

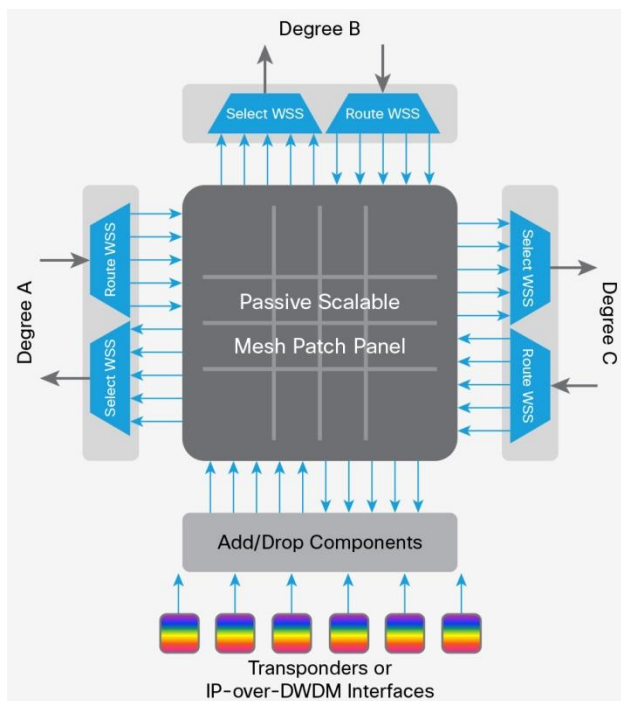
Cisco Network Convergence System 2000 Series Passive Patch Panel Modules

The Cisco® Network Convergence System (NCS) 2000 Series evolved the Cisco ROADM portfolio by introducing Cisco nLight reconfigurable add-drop multiplexer (ROADM) technology. The support of touchless reconfigurability through colorless, omnidirectional, and contentionless add/drop is based upon nLight ROADM and upon a new set of self-healing patch panel modules that dramatically reduce installation time and maintenance cost.

Product Introduction

The large numbers of ports on the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards are made possible by the twin-WSS route and select architecture featured by Cisco nLight ROADMs (Figure 1). Channels are isolated by both the ingress and egress WSS, improving performance. By routing, instead of broadcasting, express channels, insertion loss is reduced, preserving optical signal-to-noise ratio (OSNR). The Cisco nLight architecture therefore allows multidegree ROADM nodes, plus CCOFS add/drop, at large scale.

Figure 1. Cisco nLight ROADM Architecture



A specific set of passive auxiliary modules is used to support this level of flexibility, simplifying the fiber connectivity and allowing dramatic reduction in maintenance activities.

ROADM Passive Auxiliary Modules

Product Overview

The Cisco NCS 2000 features a new generation of passive modules to accommodate ROADM nodes built with the 16-Port Flex Spectrum ROADM Line Card and with the Flex Spectrum Single Module ROADM Line Cards.

Three types of modules—patch panel modules, add/drop modules, and adapter modules—are available, which fit into four slots of a 1-rack-unit (1-RU) mechanical frame chassis (MF-1RU) (Figure 2), in a 6-rack-unit (6-RU) 14-slot mechanical frame chassis (MF-6RU) (Figure 3), and 6-rack-unit (6-RU) 10-slot mechanical frame chassis (MF10-6RU) (Figure 4). Their passive nature helps ensure extremely high availability in a small, low-power footprint.

All the optical passive modules support USB connection, which is used to provide power to the modules and inventory information.

Figure 2. 1-RU Mechanical Frame Chassis



Figure 3. 6-RU 14-Slot Mechanical Frame Chassis



Figure 4. 6-RU 10-Slot Mechanical Frame Chassis



Both of the 6-RU versions of the chassis feature an integrated USB hub that allows a single USB 3.0 cable back to the external connection unit (ECU). Each of the modules is then connected to the USB hub with an internal USB connector, as shown in Figure 4.

Modular Patch Panel Modules

ROADM node architectures built with the 16-WXC and SMR-FS modules feature a modular approach to degree interconnection, offering a pay-as-you-grow model consisting of a combination of just two units: a 5-Degree Patch Panel Module (MF-DEG-5) and a 4-Degree Upgrade Patch Panel Module (MF-UPG-4) (Figure 5).

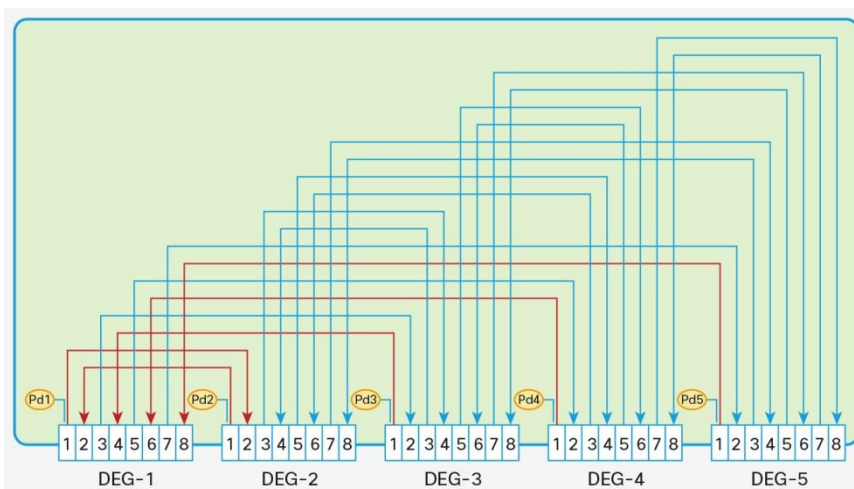
Figure 5. Cisco 5-Degree Patch Panel and 4-Degree Upgrade Patch Panel Modular Modules



