

Cisco ONS 15454 40 Gbps CP-DQPSK Full C-Band Tuneable Transponder Card

Product Overview

The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) supports a 40-Gbps Full C-Band Tuneable CP-DQPSK Transponder Card, which simplifies the integration and transport of 40 Gigabit Ethernet and OC-768/STM-256 interfaces and services into enterprises or service provider optical networks (Figure 1).

Cisco ONS 15454 MSTP Release 9.2.1 extends the overall data bandwidth that can be transported by the system with a factor of four, allowing transmission across Cisco ONS15454 MSTP dense wavelength-division multiplexing (DWDM) networks up to 3.20 Tbps over 80 wavelengths at 40 Gbps.

Figure 1. 40 Gbps Full C-Band Tuneable CP-DQPSK Transponder Card



Challenge and Solution

The bandwidth carried on core and metropolitan (metro) DWDM networks is growing exponentially, while operators' revenues are not growing as quickly. The Cisco ONS 15454 40 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.

This growth slows transmission in DWDM networks that require technology advances to support such large bandwidth. The scale of 10 Gbps to 40 Gbps is the perfect solution for this problem; it quadruples the bandwidth that can be transported over existing fiber networks.

New modulation techniques now support ultra-long-haul (ULH) networks with more than 2000 km of unregenerated optical links. The Cisco ONS 15454 MSTP 40 Gbps Full-Band Tunable CP-DQPSK Transponder Card is designed to satisfy the following requirements.

- 40-Gbps signals must work in fully uncompensated networks up to more than 2000 km.
- 40-Gbps signals must work with very low-quality fiber with very high polarization mode dispersion (PMD) coefficients.
- 40-Gbps technology must work on 50-GHz systems with negligible filtering penalty.
- 40-Gbps units must fit mechanically and thermally with existing installed shelves with no effect on existing units, allowing full back-compatibility and no restriction rules for where the units can be placed.
- 40-Gbps units must support the widest variety of signals without impairments and with full compliance to international standards.

Product Features and Benefits

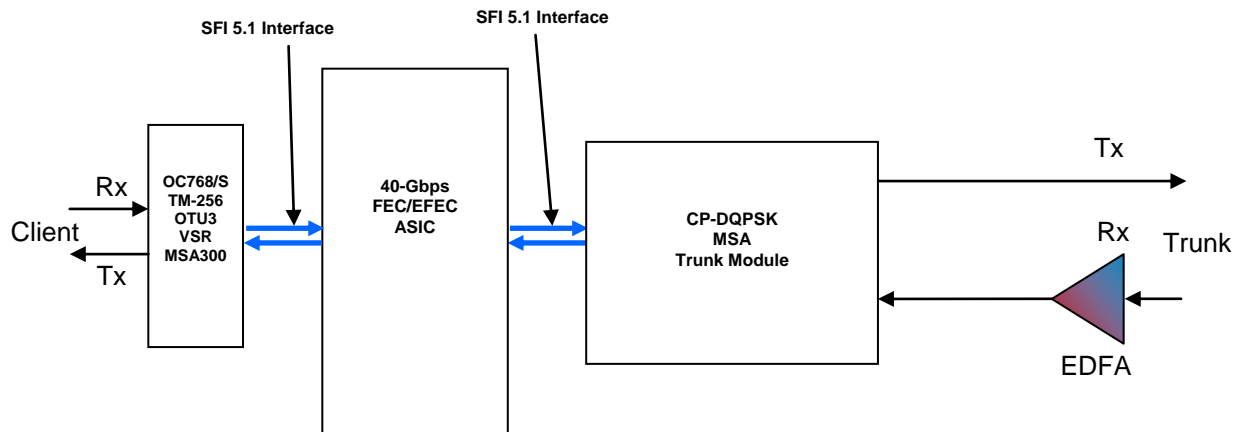
The Cisco 40-Gbps Full-Band CP-DQPSK Transponder Card can transport SONET OC-768, SDH STM-256, optical transport network (OTN) Optical Transport Unit Level 3 (OTU3), 40 GbE WAN PHY and constant bit rate (CBR) signals at 40 GbE LAN PHY rate over a 50-GHz spaced, 50-GHz stabilized, ITU-compliant wavelength. The transponder card is a plug-in module to the Cisco ONS 15454 MSTP, providing a cost-effective architecture for delivering high-rate 40-Gbps services as well as low-rate services down to 1.5 Mbps. The transponder card architecture contains a single client interface that is mapped to a single line interface, without accessing the Cisco ONS 15454 shelf cross-connect fabric.

