

Extended Performance 8-Port Data Muxponder Card for the Cisco ONS 15454 Multiservice Transport Platform

The Extended Performance 8-Port Data Muxponder Card (Figure 1) for the Cisco® ONS 15454 Multiservice Transport Platform (MSTP) expands the platform's storage area network (SAN) and data interface density. The card facilitates the delivery of Gigabit Ethernet, 1-Gbps to 4-Gbps Fibre Channel, IBM Fiber Connection (FICON), and IBM ISC services for enterprises or metropolitan-area (metro) and regional service provider networks.

Cisco ONS 15454 MSTP Release 9.1 extends the capabilities of this card with an enhanced-performance optical trunk module, which implements an Electronic Dispersion Compensation (EDC) mechanism based on the Maximum Likelihood Sequence Estimation (MLSE) algorithm to improve chromatic dispersion (CD) and polarization-mode dispersion (PMD) robustness.

Figure 1. Cisco ONS 15454 Extended Performance 8-Port Data Muxponder Card



Background

Large and medium-sized enterprises and service providers increasingly find themselves at a critical stage in the expansion of their networked data centers. They typically need to consolidate a variety of network services and protocols that support their storage and data applications in order to simplify operations and reduce costs. These services range from Gigabit Ethernet to 10-Gbps Fibre Channel and include 1-Gbps and 2-Gbps Fibre Channel, the emerging 4-Gbps Fibre Channel data rate, IBM FICON, ISC Compat, and ISC-3 (1-Gbps/2-Gbps).

In the recent past, SONET add/drop multiplexers (ADMs) provided the services platform to aggregate and transport services up to OC-48/STM-16, whereas metro dense wavelength-division multiplexing (DWDM) platforms were designed for optical signals from OC-3/STM-1 to OC-192/STM-64, including Gigabit and 10 Gigabit Ethernet. Unfortunately, deploying multiple platforms (including metro DWDM and SONET ADMs) to support multiple services is not cost-effective for many service provider and enterprise networks. The Cisco ONS 15454 MSTP with a variety of muxponder cards provides a more cost-effective networking solution to facilitate the delivery of all data, storage area networking, and TDM services.

Product Overview

The Cisco ONS 15454 Extended Performance 8-Port 10-Gbps Data Muxponder Card can transport up to 8 x 1-Gbps services, 4 x 2-Gbps services, 2 x 4-Gbps services, or a mix of these services aggregated over a G.709 OTU-2-based, 50-GHz spaced, 50-GHz stabilized, ITU-compliant wavelength with selectable Forward Error Correction (FEC) and Enhanced Forward Error Correction (E-FEC). The muxponder card is a plug-in module to the Cisco ONS 15454 MSTP, helping enable a high-density, cost-effective solution for Gigabit Ethernet, Fibre Channel, FICON, and ISC transport over a highly resilient optical platform. The muxponder card architecture contains eight client interfaces that are mapped to a single line interface, without accessing the Cisco ONS 15454 shelf cross-connect fabric.

Each client interface supports Gigabit Ethernet, 1-Gbps or 2-Gbps Fibre Channel/FICON/ISC, or 4-Gbps Fibre Channel using a Small Form-Factor Pluggable (SFP) optics module with LC connectors, providing the flexibility to support several protocols, data rates, or fiber types. The data muxponder card supports a mixture of SFP types and also supports in-service insertion or removal without affecting other active ports, allowing networking flexibility and simplifying deployment.

The DWDM line interface provides one 10.70923-Gbps G.709 OTU-2 digital wrapper, long-reach/long-haul, ITU-compliant, 50-GHz spaced optical interface using LC connectors supporting G.709 OTU-2 digital wrapper interfaces. The DWDM output line interface is tunable across the full optical C or L band, dramatically reducing the inventory of spares. When operating within the outlined specifications, each card will transport the aggregated signals with a maximum bit error rate (BER) of 10E-15.