5-Degree Modular Patch Panel Module

The 5-Degree Patch Panel Module (MF-DEG-5) provides interconnections between five 8-port MPO connectors; it is used to connect any combination of up to five ROADM line degrees (express connections) and add/drop components (add/drop connections). The 40 optical paths are interconnected as shown in Figure 6. Five photodiodes provide power monitoring of fiber 1 of each MPO connector. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

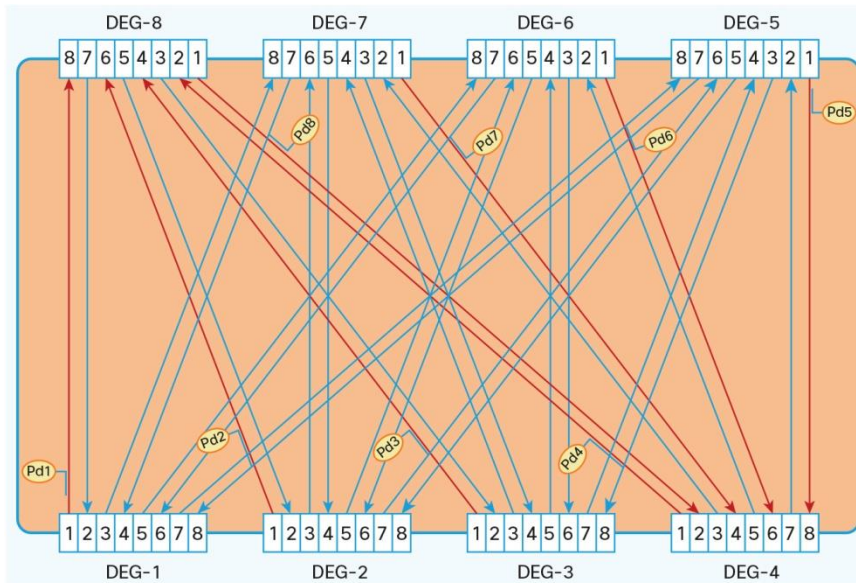
Figure 6. Cisco 5-Degree Patch Panel Module Optical Diagram



4-Degree Upgrade Modular Patch Panel Module

The Cisco 4-Degree Upgrade Modular Patch Panel Module (MF-UPG-4) provides interconnections among eight 8-fiber MPO connectors; it is used to expand the number of degrees and the number of add/drop ports supported by the node. The 64 optical paths are interconnected as shown in Figure 7. A total of eight photodiodes provides power monitoring of fiber 1 of each MPO connector. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

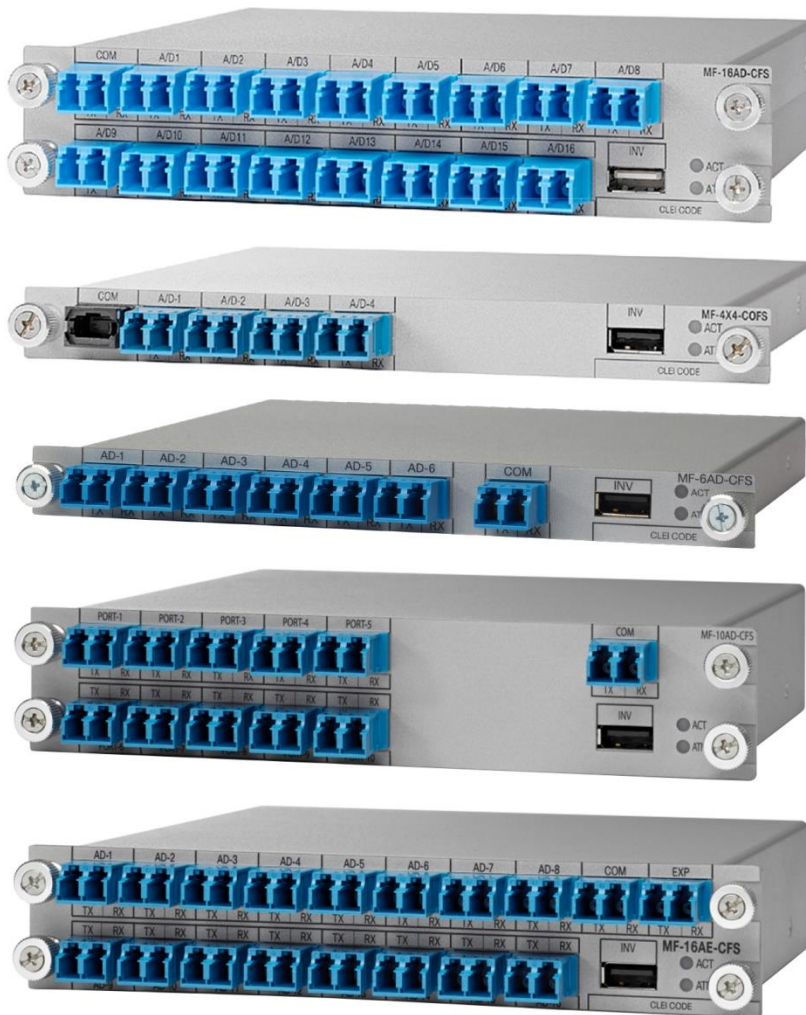
Figure 7. Cisco 4-Degree Upgrade Modular Patch Panel Module



Add/Drop Modules

A set of add/drop modules provides colorless, omnidirectional, and FlexSpectrum add/drop functions to 16-port Flex Spectrum ROADMs Line Card–based ROADMs. Four different add/drop modules are available: the Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module, the Cisco 1 x 10 Colorless FlexSpectrum Add/Drop Module, the Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module, and the Cisco 1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Module (Figure 8).