The client interface supports a standard VSR2000-3R2(F) SONET OC-768, SDH STM-256, OTN OTU3, 40-GbE WAN PHY, and CBR signals at 40 GbE LAN PHY rate.

The DWDM line interface provides a configurable 43.018-Gbps to 44.570-Gbps G.709 OTU3 digital wrapper, long-reach/long-haul, ITU-compliant, 50-GHz spaced optical interface using LC connectors supporting G.709 OTU3 digital wrapper interfaces. The DWDM output line interface is tuneable across the full optical C band, dramatically reducing inventories for spares. When operated within the outlined specifications, each card will transport the 40-Gbps signals with a maximum bit error rate (BER) of 10E-15.

The Cisco 40 Gbps Full-Band Tuneable CP-DQPSK Transponder Card provides many carrier-class features and advanced capabilities necessary to deliver 40-Gbps services, including protocol transparency, wavelength tuneability, flexible protection mechanisms, flow-through timing, and management and performance monitoring capabilities (Figure 2).

Figure 2. 40 Gbps Full-Band Tunable CP-DQPSK Transponder Card Block Diagram



Enhanced FEC Capability

The card can support a forward error correction mechanism on trunk and client interfaces.

The trunk port supports FEC and enhanced FEC (EFEC); you cannot disable such mechanisms. The output bit rate does not depend on the selected algorithm, but you can provision the error coding performance.

- FEC: Standard G.975 Reed-Salomon algorithm
- EFEC: Standard G.975.1 (Subclause I.7); two orthogonally concatenated BCH super FEC code. 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. EFEC provides 2 to 3 dB of additional reach compared to standard FEC pending OH redundancy (10 percent to 13 percent).

The client port supports an FED mechanism that you can disable:

- FEC: Standard G.975 Reed-Salomon algorithm

Advanced Modulation Scheme

Cisco 40 Gbps Full-Band Tunable CP-DQPSK Transponders feature an advanced modulation scheme that aims to reach performance beyond industry-standard 10-Gbps equivalent units.

Cisco selected a Coherent Polarization Differential Quadrature Phase Shift Keying (CP-DQPSK) modulation format to optimize 40-Gbps Transmission in terms of optical signal-to-noise ratio (OSNR), chromatic dispersion robustness, and PMD robustness.