The integrated MLSE-based Electronic Dispersion Compensation extends DWDM network performances, providing support to the following applications:

- **High PMD fiber applications:** MLSE technology can monitor and correct errors due to time variant effects
- **Low-latency data center applications:** SAN protocols, such as Server Time Protocol (STP), are extremely sensitive to additional latency introduced by CD optical fiber.
- **Enterprise point-to-point applications:** Installation costs for the dispersion compensation unit (DCU) and fiber can be avoided. This is particularly important in low-end markets, where DCU can comprise up to 10 percent of simple point-to-point systems cost.
- **Ultra-long-haul (ULH) applications:** Improvement in CD and PMD performance can be translated in better ULH performance. Additional OSNR margin can be allocated to compensate for non-linear effects (NLE) impairment, allowing for better system performance.

The muxponder card incorporates the eight client interfaces and one DWDM line interface on the same card. The muxponder cards are deployable in the 12 multiservice interface card slots of the Cisco ONS 15454 MSTP, in systems with or without cross-connect cards. The only other common card required for operation is the timing, communications, and control (TCC) card.

The data muxponder card provides many carrier-class features and capabilities necessary to deliver SAN and data services, including selectable service mix, wavelength tunability, flexible protection mechanisms, flexible timing options, and management capabilities.

Enhanced FEC Capability

An important feature of the data muxponder card is its ability to configure the Forward Error Correction in two modes: FEC and Enhanced FEC (E-FEC). The output bit rate will always be 10.7092 Gbps as defined in G.709 but the error-coding performance can be provisioned:

- FEC: standard G.975 Reed-Salomon algorithm
- E-FEC: standard G.975.1 two orthogonally concatenated BCH super FEC codes. This FEC scheme contains three parameterizations of the same scheme of two orthogonally interleaved block codes (BCH). The constructed code is decoded iteratively to achieve the expected performance.

Note: E-FEC gains 2 dB when compared to standard FEC.

Wavelength Tunability

The data muxponder cards operate on the 50-GHz ITU grid and are tunable across 82 adjacent 50-GHz channels for the C-band module and across 80 adjacent 50-GHz channels for the L-band module. The incorporation of tunability into the data muxponder cards dramatically reduces the customer's inventory required to cover all the system wavelengths.

Flexible Protection Mechanism Support

The data muxponder card, depending on the requirements of the network, can be deployed to support a choice of protection mechanisms. Table 1 outlines the protection options available to help meet the service-level agreements (SLAs) required by the application.

Table 1. Protection Formats

Protection Type	Capabilities	Figure
Unprotected	Offers no client terminal interface, data muxponder card, or DWDM line protection. The client signal is transported over a single unprotected data muxponder card.	Figure 2
1+1 protection	Provides protection for the client terminal interface, muxponder card, and DWDM line protection through client automatic protection switching/linear multiplex section protection signaling transported transparently over the muxponder card.	Figure 3
Y-cable protection	Provides muxponder card and DWDM line protection without requiring client terminal equipment interface protection. Uses Y-protection device to optically split a single client interface to two muxponder cards. The Cisco ONS 15454 system controls the muxponder card active/standby status to provide a single signal feed to client equipment.	Figure 4