Figure 8. Cisco 1 x 16 CFS Add/Drop, 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop, 1 x 6 Colorless FlexSpectrum Add/Drop, 1 x 10 Colorless FlexSpectrum Add/Drop, and 1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Modules

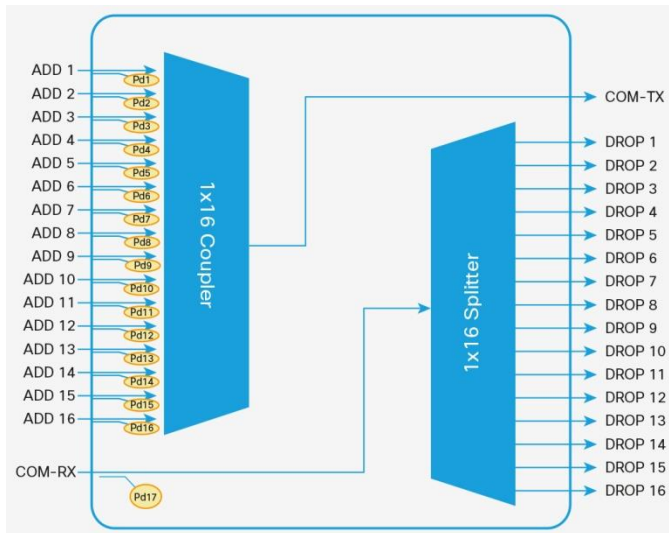


1 x 16 Colorless FlexSpectrum Add/Drop Module

The Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module (16AD-CFS) is a passive unit including one 1 x 16 splitter and one 16 x 1 combiner, plus 17 photodiodes arranged as shown in Figure 9. This module is double-slot height (full height) in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 16 optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 16 client ports of the unit.

Integrated photodiodes provide connectivity check and monitoring functions. Virtual photodiodes are implemented on the drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX port. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection.

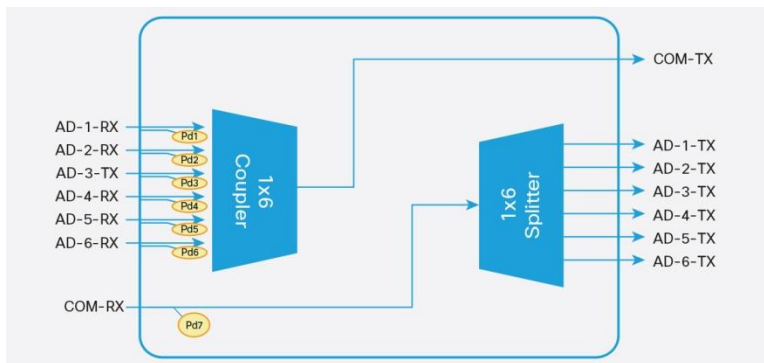
Figure 9. Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module



1 x 6 Colorless FlexSpectrum Add/Drop Module

The Cisco 1 x 6 Colorless FlexSpectrum Add/Drop Module (6AD-CFS) is a passive unit including one 1 x 6 splitter and one 6 x 1 combiner, plus 7 photodiodes arranged as shown in Figure 10. This module is single-slot height in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 6 optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 6 client ports of the unit. Integrated photodiodes provide connectivity check and monitoring functions. Virtual PDs are implemented by the unit on the output ports (AD-i-TX, COM-TX) by subtracting the insertion losses from the real PD reading. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection.

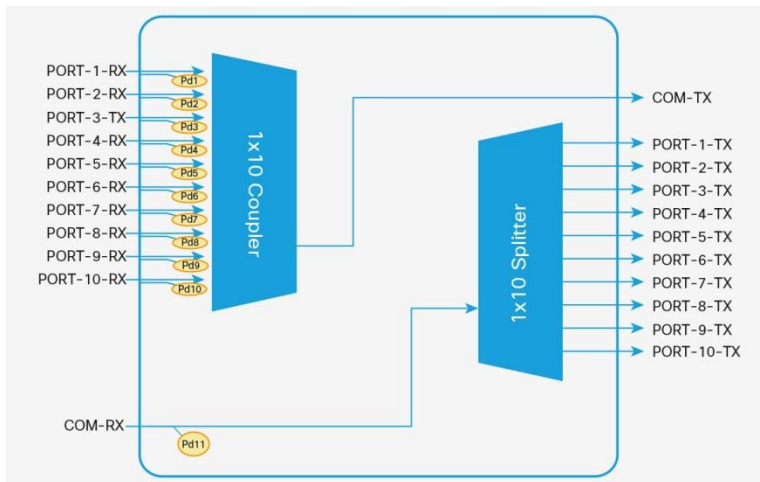
Figure 10. Cisco 1 x 6 Colorless FlexSpectrum Add/Drop Module



1 x 10 Colorless FlexSpectrum Add/Drop Module

The Cisco 1 x 10 Colorless FlexSpectrum Add/Drop Module (10AD-CFS) is a passive unit including one 1 x 10 splitter and one 10 x 1 combiner, plus 11 photodiodes arranged as shown in Figure 11. This module is double-slot height (full height) in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 10 optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 10 client ports of the unit. Integrated photodiodes provide connectivity check and monitoring functions. Virtual photodiodes are implemented on the drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX port. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection.