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

Figure 3. CP-DQPSK Tx Domain scheme and Transmitter Scheme

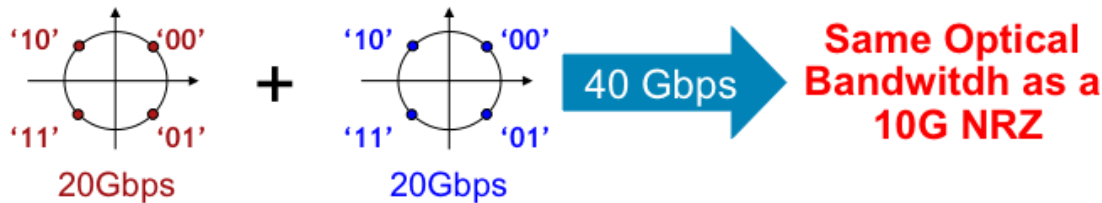
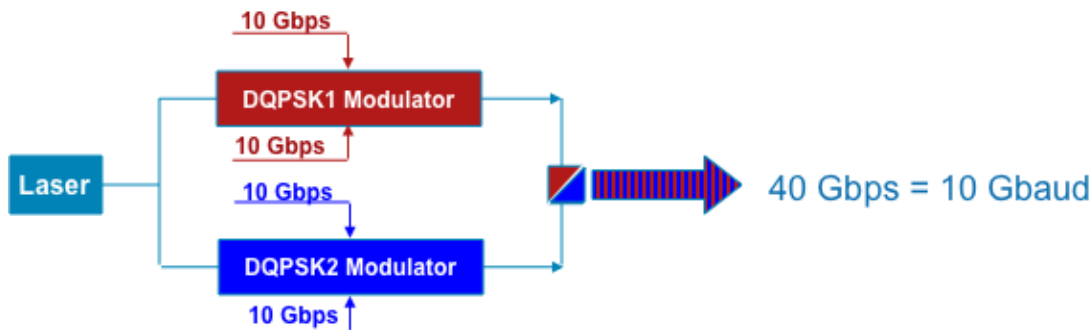
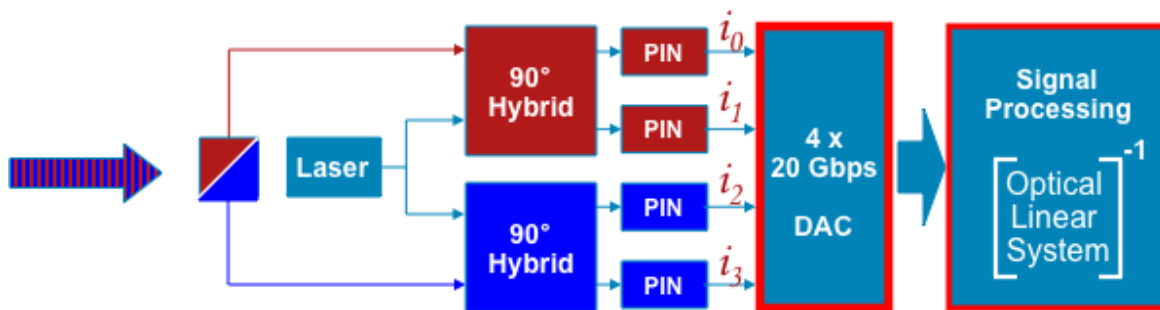


Figure 4. CP-DQPSK Transmitter Scheme



The core of the 40-Gbps PM DQPSK modulation scheme is the receiver that is based on coherent 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 Receiver Scheme



The main benefits of CP-DQPSK are:

- Strong OSNR performance (better than 10-Gbps units)
- Outstanding chromatic dispersion robustness for performance in a completely uncompensated network
- Very strong PMD robustness (three times better than 10-Gbps units)
- Very good spectral density that allows traffic to cross a long cascade of reconfigurable optical ad-drop multiplexers (ROADMs) with negligible penalty

Transponder Card Versions

Two versions of the Cisco 40-Gbps Full-Band Tunable CP-DQPSK Transponder Cards are offered to support different application requirements:

- An extended performance version offering full performances targeting ULH application, where the network is optimized for CP-DQPSK transmission (no 10-Gbps channels and Dispersion Compensation Units [DCUs])
- A metro edge performance version with differential mode only (CP-DQPSK), cost-optimized for metro application and 10-Gbps installed networks

Protocol Transparency and Card Configuration

The Cisco 40-Gbps Full-Band Tuneable CP-DQPSK Transponder can deliver transparently any 40-Gbps services for cost-effective, point-to-point networking for the Cisco ONS 15454 platform.

The card can be provisioned in two operational modes: OTU3 or OTU3e.

In OTU3 mode, the card can transparently transport STM-256, OC-768 40 GbE WAN-PHY signals. In OTU3e mode, to the card can transparently transport a 40 GbE LAN PHY Constant Bit Rate (CBR) signal on a serial interface, as shown in Table 1.

Table 1. Transponder Client Configurations and Mapping

Client Format	Frequency (GHz)	Mapping	Trunk Format	Frequency (GHz) with FEC	Frequency (GHz) with EFEC
OC768/STM256/40GeWAN-PHY	39.813	Bit transparent through standard G.709 mapping	OTU3	43.018 (7% OH)	45.548 (13% OH)
OTU3 (OC768/STM256/40GeWAN-PHY)	43.018	Transparent G.709 standard	OTU3	43.018 (7% OH)	45.548 (13% OH)
40GE LAN-PHY CBR	41.250	Bit transparent overclock	OTU3e	44.570 (7% OH)	45.794 (10% OH)

The card can also process provisionable SONET/SDH overhead bytes. It is possible to pass the bytes transparently or to terminate the line and section overhead. In transparent mode, client terminal equipment interconnected over a transponder-based circuit can communicate over the section (or multiplexer section) data communications channel (SDCC/MSDCC), can signal 1+1 and bidirectional line switched ring or multiplex section-shared protection ring (BLSR/MS-SPR) protection switching using the K1 and K2 bytes, and can support provisionable section trace capabilities over the J0 byte.

