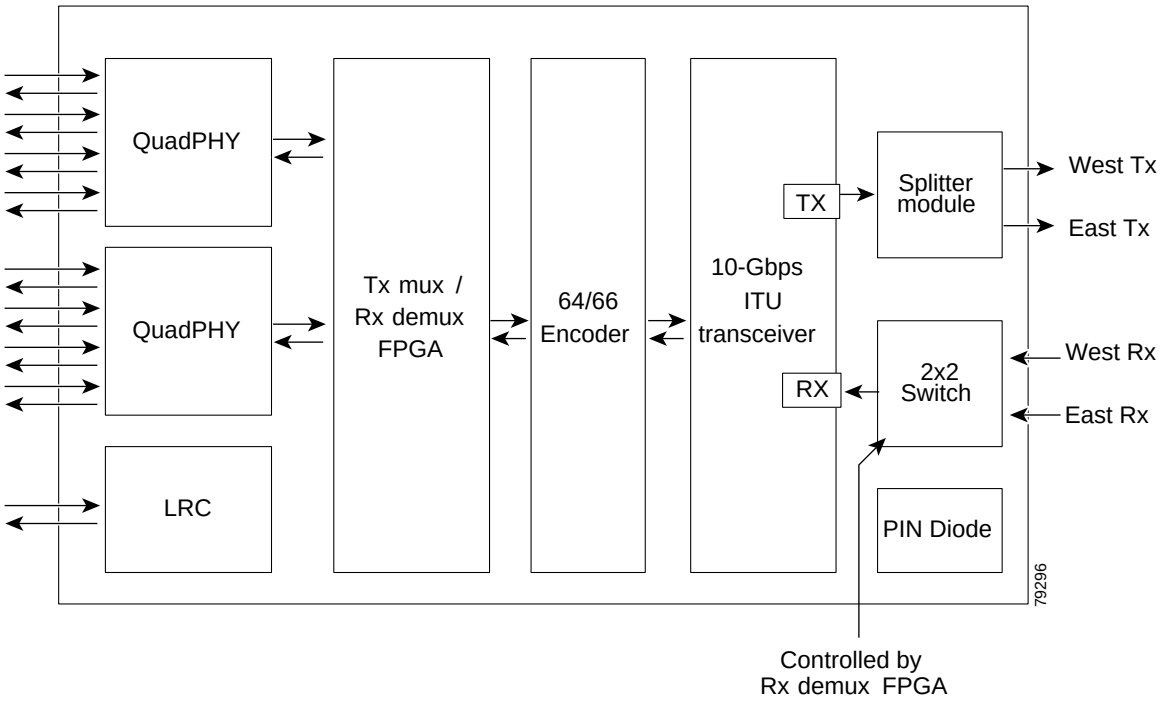
The 10-Gbps ITU trunk card has two version: nonsplitter and splitter. The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications (see Figure 1-11).

Figure 1-11 Nonsplitter 10-Gbps ITU Trunk Card Architecture



The splitter version of the 10-Gbps ITU trunk card has two pairs of optical connectors on the front panel, which connect to the east and west OADM modules, and is designed for splitter protected applications (see Figure 1-12).

Figure 1-12 Splitter 10-Gbps ITU Trunk Card Architecture



The Cisco ONS 15530 supports up to four 10-Gbps ITU trunk cards for a total of four channels.

10-Gbps ITU Tunable Trunk Cards

The 10-Gbps ITU tunable trunk card sends and receives the ITU grid wavelength signal to and from an OADM module. This card accepts up to four 2.5-Gbps (3.125-Gbps line rate) electrical signals from the ESCON aggregation cards, 8-port FC/GE aggregation cards, or a 4-port FC aggregation card, and combines them into one 10-Gbps signal, which is converted to the ITU grid wavelength, or channel. The 10-Gbps ITU tunable trunk card has four separate redundant interfaces to the backplane, each connecting to the switch fabrics on the active and standby CPU switch modules.

The 10-Gbps tunable trunk card is equipped with tunable lasers, and can be tuned to four different channels belonging to one band. Table 1-8 shows the tunable frequencies and the corresponding wavelengths. You must use the **show optical wavelength mapping** command to obtain this mapping.