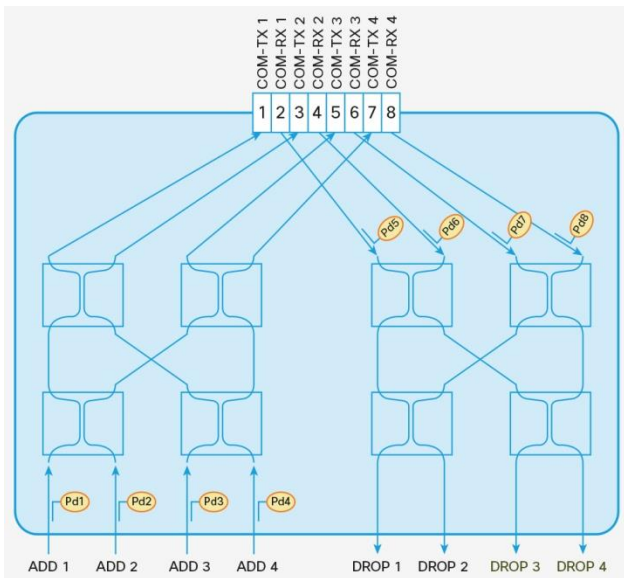
Figure 11. Cisco 1 x 10 Colorless FlexSpectrum Add/Drop Module



4x4 Colorless Omnidirectional FlexSpectrum Add/Drop Module

The Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module (4X4-COFS-AD) is a passive unit consisting of eight 2 x 2 optical couplers and eight photodiodes, arranged as shown in Figure 11. This module is single-slot height in the mechanical frame chassis. Power monitoring is present at each channel input port and at each common input port. Virtual photodiodes are implemented on the channel drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX ports. Power values as well as the manufacturing data stored in the flash memory are provided to the Cisco Transport Controller through the USB connection. Its primary function is to provide optical multiplexing and demultiplexing for up to four optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to 4 client ports of this unit.

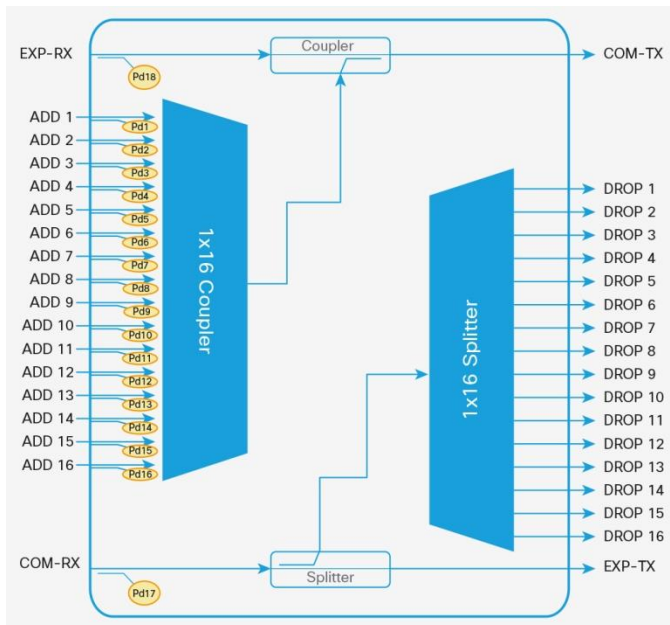
Figure 12. Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module



1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Module

The Cisco 1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Module (16AE-CFS) is a passive unit including one 1x16 splitter and one 16x1 combiner together with "unbalanced" coupler and splitter paths to provides express traffic capability as shown in Figure 11, plus 18 photodiodes arranged as shown in Figure 12. This module is double-slot height (full height) in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 16 optical signals, allowing it to replicate the signal in the express path for a drop and waste architecture. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 16 client ports of the unit. Integrated photodiodes provide connectivity check and monitoring functions. Virtual photodiodes are implemented on the drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX port. Power values as well as the manufacturing data stored in the flash memory are provided to a Cisco Transport Controller through the USB connection.

Figure 13. Cisco 1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Module



Patch Panel Adapters

A set of passive Patch panel modules provides adaptive functions from MPO- LC-LC fibers and from MPO-16 to MPO-8 connections. Four different passive Patch panel modules are available: the Cisco MPO-8xLC Adapter Module, the Cisco MPO-16xLC Adapter Module, Cisco MPO-20xLC Adapter Module and the Cisco MPO-8 to MPO-16 Adapter Module.

MPO-8xLC Adapter Module

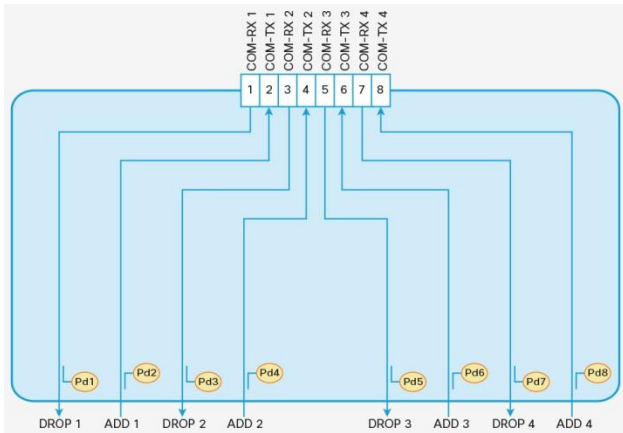
The Cisco MPO-8xLC Adapter Module provides mechanical adaptation from units offering LC connections to those with MPO connectors, such as the 16-WXC-FS (Figure 13).