Figure 2. Unprotected

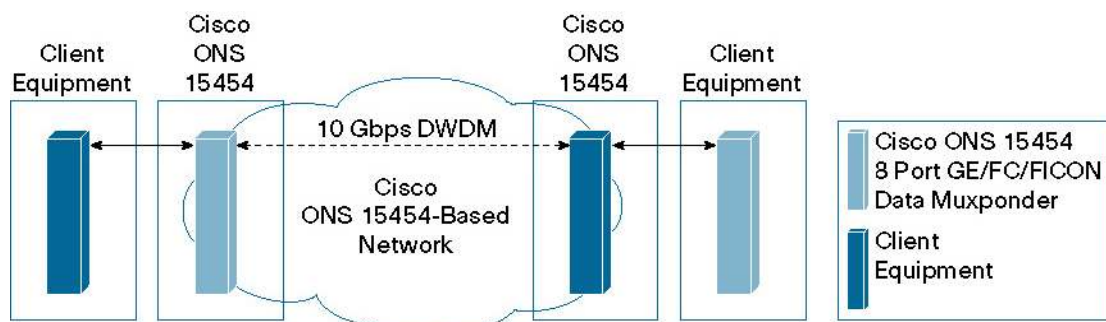


Figure 3. 1+1 Protection

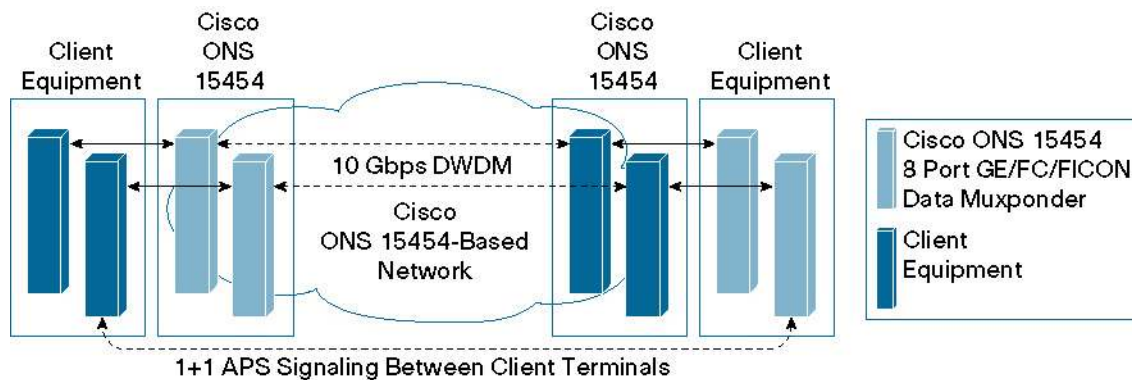
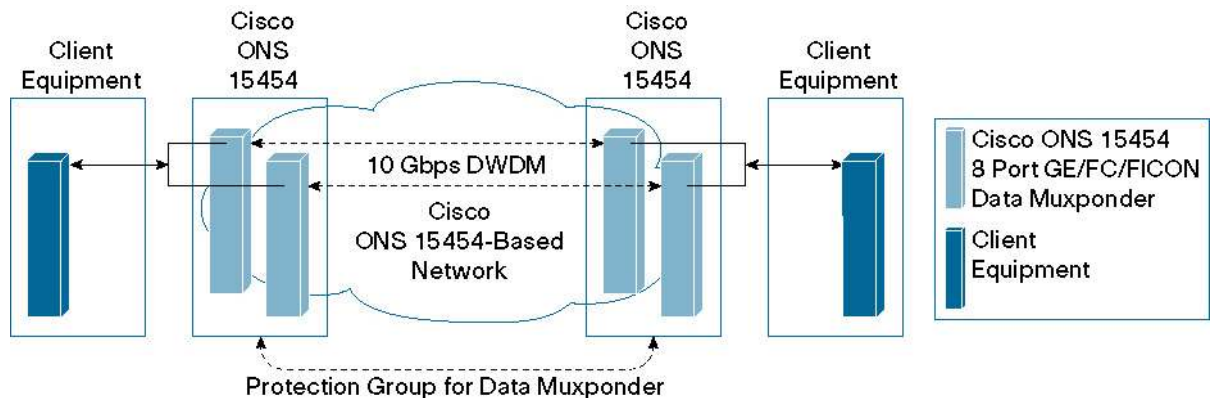


Figure 4. Y-Cable Configuration



SAN Extension Beyond the Metro

When a Fiber Channel link is extended over a long distance, the inherent flow-control mechanism can significantly reduce the overall throughput performance. The data muxponder card implements a buffer-to-buffer distance extension scheme that effectively increases the supported distance up to 1200 kilometers (km) for 1-Gbps Fibre Channel, 600 km for 2-Gbps, and 500 km for 4-Gbps. Buffer-to-buffer credit and R_RDY spoofing allow users to extend their business continuance and disaster recovery applications beyond the boundaries of a metro network.

