

40-Channel Reconfigurable Optical Add/Drop Multiplexing Portfolio for the Cisco ONS 15454 Multiservice Transport Platform

The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) (Figure 1) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro) and regional bandwidth.

Figure 1. 40-Channel Wavelength Cross-Connect (40-WXC), Wavelength Selective Switch (40-WSS), Multiplexer (40-MUX), and Demultiplexer (40-DMX) Units



Product Overview

Release 8.0 expands Cisco ONS 15454 MSTP transport capacity in C band to 40 channels (100-GHz spacing) and to 80 channels (50-GHz spacing). In parallel with the existing 32-channel Reconfigurable Optical Add/Drop Multiplexing (ROADM) solutions, a new set of units is introduced in this release to enhance reconfigurability options for the MSTP platform, allowing multidegree reconfigurability as well. By making use of the Release 8.0 MSTP features and configuration flexibility, a Cisco DWDM network can scale to 112 channels of composite DWDM traffic, using both the C band and the L band spectrum.

The new 40-channel Wavelength Cross-Connect (40-WXC) card and the software functionalities extended from previous releases provide multidegree switching capabilities at the individual wavelength level. Mesh and multiring network topologies can now be deployed using Cisco ONS 15454 MSTP platform with complete flexibility of service routing at all nodes in the network. While Wavelength Selective Switch (WSS) units provide degree-2 type reconfigurability (drop wavelength in a node vs. let it pass through the node), an ROADM node based on 40-WXC units can support up to degree-8 reconfigurability. This means that for each wavelength it is possible to decide if it has to be locally dropped or routed to any of the other 7 pass-through directions of the node. Such a capability not only enhances the flexibility of the DWDM transport network but also dramatically reduces the need for costly transponders to perform optical-to-electrical-to-optical conversion (typically 2 transponders/crossponders per add/drop channel or wavelength). This capability allows

carriers to more cost-effectively (from both a CapEx and OpEx perspective) build secure and efficient transport networks that can scale with their growing bandwidth and interconnect needs. The Cisco approach to DWDM gives carriers the freedom to reevaluate and alter their wavelength forecasts as service demands grow and business concentrations emerge—without suffering the heavy price typically associated with redesigning and mapping DWDM networks.

As even in complex mesh network topologies it is likely that degree-2 reconfigurability would be enough for most of the node, the 40-channel ROADM portfolio includes also two different versions of the 40-WSS units, one operating on the odd channels of the C band spectrum (40-WSS-C) and the other one operating on the even channels of the C band spectrum (40-WSS-CE). The units can be used in conjunction with existing 32-channel ROADM solutions and with 40-WXC units to provide the greatest degree of flexibility for Cisco ONS 15454 MSTP deployments.

The Cisco ONS 15454 ROADM cards are plug-in modules that use the proven Cisco ONS 15454 carrier-class features to deliver the flexibility to access network bandwidth from a single DWDM channel all the way to 112 channels, to support the requirements of service provider and enterprise networks. (See Table 1)

