

# Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card

## Product Overview

The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) supports a trunk card that delivers Dense Wavelength-Division Multiplexing (DWDM) transmission using a coherent polarization-multiplexed differential quadrature phase shift keying (CP-DQPSK) modulation scheme. The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card (Figure 1) simplifies the integration and transport of 100 Gigabit Ethernet and Optical Transport Unit Level 4 (OTU-4) interfaces and services into enterprises and service provider optical networks.

Release 9.6 of the Cisco ONS 15454 MSTP extends the total data transport capacity by a factor of three, allowing DWDM transmission of up to 9.6 Tbps (96 wavelengths at 100 Gbps each) in the C band.

**Figure 1.** Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card



## Challenge and Solution

The bandwidth carried on core and metropolitan DWDM networks is growing exponentially, while operators' revenues are not keeping pace. The Cisco ONS 15454 100-Gbps solution can dramatically lower the cost to carry bandwidth, helping to maintain and improve customers' profitability. Internet growth is still exponential, mainly due to demand for next-generation services such as quadruple play (data, voice, video, and mobility), video distribution, Internet Protocol Television (IPTV), and other high-bandwidth services.

With advanced modulation schemes, the ability to transmit 100-Gbps wavelengths on existing or new DWDM systems improves return on investment by increasing the overall capacity per fiber pair without impacting the unregenerated transmission distance supported by the system. Scaling from 10 Gbps to 40 Gbps and now 100 Gbps increases by a factor of 10 the bandwidth that can be transported over existing fiber networks.

The new CP-DQPSK modulation supports 9.6 Tbps capacity transmission over Ultra-Long-Haul (ULH) networks of up to 3000 km of unregenerated optical spans.

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card is designed to provide the following benefits:

- Transport of 100-Gbps wavelengths over fully uncompensated networks, up to 3000 km of unregenerated optical spans
- Transport at 100 Gbps over very low-quality fiber with very high Polarization Mode Dispersion (PMD)
- Support for up to ninety-six 100-Gbps wavelengths (50-GHz channel spacing) with very high tolerance to filtering penalties
- Improved overall system density for 100 Gbps per slot, five times greater than the density achieved with 40-Gbps units
- Support for different configurations (transponder, muxponder, or regenerator) through software provisioning only

## Product Features and Benefits

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card is a plug-in module to the Cisco ONS 15454 MSTP, providing a cost-effective architecture for delivering 100-Gbps services. The card also features a pluggable client interface that can be used to provide transponder capabilities, mapping the client signal to a single DWDM line interface.

The client port supports a standard Channel Express (CXP) format pluggable compliant with IEEE 100GBASE-SR10 LAN PHY or OTU-4 equivalent interface.

The trunk card features a software-configurable baud rate between 27.952 Gbaud and 31.241 Gbaud, depending on Forward Error Correction (FEC) selection as well as a G.709v3 OTU-4 digital wrapper, long-reach and long-haul, ITU-compliant, 50-GHz spaced optical interface using LC connectors. The DWDM output line interface is tunable to 96 wavelengths across the full optical C band, dramatically reducing inventories for spares. When operated within the outlined specifications, the trunk card can operate with a post-FEC bit error rate (BER) of better than  $10E-15$ .

The trunk card provides many carrier-class features and advanced capabilities necessary to deliver 100-Gbps services, including protocol transparency, wavelength tunability, flexible protection mechanisms, flow-through timing, and management and performance monitoring capabilities (Figure 2).

**Figure 2.** Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card Block Diagram



## Enhanced Forward Error Correction Capability

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can support FEC mechanisms on trunk and client interfaces.

The trunk port supports three software-configurable FEC coding options, which cannot be disabled.

- Generic FEC (GFEC): Standard G.975 Reed-Solomon algorithm with 7 percent overhead (OH).
- Ultra FEC (UFEC): Standard G.975.1 (Subclause I.7) with 20 percent overhead. This FEC scheme uses two orthogonally concatenated BCH Enhanced FEC (EFEC) codes. The constructed code is decoded iteratively to rebuild the original frame.

- High-Gain FEC (HG-FEC): High-Gain FEC with 7 percent overhead, providing better performance than standard G.975.1 seven percent overhead FEC. Because of the reduced overhead and lower bit rate, HG-FEC is suitable for applications where 100-Gbps wavelengths are passing through a large number of reconfigurable optical add-drop multiplexer (ROADM) nodes with limited pass-band performance.

The client port supports the standard G.975 Reed-Solomon FEC algorithm, which can be enabled or disabled through software configuration.