Table 1-8 Tunable Frequencies and Wavelengths

Channel	Frequency (THz)	Wavelength (nm)
0	191.9	1562.23
1	192.	1560.61
2	192.2	1559.79
3	192.3	1558.98
4	192.4	1558.17
5	192.6	1556.55
6	192.7	1555.75
7	192.8	1554.94
8	192.9	1554.13
9	193.1	1552.52
10	193.2	1551.72
11	193.3	1550.92
12	193.4	1550.12
13	193.6	1548.51
14	193.7	1547.72
15	193.8	1546.92
16	193.9	1546.12
17	194.1	1544.53
18	194.2	1543.73
19	194.3	1542.94
20	194.4	1542.14
21	194.6	1540.56
22	194.7	1539.77
23	194.8	1538.98
24	194.9	1538.19
25	195.1	1536.61
26	195.2	1535.82

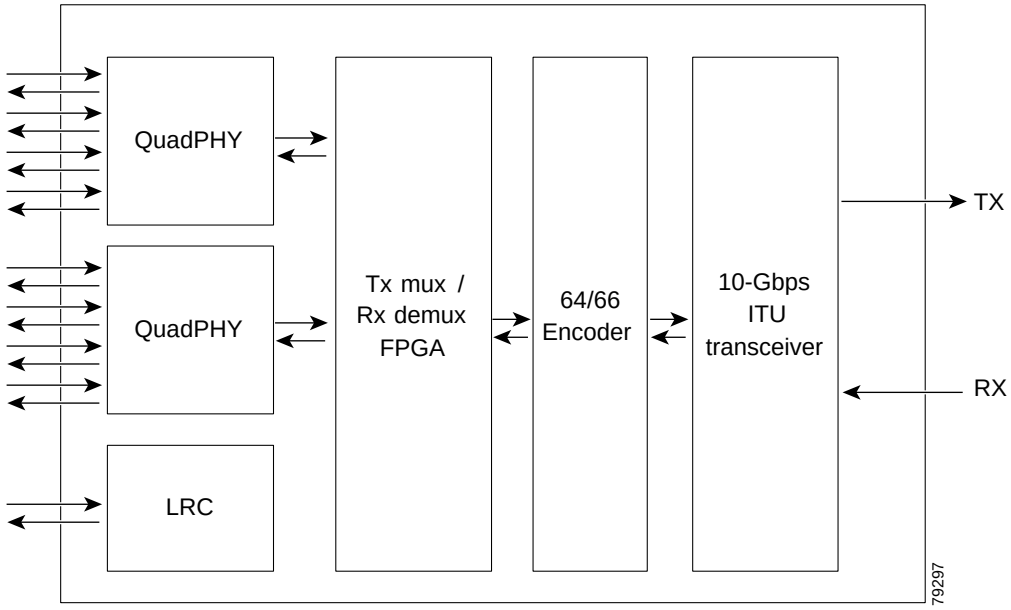
Table 1-8 Tunable Frequencies and Wavelengths (continued)

Channel	Frequency (THz)	Wavelength (nm)
27	195.3	1535.04
28	195.4	1534.25
29	195.6	1532.68
30	195.7	1531.90
31	195.8	1531.12
32	195.9	1530.33

Note When designing your network, consider designs with 10-Gbps ITU tunable trunk cards as well as designs with 2.5-Gbps ITU trunk cards. The type of ITU trunk card used affects the design parameters, such as dispersion compensation, amplification, and available wavelengths.

