Cisco ONS 15454 Any Rate Enhanced Xponder Card

The multiport Cisco® ONS 15454 Any Rate Enhanced Xponder Card (Figure 1) is a plug-in module for the Cisco ONS 15454 Multiservice Transport Platform (MSTP). The card provides a high degree of flexibility for the multiservice aggregation transport of a large variety of signals and interfaces into enterprises or metropolitan-area (metro) and regional service provider networks.

Figure 1. Cisco ONS 15454 Any Rate Enhanced XPonder Card

Metro transport networks must support numerous service demands: transmission of low-rate 10/100BASE-T and OC-3/STM-1 signals; higher-rate OC-12/STM-4, Gigabit Ethernet, and OC-48/STM-16 signals; video signals such as standard-definition Serial Data Input (SDI) and high-definition SDI (HD-SDI); optical-transport-unit-1 (OTU-1) services; and first-generation (1G), 2G, 4G, and 8-Gb Fibre Channel services. The flexibility to support multiple rates and aggregate them over a dense wavelength-division multiplexing (DWDM) interface using Optical Transport Network (OTN) technology brings huge savings in operating and management costs.

Product Overview

The Cisco ONS 15454 Any Rate Enhanced Xponder Card provides an 8-port Small Form-Factor Pluggable (SFP) muxponder with two 10-Gigabit XFP (XFP) ports. The card supports the following services:

- SONET/SDH:
  - STM-1/OC-3
  - STM-4/OC-12
  - STM-16/OC-48
- OTN:
  - OTU-1
  - OTU-2
- Ethernet:
  - Fast Ethernet (FE)
  - Gigabit Ethernet (GE)
- SAN:
  - Enterprise Systems Connection (ESCON)
  - 1-Gigabit Fibre Channel or fiber connectivity (FICON)
  - 2-Gigabit Fibre Channel or FICON
  - 4-Gigabit Fibre Channel or FICON
  - 8-Gigabit Fibre Channel or FICON
- Video:
  - SD-SDI (270 Mbps)
  - HD-SDI (1.485 Gbps)
  - Third-generation SDI (3G-SDI) (2.970 Gbps)

The card can aggregate any mix of services on the client SFP ports into an OTU-2 trunk interface.

Operating Mode Configurations

The card is equipped with pluggables for client and trunk options, and it offers a large variety of configurations. The following configurations are supported by Cisco ONS 15454 Any Rate Enhanced Xponder Card.

2.5-Gbps Operating Mode

Four 2.5-Gigabit Transponders (Figure 2)

- Up to four transponders mapping client SFP signals onto an OTU-1 trunk DWDM SFP
- Supported rates in this configuration: OC-3/STM-1, OC-12/STM-4, OC-48/STM-1, 6/FE/GE/ESCON, 1GFC, and 2GFC

**Figure 2.** Four 2.5-Gigabit Transponder Configuration
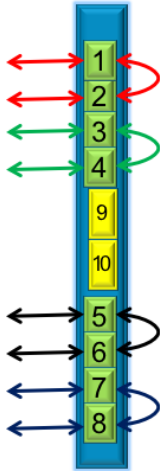
Four 4-Gigabit Fibre Channel Transponders

- Up to four 4-Gigabit Fibre Channel transponders mapping client 4-Gb SFP signals onto a 4G trunk DWDM SFP without an OTN wrapper

Two 2.5-Gigabit Protected Transponders (Figure 3)

- Up to two protected transponders mapping client SFP signals onto a working and protected OTU-1 trunk DWDM SFP
- Supported rates in this configuration: OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, FE/GE/ESCON, 1G FC, and 2G FC
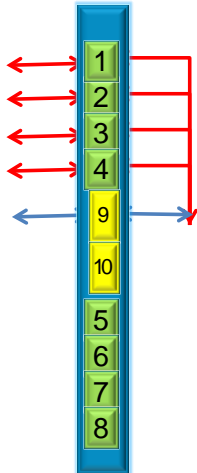
Figure 3. Two 2.5-Gigabit Protected Transponder Configuration
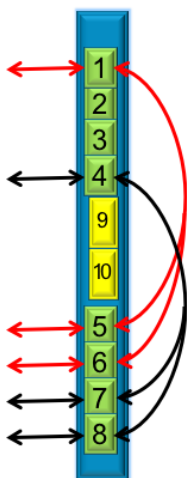
Two 2.5-Gigabit Muxponders (Figure 4)