In addition, the transponder circuit, whether provisioned in transparent or terminating mode, can support client circuits based on unidirectional-path switched ring (UPSR) or subnetwork connection protection (SNCP). The transponder card is transparent to the embedded payload and does not access the Cisco ONS 15454 platform's cross-connection. It can carry any type of concatenated SONET/SDH payloads (STS-Nc or VC-4-Mc), or nonconcatenated payloads on an STS-1, VC-4, VC-3, VC-12, or VT1.5 basis.

Wavelength Tuneability

The transponder card operates on the 50-GHz ITU grid and it is tuneable across the full C-band, on 50-GHz channels. Tuneability reduces the customer's inventory required to cover all of the wavelengths for deployment and spares. Tuneability is software-provisionable.

Flexible Protection Mechanism Support

You can deploy the 40-Gbps Full-Band Tunable CP-DQPSK Transponder card, depending on your network requirements, to support the many protection mechanisms found in optical transport networks. Table 2 outlines the supported protection options that help to deliver the service-level agreements (SLAs) required by the application.

Table 2. Protection Formats

Protection Type	Capabilities
Unprotected	No client terminal interface, transponder card, or DWDM line protection. The client signal is transported over a single unprotected transponder card.
1+1 protection or UPSR/SNCP and BLSR/MSP-SPR	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. Similar to unprotected format. Protection is provided through client line or path protection through transparent signal transport through a transponder circuit.
Y-cable protection	Provides transponder 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 transponder cards. The Cisco ONS 15454 system controls the transponder card active or standby status to provide a single signal feed to client equipment.
OCH-Trail Protection	Provides protection for DWDM signal through external optical switch units (Protection Switch Module).

Flow-Through Timing

The transponder card allows the timing to flow through from client to line optical interfaces. The receive timing from one interface (client or line) is used to time the other transmitter interface (line or client). This flow-through timing allows the transported signal to remain independent of the node timing.

Management

The Cisco ONS 15454 MSTP provides comprehensive management capabilities to support the operations, administration, monitoring, and provisioning (OAM&P) capabilities through the integrated Cisco Transport Controller craft interface with support from the Cisco Transport Manager element management system. The 40-Gbps Full-Band Tunable CP-DQPSK Transponder Card incorporates provisionable digital wrapper (G.709) functions, 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 exceed SLA requirements. The digital wrapper's generic communication channel (GCC) provides a separate communications channel on a per-wavelength basis, other than the SDCC or regenerator SDCC (RSDCC) in SONET/SDH signals, to be used by the platform when transparent signals are transported. This GCC allows the Cisco ONS 15454 system to extend its advanced network autodiscovery capabilities to DWDM-based services. The integrated Cisco ONS 15454 Transport Controller craft manager and the Cisco Transport Manager provide the user with OAM&P access for the system.

Far-End-Laser-Off Behavior

The Cisco 40-Gbps Full-Band Tunable CP-DQPSK Transponder Card can provision the far-end-laser-off behavior in case of ONSET/SDH payloads. Customers can use the 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 data signals (40 GbE CBR), the behavior is squelching.

Performance Monitoring

The performance monitoring capabilities of the transponder card provide support for both transparent and nontransparent signal transport. For SONET/SDH signals, standard performance monitoring, threshold-crossing conditions, and alarms are supported per Telcordia GR-253, GR-474, and GR-2918; ITU G.828; and ETS 300 417-1 standards. The digital wrapper channel is monitored per G.709 (OTN), G.8021. Optical parameters on the client and DWDM line interfaces support loss of signal (LOS), laser bias current, transmit optical power, and receive optical power. Calculation and accumulation of the performance-monitoring data are in 15-minute and 24-hour intervals as per G.7710.