Table 1. 40-Channel ROADM Units with Applications

Component	Deployment Application
40-Channel Wavelength Cross-Connect – C Band – Odd Channels	This unit is the primary unit for the multidegree ROADM solution operating in the C band – odd channels. It allows the possibility to remotely and automatically control a wavelength to be routed to any of the 8 directions of a multidegree ROADM node. Embedded automatic power control mechanisms feature the possibility to interface with different types of DWDM units without requiring external attenuators. Used in conjunction with the 40-channel Multiplexer and 40-channel Demultiplexer allows to manage local add/drop traffic of the specific direction supported by the 40-WXC unit.
40-Channel Wavelength Selective Switch – C Band – Odd Channels	This unit is the primary unit for the degree-2 ROADM solution operating in the C band – odd channels. It allows the possibility to remotely and automatically control a wavelength to bypass or be added in a node of the network. Automatic per-channel power control capabilities embedded in the unit (dynamic gain equalization [DGE]) feature the possibility to deploy this unit also in selected line amplification sites in the network to improve overall system performance.
40-Channel Wavelength Selective Switch – C Band – Even Channels	This unit is the primary unit for the degree-2 ROADM solution operating in the C band – even channels. It allows the possibility to remotely and automatically control a wavelength to bypass or be added in a node of the network. Automatic per-channel power control capabilities embedded in the unit (DGE) feature the possibility to deploy this unit also in selected line amplification sites in the network to improve overall system performance.
40-Channel Demultiplexer – C band – Odd Channels	This unit can be used with the 40-WXC-C in multidegree ROADM nodes to manage the traffic to be dropped on the specific direction supported by the WXC unit. Used in conjunction with the 40-WSS-C unit in ROADM nodes, it provides access to the channels to be dropped locally. This unit can also be used with the 40-MUX-C in terminal nodes to support point-to-point applications. Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators.
40-Channel Demultiplexer – C Band – Even Channels	This unit operates with the 40-WSS-CE in degree-2 ROADM nodes to provide access to channels to be dropped locally. Embedded automatic power control mechanisms feature the possibility to interface with different type of DWDM units without requiring external attenuators.
40-Channel Multiplexer – C Band – Odd Channels	This unit can be used with the 40-WXC-C in multidegree ROADM nodes to manage the traffic to be added on the specific direction supported by the WXC unit. Used in conjunction with the 40-MUX-C unit in Terminal nodes it supports point-to-point applications.
Degree-4 Mesh Patch Panel	This 2-RU-high passive unit is used in multidegree ROADM nodes with up to 4 40-WXC-C units to provide broadcast functionalities and replicate to all the directions of the node the wavelengths to be routed through the ROADM node.
Degree-8 Mesh Patch Panel	This 2-RU-high passive unit is used in multidegree ROADM nodes with up to 8 40-WXC-C units to provide broadcast functionalities and replicate to all the directions of the node the wavelengths to be routed through the ROADM node.

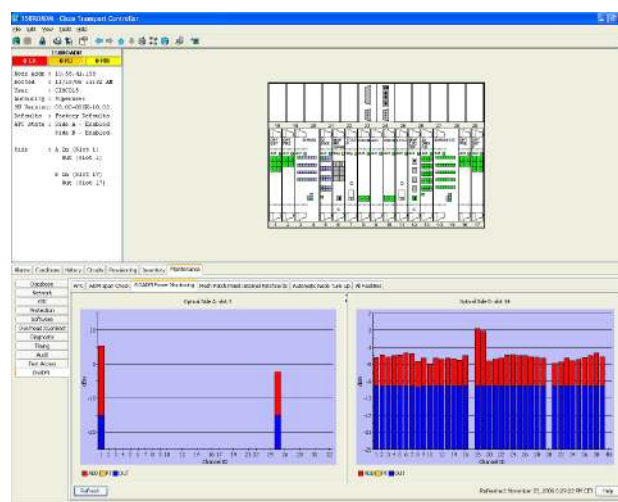
The Cisco ONS 15454 ROADM cards (40-WXC-C, 40-WSS-C, and 40-WSS-CE) operate on the ITU 100-GHz wavelength plan. Each card integrates automatic per-channel power control capabilities, providing node-based and network-based automatic-power-level management. Per-channel optical path selection is also done in a completely automated way through Wavelength Path Provisioning (WPP) at the network level, featuring end-to-end point and click wavelength provisioning and easy SONET/SDH-like wavelength management.

ROADM node architecture has been specifically defined and engineered to be able to provide:

- High reliability: Complete independence between specific direction-facing units with the possibility to house units in physically separated shelves.
- Automatic optical power balancing: Per-channel automatic power control allows a “self-healing” intelligent approach to DWDM.
- Low insertion loss: Selected technology allows direct integration of different functionalities in the same optical module, reducing to the bare minimum the number of optical connections.
- Fast switching time: 40-WSS-C and 40-WSS-CE units can be used to provide shared optical protection directly in the optical domain with a protection time comparable with what SONET/SDH is able to guarantee.