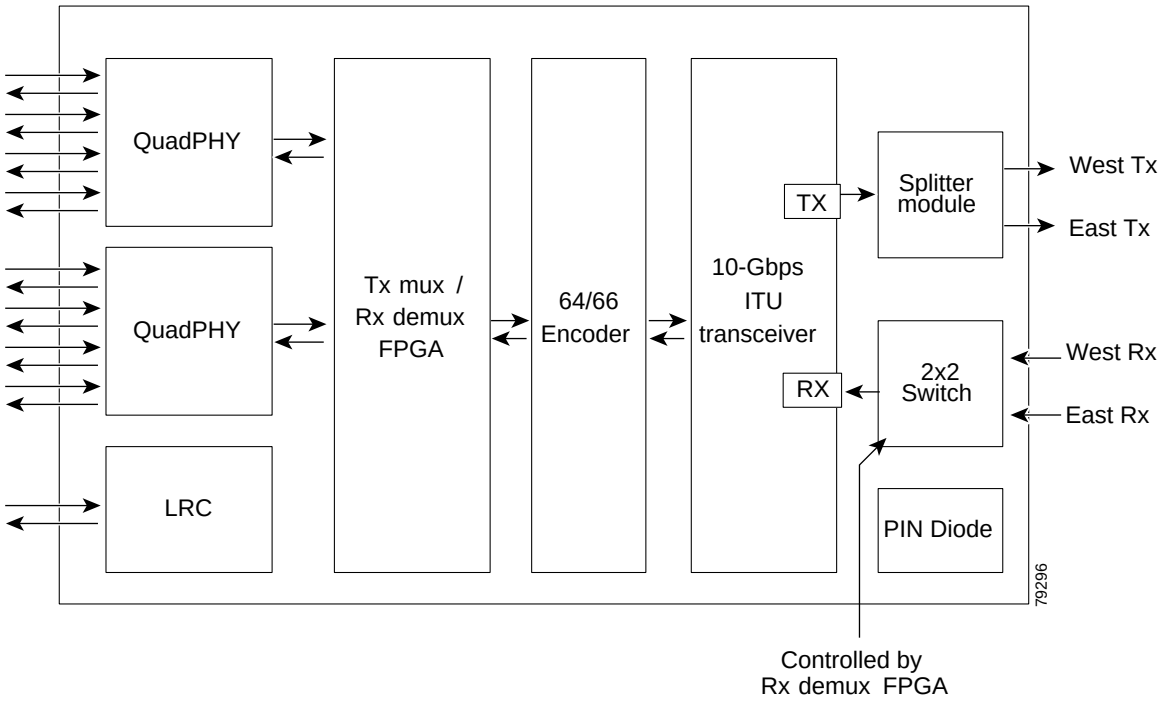
The 10-Gbps ITU tunable trunk card has two version: nonsplitter and splitter. The nonsplitter version has only one pair of optical connectors on the front panel, which connects to either the east or the west OADM module, and can be used for unprotected, line card protected, or switch fabric protected applications (see Figure 1-11).

Figure 1-13 Nonsplitter 10-Gbps ITU Tunable Trunk Card Architecture



The splitter version of the 10-Gbps ITU tunable trunk card has two pairs of optical connectors on the front panel, which connect to the east and west OADM modules and is designed for splitter protected applications (see Figure 1-12).

Figure 1-14 Splitter 10-Gbps ITU Tunable Trunk Card Architecture



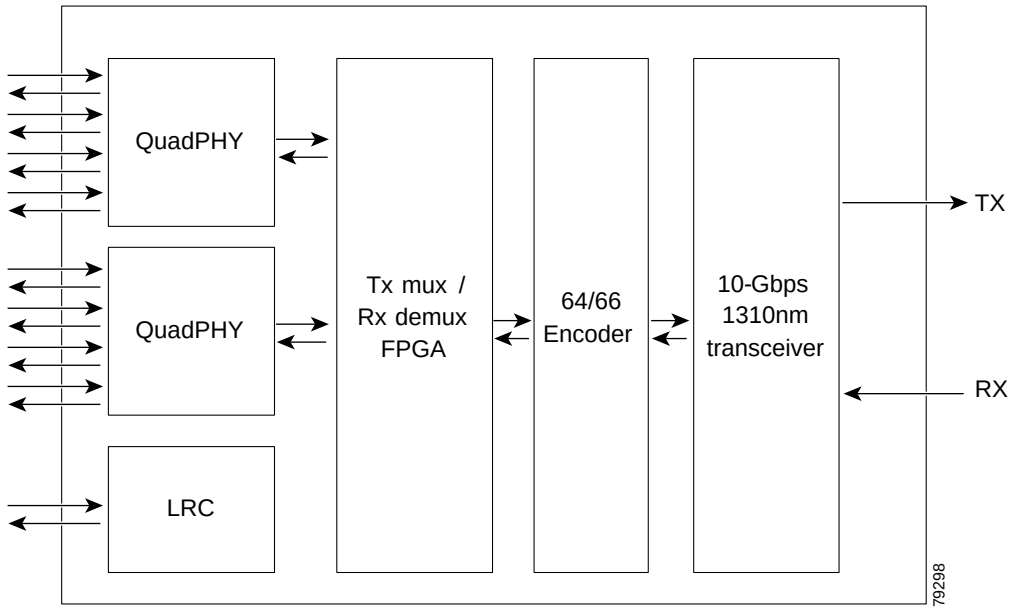
The Cisco ONS 15530 supports up to four 10-Gbps ITU tunable trunk cards for a total of 4 channels.