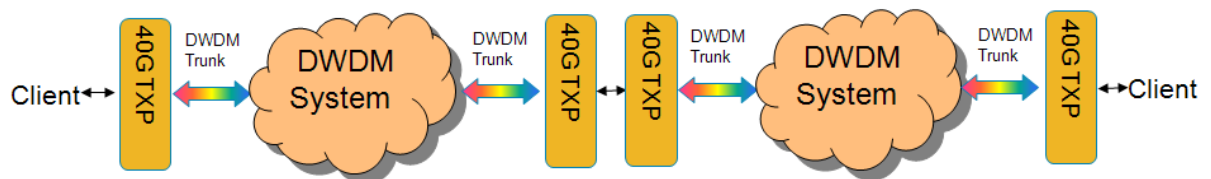
A detailed list of performance monitors is given in Table 8.

The transponder 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.

Regenerator Configuration

The Cisco 40-Gbps Full-Band Tunable CP-DQPSK Transponder Card supports the OTU3 Regeneration function. You can configure two cards to work in back-to-back mode, allowing the transponder to perform the OTN O-E-O regeneration function as depicted in Figure 6.

Figure 6. OTU3 Regeneration Configuration for 40-Gbps Full-Band Tunable CP-DQPSK Transponder Card



The client can be OC768, STM-256, or OTU3. Regeneration is performed through the OTU3 client-to-client interconnection, where OTU3 overhead is terminated, allowing ODU3 to transparently pass through. GCC0 are properly terminated, and GCC1 and GCC2 are properly passed through.

In case of failure on one side, ODUk-AIS is generated and propagated and an OTUk-BDI is sent back as defined by the ITU G.709 standard.

Application Description

The Cisco ONS 15454 MSTP 40-Gbps Full-Band Tunable CP-DQPSK Transponder Card adds the capability to cost-effectively transport 40-Gbps services. Two main applications are expected.

- 40-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 40 Gbps. The transponder solution aims to provide DWDM interconnection between 40-Gbps interfaces among routers across DWDM metro, regional, or long-haul networks. The advanced modulation scheme is designed to cope with long-distance application performance requirements, allowing the extension of 40-Gbps service over 1500 km.
- OTU3 links in national carrier backbone networks: OTN technology is vital to backbone carrier networks. It is the baseline method that offers intercarrier or interdomain transfer to any next-generation transport network at 2.5-Gbps (OTU1), 10-Gbps (OTU2), or 40-Gbps (OTU3) rates. The Cisco 40-Gbps Full-Band Tunable CP-DQPSK Transponder supports a fully standard OTU3 interface that can cope with signals from

any G.709-based OTU3 interface from an OTN cross-connection, a 40-Gbps router Interface, or other 40-Gbps transponder interfaces.

Product Specifications

Compact Design

- Double-width card slot design for high-density, 40-Gbps solutions
- Up to 6 transponder cards per shelf assembly supports up to 24 40-Gbps interfaces per bay frame

Flexible Restoration Options

- Transparent support for UPSR/SNCP, BLSR/MSP, and 1+1 APS/MSP
- Client Y-protection
- OCH-trail protection through PSM
- Unprotected (0+1)

Tables 3 and 4 list the regulatory compliance and system requirements for the transponder card. Table 5 lists the client-side specifications, Table 6 provides the DWDM specifications, Table 7 provides DWDM receive-side optical performance information, Table 8 gives performance-monitoring parameters, Table 9 gives card specifications, and Table 10 gives ordering information for the card.

Regulatory Compliance

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 3. Regulatory Compliance

ANSI System	ETSI System	
Countries Supported		
<ul style="list-style-type: none"> • Canada • United States • Korea • Japan • European Union 	<ul style="list-style-type: none"> • European Union • Africa • CSI • Australia • New Zealand 	<ul style="list-style-type: none"> • China • Korea • India • Saudi Arabia • South America
EMC (Class A)		
<ul style="list-style-type: none"> • ICES-003, 2004 • GR-1089-CORE Issue 4, NEBS EMC and Safety, June 2006 • FCC 47CFR15, 2007 	<ul style="list-style-type: none"> • ETSI EN 300 386 V1.4.1 (2008-04) Telecommunication network equipment EMC requirements (Note: EMC-1) • CISPR22:2008 and EN55022:2006/A1:2007 Information Technology Equipment (Emissions) (EMC-2) • 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) 	
Safety		
<ul style="list-style-type: none"> • CSA C22.2 #60950-1 - Edition 7, March 2007 • UL 60950-1 - Edition 2, March 2007 • GR-1089-CORE Issue 4, NEBS EMC and Safety, June 2006 	<ul style="list-style-type: none"> • UL 60950-1 - Edition 2, March 2007 • IEC 60950-1 Information technology equipment Safety Part 1: General requirements - Edition 2, 2005 and National Differences as per CB Bulletin 112A • 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. • EN 60950-1, Edition 2 (2006) Information technology equipment – Safety – Part 1: General requirements • CE Safety Directive: 2006/95/EC 	