The optical cards incorporate faceplate-mounted LEDs to provide a quick visual check of the operational status at the card. Printed on each of the faceplates is an icon, an orange circle, which is mapped to shelf-slot icons indicating the shelf slot where the card can be physically installed. The cards are supported by the integrated Cisco ONS 15454 Cisco Transport Controller craft manager, which provides the user access for operations, administration, maintenance, and provisioning (OAM&P) for the system. Using the embedded unit’s capabilities, Cisco Transport Controller features also the possibility to provide a per-channel graphical representation of the optical power levels associated with each individual path in the ROADM nodes (Figure 2).

Figure 2. Cisco Transport Control Per-Channel Optical Power-Monitoring Representation



Complete flexibility provided by the ROADM unit highly simplifies the design of optical networks in terms of unit placement. Flexibility provided by units per se, in any case, is not enough to guarantee the possibility to define any possible optical path at the network level. The Cisco Transport Planner optical design tool features the possibility to design DWDM networks based on ROADM functionalities and to verify all the possible optical paths and the DWDM interface types (fully flexible network design) defined by the user. Fully flexible network design resulting from the joint selection of both optical paths and DWDM interface types is highly customizable by the user, who has the possibility to compare different solutions and to create what-if scenarios in a simple and effective way.

Figures 3 through 5 show a sample signal-flow diagram for a Cisco ONS 15454 MSTP ROADM node, outlining the use for each unit type.