Figure 14. Cisco MPO-8xLC Adapter Module



A total of eight photodiodes provides power monitoring of channel input and output port, as shown in Figure 14.

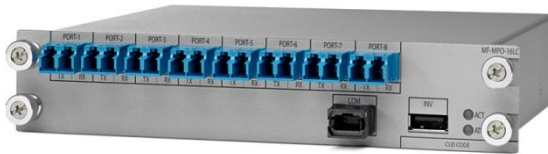
Figure 15. Cisco MPO-8LC Optical Block Diagram



MPO-16xLC Adapter Module

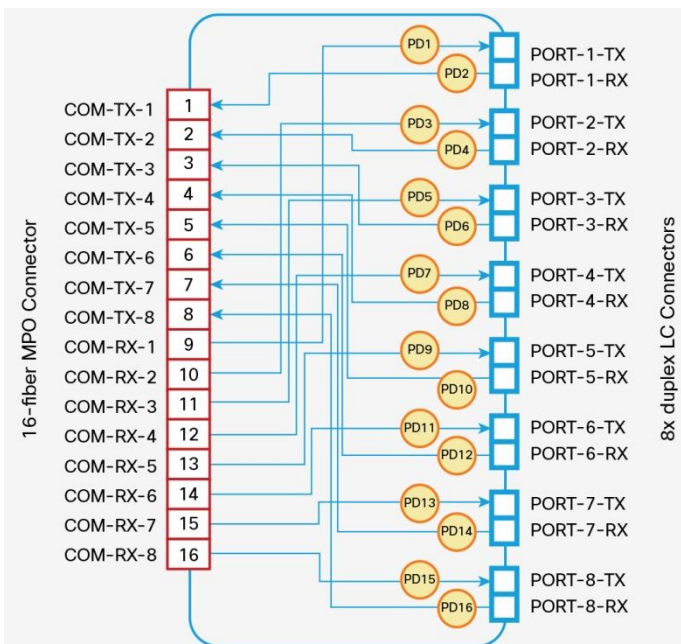
The Cisco MPO-16xLC Adapter Module provides mechanical adaptation from units offering LC connections to those with MPO connectors, such as the CCOFS (Figure 15).

Figure 16. Cisco MPO-16xLC Adapter Module



A total of 16 photodiodes provides power monitoring of channel input and output port, as shown in Figure 16.

Figure 17. Cisco MPO-16LC Optical Block Diagram



MPO-20xLC Adapter Module

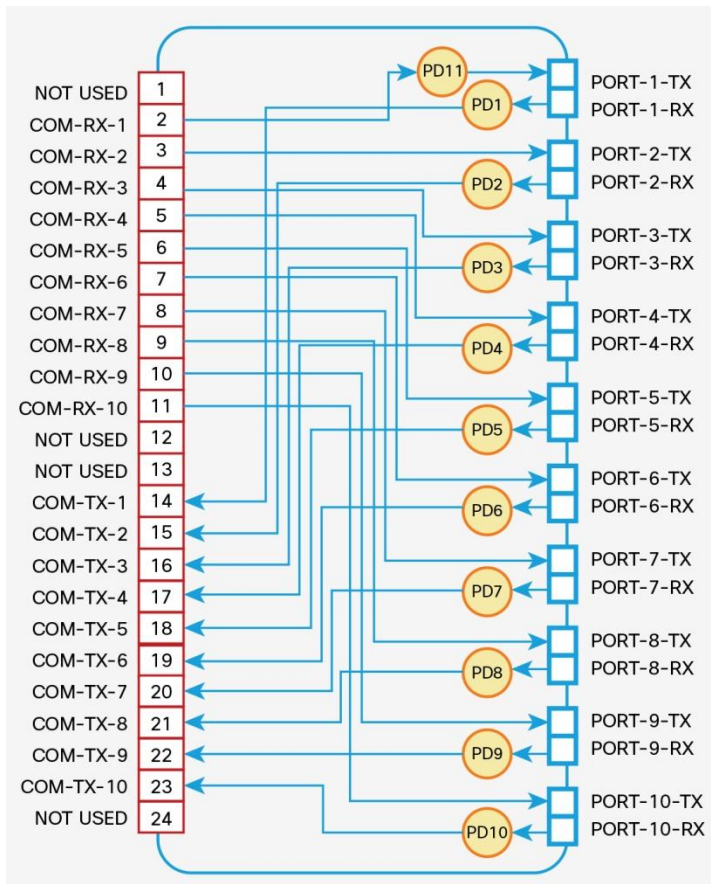
The Cisco MPO-20xLC Adapter Module provides mechanical adaptation from units offering LC connections to those with MPO connectors such as the Combo 2x100G, 20x10G NCS4000 line card, which requires a fan-out to distribute the 10G client coming from CPAK 10x10G LR (Figure 17).

Figure 18. Cisco MPO-20xLC Adapter Module



A total of 16 photodiodes provides power monitoring of channel input and output port, as shown in Figure 18.