Management

The Cisco ONS 15454 MSPT provides comprehensive management capabilities for operations, administration, monitoring, and provisioning (OAM&P) accessed through the integrated Cisco Transport Controller craft interface with support from the Cisco Transport Manager Element Management System (EMS). The data muxponder card incorporates provisionable digital wrapper (G.709) functions, providing DWDM wavelength performance-management capabilities, especially for services being transported transparently across the network. Without the digital wrapper function, a carrier transporting a service transparently would be unable to identify network impairments that may degrade the transported signal and exceed SLA requirements. The digital wrapper's general communications channel (GCC) enables a separate communications channel, versus the section data communications channel (SDCC)/regenerator SDCC (RSDCC) in SONET/SDH signals, to be used by the platform when transparent signals are transported. This GCC enables the Cisco ONS 15454 to extend its advanced network autodiscovery capabilities to DWDM-based services. The integrated Cisco Transport Controller craft manager and the Cisco Transport Manager EMS provide the user with OAM&P access for the system.

Performance Monitoring

The data muxponder provides extensive performance-monitoring capability, by wavelength or service level. At the wavelength level, the card continuously monitors transmit and receive power, loss of signal or frame, alarm-indication signal, and remote defect indication. Additionally, based on the protocols of the client interfaces which include Gigabit Ethernet, 1-Gbps and 2-Gbps Fibre Channel, 4-Gbps Fibre Channel, FICON, and ISC, the card provides detailed performance statistics and alarms including 8b/10b code violation, received and transmit frame or packet count, and received and transmit R_RDYcount (Fibre Channel only). Enhanced performance monitoring allows the user to define additional criteria to better assess the health of the network and support the decision for protection switching. The card's performance-monitoring capabilities provide support for G.709 (OTN). Calculation and accumulation of the performance-monitoring data is in 15-minute and 24-hour intervals as per G.7710. The data muxponder card also incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status at the card. An orange circle is printed on the faceplate, indicating the shelf slot in which the card can be installed.

Configurable Far-End-Laser-Off Behavior

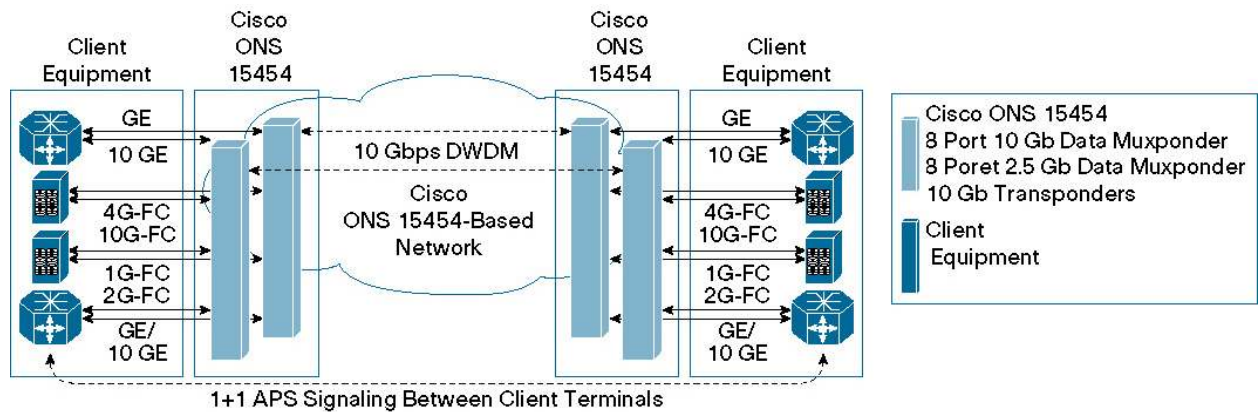
The data muxponder card offers the capability to provision the Far-End-Laser-Off behavior. Customers can use Cisco Transport Controller to configure how the remote client interface will behave following a fault condition. It is possible to configure the remote client to squelch or to send an alarm indication signal (AIS).

Application Description

The data muxponder card effectively addresses demands for high-density data and storage service aggregation. Whether they are using a dedicated enterprise infrastructure or a metro or regional service provider's network, customers can efficiently and cost-effectively scale their business continuance applications and consolidate their backbone network infrastructures.