10-Gbps Uplink Cards

The 10-Gbps uplink card sends and receives a 10-Gbps 1310-nm signal to and from a 10-Gbps uplink card on another Cisco ONS 15530, or to and from a 10-GE transponder module on a Cisco ONS 15540 ESP or Cisco ONS 15540 ESPx. This card accepts up to four (3.125-Gbps line rate) electrical signals from ESCON aggregation cards, 8-port FC/GE aggregation cards, or a 4-port FC aggregation card, and combines them into one 10-Gbps signal (see Figure 1-15).

The 10-Gbps uplink card has four separate redundant interfaces to the backplane. Each interface connects to the switch fabrics on the active and standby CPU switch modules.

Figure 1-15 10-Gbps Uplink Card Architecture



The 10-Gbps uplink card has only one pair of optical connectors on the front panel and can be used for unprotected or line card protected applications. For splitter protected configurations, use the 10-Gbps ITU trunk card.

The Cisco ONS 15530 supports up to four 10-Gbps uplink cards for a total of four channels.

OSC Modules

The Cisco ONS 15530 supports the OSC on a separate module installed in a carrier motherboard. The carrier motherboard accepts up to two OSC modules. Implemented as a 33rd wavelength (channel 0), the OSC is a per-fiber duplex management channel for communicating between Cisco ONS 15530, Cisco ONS 15540 ESP, and Cisco ONS 15540 ESPx systems. The OSC allows control and management traffic to be carried without the necessity of a separate Ethernet connection to each Cisco ONS 15530, Cisco ONS 15540 ESP, and Cisco ONS 15540 ESPx in the network.

The OSC is established over a point-to-point connection and is always terminated on a neighboring node. By contrast, data channels may or may not be terminated on a given node, depending on whether the channels are express (pass-through) or add/drop.

The OSC carries the following types of information:

- CDP (Cisco Discovery Protocol) packets—Used to discover neighboring devices
- IP packets—Used for SNMP and Telnet sessions between nodes
- OSCP (OSC Protocol)—Used to determine whether the OSC link is up
- APS protocol packets—Used for controlling signal path switching

Note A Cisco ONS 15530 system without the OSC and the in-band message channel is not known to other systems in the network and cannot be managed by any NMS. Without the OSC and the in-band message channel, a Cisco ONS 15530 system must be managed individually by separate Ethernet or serial connections. Thus, it is important when adding a node to an existing network of Cisco ONS 15530 systems that the added node have appropriate OSC or the in-band message channel support.