Figure 19. Cisco MPO-20xLC Optical Block Diagram



MPO-8 to MPO-16 Adapter Module

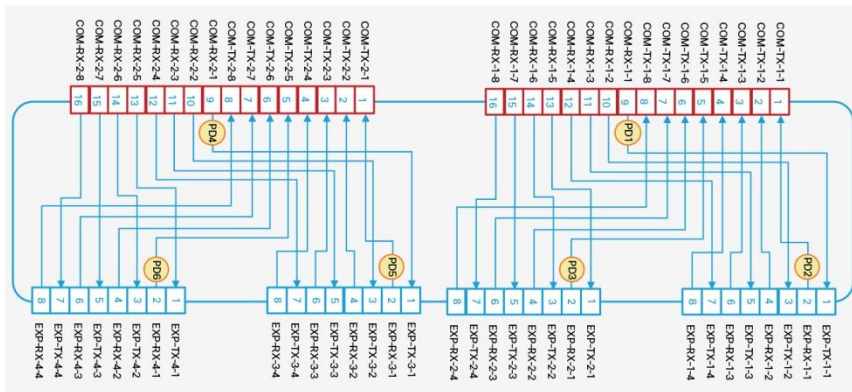
The Cisco MPO-8 to 16 Adapter Module provides mechanical adaptation from units offering MPO-8 connectors to those with MPO-16 connectors (Figure 19).

Figure 20. Cisco MPO-8 to MPO-16 Adapter Module



A total of six photodiodes provides power monitoring of channel input and output port, as shown in Figure 20.

Figure 21. Cisco MPO-8 to 16 Adapter Module Optical Block Diagram



Cisco 2x4x10G QSFP+ to 10G Fan Out Module

The Cisco 2x4x10G QSFP+ to 10G Fan Out Module provides the fan-out of the MPO12 connector to/from 8 LC-PC connections. The module is used for split 4x10G signals from the QSFP+ MPO cable into 4 single 10G bidirectional connections. Two fanout units are embedded into a single module in order to provide interconnection between 2x MPO12 connectors and 8x Dual LC adapters.

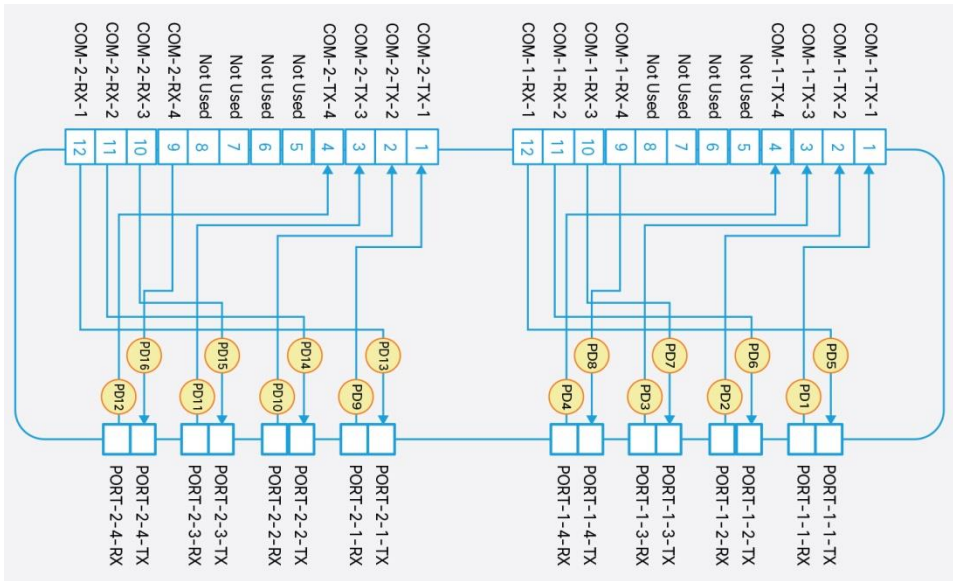
This module is 2 slots high (1 RU) in the NCS2K-MF-1RU or it can fit in one single slot of the NCS2K-MF10-6RU shelf frame with 2 MPO-12 connectors and 8x LC-duplex connectors as shown in the front panel layout figure.

Figure 22. Cisco 2x4x10G QSFP+ to 10G Fan Out Module



A total of 16 photodiodes provide power monitoring of channel at all input ports as shown in Figure 22.

Figure 23. Cisco 2x4x10G QSFP+ to 10G Fan Out Module Block Diagram



Cisco 8-Degree Mesh Patch Panel

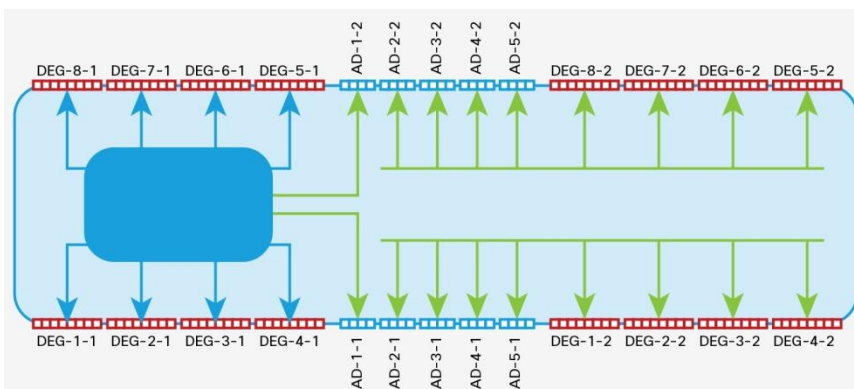
The Cisco 8 Degree Mesh Patch Panel supports 26 MPOs and is used as single patch panel unit supporting up to 8 ROADM degrees and up to 5 add/drop groups (Figure 21).