The tremendous growth of business applications is quickly heightening data-storage requirements and network expectations. As shown in Figure 5, customers demand uninterrupted access to corporate systems and data. Enterprises must respond to this surge in demand by providing robust, highly secure, interconnected SANs and geographically dispersed data-recovery solutions. The data muxponder card provides the capability to efficiently aggregate mission-critical Gigabit Ethernet, Fibre Channel, FICON, and ISC services across the metro optical transport network, enabling real-time synchronous replication of information between the primary and backup data centers. For enterprise customers with less stringent requirements, the data muxponder card provides a highly cost-effective data and storage transport solution for asynchronous disk mirroring or tape backup applications. The Cisco ONS 15454 MSTP also supports 2.5-Gbps data muxponding and the transport of 10-Gbps Fibre Channel and 10 Gigabit Ethernet services.

Figure 5. SAN Aggregation



Card Features and Specifications

Compact Design

- Single-width card slot design for high-density, up to eight 1-Gbps, four 2-Gbps, or two 4-Gbps solutions
- Up to 12 data muxponder cards per shelf assembly on the Cisco ONS 15454 platform
- Up to 6 data muxponder cards per shelf assembly on the Cisco ONS 15454 M6 platform
- Up to 2 data muxponder cards per shelf assembly on the Cisco ONS 15454 M2 platform

Flexible Restoration Options

- Transparent protection
- Unprotected (1+0)
- 1+1 transparent protection
- Client Y-protection option

Regulatory Compliance

Tables 2 and 3 list the regulatory compliance and system requirements for the muxponder card. Tables 4 through 7 list technical specifications, and Table 8 provides ordering information.

Table 2. Regulatory Compliance¹

ANSI System	ETSI System
Countries Supported	
• Canada • United States • Korea • Japan • European Union	• European Union • Africa • CSI • Australia • New Zealand • China • Korea • India • Saudi Arabia • South America
EMC (Class A)	
• ICES-003 (2004) • GR-1089-CORE Issue 4, NEBS EMC and Safety (June 2006) • FCC 47CFR15 (2006)	• EN 300 386 Telecommunications Network Equipment (EMC): 2007 (Note: EMC-1) • CISPR22 (2008) and CISPR24: 2002/ EN55024:2007: Immunity levels: see EN61000-4-xx • EN55022: 2007 Information Technology Equipment (Emissions)(2006) (EMC-2) • EN55024: 1998/a2: 2003 Information Technology Equipment (Immunity)
Safety	
• UL/CSA 60950-1, 2006 • GR-1089-CORE Issue 4, NEBS EMC and Safety (June 2006)	• UL/CSA 60950-1, 2006 • IEC 60950-1(2005/12), 2nd Edition and National Differences as per CB Bulletin 112A
Laser	
• UL/CSA 60950-1, 2006 • IEC 60950-1(2005/12), 2nd Edition and National Differences as per CB Bulletin 112A • IEC-60825-2 Edition 3.1, 2007/01	• CDRH (accession letter and report) • IEC 60825-1 Consol. Ed. 1.2 (incl. am1+am2) 2001-08
Environmental	
• GR-63-CORE Issue 3, NEBS Physical Protection (Mar 2006) • ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1)	• ETS 300-019-2-2 V2.1.2 (1999-09): Transportation, Class 2.3 • ETS 300-019-2-3 V2.2.2 (2003-04):Operational, Class 3.1E
Optical	
• GR-253-CORE - Issue 04 • ITU-T G.691	• ITU-T G.709 • ITU-T G.975
Quality	
• TR-NWT-000332, Issue 4, Method 1 calculation for 20-year mean time between failure (MTBF)	
Miscellaneous	
• AT&T Network Equipment Development Standards (NEDS) Generic Requirements, AT&T 802-900-260 • SBC TP76200MP	• Verizon SIT.NEBS.NPI.2002.010 • Worldcom ESD requirement

1. All compliance documentation may not be completed at the time of product release. Please check with your Cisco sales representative for countries outside of Canada, the United States, and the European Union.