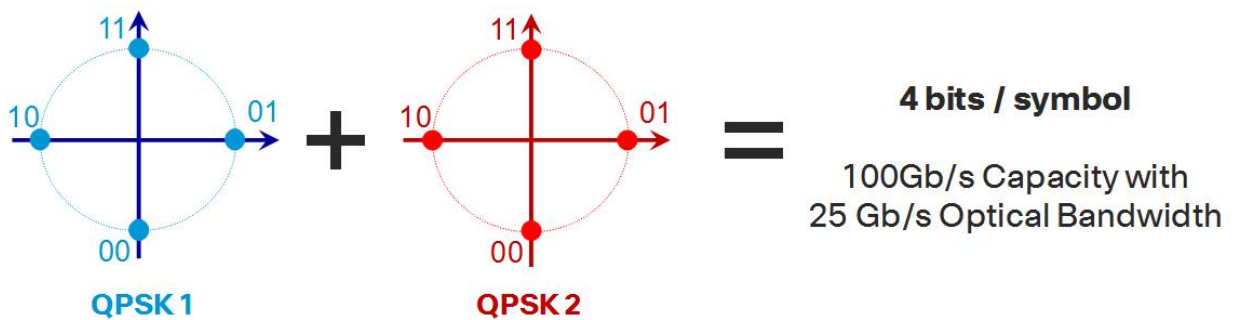
### Advanced Modulation Scheme

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card features an advanced modulation scheme to provide optical performance significantly better than industry-standard 10-Gbps equivalent interfaces.

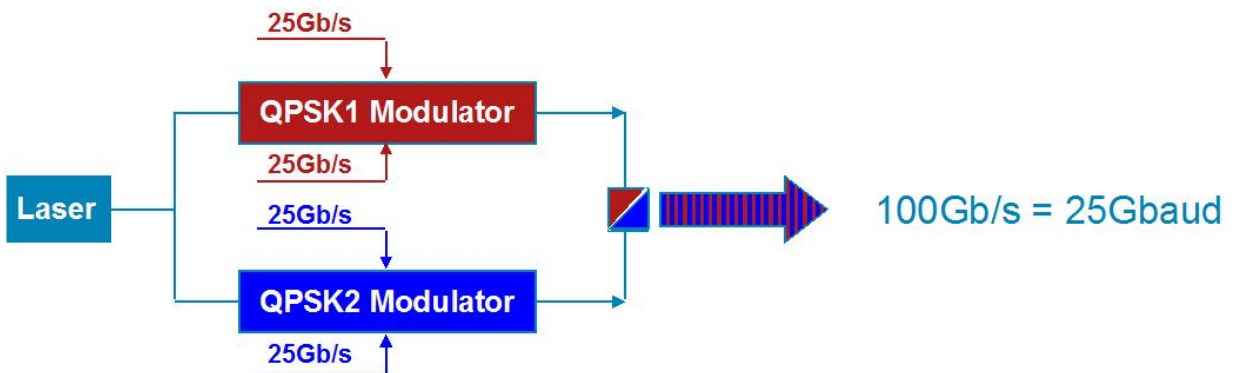
Cisco selected a CP-DQPSK modulation format to optimize 100-Gbps transmission in terms of Optical Signal-to-Noise Ratio (OSNR), Chromatic Dispersion (CD), and Polarization Mode Dispersion (PMD) robustness.

The CP-DQPSK modulation scheme consists of multiplexing two DQPSK signals using two different orthogonal light polarizations, as shown in Figures 3 and 4.

**Figure 3.** CP-DQPSK Logical Modulation Scheme

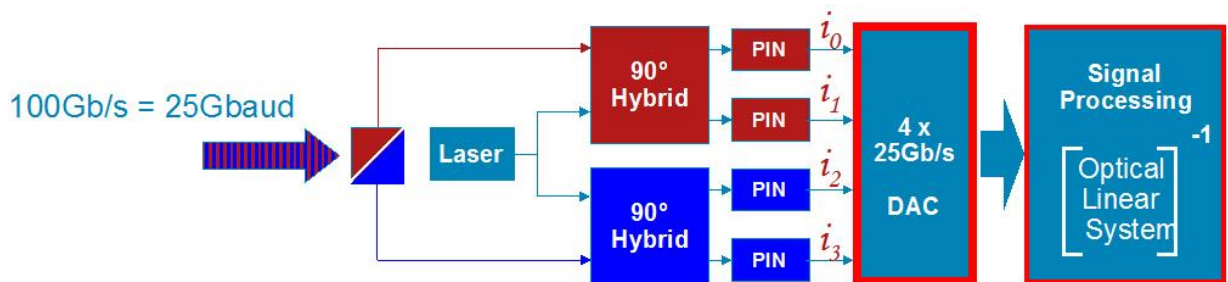


**Figure 4.** CP-DQPSK Logical Transmitter Scheme



The core of the 100-Gbps CP-DQPSK modulation scheme is the optical receiver, based on coherent optical detection, where a Digital Signal Processor (DSP) calculates the inverse of the optical system matrix, allowing the receiver to recover the original transmitted signals (Figure 5).

**Figure 5.** CP-DQPSK Logical Receiver Scheme



The primary benefits of CP-DQPSK are:

- Strong optical signal-to-noise ratio performance
- Outstanding chromatic dispersion robustness, avoiding any additional cost related to optical chromatic dispersion compensation equipment
- Extended polarization mode dispersion robustness (three times better than 10-Gbps units)
- Very high spectral efficiency, allowing 100-Gbps wavelengths to be transmitted across a large number of ROADMs with negligible penalty

#### Trunk Card Versions

Two versions of the Cisco ONS 15454 100 Gbps Coherent DWDM Trunk card are offered to support different application requirements:

- An extended-performance version offering full performance targeting Ultra Long-Haul applications where the network is optimized for CP-DQPSK transmission (no 10-Gbps channels or dispersion compensation units [DCUs])
- A metro edge performance version with differential mode only (CP-DQPSK), cost-optimized for metropolitan application and 10-Gbps installed networks

#### Protocol Transparency

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can transparently deliver 100-Gbps point-to-point services cost-effectively for the Cisco ONS 15454 MSTP platform. Table 1 shows transponder client configurations and mapping.