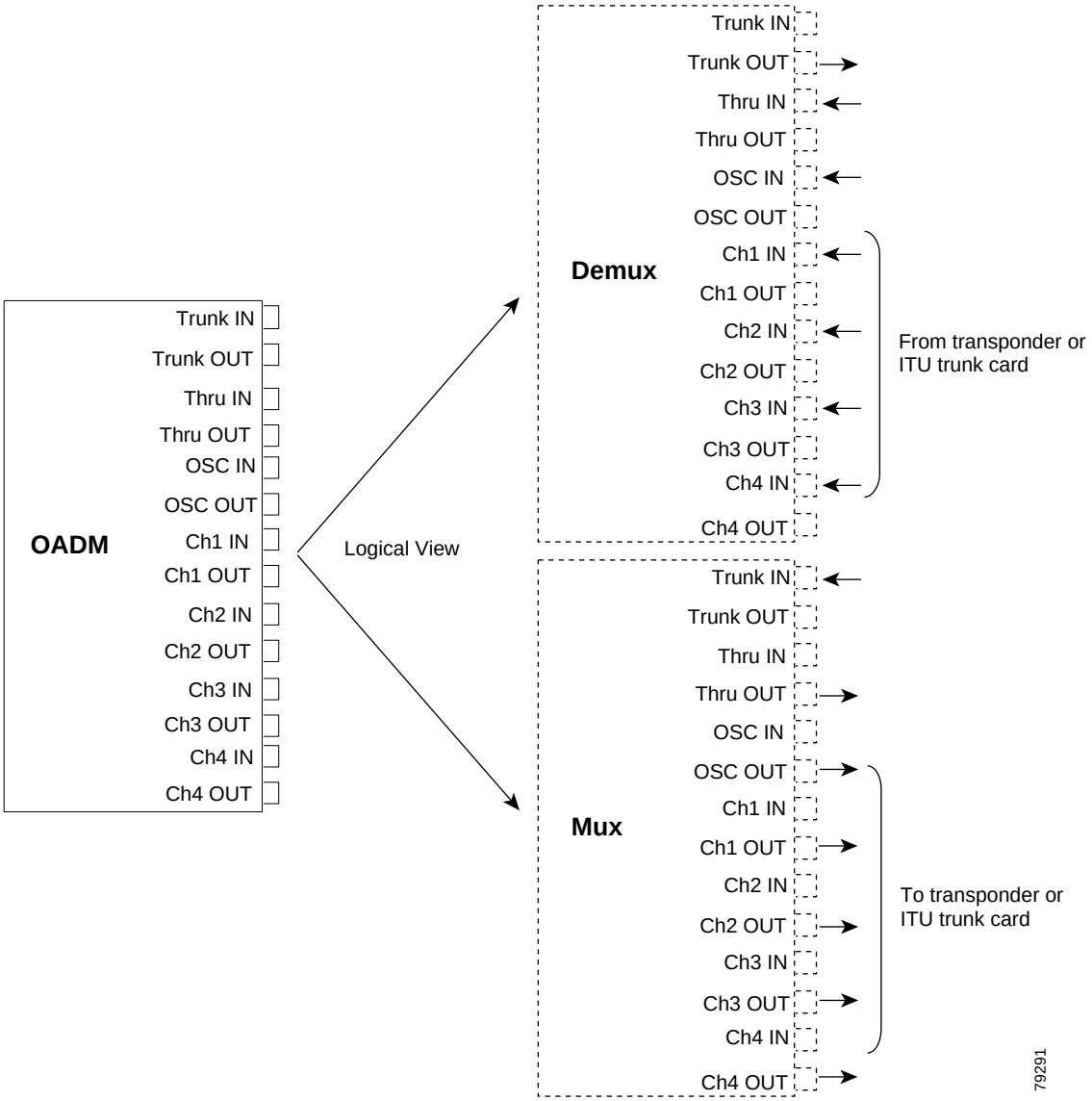
OADM Modules

The OADM (optical add/drop multiplexer/demultiplexer) modules are passive devices that optically multiplex and demultiplex a specific band of 16 ITU wavelengths. The OADM modules supported by the Cisco ONS 15530 each add and drop a band of channels at a node and pass the other bands through. To support the 32-channel spectrum, there are eight different 4-channel OADM modules, each supporting a different band of channels.

In the transmit direction, the OADM modules multiplex signals transmitted by the line cards over optical cross connections and provide the interfaces to connect the multiplexed signal to the DWDM trunk side. In the receive direction, the OADM modules demultiplex the signals from the trunk side before passing them over optical cross connections to the line cards.

Figure 1-16 shows the physical layout of the OADM module for the channels in band A (1–4) along with a logical view of its multiplexing and demultiplexing functions. Optical signals received from the line card, the Thru IN connector, and the OSC IN connector are multiplexed and sent through the Trunk OUT connector. The optical signal received from the Trunk IN connector is demultiplexed and the OSC signal is sent to the OSC OUT connector; the dropped channels are sent to the line card; and the passed channels are sent to the Thru OUT connector.

Figure 1-16 OADM Module Architecture



OADM Modules and Channel Bands

Each OADM module supports a range of channels called a *band*. A band contains 4 channels.

Table 1-9 lists the OADM modules that support each channel band. All cards are available with or without OSC support. For correspondence between channel numbers and wavelengths on the ITU grid, refer to the *Cisco ONS 15530 Hardware Installation Guide*. See Table 1-8 for more information on the tunable frequencies and the corresponding wavelengths.

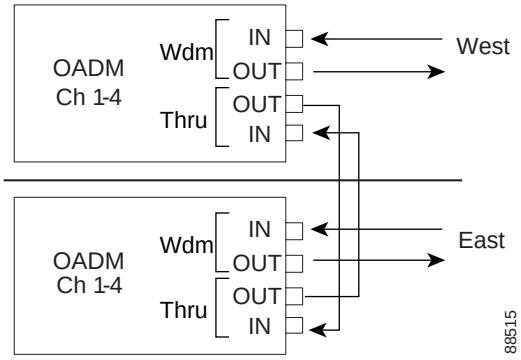
Table 1-9 OADM Modules and Supported Channel Bands

Cisco ONS 15530 Channels	OADM Module
1–4	Band A
5–8	Band B
9–12	Band C
13–16	Band D
17–20	Band E
21–24	Band F
25–28	Band G
29–32	Band H

OADM Module Configurations

In ring configurations, channels that are not supported by a node are passed through that node and sent out on the ring. Figure 1-17 shows an example of how two OADM modules might be cabled in a protected ring configuration.