- Up to two muxponders mapping multiple client SFP signals onto an OTU-1 trunk DWDM SFP
- Supported rates in this configuration: FE OC-3/STM-1 and OC-12/STM-4 over an OTU-1 trunk, or GE 1G FC over an OTU-1 trunk

Figure 4.   Two 2.5-Gigabit Muxponder Configuration

Two 2.5-Gigabit Protected Muxponders (Figure 5)

- Up to two protected muxponders mapping multiple client SFP signals onto a working and a protection OTU-1 trunk DWDM SFP
- Supported rates in this configuration: FE OC-3/STM-1 and OC-12/STM-4 over an OTU-1 trunk, or GE 1G FC over an OTU-1 trunk

Figure 5.   Two 2.5-Gigabit Protected Muxponder Configuration
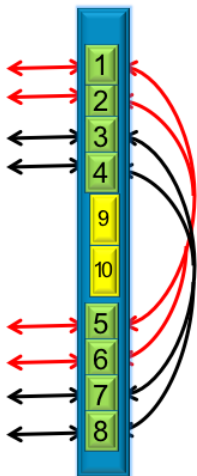
Transponder and muxponder configurations can be mixed; they are limited only by the number of ports.

10-Gbps Operating Mode

- 8:1 muxponder:
  - Up to eight client SFP signals onto one OTU-2 trunk equipped with XFP
  - Supported rates in this configuration: GE/1G, FC/2G, FC/4G, FC/OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, and OTU-1; flexible bandwidth assignment is offered through a dedicated wizard

- 8:1 data muxponder:
  - Up to eight client SFP signals onto one OTU-2 trunk equipped with XFP
  - Supported rates in this configuration: GE/1G, FC/2G, FC/4G, and FC/GE
- 4:1 2.5-Gigabit Ethernet muxponder:
  - Up to four client SFP signals onto one OTU-2 trunk equipped with XFP
  - Supported rates in this configuration: OC-48/STM-16/OTU-1
- 8-Gigabit Ethernet FC transponder:
  - 8-Gigabit Ethernet FC XFP client mapped into OTU-2 onto the second XFP
  - 10-Gigabit Ethernet Any-Forward Error Correction (FEC) regenerator
  - Ability to regenerate OTU-2 signals from XFP to XFP port; the card supports a multiple FEC scheme, allowing for interoperability among different Cisco line cards
- Mixed client and trunk configuration:
  - Supports any mix of client-to-trunk aggregation matrix, including a mix of 2.5-Gbps muxponder, 10-Gbps Muxponder, or 2.5-Gigabit transponders
- Fiber-switched protection configuration:
  - Can configure the two-trunk XFP ports as working and protection ports
- Two 4:1 data muxponder configuration:
  - Supports two 4:1 data muxponders, because both trunk XFP ports can be used
- Two 4:1 Cisco ONS 15454 Any Rate Muxponders:
  - Supports two 4:1 Cisco ONS 15454 Any-Rate Muxponders, because both trunk XFP ports can be used
- Video Xponder:
  - Can aggregate over one or two trunk XFP ports: SD-SDI, HD-SDI, or 3G-SDI signals

Card Architecture

The Cisco ONS 15454 Any Rate Enhanced Xponder Card is a plug-in module to the Cisco ONS 15454 MSTP, providing a cost-effective architecture for aggregating a large variety of services over OTU-1 or OTU-2 signals (Figure 6). The card architectures include a virtual cross-connect that supports a fully transparent aggregation of incoming signals.