ANSI System	ETSI System
Laser	
<ul style="list-style-type: none"> UL 60950-1 - Edition 2, March 2007 IEC 60825-1: 2001 Ed.1.2 (incl. am1+am2) Safety of laser products Part 1: Equipment classification, requirements and users guide IEC60825-2 Ed.3 (2004) Safety of laser products Part 2: Safety of optical fiber communication systems + A1:2006 	<ul style="list-style-type: none"> IEC 60825-1: 2001 Ed.1.2 (incl. am1+am2) Safety of laser products Part 1: Equipment classification, requirements and users guide IEC60825-2 Ed.3 (2004) Safety of laser products Part 2: Safety of optical fibre communication systems + A1:2006 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 Laser Products – Conformance with IEC 60825-1 and IEC 60601-2-22; Guidance for Industry and FDA Staff (Laser Notice No. 50), June 2007
Environmental	
<ul style="list-style-type: none"> GR-63-CORE Issue 3, NEBS Physical Protection, March 2006 	<ul style="list-style-type: none"> 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	
<ul style="list-style-type: none"> GR-253-CORE - Issue 04 ITU-T G.691 	<ul style="list-style-type: none"> ITU-T G.709 ITU-T G.975
Quality	
<ul style="list-style-type: none"> TR-NWT-000332, Issue 4, Method 1 calculation for 20-year mean time between failure (MTBF) 	
Miscellaneous	
<ul style="list-style-type: none"> GR-1089-CORE Issue 4, NEBS EMC and Safety (June 2006) (Note: NEBS-1) GR-63-CORE Issue 3, NEBS Physical Protection (March 2006) (Note: NEBS-2) ATT-TP-76200: 2008 ANSI T1.315-2001 GR-499: 2004 Transport Systems Generic Requirements (TSGR): Common Requirements 	

Table 4. System Requirements

Component	Cisco ONS 15454 ANSI	Cisco ONS 15454 ETSI	Cisco ONS15454 M6	Cisco ONS15454 M2
Processor	TCC3/TCC2P/TCC2	TCC3/TCC2P/TCC2	TNC/TSC	TNC/TSC
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 9.2.1 ANSI or later	Release 9.2.1 ETSI or later	Release 9.2.1 ANSI/ETSI or later	Release 9.2.1 ANSI/ETSI or later
Slot compatibility	1 – 6, 12 – 17	1 – 6, 12 – 17	2 – 7	2 – 3

Table 5. Client Side Specifications

Specification	VSR Interface
ITU G.693 SONET/SDH	VSR2000-3R2 ² VSR2000-3R3 ³ VSR2000-3R5 ³
ITU G.693 OTU3	VSR2000-3R2F ^{2,4} VSR2000-3R3F ^{3,4} VSR2000-3R5F ³
Automatic laser shutdown and restart	ITU-T G.664
Unamplified targeted fiber distance, SMF28 ¹ (FD ^{smf28})	2 km
Nominal wavelength (λ_{Tnom})	1550 nm
Optical transmitter	
Operating wavelength range (λ_{Tmin} to λ_{Tmax})	1530 nm to 1565 nm

Specification	VSR Interface
Type	External modulation (LiNbO3)
Output power (P_{Tmin} to P_{Tmax})	0 to +3 dBm
Minimum required optical return loss	24 dB
Minimum extinction ratio (r_{eminx})	8.2 dB
Laser safety class	1
Optical Receiver	
Type	PIN
Sensitivity @ BER (P_{Rmin})	-6 for G.652 -5 for G.653 -5 for G.655
Overload	
Chromatic dispersion tolerance (D_{SRmax})	40 for G.652 ⁵ 6.6 for G.653 20 for G.655
Minimum BER (BER_{min})	10E-12
Maximum DGD	7.7 ps
Maximum receiver reflectance	-27 dB
Input wavelength bandwidth (λ_{c-rx})	1530 nm-1565 nm ²
Connector type (Tx/Rx)	LC, duplex