**Table 1.** Transponder Client Configurations and Mapping

Client			Trunk		
Format	Rate (Gbps)	Mapping	Format	Rate with 7% GFEC or HG-FEC OH (Gbps)	Rate with 20% UFEC OH (Gbps)
100GE LAN-PHY	101.125	Bit transparent through standard G.709v3 mapping	OTU-4	111.809	124.964
OTU-4	111.809	Transparent G.709 standard			

#### Wavelength Tunability

The trunk card supports software-provisionable tunability across the full C band, covering 96 channels on the 50-GHz grid. Tunability provides flexibility and reconfigurability of services transported on ROADM-based networks, and also allows ordering and inventory of a single part for deployment and sparring.

## Flexible Protection Mechanism Support

The trunk card supports multiple protection mechanisms commonly used in optical transport networks. Table 2 outlines the available protection options and the associated service-level agreements (SLAs) that can be provided.

**Table 2.** Protection Formats

Protection Type	Capabilities
<b>Unprotected</b>	No client terminal interface, transponder card, or DWDM line protection. The client signal is transported over a single unprotected transponder card or optical path.
<b>1+1 protection</b>	Provides protection for the client terminal interface, transponder card, and DWDM line through client Automatic Protection Switching (APS) or Linear Multiplex Section Protection (LMSP) signaling transported transparently over the transponder card or optical path. Protection is provided through client line or path protection through transparent signal transport through a transponder circuit.
<b>OCH-trail protection</b>	Provides protection for DWDM signal through external optical switch units: Protection Switch Module (PSM).

## Flow-Through Timing

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card allows timing to flow through from client to line optical interface. The received timing from the client interface is used to time the line transmitter interface. This flow-through timing allows multiple trunk cards to be placed in the same shelf but be independently timed, independent of the network element timing.

## Management

The Cisco ONS 15454 MSTP system provides comprehensive management capabilities to support Operations, Administration, Maintenance, and Provisioning (OAM&P) capabilities through the integrated Cisco Transport Controller craft interface with support from the Cisco Prime™ optical element management system. The trunk card features provisionable digital wrapper (G.709) functionality, providing per-wavelength performance management capabilities, especially for services transported transparently across the network. Without the digital wrapper functions, a carrier transporting a service transparently would be unable to identify network impairments that may degrade the transported signal and violate the SLA agreements. The digital wrapper's Generic Communication Channel (GCC) provides a separate communications channel on a per-wavelength basis to be used by the platform when transparent signals are transported. GCC allows the Cisco ONS 15454 MSTP system to extend its advanced network autodiscovery capabilities to DWDM-based services. The integrated Cisco Transport Controller craft manager and Cisco Prime provide the user with OAM&P functionalities for the system.

## Far-End-Laser-Off Behavior

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can provision the far-end-laser-off behavior when SONET/SDH payloads are present. Customers can use Cisco Transport Controller to configure how the remote client interface will behave following a fault condition. It is possible to configure the remote client to Squelch or to send an Alarm Indication Signal (AIS). For 100-Gigabit Ethernet signals, the default behavior is Squelching.

## Performance Monitoring

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card provides support for both transparent and nontransparent signal transport performance monitoring. The digital wrapper channel is monitored according to G.709 Optical Transport Network (OTN) and G.8021 standards. Performance monitoring of optical parameters on the client and DWDM line interface include Loss of Signal (LOS), laser bias current, transmit optical power, and receive optical power. Calculation and accumulation of the performance monitoring data are supported in 15-minute and 24-hour intervals as per G.7710.

Physical system parameters measured at the wavelength level, such as mean polarization mode dispersion, accumulated chromatic dispersion, or received optical signal to noise ratio, are also included in the set of performance monitoring parameters. These can greatly simplify troubleshooting operations and enhance the set of data that can be collected directly from the equipment. A detailed list of performance monitors is given in Table 8.