Figure 6.   Cisco ONS 15454 Any Rate Enhanced Xponder Architecture
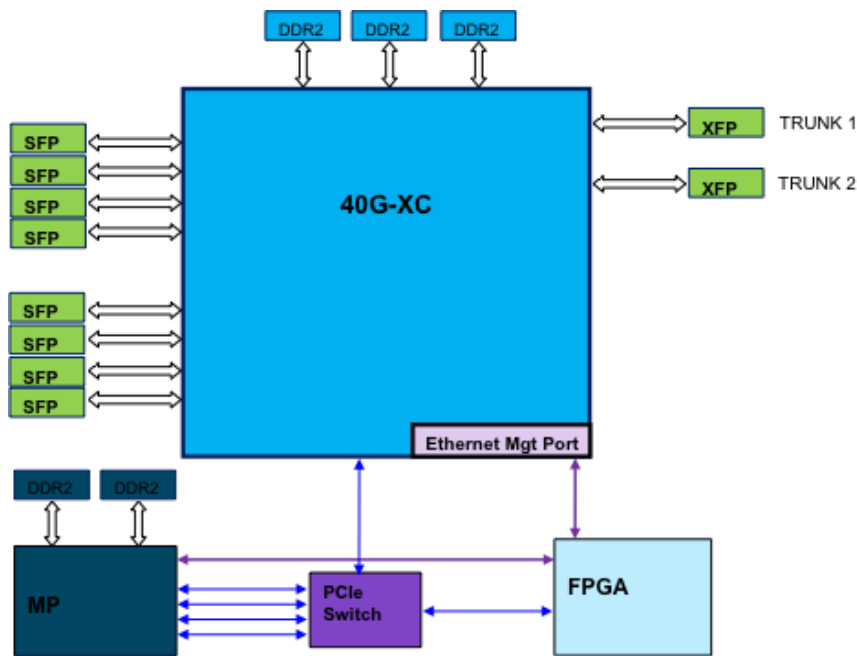
Pluggable Interfaces

To support such levels of flexibility, the Cisco ONS 15454 Any Rate Enhanced Xponder Card supports pluggable
interfaces (ports 1 to 8 are SFP-based, and ports 9 and 10 are XFP-based). The interfaces can be grey, DWDM, or
CWDM. Tables 1 and 2 list the part numbers of the supported XFPs and SFPs.

Table 1.   Supported XFPs

Pluggables	OTN	FC/FICON	DWDM	CWDM
ONS-XC-10G-S1=	X			
ONS-XC-10G-SR-MM=	X			
ONS-XC-8G-SM=		X		
ONS-XC-8G-MM=		X		
ONS-XC-10G-C=	X		X	
ONS-XC-10G-EPxx.x=	X		X	
ONS-XC-10G-xxxxx=	X			X

Table 2.   Supported SFPs

Pluggables	SONET/SDH	OTN	Ethernet	SAN	Video	DWDM	CWDM
ONS-SC-155-EL=	X						
ONS-SI-155-SR-MM=	X						
ONS-SI-622-SR-MM=	X						
ONS-SI-155-I1=	X						
ONS-SI-155-L1=	X						
ONS-SI-155-L2=	X						
ONS-SI-622-I1=	X						
ONS-SI-622-L1=	X						

Pluggables	SONET/SDH	OTN	Ethernet	SAN	Video	DWDM	CWDM
ONS-SI-622-L2=	X						
ONS-SI-2G-S1=	X						
ONS-SI-2G-L1=	X						
ONS-SI-2G-L2=	X						
ONS-SE-Z1=	X	X					
ONS-SE-100-BX10U=			X				
ONS-SE-100-BX10D=			X				
ONS-SE-GE-BXU=			X				
ONS-SE-GE-BXD=			X				
ONS-SE-ZE-EL=			X				
ONS-SI-100-FX=			X				
ONS-SI-100-LX10=			X				
ONS-SI-GE-SX=			X				
ONS-SI-GE-LX=			X				
ONS-SI-GE-ZX=			X				
ONS-SE-200-MM=				X			
ONS-SE-4G-MM=				X			
ONS-SE-4G-SM=				X			
ONS-SE-155-xxxx*							X
ONS-SC-4G-xx.x**						X	
ONS-SE-2G-xxxx=*		X					X
ONS-SC-2G-xx.x=**		X				X	
ONS-SC-HD3GV-TX=					X		
ONS-SC-HD3GV-RX=					X		

*The xxxx range is from 1470 to 1610, coping with 8 CWDM wavelengths defined by ITU standards.