1. Fiber distance of $\langle FD_{smf28} \rangle$ km in SMF28 of equivalent $\langle SR_{olt} \rangle$ dB optical link budget. Assumes $D_{1550} = 17$ ps/nm/km, $D_{1310} = 3.3$ ps/nm/km; fiber+splice+connector loss at 1550 nm = 0.275 dB/km and 1310 nm = 0.55 dB/km; includes $\langle P^0 \rangle$ dB dispersion penalty at $\langle D_{Lrlong-reachmax} \rangle$ ps.
2. A receiver in compliance with application VSR2000-3R2(F) will operate in either of the application codes VSR2000-3R3 or VSR2000-3R5. It will also operate in the application code VSR2000-3R1 if its operating wavelength range includes 1290-1330 nm.
3. A receiver in compliance with this application is required to operate in any of the application codes VSR2000-3R1, VSR2000-3R3 or VSR2000-3R5. It shall, as a minimum, operate over the wavelength range of 1290-1330 nm as well as the range 1530-1565 nm.
4. The BER for this application is required to be met only after the error correction (if used) has been applied. The BER at the input of the FEC decoder can, therefore, be significantly higher than 10⁻¹².
5. This application can also be used on G.653 and G.655 fiber.
6. If passive optical devices in the main optical path introduce additional chromatic dispersion, the achievable link distance may be reduced. Alternatively, an application with a higher chromatic dispersion tolerance may be used to overcome this restriction.
7. The method used to verify this penalty is ffs.

Table 6. DWDM Specifications

Specification	DWDM Line Interface
DWDM line interface	
Bit rate	43.018 ±100 ppm (OTU3 with GFEC) 45.548 ±100 ppm (OTU3 with EFEC at 13% OH) 44.570 ±100 ppm (OTU3e with GFEC) 45.794 ±100 ppm (OTU3e with EFEC at 10% OH)
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λ_{Tnom})	Full tuneable from 1529.55 to 1561.83 (C-Band – 50 GHz)
Spectral width @ 3dB ($\lambda_{\Delta 3}$)	<25 GHz
Optical transmitter	
Type	CP-DQPSK modulation format
Output power (P_{Tmin})	+1 to +6.5 dBm
Required optical return loss, minimum (ORL _{min})	30 dB
Laser safety class	1
Optical receiver	
Type	PIN photodetector

Specification	DWDM Line Interface
Chromatic dispersion tolerance (DLR _{max}) <ul style="list-style-type: none"> Extended Performance version Metro Edge Performance version 	+/- 29,000 ps/nm +/- 3,000 ps/nm
Minimum BER (BER _{min}) <ul style="list-style-type: none"> FEC on EFEC on 	10E-15 10E-15
Overload	-8 dBm
Receiver reflectance (maximum)	30 dB
Input wavelength bandwidth ($\lambda_{c,rx}$)	Full tuneable from 1529.55 to 1561.83 (C-Band – 50 GHz)
Connector type (Tx/Rx)	LC, duplex (shuttered)

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)
Extended performance						
0 ps/nm	STD 7%	<10E(-5)	<10E(-15)	-8 to -20dBm	-	10 dB
0 ps/nm					100 ps	11 dB
+/- 34,000 ps/nm					100 ps	14 dB
0 ps/nm	ENH 10%	<4.6x10E(-3)	<10E(-15)	-8 to -20 dBm	-	5.2 dB
0 ps/nm					100 ps	5.7 dB
+/- 29,000 ps/nm					100 ps	6.2 dB
0 ps/nm	ENH 13%	<7x10E(-3)	<10E(-15)	-8 to -20 dBm	-	4.7 dB
0 ps/nm					100 ps	5.1 dB
+/- 29,000 ps/nm					100 ps	5.5 dB
Metro edge performance						
0 ps/nm	STD	<10E(-5)	<10E(-15)	-8 to -20 dBm	-	10 dB
+/- 3,000 ps/nm					10 ps	11 dB
0 ps/nm	ENH 10%	<4.6x10E(-3)	<10E(-15)	-8 to -20 dBm	-	5.2 dB
+/- 3,000 ps/nm					10 ps	6.2 dB
0 ps/nm	ENH 13%	<7x10E(-3)	<10E(-15)	-8 to -20 dBm	-	4.7 dB
+/- 3,000 ps/nm					10 ps	5.5 dB