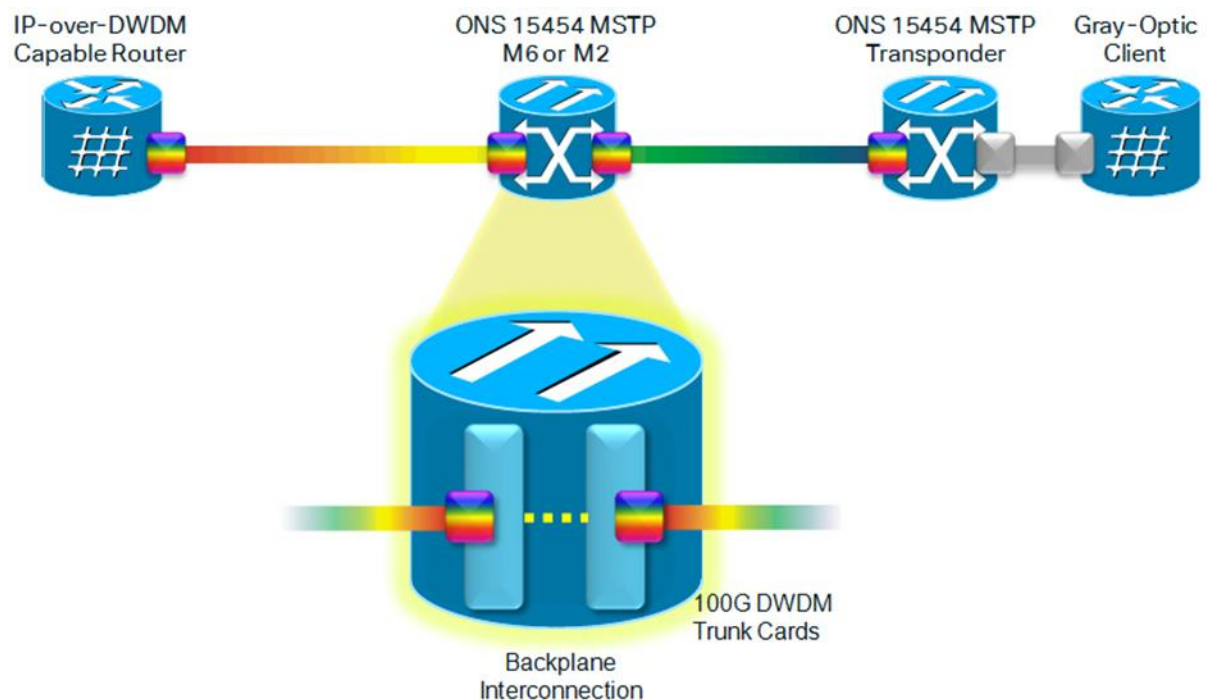
The trunk card incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status of the card. An orange circle is printed on the faceplate, indicating the shelf slot in which you can install the card.

A specific configuration of the client will support IP over DWDM (IPoDWDM) proactive Fast Reroute (FRR) messaging over the CXP client in case of 100 Gigabit Ethernet connectivity.

### Regeneration Application

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card supports OTU-4 regeneration capabilities. Two cards can be configured to work in back-to-back mode connecting through the backplane in the same shelf, and perform the OTN Optical-Electrical-Optical (OEO) regeneration of the frame as depicted in Figure 6.

**Figure 6.** OTU-4 Regeneration Application for 100 Gbps OTU-4 Client Signal

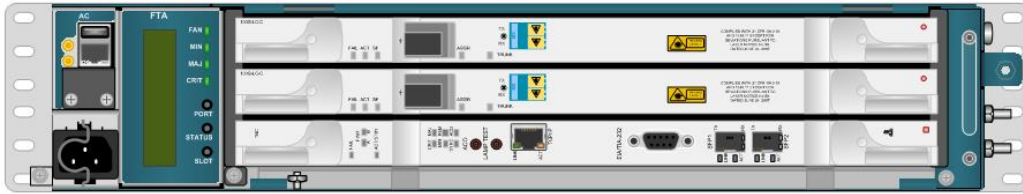


100 Gigabit Ethernet or OTU-4 clients are supported. Regeneration capability uses the OTU-4 backplane interconnection supported by the Cisco ONS 15454 MSTP M6 or M2 chassis; OTU-4 overhead is terminated, allowing ODU-4 traffic to transparently pass through. GCC0 is properly terminated, while GCC1 and GCC2 are properly passed through (Figure 7).

No CXP client is required, as communication between the two cards acting as a regeneration group is supported through the chassis backplane.

A dedicated IPoDWDM configuration can be enabled in the regeneration configuration to support proactive FRR messaging between IPoDWDM router interfaces.

**Figure 7.** OTU-4 Regeneration Configuration in a Cisco ONS 15454 M2 chassis



In case of failure on one side, ODUK-AIS is generated and propagated on the other side while an OTUK-BDI is sent back on the same side as defined by the ITU G.709 standard.

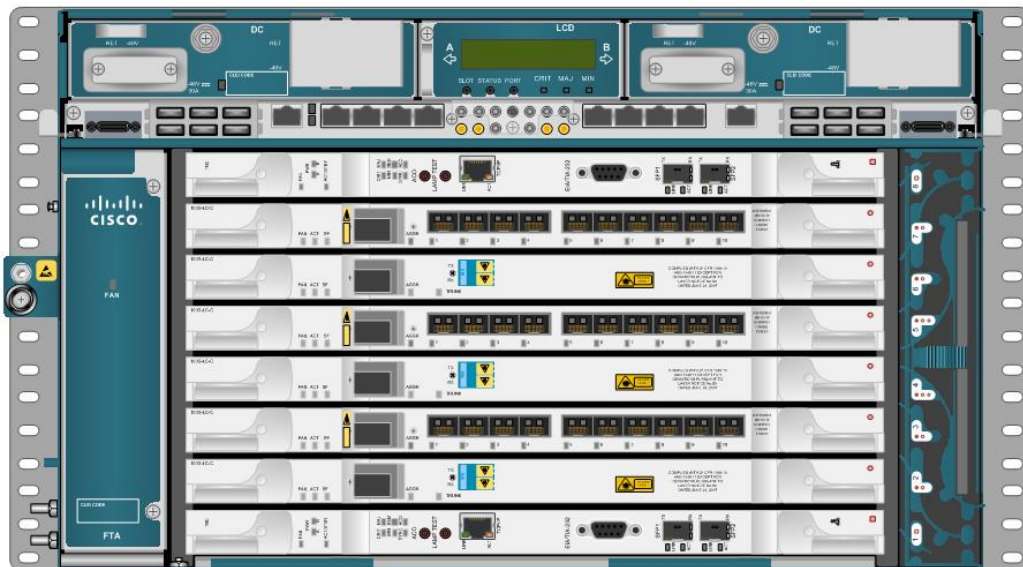
### Cisco ONS 15454 10-Port 10 Gbps Line Card Configuration