Figure 1-17 OADM Modules in a Protected Ring Configuration

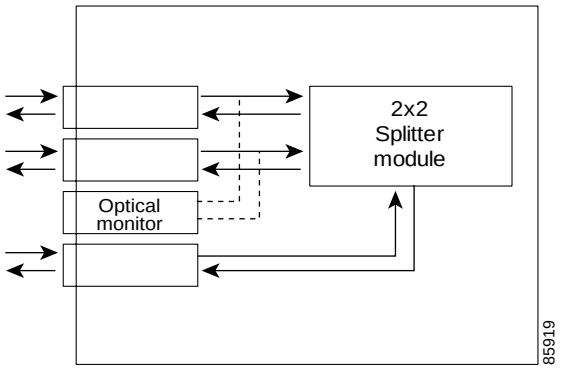


PSMs

The PSM (protection switch module) provides trunk fiber protection for Cisco ONS 15530 systems configured in point-to-point topologies. The PSM sends the signal from an OADM module, an ITU trunk card, or a transponder line card to both the west and east directions. It receives both the west and east signals and selects one to send to the OADM module, ITU trunk card, or transponder line card. Both nodes in the network topology must have the same shelf configuration.When a trunk fiber cut occurs on the active path, the PSM switches the received signal to the standby path. Since the PSM occupies one of the OADM subslots in the shelf, it protects a maximum of four channels and the OSC in a single shelf configuration (see Figure 1-18).

The PSM also has a optical monitor port for testing the west and east receive signals. This port samples one percent of the receive signals that can be monitored with an optical power meter.

Figure 1-18 PSM Architecture



CPU Switch Modules

The Cisco ONS 15530 includes two CPU switch modules for redundancy. Each CPU switch module consists of a number of subsystems, including a CPU, a system clock, Ethernet switch for communicating between CPU switch modules and with the LRC (line card redundancy controller) on the OADM modules, line cards, and carrier motherboards, and the SRC (switch redundancy controller). The active CPU switch module controls the node, and all cards in the system make use of the system clock and synchronization signals from the active CPU switch module.

The CPU switch module is equipped with a console port, a Fast Ethernet interface for Telnet access and network management, and an auxiliary port. There is one slot for a compact Flash disk.

On the CPU switch module front panel are LEDs that display the status of critical, major, and minor signals, as well as the status of alarm cutoff and history conditions.

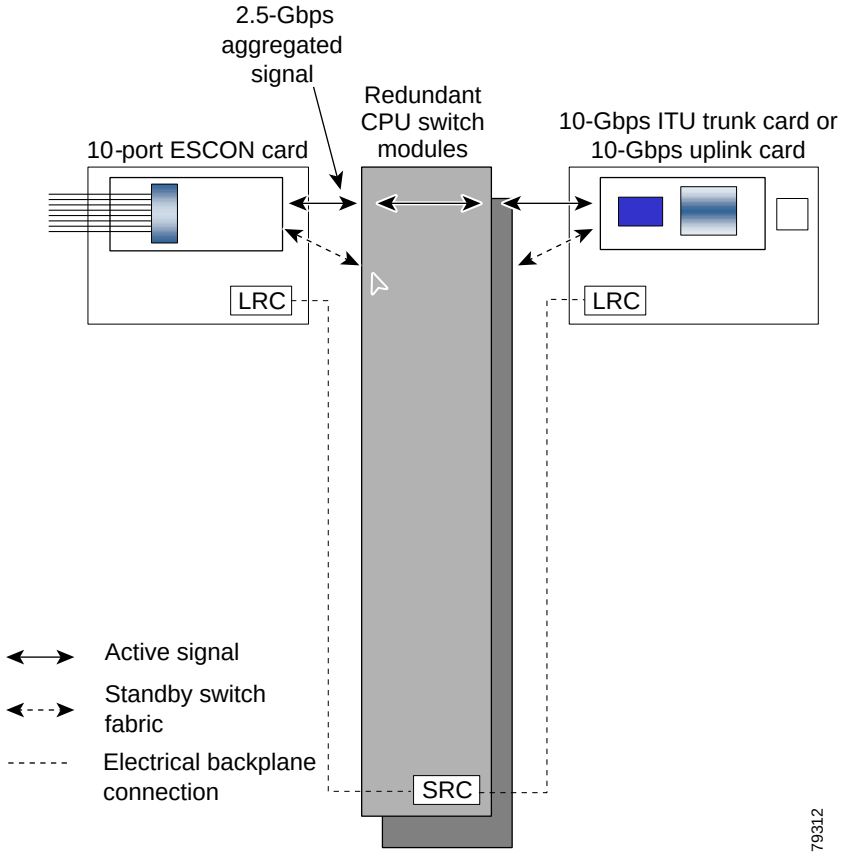
The CPU switch modules run Cisco IOS software and support the following features:

- Automatic configuration at startup
- Automatic discovery of network neighbors
- Online self-diagnostics and tests
- Power-on diagnostics and tests
- Arbitration of CPU switch module status (active/standby) and switchover in case of failure without loss of connections
- Automatic synchronization of startup and running configurations
- In-service software upgrades
- Per-channel APS (Automatic Protection Switching) in linear and ring topologies using redundant subsystems that monitor link integrity and signal quality
- Trunk fiber based DWDM signal protection using APS in point-to-point topologies
- System configuration and management through the CLI and SNMP
- Optical power monitoring on the trunk side, digital monitoring on the client side, and per-channel transponder in-service and out-of-service loopback (client and trunk sides)
- Optional out-of-band management of other Cisco ONS 15530, Cisco ONS 15540 ESP, and Cisco ONS 15540 ESPx systems on the network through the OSC (optical supervisory channel)
- Optional inband management of other Cisco ONS 15530 systems in the network through the in-band message channel

Switch Fabric

The Cisco ONS 15530 CPU switch module has a 32-port by 32-port, nonblocking switch fabric, which can carry up to 3.125 Gbps of traffic per port (for data traffic and the remainder for control traffic). The switch fabric connects signals from client side line cards, such as the ESCON aggregation card, to ITU side line cards, such as the 10-Gbps ITU trunk card (see Figure 1-19). When a shelf is configured for CPU switch module redundancy, the redundant switch fabric increases system availability by protecting against switch fabric failures.

Figure 1-19 Redundant Switch Fabrics



Note Transponder line cards contain both client and ITU optics and do not interface with the switch fabric.

CPU Switch Module Redundancy and Online Insertion and Removal

When the Cisco ONS 15530 is powered up, the two CPU switch modules engage in an arbitration process to determine which will be the active and which will be the standby. Previous power state information is stored in the CPU non-volatile random access memory (NVRAM). The CPU that was previously active reassumes the active role. During operation, the two CPU switch modules remain synchronized (application states, running and startup configurations, system images). The operational status of each CPU switch module is monitored by the CPU switch module redundancy controller of the other CPU switch module through the backplane Ethernet. In the event of a failure or removal of an

active CPU switch module, the standby CPU switch module immediately takes over and assumes the active role. Once the problem on the faulty card has been resolved, it can be manually restored to the active function.

In addition to providing protection against hardware or software failure, the redundant CPU switch module arrangement also permits installing a new Cisco IOS system image without system downtime. For more information about CPU switch module redundancy operation, as well as other software features, refer to the *Cisco ONS 15530 Configuration Guide*.

Security Features

The Cisco ONS 15530 supports the following Cisco IOS software security features:

- AAA (authentication, authorization, and accounting)
- Kerberos
- RADIUS
- TACACS+
- SSH (Secure Shell)
- Traffic filters and firewalls
- Passwords and privileges

For detailed information about the security features supported on the Cisco ONS 15530, refer to the *Cisco IOS Security Configuration Guide*.

System and Network Management

The Cisco ONS 15530 is fully manageable through any of the following four mechanisms: the in-band message channel, the OSC, SONET SDCC, and a direct Ethernet connection to the NME (network management Ethernet) on the CPU switch module. While all shelves will be equipped with at least one CPU switch module, provisioning the OSC is optional. The in-band message channel is only available on the 2.5-Gbps ITU trunk cards, 10-Gbps ITU tunable and non tunable trunk cards, and 10-Gbps uplink cards. DCC is only available on the 8-port multi-service muxponder.

All four mechanisms can be deployed within a single network. Each mechanism is associated with an interface that can be assigned an IP address. Management information will be routed between these interfaces.

Different levels of availability exist for each of these management mechanisms. High availability for the direct NME connection can be achieved with redundant CPU switch modules. The OSC becomes highly available when it is provisioned on both the working and protection trunk fibers. The availability of a particular in-band message channel or DCC will mirror the availability of the ITU wavelength with which it is associated.

In-Band Message Channel

The in-band message channel establishes a method for providing in-band, per-wavelength OAM&P (operations, administration, management, and provisioning) functions.