Figure 24. Cisco 8-Degree Mesh Patch Panel



A total of 26 photodiodes provides power monitoring of channel input and output port, as shown in Figure 22.

Figure 25. Cisco 8-Degree Mesh Patch Panel Scheme



Features and Benefits

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

- **High reliability:** The modular architecture enables complete independence between specific direction-facing units with the ability to house units in physically separated shelves.
- **Low insertion loss:** Selected technology allows direct integration of different functions in the same optical module, reducing to a minimum the number of optical connections.
- **Reduced footprint:** The auxiliary passive units integrate power monitoring with a minimum footprint, reducing node power consumption and increasing system density.

Each module is connected by USB with the ECU of the NCS 2006 chassis. The USB communication channel is used to:

- Retrieve the data stored in the nonvolatile memory of the module, specifically inventory data and the insertion loss of the optical paths
- Retrieve the optical power levels monitored by the photodiode of the module
- Activate an LED indicator on the front panel of each module

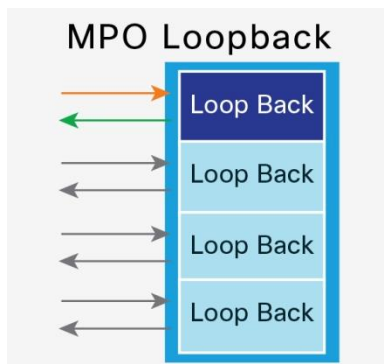
Connection Verification

Connection verification strategy has been built upon the specific hardware: that is, probe source signals and photodiodes distributed on primary points of optical units involved:

- Wavelength 97 laser and PD integrated in 20-port FS-SMR to:
 - Check proper cabling of the SMR to the patch panel
 - Measure insertion loss of the cabling
- All MPO connectors on the patch panel units equipped with PD on fiber 1
 - Configuring the wavelength 97 signal to port 1 of the MPO allows verification of proper cabling between the SMR and the patch panel
- 8-fiber in the MPO connectors used for TX and RX interleaved
 - All patch panel units shipped with loopbacks to be removed only for ports connected to SMR or CDC units
 - From SMR and CDC units, it is possible to test all paths and validate insertion losses

A special MPO loopback connector is added during the manufacturing process on some ports of the optic cards, as shown in Figure 23.

Figure 26. MPO Loopback Optical Diagram



The MPO connector is used to loop back TX signals on RX directions. This special tool shall both preserve connector status as it was after the manufacturing validation process of every produced unit and permit it to perform without any touch from the connection verification procedure.

The connection verification software application will monitor that insertion loss of all the connections as well as appropriate fiber connections are matching the target parameter, raising an alarm in case of mismatch with respect to the expected value.

Variants of MPO-16xLC, UPG-4, and DEG-5 passive optical modules are offered with pre-equipped loopbacks on the ports.

ROADM Passive Auxiliary Modules Product Specifications

Tables 1 through 8 list the optical specifications of the modules.

Table 1. Optical Specifications for Cisco 5-Degree Patch Panel Module

Parameter	Minimum	Maximum	Unit
Insertion loss	0	1.5	dB
Insertion loss ripple (wavelength-dependent loss [WDL])		0.1	dB
PDL		0.1	dB
Polarization mode dispersion [PMD]		0.05	ps
Return loss	40		dB

Table 2. Optical Specifications for 4-Degree Upgrade Patch Panel Modules

Parameter	Minimum	Maximum	Unit	Note
Insertion loss	0	1.5	dB	Any input to any output port
Insertion loss ripple (WDL)		0.1	dB	Aka wavelength dependent loss (WDL)
PDL		0.1	dB	
PMD		0.05	ps	
Return loss	40		dB	Any port

Table 3. Optical Specifications for Cisco 1 x 16 CFS Add/Drop Module

Parameter	Minimum	Maximum	Unit
Insertion loss	12	14.5	dB
Insertion loss ripple (WDL)		0.3	dB
Insertion loss uniformity		1	dB
PDL		0.2	dB
PMD		0.05	ps
Chromatic dispersion		± 5	ps/nm
Group delay ripple		10	ps
Return loss	45		dB

Table 4. Optical Specifications for Cisco 1 x 16 Plus Express Colorless FlexSpectrum Add/Drop Module

Parameter	Minimum	Maximum	Unit
Insertion loss COM-RX → EXP-TX or EXP-RX → COM-TX	6	7.5	dB
Insertion loss COM-RX → ADD-i → COM-TX or EXP-RX → DROP-i	13.5	15	dB
Insertion loss ripple (WDL)		0.3	dB
Insertion loss uniformity		1	dB
PDL		0.2	dB
PMD		0.05	ps
Chromatic dispersion		± 5	ps/nm
Group delay ripple		10	ps
Return loss	45		dB

Table 5. Optical Specifications for Cisco 1 x 10 CFS Add/Drop Module

Parameter	Minimum	Maximum	Unit
Insertion loss	10	12	dB
Insertion loss ripple (WDL)		0.5	dB
Insertion loss uniformity		1	dB
PDL		0.2	dB
PMD		0.05	ps
Chromatic dispersion		± 5	ps/nm
Group delay ripple		10	ps
Return loss	45		dB