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can be coupled with the Cisco ONS 15454 10-Port 10-Gbps Line Card to support 10-port 10-Gbps muxponder capability. The Cisco ONS 100 Gbps Coherent DWDM Trunk Card can be connected through the Cisco ONS 15454 MSTP M6 or M2 backplane (no client CXP required) with the Cisco ONS 15454 10-Port 10 Gbps Line Card to provide OTN multiplexing of 10 ports of 10-Gbps data streams into a single 100-Gbps DWDM OTU-4 wavelength (Figure 8).

Supported client signals are any combination of 10 Gigabit Ethernet LAN-PHY, 10 Gigabit Ethernet WAN-PHY, OC-192, STM-64, 10-Gbps and 8-Gbps Fibre Channel (FICON), or OTU-2 data rates.

Please refer to the [Cisco ONS 15454 10-Port 10 Gbps Line Card data sheet](#) for additional information.

**Figure 8.** Three Cisco ONS 15454 10-Port 10 Gbps Line Card Applications in an M6 Chassis



### Cisco ONS 15454 2-Port CFP 40-Gbps Muxponder Application

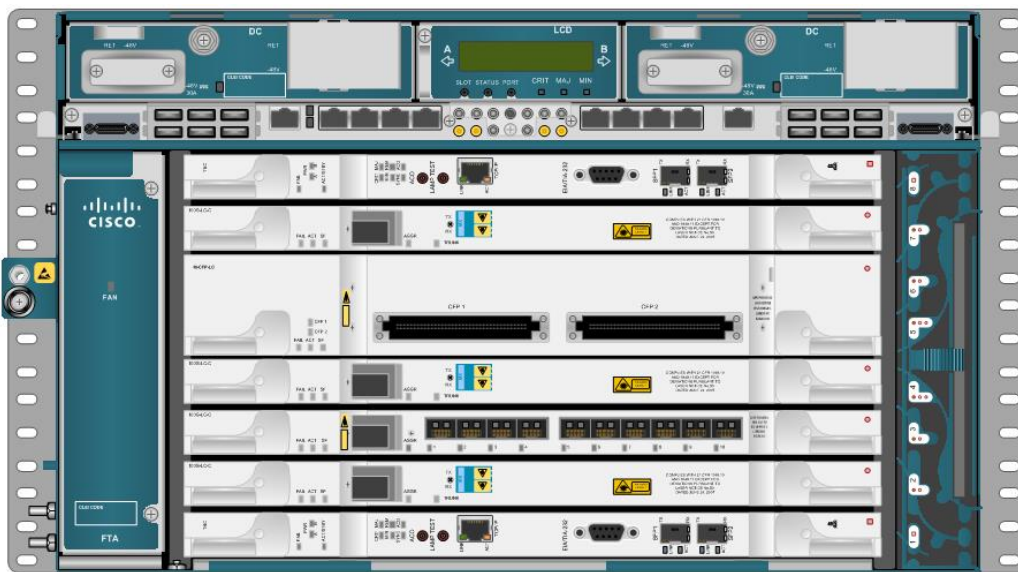
The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can be coupled with the Cisco ONS 15454 2-Port CFP Line Card to support two ports of 40-Gbps muxponder capability in a C Form-Factor Pluggable (CFP) configuration. The trunk card can be connected through the Cisco ONS 15454 MSTP M6 or M2 backplane (no client CXP required) with the 2-port CFP line card and provides OTN multiplexing of the two ports of 40-Gbps data streams into a single 100-Gbps DWDM OTU-4 wavelength.

Supported client signals are any mix and combination of 40 Gigabit Ethernet LAN-PHY, or OTU-3 data rates. Please refer to the [Cisco ONS 15454 2-Port CFP Line Card data sheet](#) for additional information.

### Cisco 100-Gbps LR4 Transponder Application

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card can be coupled with the Cisco ONS 15454 2-Port CFP Line Card to support the 100GBASE-LR4 client interface for the 100-Gbps transponder. The 2-port CFP line card can be connected through the Cisco ONS 15454 M6 or M2 backplane with up to two trunk cards placed in slots immediately above and below the line card to provide the functionality of two 100-Gbps LR4 transponders, using CFP pluggables as the client-facing interface (Figure 9).