**The xx.x range is from 30.3 to 61.4, coping with 40 wavelengths at 100-GHz ITU grid; DWDM SFP ports are placed on the last four bottom ports in case the card is placed on an M12 chassis.

Enhanced FEC Capability

An important feature of the Cisco ONS 15454 Any Rate Enhanced Xponder Card is the ability to configure the FEC mode. SFP ports 1 to 8 have two modes of operation, NO FEC and FEC, whereas ports 9 and 10 can also be configured in E-FEC mode.

You can configure error-coding performance:

- NO FEC: No Forward Error Correction
- FEC: Standard G.975 Reed-Salomon algorithm
- E-FEC: Standard G.975.1 I-7 with two orthogonally concatenated block (BCH) super FEC codes; this FEC scheme contains three parameterizations of the same scheme of two BCH codes, with the constructed code decoded iteratively to achieve the expected performance
- E-FEC: Standard G.975.1 I-4 with two interleaved codes (RS and BCH) super FEC codes

Protocol Transparency

The Cisco ONS 15454 Any Rate Enhanced Xponder architecture allows you to aggregate multiple signals without terminating the overhead. Thus full signal transparency is maintained during multiplexing functions over higher bit rates.

ODU-0 Mapping

The card architecture allows you to map GbE signals and FC-1G signals onto the ODU-0 container. The selected mapping method is GFP-T (ITU-T G.709 Section 17.7.1.1 1000BASE-X transcoding) that guarantees fully transparent transmission of the signals. This supports transport of SyncE-based services across an OTN and DWDM network.

Protocol Autosensing

The card architecture also allows the clients to self-configure the rate-versus-input signals. The cards automatically set mapping and provisioning without any user provisioning step. The initial release supports autosensing functions among Gigabit Ethernet, OC-3/STM-1, OC-12/STM-4, and OC-48/STM-16.

Proactive FRR Regeneration Implementation

Fast Reroute (FRR) is a Layer 3 protection mechanism that allows for switching of the data path without reference to Layer 1 concerns. The switch in most cases happens with little or no loss of data and happens within 50 milliseconds. The switch is indirectly triggered by events that would bring the interface down, resulting in almost certain data loss during the time when defects are detected until a FRR switch is completed.

With IP over DWDM (IPoDWDM), the FEC circuitry resides on a router line card. Therefore, the router has visibility into the bit-error-rate (BER) statistics before the FEC mechanism corrects these errors, allowing the router to realize that the working path is degrading beyond a reasonable point (which is defined by a user-settable threshold). At this point, the router can start its protection logic and establish a protection path while traffic continues to flow on the degrading working path. Depending on the failure mode, the router may have tens or even hundreds of milliseconds to move away from the working path before the FEC mechanism fails.

The FEC mechanism detects failures before they actually happen and also corrects errors either introduced during transmission or due to a degrading signal. DWDM physical layer interface modules (PLIMs) trigger an FRR switch based on the number of FEC corrected bits. The number of FEC corrected bits would provide a good indication that the line is about to have a failure. FEC-based FRR therefore allows for triggering the switch before that failure happens with little or no loss of data. In fact, the FEC function can correct a high BER (up to 10E-3), providing an error-free signal to the line card connected to the PLIM. Triggering the FRR with a lower BER will cause a FRR before any packet is lost.

The prevailing video encoding is based on MPEG-2 and MPEG-4 standards, which use differential coding of the frame with reference to a full frame that is sent only relatively infrequently. When this frame (called the I-frame) is lost, a large number of users may experience a visible outage on their screens, lasting for up to several seconds. High-resolution encoding schemes, such as MPEG-4, are actually more susceptible to longer outages because I-frames are less common in the data stream. For this reason it is important to minimize the packet loss even below the SONET/SDH benchmark, ideally aiming for zero packet loss.

Cisco ONS 15454 Any Rate Enhanced Xponder Card supports Proactive Protection Regeneration, which notifies the routers of the incoming FEC errors. This feature involves modifying the G709 protection bytes in Overhead (Figure 7).