Figure 3. MSTP 40-Channel Degree-2 ROADM Node

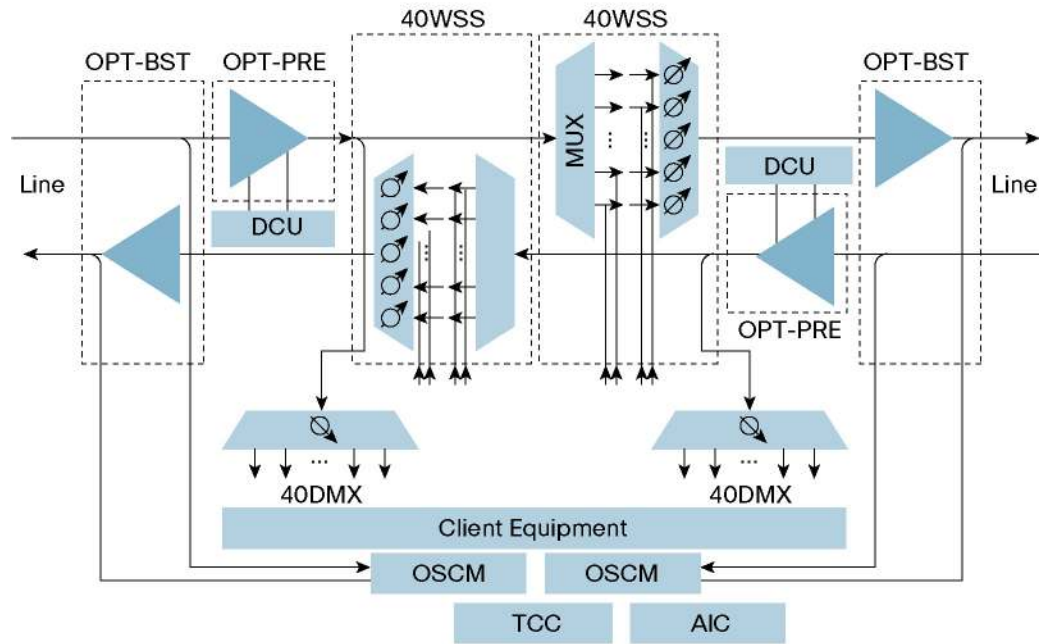


Figure 4. MSTP 80-Channel Degree-2 ROADM Node

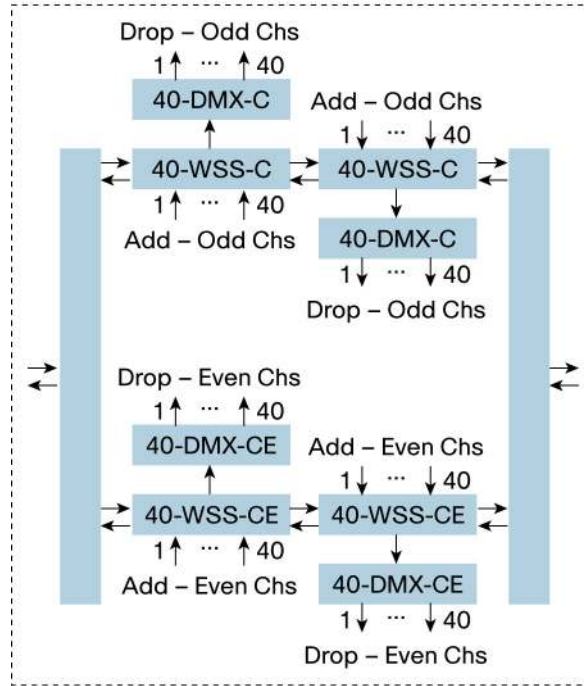
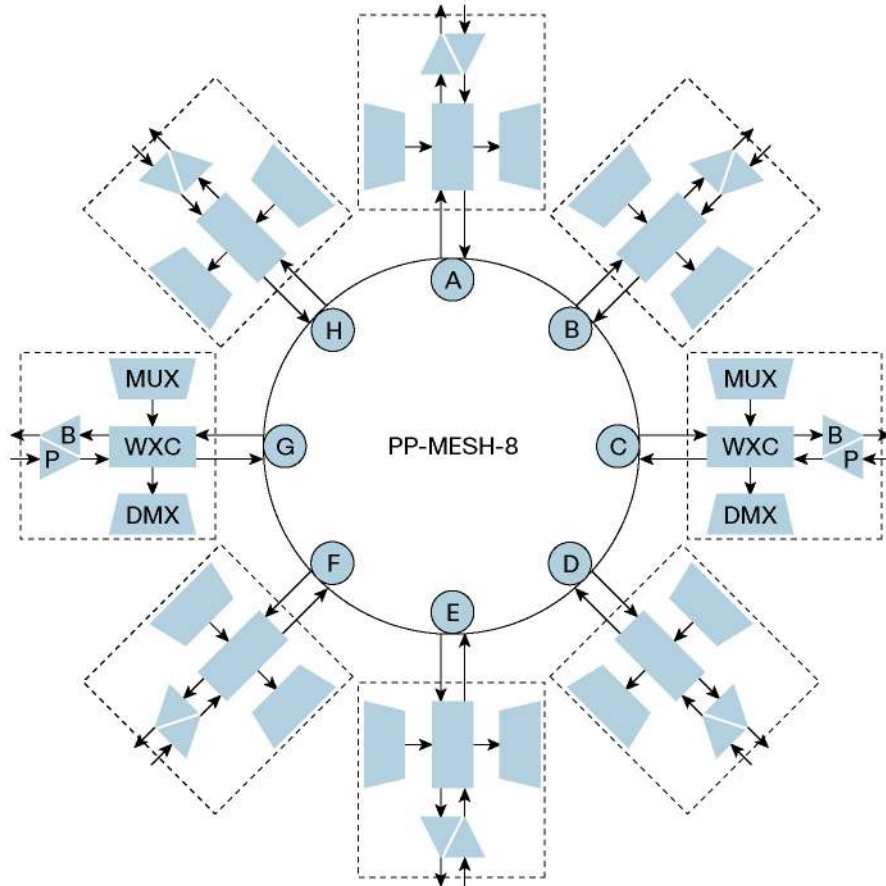


Figure 5. MSTP 40-Channel 8-Degree ROADM Node



Cisco ONS 15454 ROADM Card Specifications

Tables 2 through 6 give specifications of the Cisco ONS 15454 ROADM cards. Figures 3, 4, and 5 give the functional diagrams for the Cisco ONS 15454 ROADM cards.