**Figure 9.** LR4 Transponder Application Plus One 10-Port 10 Gbps Muxponder in an M6 Chassis



Supported client signals are 100 Gigabit Ethernet LAN-PHY or OTU-4 data rates.

Please refer to the [Cisco ONS 15454 2-Port CFP Line Card data sheet](#) for additional information.

### Application Description

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card provides cost-effective 100-Gbps transport services using the Cisco ONS 15454 MSTP platform.

Two main applications promote the 100-Gbps deployments.

- 100-Gbps router interconnection for business services and research networks: Cisco research indicates that the total volume of worldwide IP traffic is doubling every two years, requiring an increase in transfer rate from 10 Gbps to 100 Gbps. The transponder solution aims to provide DWDM interconnection between 100-Gbps router interfaces across DWDM metro, regional, or ULH networks. The advanced CP-DQPSK modulation scheme is designed to cope with long-distance applications, allowing the extension of unregenerated 100-Gbps services across fiber spans up to 3000 km.



- OTU-4 links in carrier backbone networks: OTN technology is crucial to backbone carrier networks. OTN is normally the preferred method used for inter-carrier or inter-domain capacity exchange at 2.5-Gbps (OTU-1), 10-Gbps (OTU-2), 40-Gbps (OTU-3) and 100-Gbps (OTU-4) data rates. The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card supports a fully standard OTU-4 client interface, which can be connected to any G.709-based OTN cross-connect, 100-Gbps router interface, or other 100-Gbps transponder interfaces.

## Licensing Approach

The Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card includes the ability to cost-effectively transport 10-Gbps services through a pay-as-you-grow licensing model for the 10-Port 10-Gbps muxponder configuration. A licensed version of the Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card works in conjunction with a licensed version of the Cisco ONS 15454 10-Port 10 Gbps Line Card, offering a cost-effective solution for aggregation and transport of 10-Gbps services. These two cards can only work in this configuration. Additional 10-Gbps services will be provided by mounting a 10-Gbps license through software key distribution. Up to nine additional 10-Gbps licenses can be added to the Cisco ONS 15454 10-Port 10 Gbps Line Card (only one is provided in the initial configuration).

To simplify spares management, it is also possible to upgrade the licensed version of the trunk card to full functionality.

**Table 3.** Supported Software Licenses

License Part Number	License Description	Card Applicability	Card Description
15454-M-LIC-10G=	One-Port 10-Gb License for 100-Gb muxponder	15454-M-10X10-LIC=	10x10G Multirate client line card licensed with 1 license at 10 Gb
15454-M-LIC-100G=	100G TXP Reg License for 100-Gb trunk line card	15454-M-100GC-LIC=	100G OTU-4 ITU-T CP-DQPSK Full C-Band Tunable Line Card License

More information about the Cisco licensing policy is available at [http://www.cisco.com/en/US/docs/general/warranty/English/EU1KEN\\_.html](http://www.cisco.com/en/US/docs/general/warranty/English/EU1KEN_.html).

## Product Specifications

### Compact Design

- Single-slot card design for high-density, 100-Gbps solutions
- Up to six trunk cards per Cisco ONS 15454 M6 shelf assembly, supporting up to forty-two 100-Gbps ports per 42-rack-unit (RU) bay frame

### Flexible Restoration Options

- Transparent support for UPSR, SNCP, BLSR, MS-SPRing, and 1+1 APS and MSP
- OCH-trail protection through protection switch module
- Unprotected (0+1)

### Regulatory Compliance

Table 4 lists regulatory compliance information for the trunk card. Note that all compliance documentation may not be completed at the time of product release. Please check with your Cisco sales representative for countries other than Canada, the United States, and the European Union.