FRR Regen is supported on 10G Ports, only

Figure 7. Proactive FRR implementation
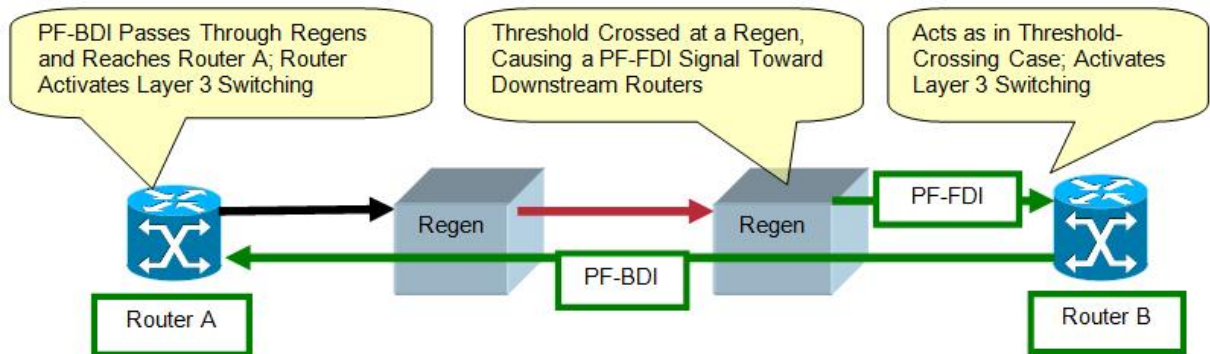
- When there is a span between two routers, a Cisco ONS 15454 Any Rate Enhanced Xponder Card is used because the OTU-2 Regen is degrading, but the downstream router is not aware of it (so the router does not switch to an alternate path).
- The card signals the downstream router about the degradation. This signal is called a pre-FEC error backward defect indicator (PF-BDI) (using the APS/PCC bytes of the G.709 ODU OH).
- The router integrates the PF-FDI for three frames and then acts as if it has detected the BER threshold crossing.
- Router B activates its Layer 3 switching.
- Router B raises a PF Backward Defect Indication (PF-BDI) flag to ask router A to switch. This PF-BDI propagates through the Cisco ONS 15454 Any Rate Enhanced Xponder Card.
- When router A gets this PF-BDI message, router A also activates its Layer 3 switching.

The Cisco ONS 15454 Any Rate Enhanced Xponder Card allows you to extend FRR when OTU-2 regeneration is required between the routers, sending PF-FDI when it sees a degrading link.

Flexible Protection Mechanisms

The Cisco ONS 15454 Any Rate Enhanced Xponder Card provides flexible protection capabilities for both client and DWDM line interfaces, supporting numerous network configurations to uphold the various service-level agreements (SLAs) the customer application requires.

- Unprotected client and line: This configuration has no client terminal interface, transponder card, or DWDM line protection. The client signal is transported over a single unprotected transponder card. This configuration is suitable for transporting client payloads over a DWDM network that is being protected by a Layer 2 or Layer 3 protocol.
- Y-cable client interface: This configuration provides transponder equipment protection without client terminal equipment interface protection. A single client interface is split into two transponder cards using a Y-protection device.
- Fiber-switched protection: This configuration, valid at 10 Gbps only for the card, provides redundant DWDM trunk interface protection for a single unprotected client interface.

Management

The Cisco ONS 15454 platform provides comprehensive management capabilities to support operations, administration, maintenance, and provisioning (OAMP) capabilities through the integrated Cisco Transport Controller Craft Interface with support from the Cisco Transport Manager Element Management System (EMS). The Cisco ONS 15454 Any Rate Enhanced Xponder Card incorporates provisionable digital-wrapper (G.709) functions, providing per-wavelength performance-management capabilities, especially for services being 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 exceed SLA requirements.

The generic communications channel (GCC) of the digital wrapper allows a separate communications channel on a per-wavelength basis. This GCC allows the Cisco ONS 15454 MSTP to extend its advanced network autodiscovery capabilities to DWDM-based services. The integrated Cisco ONS 15454 MSTP Transport Controller Craft Manager and the Cisco Transport Manager EMS give you OAMP access for the system.