Table 8. Performance Monitoring Parameters

Payload	Description		
OTN	OTUk SM counters	ODUk PM counters	Description
	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

Payload	Description
OC192	CV-L: Line Coding Violation (CV-L) CV-S: Section Coding Violation (CV-S) ES-L: Line Errored Seconds (ES-L) ES-S: Section Errored Seconds (ES-S) FC-L: Line Failure Count (FC-L) SEF-S: Severely Errored Framing Seconds (SEFS-S) SES-L: Line Severely Errored Seconds (SES-L) SES-S: Section Severely Errored Seconds (SES-S) UAS-L: Line Unavailable Seconds (UAS-L)
STM-64	MS-BBE: Multiplex Section Background Block Error (MS-BBE) MS-BBER: Multiplex Section Background Block Error Ratio (MS-BBER) MS-EB: Multiplex Section Errored Block (MS-EB) MS-ES: Multiplex Section Errored Second (MS-ES) MS-ESR: Multiplex Section Errored Second Ratio (MS-ESR) MS-SES: Multiplex Section Severely Errored Second (MS-SES) MS-SESR: Multiplex Section Severely Errored Second ratio (MS-SESR) MS-UAS: Multiplex Section Unavailable Seconds (MS-UAS) RS-BBE: Regenerator Section Background Block Error (RS-BBE) RS-BBER: Regenerator Section Background Block Error Ratio (RS-BBER) RS-EB: Regenerator Section Errored Block (RS-EB) RS-ES: Regenerator Section Errored Second (RS-ES) RS-ESR: Regenerator Section Errored Second Ratio (RS-ESR) RS-SES: Regenerator Section Severely Errored Second (RS-SES) RS-SESR: Regenerator Section Severely Errored Second Ratio (RS-SESR) RS-UAS: Regenerator Section Unavailable Second (RS-UAS)
FEC	Bit errors: Number of corrected bit errors Uncorrectable words: Number of uncorrectable words
10G FC and 8G FC	rxTotalPkts: Client RX - Receive frame counter mediaIndStatsRxFramesTruncated: Client RX - mediaIndStatsRxFramesTooLong: Client RX - Receive oversize frame counter mediaIndStatsRxFrameBadCRC: Client RX - Receive frame CRC error counter ifInOctets: Client RX - Receive (frame) octets counter ifInErros: Client RX - Receive Total Errored Frame counter
Trunk and Client Optical Performance Monitoring	Transmit optical power (OPT) PM Transmitter laser bias current (LBC) Receiver optical power (OPR)

Table 9. Card Specifications

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
DWDM Pport LEDs	
Active input signal	Green
Output wavelength	Green
Power (including worst case pluggable)	
Typical	126W
Maximum	129W

Specification	
Physical	
Dimensions	Occupies 2 slots
Weight	2.86 kg (6.3 lb)
Reliability and availability	
Mean time between failures (MTBF)	86,123 hours
Latency (end to end)	
Client OTU3:	
G.709 On – Standard FEC	11.5 microsecond
G.709 On – Enhanced FEC	52.9 microseconds
Client OC768 / STM256:	
G.709 On – Standard FEC	6.6 microsecond
G.709 On – Enhanced FEC	47.9 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 ¹	–5°C to 55°C (23°F to 131°F)
Relative humidity	
Normal	5% to 85%, noncondensing
Short term ¹	5% to 90% but not to exceed 0.024 kg water/kg of dry air

1. 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. M12 chassis will support maximum of 50°C.

Table 10. Ordering Information

Part Number	Description
15454-40E-TXP-C=	OC-768/STM-256/40 GE Transponder CP-DQPSK Extended Performance
15454-40EX-TXP-C=	OC-768/STM-256/40 GE Transponder CP-DQPSK Extended Performance
15454-40ME-TXP-C=	OC-768/STM-256/40 GE Transponder CP-DQPSK Metro Edge Performance

For More Information

For more information about the ONS15454 MSTP, visit

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



Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
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The Netherlands

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