**Table 4.** Regulatory Compliance

ANSI System	ETSI System
<b>Countries and Regions Supported</b>	
<ul style="list-style-type: none"> <li>• Canada</li> <li>• United States</li> <li>• Korea</li> <li>• Japan</li> <li>• European Union</li> </ul>	<ul style="list-style-type: none"> <li>• European Union</li> <li>• Africa</li> <li>• CSI</li> <li>• Australia</li> <li>• New Zealand</li> <li>• China</li> <li>• Korea</li> <li>• India</li> <li>• Saudi Arabia</li> <li>• South America</li> </ul>
<b>EMC (Class A)</b>	
<ul style="list-style-type: none"> <li>• ICES-003, 2004</li> <li>• GR-1089-CORE Issue 4, NEBS EMC and Safety, June 2006</li> <li>• FCC 47CFR15, 2007</li> </ul>	<ul style="list-style-type: none"> <li>• ETSI EN 300 386 V1.4.1 (2008-04) Telecommunication network equipment EMC requirements (Note: EMC-1)</li> <li>• CISPR22:2008 and EN55022:2006/A1:2007 Information Technology Equipment (Emissions) (EMC-2)</li> <li>• CISPR24: 1997/ A1:2001/A2:2002 and EN55024:1998/A1:2001/A2:2003: Information Technology Equipment – Immunity characteristics – Limits and Methods of Measurement (test levels)</li> </ul>
<b>Safety</b>	
<ul style="list-style-type: none"> <li>• CSA C22.2 #60950-1 – Edition 7, March 2007</li> <li>• UL 60950-1 – Edition 2, March 2007</li> <li>• GR-1089-CORE Issue 4, NEBS EMC and Safety, June 2006</li> </ul>	<ul style="list-style-type: none"> <li>• UL 60950-1 – Edition 2, March 2007</li> <li>• IEC 60950-1 Information technology equipment Safety Part 1: General requirements – Edition 2, 2005 and National Differences as per CB Bulletin 112A</li> <li>• IEC/EN 60950-1 (2006/10) with Amendment 11:2004 to EN 60950-1:2001, 1st Edition and National Differences as per CB Bulletin 112A.</li> <li>• EN 60950-1, Edition 2 (2006) Information technology equipment – Safety – Part 1: General requirements</li> <li>• CE Safety Directive: 2006/95/EC</li> </ul>
<b>Laser</b>	
<ul style="list-style-type: none"> <li>• UL 60950-1 – Edition 2, March 2007</li> <li>• IEC 60825-1: 2001 Ed.1.2 (incl. am1+am2) Safety of laser products Part 1: Equipment classification, requirements and users guide</li> <li>• IEC60825-2 Ed.3 (2004) Safety of laser products Part 2: Safety of optical fiber communication systems + A1:2006</li> </ul>	<ul style="list-style-type: none"> <li>• IEC 60825-1: 2001 Ed.1.2 (incl. am1+am2) Safety of laser products Part 1: Equipment classification, requirements and users guide</li> <li>• IEC60825-2 Ed.3 (2004) Safety of laser products Part 2: Safety of optical fibre communication systems + A1:2006</li> <li>• 21CFR1040 (2008/04) (Accession Letter and CDRH Report) Automatic Laser Shutdown and restart (ALS) according to ITU-T G.664 (03/06). Guidance for Industry and FDA Staff (Laser Notice No. 50) , June 2007</li> <li>• Laser Products: Conformance with IEC 60825-1 and IEC 60601-2-22; Guidance for Industry and FDA Staff (Laser Notice No. 50), June 2007</li> </ul>
<b>Environmental</b>	
<ul style="list-style-type: none"> <li>• GR-63-CORE Issue 3 ,Network Equipment Building Standards (NEBS) Physical Protection, March 2006</li> </ul>	<ul style="list-style-type: none"> <li>• ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1)</li> <li>• ETS 300-019-2-2 V2.1.2 (1999-09): Transportation, Class 2.3</li> <li>• ETS 300-019-2-3 V2.2.2 (2003-04):Operational, Class 3.1E</li> </ul>
<b>Optical</b>	
<ul style="list-style-type: none"> <li>• GR-253-CORE – Issue 04</li> <li>• ITU-T G.691</li> </ul>	<ul style="list-style-type: none"> <li>• ITU-T G.709</li> <li>• ITU-T G.975</li> </ul>
<b>Quality</b>	
<ul style="list-style-type: none"> <li>• TR-NWT-000332, Issue 4, Method 1 calculation for 20-year mean time between failure (MTBF)</li> </ul>	

ANSI System	ETSI System
<b>Miscellaneous</b>	
<ul style="list-style-type: none"> <li>GR-1089-CORE Issue 4, NEBS EMC and Safety (June 2006) (Note: NEBS-1)</li> <li>GR-63-CORE Issue 3, NEBS Physical Protection (March 2006) (Note: NEBS-2)</li> <li>ATT-TP-76200 : 2008</li> <li>ANSI T1.315-2001</li> <li>GR-499: 2004 Transport Systems Generic Requirements (TSGR): Common Requirements</li> </ul>	

## Other Specifications

Table 5 lists system requirements for the Cisco ONS 15454 100 Gbps Coherent DWDM Trunk Card. Table 6 provides the DWDM specifications, Table 7 details receive-side optical performances, Table 8 lists performance monitoring parameters, Table 9 provides card specifications, and Table 10 gives ordering information.

**Table 5.** System Requirements

Component	Cisco ONS 15454 M6	Cisco ONS 15454 M2
<b>Processor</b>	TNC/TSC/TNC-E/TSC-E	TNC/TSC/TNC-E/TSC-E
<b>Shelf assembly</b>	Cisco ONS 15454-M6-SA shelf assembly with FTA2	Cisco ONS15454-M2-SA shelf assembly with FTA2
<b>System software</b>	Release 9.6 ANSI/ETSI or later	Release 9.6 ANSI/ETSI or later
<b>Slot compatibility</b>	2 through 7	2 through 3