Performance Monitoring

The performance-monitoring capabilities of the Cisco ONS 15454 Any Rate Enhanced Xponder Card support both transparent and nontransparent signal transport. Calculation and accumulation of the performance-monitoring data is in 15-minute and 24-hour intervals.

For SONET/SDH signals, standard performance-monitoring and threshold-crossing conditions and alarms are supported per Telcordia GR-474, GR-2918, ITU G.783, and ETS 300 417-1 standards (Tables 3 and 4).

Table 3. SONET Performance Monitoring

SONET Performance Monitoring	Section	Line (Near End)	Line (Far End)
Number of coding violations (CVs)	CV-S	CV-L	CV-L
Number of errored seconds (ESs)	ES-S	ES-L	ES-L
Number of severely errored seconds (SESs)	SES-S	SES-L	SES-L
Number of severely errored frame seconds (SEFSs)	SEFS-S	–	–
Number of unavailable seconds (UASs)	–	UAS-L	UAS-L
Number of failure counts (AIS/RFI detected) (FC)	–	FC-L	FC-L

Table 4. SDH Performance Monitoring

SDH Performance Monitoring	Regenerator Section	Multiplex Section (Near End)	Multiplex Section (Far End)
Number of errored seconds (ESs)	RS-ES	MS-ES	MS-ES
Error seconds ratio (ESR)	RS-ESR	MS-ESR	MS-ESR
Number of severely errored seconds (SESs)	RS-SES	MS-SES	MS-SES
Severely errored seconds ratio (SESR)	RS-SESR	MS-SESR	MS-SESR
Number of background block errors (BBEs)	RS-BBE	MS-BBE	MS-BBE
Background block errors ratio (BBER)	RS-BBER	MS-BBER	MS-BBER
Number of unavailable seconds (UASs)	RS-UAS	MS-UAS	MS-UAS
Number of errored blocks (EBs)	RS-EB	MS-EB	MS-EB

For Ethernet signals, standard performance parameters for transmit and receive signals are based on Remote Monitoring (RMON) Ethernet compliant with RFCs 1573, 1757, 2233, 2358, 3273, and 3635 (Table 5).

For Fibre Channel, the following parameters are available:

- txTotalPkts, rxTotalPkts, mediaIndStatsTxFramesBadCRC, mediaIndStatsRxFramesTruncated, ifOutOversizePkts, mediaIndStatsRxFramesTooLong, mediaIndStatsRxFrameBadCRC, ifOutOctects, ifInOctects, and ifInErros

Each digital-wrapper channel is monitored per ITU-T digital-wrapper requirements (G.709).

Table 5.   OTN Performance Monitoring

OTUk SM Counters	ODUk SM PM Counters	Description
BBE-SM	BBE-PM	Number of background block errors
BBER-SM	BBER-PM	Background block errors ratio
ES-SM	ES-PM	Number of errored seconds
ESR-SM	ESR-PM	Errored seconds ratio
SES-SM	SES-PM	Number of errored seconds ratio
SESR-SM	SESR-PM	Severely errored seconds ratio
UAS-SM	EAS-PM	Number of unavailable seconds
FC-SM	FC-PM	Number of failure counts

FEC and Enhanced FEC (EFEC) performance-monitoring parameters are also available; they are listed in Table 6.

Table 6.   FEC Performance Monitoring

Counters	Description
Bit errors	Number of corrected bit errors
Uncorrectable words	Number of uncorrectable words

Optical parameters on the DWDM line interface are supported, including laser bias, transmit optical power, and receiver optical power.

For any client interface, optical parameters such as transmit optical power and receiver optical power are also supported.

The card incorporates faceplate-mounted LEDs to provide a quick visual check of its operational status. An orange circle is printed on the faceplate, indicating the shelf slots where the card can be installed.

Application Description

The Cisco ONS 15454 Any Rate Enhanced Xponder Card provides an unprecedented flexibility to aggregate and transport a large variety of services over 10-Gbps signals. This capability allows the card to provide a solution to multiple applications.