Table 3. System Requirements

Component	Cisco ONS 15454 ANSI	Cisco ONS 15454 ETSI	Cisco ONS 15454 M6	Cisco ONS 15454 M2
Processor	TCC3 ¹ , TCC2P and TCC2	TCC3 ¹ , TCC2P and TCC2	TNC, TSC, TNC-E ² , or TSC-E ²	TNC, TSC, TNC-E ² , or TSC-E ²
Cross-connect	All (not required)	All (not required)	-	-
Shelf assembly	15454-SA-HD or 15454-SA-HD-DDR shelf assembly with CC-FTA or FTA3 version fan-tray assembly	15454-SA-ETSI shelf assembly with CC-FTA or SDH 48V fan-tray assembly	15454-M6-SA shelf assembly	15454-M2-SA shelf assembly
System software	Release 9.1.0 ANSI or later	Release 9.1.0 ETSI or later	Release 9.2 ANSI/ETSI or later	Release 9.2 ANSI/ETSI or later
Slot compatibility	1–6, 12–17	1–6, 12–17	2-7	2-3

1. The TCC3 card is supported on the Cisco ONS 15454 DWDM systems from Rel 9.2 onwards. However, it is backward compatible with software Release 9.1 and earlier releases. In the Release 9.1 and earlier releases, the TCC3 card boots up as the TCC2P card in the Cisco ONS 15454 DWDM systems.

2. The TNC-E and the TSC-E cards are supported on the Cisco ONS 15454 M6 and M2 DWDM systems from Rel 9.3 onwards

Table 4. Client-Side Specifications

Specification	ONS-SE-G2F-SX = 1G-FC/2G-FC 850-nm LC MM	ONS-SE-G2F-LX= 1G-FC/2G-FC 1310-nm LC SM	ONS-SE-4G-MM= 4G-FC 1310-nm LC SM	ONS-SE-4G-SM= 4G-FC 1310-nm LC SM
Client interface (SFP)				
Type	SFP	SFP	SFP	SFP
Wavelength, nominal, (λ_{Tnom})	850 nm	1310 nm	850 nm	1310 nm
Spectral range (λ_{Tmin} to λ_{Tmax})	830 to 860 nm	1270 to 1355 nm	830 to 860 nm	1270 to 1355 nm
Optical transmitter				
Output power (P_{Tmin} to P_{Tmax})	–10 to –3.5 dBm	–10 to –3.5 dBm	–9 to –2.5	290uw OMA ¹
Optical receiver				
Sensitivity at BER	–22 dBm	–22 dBm	–15 dBm	29uw OMA ²
Connector type (Tx/Rx)	LC	LC	LC	LC

1. Specified OMA at 4.25 Gbps is equivalent to an average power of –7.3 dBm at an ER of 9 dB

2. Specified OMA at 4.25 Gbps is equivalent to an average power of –17.3 dBm at an ER of 9 dB

Table 5. DWDM Specifications

Specification	DWDM Line Interface
DWDM Line Interface	
Bit Rate	10.7092 ±100 ppm 11.0957 ±100 ppm 11.3168 ±100 ppm
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λ_{Tnom})	Full tunable from 1529.55 to 1561.84 (C-Band – 50 GHz)
Spectral width at 20dB ($\lambda_{\Delta 20}$)	≤25 GHz
Optical Transmitter	
Type	Lithium-Niobate external modulator
Output power (P_{Tmin} to P_{Tmax})	+3 dBm, +6 dBm
Required optical return loss, minimum (ORL _{min})	27 dB
Extinction ratio, minimum (r_{eminx})	>10.5 dB
Laser safety class	1

Specification	DWDM Line Interface
Optical Receiver	
Type	Avalanche photo diode (APD)
Chromatic dispersion tolerance (DLR _{max})	Up to ±4000 ps/nm
Minimum BER (BER _{min})	10E-15
• FEC on	10E-15
• E-FEC on	
Reflectance between far-end Tx and near-end Rx (maximum)	–27 dB
Receiver reflectance (maximum)	–14 dB
Input wavelength bandwidth (λ_{c_rx})	1290 nm to 1605 nm
Connector type (Tx/Rx)	LC, duplex (shuttered)