**Table 6.** DWDM Specifications

Parameter	Value
Bit rate	27.952 Gbaud $\pm$ 20 ppm (OTU4 with GFEC or HG-FEC 7% OH) 31.241 Gbaud $\pm$ 20 ppm (OTU4 with UFEC 20% OH)
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths ( $\lambda_{Tnom}$ )	Full-tunable between 1528.77 and 1566.72 nm (C-Band – 50 GHz)
Connector type (TX/RX)	LC, duplex (shuttered)
<b>Optical Transmitter</b>	
Type	CP-DQPSK modulation format
Output power (PTmin)	-2 to +0.5 dBm (metro edge performance) -1 to +1.5 dBm (extended performance)
Required optical return loss, minimum (ORLmin)	27 dB
Laser safety class	1
<b>Optical Receiver</b>	
Chromatic dispersion tolerance (DLR <sub>max</sub> )	+/- 70,000 ps/nm
Overload	0 dBm
Receiver reflectance (maximum)	30 dB
Input wavelength bandwidth ( $\lambda_{c,rx}$ )	Between 1528.77 and 1566.72 nm (C-Band – 50 GHz)

**Table 7.** DWDM Receive-Side Optical Performances

CD Tolerance	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	DGD	OSNR (0.5 nm RWB)
<b>Extended Performance</b>						
0 ps/nm	UFEC (20% OH)	<1x10E (-2)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	7.5 dB
0 ps/nm					180 ps	8.0 dB
+/- 70,000 ps/nm					180 ps	9.0 dB

CD Tolerance	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	DGD	OSNR (0.5 nm RWB)
0 ps/nm	HG-FEC (7% OH)	<4.0x10E (-3)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	8.0 dB
0 ps/nm					180 ps	8.5 dB
+/- 70,000 ps/nm					180 ps	9.5 dB
0 ps/nm	GFEC (7% OH)	<1.0x10E (-3)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	14.5 dB
+/- 20,000 ps/nm					180 ps	15.5 dB
<b>Metro Edge Performance</b>						
0 ps/nm	HG-FEC 7% OH	<4.0x10E (-3)	<10E (-15)	0 to -14 dBm -20 dBm with 0.5 dB of OSNR penalty	-	11.0 dB
+/- 5,000 ps/nm					30 ps	11.5 dB

**Table 8.** Performance Monitoring Parameters

Area	Parameter Name		Description
<b>OTN</b>	<b>OTUk SM</b>	<b>ODUk PM</b>	
	BBE-SM	BBE-PM	Number of background block errors
	BBER-SM	BBER-PM	Background block error ratio
	ES-SM	ES-PM	Number of errored seconds
	ESR-SM	ESR-PM	Errored seconds ratio
	SES-SM	SES-PM	Number of severely errored seconds
	SESR-SM	SESR-PM	Severely errored seconds ratio
	UAS-SM	UAS-PM	Number of unavailable seconds
	FC-SM	FC-PM	Number of failure counts
<b>FEC</b>	Bit errors		Number of corrected bit errors
	Uncorrectable words		Number of uncorrectable words
<b>Trunk optical performance monitoring</b>	OPT		Transmitter optical power
	LBC		Transmitter laser bias current
	OPR		Receiver optical power
	RCD		Residual chromatic dispersion
	PMD		Mean polarization mode dispersion
	OSNR		Optical signal-to-noise ratio, calculated with 0.5 nm RBW
	SOPMD		Second Order PMD (SOPMD Estimation)
	SOPCR		Polarization Change Rate Estimation
	PDL		Polarization Dependent Loss (PDL) Estimation

**Table 9.** Card Specifications

Management	
Card LEDs	
Failure (FAIL)	Red
Active/standby (ACT/STBY)	Green/yellow
Signal fail (SF)	Yellow
Client port LEDs (per port)	
Active input signal	Green
DWDM port LEDs	
Active input signal	Green
Output wavelength	Green

Management	
<b>Power (including pluggable)</b>	
Typical	125W (25C and –48VDC)
Maximum	133W (55C and –38VDC)
<b>Physical</b>	
Dimensions	Occupies 1 slot
Weight	4 lb (1.8 kg)
<b>Reliability and availability</b>	
Mean time between failures (MTBF)	116,052 hrs
<b>Latency (end to end)</b>	
G.709 – GFEC	4 microseconds
G.709 – HG-FEC 7%	20 microseconds
G.709 – UFEC 20%	39 microseconds
Storage temperature	–40°C to 70°C (–40°F to 158°F)
Operating temperature	
Normal	0°C to 40°C (32°F to 104°F)
Short-term <sup>1</sup>	–5°C to 55°C (23°F to 131°F)
Relative humidity	
Normal	5% to 85%, noncondensing
Short-term <sup>1</sup>	5% to 90% but not to exceed 0.024 kg water/kg of dry air
<sup>1</sup> Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in 1 year (a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period). The values shown are valid for M6 or M2 chassis.	

**Table 10.** Ordering Information

Part Number	Description
15454-M-100G-LC-C=	100G OTU-4 ITU-T CP-DQPSK Full C Band Tuneable LC
15454-M-100G-ME-C=	100G OTU-4 CP-DQPSK Full C Band Tuneable LC Metro Edge
15454-M-100GC-LIC=	100G OTU-4 ITU-T CP-DQPSK Full C Band Tuneable LC – Licensed
15454-M-LIC-100G=	100G TXP/Reg License for 100G Trunk Line card
ONS-CXP-100G-SR10=	CXP – 100GBASE-SR – Commercial Temp

## For More Information

For more information about the Cisco ONS 15454 MSTP, visit

<http://www.cisco.com/en/US/products/hw/optical/ps2006/ps5320/index.html>.



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