Data Center Interconnections

The 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 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. Customers demand uninterrupted access to corporate systems and data. Enterprises must respond

to this surge in demand by providing comprehensive, highly secure, interconnected SANs and geographically dispersed data-recovery solutions. The Cisco ONS 14545 Any Rate Enhanced Xponder Card provides the capability to efficiently aggregate mission-critical Gigabit Ethernet, ESCON, Fibre Channel (up to 8 Gigabit Ethernet Fibre Channel), and FICON services across the metro optical transport network, providing real-time synchronous replication of information between the primary and backup data centers.

Managed Service Network

DWDM transport networks are offering service providers a basic transport layer. The capability to optimize wavelength efficiency is a critical achievement for managed service networks to provide a significant return on investment for service providers. The superb flexibility of Cisco Any Rate cards to multiplex any mix of different services (Ethernet, SONET, SDH, OTN, SAN, or video) allows you to optimize the number of wavelengths used in the network, thereby significantly reducing capital expenditures (CapEx) for the transport infrastructure.

OTN Handoff

The OTN is becoming the predominant standard for interconnecting network interfaces of different DWDM network providers. It guarantees total transparency of the wrapped payload as well as a defined standard for the interfaces. Cisco Any Rate cards provide fully standards-based OTU-1 and OTU-2 interfaces, allowing service providers to hand off services to other service providers with full SLA support.

OTU-2 EFEC Regenerator and Translator

The market offers multiple EFEC algorithms, but the vast majority of deployments use G.795.1 I-4 and I-7 options. This situation creates interoperability problems between equipment because of the different coding mechanisms. Cisco Any Rate cards can regenerate OTN signals with different EFEC algorithms, allowing them to connect equipment that cannot be interconnected. An example of this application is regeneration of OTU-2 signals coming from the Cisco CRS-1 Carrier Routing System platform that need to be terminated over a Cisco 7600 Series Router or Cisco ASR 9000 Series Aggregation Services Router.

High-Definition Video Aggregation

Video signals are increasingly popular for service providers. The requirement is not only to deploy a Layer 2 or Layer 3 network dedicated to video applications but also to support natively such services over a DWDM system. Stringent latency requirements and the capability to transmit signals without compression are becoming requirements for DWDM networks. Cisco Any Rate cards natively support the capability to multiplex SD-SDI, HD-SDI, and 3G-SDI over an OTU-2 trunk interface, allowing you to maximize the wavelength bandwidth, maintain full transparency for uncompressed signals, and dramatically reduce latency.

Cisco ONS 15454 Any Rate Enhanced Xponder Card Features and Specifications

Compact Design
- Single-width card slot design for high-density multirate solutions
- Up to 12 Cisco ONS 15454 Any-Rate Enhanced Xponder Cards on M12 shelf assembly
- Up to 6 Cisco ONS 15454 Any-Rate Enhanced Xponder Cards on M6 shelf assembly
- Flexible restoration options
  - Fiber switched
  - Client Y-protection
  - Unprotected (0 + 1)

Regulatory Compliance, System Requirements, Specifications, and Ordering Information

Table 7 lists regulatory compliance information, Table 8 gives system requirements, Table 9 gives specifications, and Table 10 gives ordering information.

Table 7.   Regulatory Compliance

SONET/ANSI System	SDH/ETSI System
Countries Supported	
• Canada • United States • Mexico • Korea • Japan • European Union	• European Union • Australia • New Zealand • Singapore • China • Mexico • Hong Kong • Korea
EMC (Class A)	

• ICES-003 Issue 4 (2004)
• GR-1089-CORE, Issue 4
  (Type 2 and Type 4 equipment)
• GR-1089-CORE – Issue 03 (Oct 2002)
  (Objective O3-2 – Section 3.2.1 – Radiated emissions requirements with all doors open)
• FCC 47CFR15, Class A subpart B (2006)
	• EN 300 386 v1.3.3 (2005) and v1.4.1 (2007)
	• CISPR 22 – Fifth edition (2005-04) Class A and Amendment 1 (2005-07)
	• CISPR 24 – First edition (1997-09) and Amendment 1 (2001-07) and amendment 2 (2002-10)
	• EN 55022:1998 Class A – CENELEC Amendment A2:2003
	• EN 55024:1998 – CENELEC Amendment A1:2001 and Amendment A2:2003