The in-band OAM&P messages carry the following types of information:

- Internodal management traffic.
- APS (Automatic Protection Switching) protocol messages.
- Subport identifiers for signal aggregation.
- Signal defect indications used by the system to identify line, segment, or path failures in the network topology and to take appropriate recovery responses to such failures. These indications include the following:
  - BDI-E (end-to-end backward defect indication)
  - FDI-E (end-to-end forward defect indication)
  - BDI-H (hop-to-hop backward defect indication)
  - FDI-H (hop-to-hop forward defect indication)
- CRC (cyclic redundancy check) computations.

In-Band Message Channel Consideration

The following considerations apply for the in-band message channel:

- The in-band message channel is carried along with the aggregated data signals and does not require extra equipment or a slot in the shelf.
- The in-band message channel is only supported on the 2.5-Gbps ITU trunk cards, 10-Gbps ITU tunable and non tunable trunk cards, and 10-Gbps uplink cards. If a shelf only has transponder line cards, the in-band message channel is not available.
- The in-band message channel must be enabled on both nodes that support the wavelength.

DCC

DCC establishes a method for providing in-band, per-wavelength OAM&P (operations, administration, management, and provisioning) functions on the 8-port multi-service muxponder.

The in-band OAM&P messages carry the following types of information:

- Internodal management traffic.
- APS (Automatic Protection Switching) protocol messages.

DCC Consideration

The following considerations apply for the DCC:

- The DCC is carried along with aggregated data signals and does not require extra equipment or a slot in the shelf.
- The data rate is slower than the in-band message channel supported on the 2.5-Gbps ITU trunk card, the 10-Gbps ITU trunk card, and the 10-Gbps uplink card. This causes the 8-port multi-service muxponder to initialize slower than those cards.
- The DCC must be configured on both 8-port multi-service muxponders that support the wavelength.

OSC

The OSC is an out-of-band method for providing OAM&P functions on a 33rd wavelength. The OSC supports a message channel that functions like the DCC for management and provisioning. Messages transit the network hop-by-hop, and they can be forwarded or routed according to established routing protocols. The OSC can be used to carry traffic to a network management system, or to carry other internodal management traffic such as link management, fiber failure isolation, performance monitoring, alarms, and APS protocol messages.

OSC Considerations

The following considerations apply for the OSC:

- OSC requires a carrier motherboard, which occupies a slot in the shelf, and one or two OSC modules.
- When a node supports OSC, the neighboring nodes in the topology must also support OSC.
- To manage the network topology, every node must support OSC.

NME

The NME is a 10/100 Ethernet port on the CPU switch module. You can connect this port to a router and configure the interface to route messages using established routing protocols. The NME can be used to carry traffic to a network management system.

Note The NME provides little in the way of topology management or fault isolation. We recommend using the in-band message channel, OSC, or both to manage and troubleshoot your network topology.

NME Considerations

The following considerations apply to the NME:

- To remotely manage nodes in the network topology using the NME, each system must be accessible through an IP network.
- The NME port is present on every CPU switch module and does not require extra equipment or a slot in the shelf.

Comparison of In-Band Message Channel, SONET, and OSC

Table 1-10 compares the features provided by the in-band message channel, SONET SDCC, and OSC.

Table 1-10 Comparison of the In-Band Message Channel, SONET, and OSC

Feature	OSC	In-Band Message Channel	SONET [1]
Management reach	Per fiber section	Per wavelength	Per wavelength
Fault isolation and topology discovery	Hop-by-hop fiber (physical topology)	End-to-end wavelength (logical topology)	End-to-end wavelength (logical topology)
Payload	Separate out-of-band channel	10-GE, Fibre Channel, FICON, GE, ESCON	SONET (OC-n)

Table 1-10 Comparison of the In-Band Message Channel, SONET, and OSC (continued)

Feature	OSC	In-Band Message Channel	SONET [1]
Management channel	Per fibre via a 33rd wavelength (channel 0)	Per wavelength via a message byte	Per wavelength via section DCC
Performance monitoring	OSC protocol	8B/10B(GE), 64/66B (10-GE), HEC[2], frame FCS	Section BIP[3]

1. SONET based management is not supported on the Cisco ONS 15530 and is included for comparison with the in-band message channel only.
2. HEC = Header Error Control
3. BIP = bit interleaved parity

For the most comprehensive set of monitoring and management capabilities, use the in-band message channel, SONET DCC, and OSC on your network. The in-band message channel and SONET DCC provide fault isolation and monitoring at the wavelength level, and OSC provides that functionality for the fiber.