Table 6. DWDM Receive-Side Optical Performances

CD Tolerance	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	PMD*	OSNR
Any bit-rate						
0 ps/nm	STD	<10E(−5)	<10E(−15)	−8 to −20 dBm	–	8 dB
+/− 800 ps/nm					–	8.5 dB
+/− 1600 ps/nm					–	9 dB
0 ps/nm	ENH	<7x10E(−4)		−8 to −27 dBm	0 ps	19 dB
+/− 2000 ps/nm				−8 to −26 dBm		
+/− 2000 ps/nm				−8 to −25 dBm	20 ps	
At 11.1 Gb/s						
0 ps/nm	STD	<10E(−5)	<10E(−15)	−8 to −20 dBm	0 ps	8.1 dB
0 ps/nm					10 ps	8.9 dB
0 ps/nm					30 ps	14.8 dB
+/ 1500 ps/nm					10 ps	10 dB
−2000 / 2500 ps/nm	ENH	<7x10E(−4)			10 ps	11.3 dB
0 ps/nm					0 ps	5.3 dB
0 ps/nm					10 ps	5.9 dB
0 ps/nm					30 ps	10.3 dB
+/− 1500 ps/nm					10 ps	6.9 dB
−2000 / 2500 ps/nm					10 ps	8.1 dB
−3000 / 4000 ps/nm					20 ps	12.7 dB
+/− 4000 ps/nm					20 ps	13.3 dB

Table 7. Card Specifications

Description	Specification
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

Description	Specification
DWDM Port LEDs - Active input signal - Output wavelength	Green Green
Power (including worst-case pluggable)	
Typical	40W
Maximum	50W
Physical	
Dimensions	Occupies one slot
Weight ¹	1.4 Kg (3.1 lbs)
Reliability and Availability	
Mean time between failure (MTBF)	236,765 hrs
Latency (End to End)	
G.709 Off / NO FEC:	1 microsecond
G.709 On – Standard FEC	5 microseconds
G.709 On – Enhanced FEC	150 microseconds
Environment Conditions	
Storage temperature	–40°C to 70°C (–40°F to 158°F)
Operating temperature - Normal - Short term²	0°C to 40°C (32°F to 104°F) –5°C to 55°C (23°F to 131°F)
Relative humidity - Normal - Short term*	5% to 85%, non condensing 5% to 90% but not to exceed 0.024 kg water/kg of dry air

1. Average PMD

2. 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. (This refers to a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period.)

Table 8. Ordering Information

Part Number	Description
15454-10DMEX-C=	Extended performance 8-port EFEC data muxponder card, 8 SFP-based client interfaces, full C-band tunable on 50-GHz ITU wavelengths, DWDM line with LC connectors
15454-10DME-L=	8-port EFEC data muxponder card, 8 SFP-based client interfaces, full L-band tunable on 50-GHz ITU wavelengths, DWDM line with LC connectors
ONS-SE-4G-MM=	4-Gbps FC SFP optics module, (0–70m 50/125 micron, 0–150m 62.5/125 micron, 850 nm, multimode, EXT temperature range, LC connectors
ONS-SE-4G-SM=	4-Gbps FC SFP optics module, 0–20,000m reach, 1310 nm, single-mode, EXT temperature range, LC connectors
ONS-SE-G2F-SX=	GE/1-Gbps FC/2-Gbps FC, 850 nm, multimode, EXT temperature range, LC connectors
ONS-SE-G2F-LX=	GE/1-Gbps FC/2-Gbps FC/HDTV, 1310 nm, single-mode, EXT temperature range, LC connectors

Service and Support

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For more information about Cisco Services, refer to [Cisco Technical Support Services](#) or [Cisco Advanced Services](#).

For More Information

For more information about the Cisco ONS 15454 Multiservice Transport Platform, contact your local account representative or visit Cisco at: <http://www.cisco.com/go/optical> or <http://www.cisco.com/go/IPoDWDM>.



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