Table 2. Regulatory Compliance¹

Countries Supported	
ANSI System	ETSI System
<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 • China • Korea • India • Saudi Arabia • South America
EMC (Class A)	
<ul style="list-style-type: none"> • ICES-003 issue 3 (1997) • GR-1089-CORE issue 3 • FCC 47CFR15 subpart B (2004) 	<ul style="list-style-type: none"> • EN 300 386 v1.3.3 • CISPR22 (2005), and CISPR24 (+ Am 1, Am.2 2002) • EN55022 and EN55024
Safety	
<ul style="list-style-type: none"> • UL/CSA 60950 -1 first edition (2003) • GR-1089-CORE issue 3 	<ul style="list-style-type: none"> • UL/CSA 60950 -1 first edition (2003) • IEC 60950 -1 (2001-01) first edition and EN60950 -1 (2001) first edition
Laser	
<ul style="list-style-type: none"> • UL/CSA 60950 -1 first edition (2003) • IEC 60950 -1 (2001-01) first edition, and EN60950 -1 (2001) first edition • IEC 60825-2 (2004-06) third edition 	<ul style="list-style-type: none"> • CDRH (accession letter and report) • IEC 60825-1 +Am.1+ Am.2 (2001)
Environmental	
<ul style="list-style-type: none"> • GR-63-CORE issues 2 and 3 • ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1) 	<ul style="list-style-type: none"> • ETS 300-019-2-2 V2.1.2 (Transportation, Class 2.3) • ETS 300-019-2-3 V2.1.2 (Operational, Class 3.1E)
Optical	
<ul style="list-style-type: none"> • G.709 • G.975 	
Miscellaneous	
<ul style="list-style-type: none"> • AT&T Network Equipment Development Standards (NEDS) Generic Requirements, AT&T 802-900-260 • SBC TP76200MP 	<ul style="list-style-type: none"> • Verizon SIT.NEBS.NPI.2002.010 • Worldcom ESD requirement

Table 3. System Requirements

Component	Cisco ONS 15454 ANSI	Cisco ONS 15454 ETSI
Processor	TCC2P/TCC2	TCC2P/TCC2
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
System Software	Release 8.0.0 ANSI or greater	Release 8.0.0 ETSI or greater

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

Table 4. ROADM Cards Specifications

Specification	40-WSS-C/ 40-WSS-CE	40-DMX-C/ 40-DMX-CE	40-WXC-C	40-MUX-C
Management				
Card LEDs:				
Failure (FAIL)	Red	Red	Red	Red
Active/Standby (ACT/STBY)	Green/yellow	Green/yellow	Green/yellow	Green/yellow
Signal Fail (SF)	Yellow	Yellow	Yellow	Yellow
Operating Environment				
Temperature	-5 to 55°C 23 to 131°F	-5 to 55°C 23 to 131°F	-5 to 55°C 23 to 131°F	-5 to 55°C 23 to 131°F
Humidity	5 to 95% RH	5 to 95% RH	5 to 95% RH	5 to 95% RH
Storage Environment				
Temperature	-40 to 70°C -40 to 158°F	-40 to 70°C -40 to 158°F	-40 to 70°C -40 to 158°F	-40 to 70°C -40 to 158°F
Humidity	5 to 95% RH	5 to 95% RH	5 to 95% RH	5 to 95% RH