Safety	
• CAN/CSA-C22.2 950-95, Third edition • GR-1089-CORE, Issue 4 (Type 2 and Type 4 equipment)	• UL/CSA 60950 –1 First edition (2003) • IEC 60950-1 (2001/10) Amendment 11:2004 to EN 60950-1:2001, First edition (with all country deviations)
Optical Safety	
• EN or IEC-60825-2 Third edition (2004-06) • EN or IEC 60825-1 Consol. Ed. 1.2 - incl. am1+am2 (2001-08) • 21CFR1040 (2004/04) (Accession Letter and CDRH Report) • IEC-60825-2 Third edition (2004-06) • ITU-T G.664 (2006)	
Environmental	
• GR-63-CORE, Issue 3 (2006)	• ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1) • ETS 300-019-2-2 V2.1.2 (Transportation, Class 2.3) • ETS 300-019-2-3 V2.1.2 (Operational, Class 3.1E) • EU WEEE regulation • EU RoHS regulation
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, Issue 3, December 1999 • SBC TP76200MP, May 2003	• Verizon SIT.NEBS.NPI.2002.010, October 2002 • Worldcom ESD requirement

Table 8.   System Requirements

Component	Cisco ONS 15454 ANSI	Cisco ONS 15454 ETSI	Cisco ONS 15454 M6	Cisco ONS 15454 M2
Processor	TCC3, TCC2P, or TCC2	TCC3, TCC2P, or TCC2	TNC, TSC, TNC-E, or TSC-E	TNC, TSC, TNC-E, or TSC-E
Cross-connect	All (not required)	All (not required)	–	–
Shelf assembly	15454-SA-HD or 15454-SA-HD-DDR shelf assembly with CC-FTA version fan-tray assembly	15454-SA-ETSI shelf assembly with CC-FTA fan-tray assembly	15454-M6-SA shelf assembly	15454-M2-SA shelf assembly
System software	Release 9.6.0.3 ANSI or later	Release 9.6.0.3 ETSI or later	Release 9.6.0.3 ANSI/ETSI or later	Release 9.6.0.3 ANSI/ETSI or later
Slot compatibility	1–6, 12–17	1–6, 12–17	2–6	2–3

Table 9.   Specifications

Specification	
Management	
Card LEDs	
• Failure (FAIL)	Red
• Active/standby (ACT/STBY)	Green/yellow
• Signal fail (SF)	Yellow
Client port LEDS	
• Active input signal	Green
DWDM port LEDs	
• Active input signal	Green
• Output wavelength	Green
Power	
Card power draw	
• Typical	50W (with no pluggables)
• Maximum	74W (fully loaded)
Physical	
Dimensions	Occupies one slot
Weight	3.13 lb (1.4 kg)
Reliability and Availability	
MTBF	223,522 hours
Latency	
8G FC TXP	
G.709 On – No FEC/ GFEC	57.1
G.709 On – EFEC I.4	108
G.709 On – EFEC I.7	183.7
4G FC over OTU-2 MXP	
G.709 On – No FEC/ GFEC	27
G.709 On – EFEC I.4	78
G.709 On – EFEC I.7	154.1
Operating Environment Long Term	
Temperature	32 to 111°F (0 to 45°C)
Humidity	5 to 85% noncondensing
Operating Environment Short Term (96 hours/year)	
Temperature	23 to 131°F (–5 to 55°C)
Humidity	5 to 95% noncondensing

Specification	
Storage Environment	
Temperature	23 to 131°F (–5 to 55°C)
Humidity	5 to 95% noncondensing

Table 10.   Ordering Information

Part Number	Description
15454-AR-XPE=	Cisco ONS 15454 Any Rate Enhanced Xponder Card

For pluggable support and software release dependency, please refer to the Pluggables Configuration Guide at: www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/brochure_c02-452560.html.

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