Table 5. Optical Specifications for ROADM Cards

Specification	40-WSS-C/ 40-WSS-CE	40-DMX-C/ 40-DMX-CE	40-WXC-C	40-MUX-C
Optical Parameters				
Insertion Loss (maximum @ minimum VOA)	7.5dB (EXP-RX – COM-TX) 2.3dB (COM-RX – EXP-TX) 6.8dB (Add 1-40 – COM-TX) 6.0dB (COM-RX – DROP-TX)	5.8 dB	6.5 Max, 5.0 Typ	5.8 dB
Minimum VOA Dynamic Range	20 dB (EXP-RX – COM-TX) 25 dB (Add 1-40 – COM-TX)	25 dB	20 dB	25 dB
Maximum Input Power	25 dBm	25 dBm	25 dBm	25 dBm
Filter Type	Array wave guide (AWG)	Array wave guide (AWG)	MEMS	Array wave guide (AWG)
Minimum Transmit Filter -1 dB Bandwidth (all operating conditions and attenuation values)	+/-135 pm (EXP-RX COM-TX) +/-160 pm (Add COM-TX)	+/-100 pm	+/-110 pm	+/-100 pm
Adjacent Crosstalk (all operating conditions and attenuation values)	23 dB (Minimum) 30 dB (Typical)	25 dB (Minimum)	30 dB (Minimum)	25 dB (Minimum)
Nonadjacent Crosstalk (all operating conditions and attenuation values)	30 dB (Minimum) 42 dB (Typical)	34 dB (Minimum)	40 dB (Minimum)	34 dB (Minimum)
Maximum Polarization Dependent Loss (PDL) (all operating conditions and attenuation values)	3.5 dB (Add 1-40 – COM-TX) 0.2 dB (COM-RX – EXP-TX) 0.4 dB (COM-RX – DROP-TX)	0.6 dB	0.6 dB (5 to 10 dB Att. range) 1 dB (15 to 20 dB Att. range) 0.4 dB (COM-RX – DROP-TX)	0.6 dB
Optical Power Setting Accuracy (all operating conditions and attenuation values)	-0.7/0.7 dB	-	±1.3dB (5 to 10 dB Att. range) ±3.0dB (15 to 20 dB Att. range)	-
Minimum Return Loss	40 dB	40 dB	40 dB	40 dB
Connectors				

Specification	40-WSS-C/ 40-WSS-CE	40-DMX-C/ 40-DMX-CE	40-WXC-C	40-MUX-C
Channel Input/Output Ports	MPO	MPO	MPO	MPO
Composite Ports	LC	LC	LC	LC
Power				
Card Power Draw				
Typical	63W	20W	25W	20W
Maximum	79W	39W	33W	39W
Physical				
Size	2 slots	1 slot	2 slots	1 slot
Supported Shelf Slots	1–6, 12–17	1–6, 12–17	1–6, 12–17	1–6, 12–17

Table 6. Optical Specifications for Mesh Patch Panel Units

Specification	PP-MESH-4	PP-MESH-8
Optical Parameters		
Maximum Insertion Loss	7.5dB	10.6dB
Maximum Polarization Dependent Loss	0.3dB	0.5dB
Maximum PMD	0.1dB	0.15dB
Minimum Return Loss	50dB	50dB

Ordering Information

Table 7 gives ordering information for the 40-channel Cisco ONS 15454 ROADMs.

Table 7. System Ordering Information

Part Number	Description
15454-40-WXC-C=	40Chs Wavelength Cross-Connect – C-band – Odd
15454-40-WSS-C=	40Chs Wavelength Selective Switch – C-band – Odd
15454-40-DMX-C=	40Chs Demultiplexer – C-band – Odd
15454-40-MUX-C=	40Chs Multiplexer – C-band – Odd
15454-40-WSS-CE=	40Chs Wavelength Selective Switch – C-band – Even
15454-40-DMX-CE=	40Chs Demultiplexer – C-band – Even
15454-PP-MESH-8=	2RU 8-Degree Mesh Patch Panel
15454-PP-MESH-4=	2RU 4-Degree Mesh Patch Panel
15454-PP-80-LC=	2RU 80 Ports LC Patch Panel
15454-MPO-MPO-2=	Multifiber patchcord – MPO to MPO – 2m
15454-MPO-MPO-4=	Multifiber patchcord – MPO to MPO – 4m
15454-MPO-MPO-6=	Multifiber patchcord – MPO to MPO – 6m
15454-MPO-MPO-8=	Multifiber patchcord – MPO to MPO – 8m



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