Table 6. Optical Specifications for Cisco 1 x 6 CFS Add/Drop Module

Parameter	Minimum	Maximum	Unit
Insertion loss	7.8	9.6	dB
Insertion loss ripple (WDL)		0.5	dB
Insertion loss uniformity		1	dB
PDL		0.2	dB
PMD		0.05	ps
Operating Wavelength Range	1520	1570	nm
Return loss	45		dB

Table 7. Optical Specifications for Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module

Parameter	Minimum	Maximum	Unit
Insertion loss	6	8	dB
Insertion loss ripple (WDL)		0.5	dB
Insertion loss uniformity		1	dB
PDL		0.1	dB
PMD		0.05	ps
Chromatic dispersion		± 5	ps/nm
Group delay ripple		10	ps
Return loss	40		dB

Table 8. Optical Specifications for Cisco 2x4x10G QSFP+ to 10G Fan Out Module

Parameter	Minimum	Maximum	Unit
Insertion loss		1.2	dB
Insertion loss ripple (WDL)		0.25	dB
PDL		0.2	dB
PMD		0.1	ps
Operating Wavelength Range 1	1260	1355	nm
Operating Wavelength Range 2	1520	1570	nm
Return loss	40		dB

Table 9. Optical Specifications for Cisco MPO-8xLC and MPO-16xLC Adapter Module

Parameter	Minimum	Maximum	Unit	Note
Insertion loss	0	1.1	dB	Including 1MPO-MPO and 1 LC-LC connection; any input to any output
Insertion loss ripple (WDL)		0.1	dB	Aka wavelength dependent loss (WDL)
PDL		0.1	dB	
PMD		0.1	ps	
Return loss	40		dB	Any port

Table 10. Optical Specifications for Cisco MPO-20xLC Adapter Module

Parameter	Minimum	Maximum	Unit	Note
Insertion loss	0	1.2	dB	Including 1MPO-MPO and 1 LC-LC connection; any input to any output
Insertion loss ripple (WDL)		0.1	dB	Aka wavelength dependent loss (WDL)
PDL		0.1	dB	
PMD		0.1	ps	
Return loss	40		dB	Any port

Table 11. Optical Specifications for Cisco MPO-8 to MPO-16 Adapter Module

Parameter	Minimum	Maximum	Unit	Note
Insertion loss	0	1.2	dB	Including MPO-MPO connection; any input to any output
Insertion loss ripple (WDL)		0.1	dB	Aka wavelength dependent loss (WDL)
PDL		0.1	dB	

Parameter	Minimum	Maximum	Unit	Note
PMD		0.1	ps	
Return loss	40		dB	Any port

Table 12. Optical Specifications for Cisco 8-Degree Patch Panel

Parameter	Minimum	Maximum	Unit	Note
Insertion loss	0	1.5	dB	Including MPO-MPO connection; any input to any output
Insertion loss ripple (WDL)		0.1	dB	Aka wavelength dependent loss (WDL)
PDL		0.1	dB	
PMD		0.1	ps	
Return loss	40		dB	Any port

Tables 9 and 10 list the physical specifications of the modules.

Table 13. ROADM Passive Auxiliary Modules Physical Specifications

Parameter	Value
Power	500 mW maximum
Size	(H x W x D): 0.67 x 7.05 x 6.5 in. (16.9926 x 178.9938 x 164.9984 mm) for DEG-5, UPG-4, MPO-8LC, 6AD-CFS, MPO-8 to MPO-16 Adapter and 4x4 COFS-AD 1.39 x 7.05 x 6.50 in. (35.2044 x 178.9938 x 164.9984 mm) for 16AD-CFS, 16AE-CFS, 10AD-CFS, 8X10G-FO, MPO-20LC, and MPO-16LC 3.449 x 17.205 x 10.457 in. (87.604 x 437.007 x 265.607 mm) for PPMESH8
Weight	1.28 lb (0.58 kg) for DEG-5, UPG-4, MPO-8LC, 6AD-CFS, MPO16 to MPO8 adapter and 4x4 COFS-AD 1.76 lb (0.8 kg) for 16AD-CFS and 16AE-CFS 1.72 (0.78kg) for MPO-16LC, 8X10G-FO and MPO-20LC 6.61 lb (2.97kg) for PPMESH8
MTBF (predicted)	NCS2K-MF-16AD-CFS 5,422,405 NCS2K-MF-16AE-CFS 3,455,254 NCS2K-MF-10AD-CFS= 3,218,542 NCS2K-MF-6AD-CFS= 2,857,818 NCS2K-MF-8X10G-FO= 2,857,818 NCS2K-MF-4X4-COFS 3,800,000 NCS2K-MF-MPO-8LC 4,901,960 NCS2K-MF-DEG-5 5,547,264 NCS2K-MF-UPG-4 5,036,349 NCS2K-MF-MPO-20LC 5,615,751 NCS2K-MF-M16LC 4,130,069 NCS2K-MF-2MPO-ADP 5,459,497 NCS2K-PPMESH8-5AD 3,286,243 NCS2K-MF-6RU 759,750 NCS2K-MF10-6RU 759,750
Management	
Card LEDs	Each module has two LEDs at front panel: one blue LED and one three-color LED (yellow, green, and red). Both LEDs can also blink at 0.5 Hz and 2.5 Hz on request. The LED is used to: <ul style="list-style-type: none"> Notify that the module is powered but not associated. LED not blinking, color yellow Notify that the module is powered and associated. LED not blinking, color green Help operator identify a specific module, light-up blue LED (blinking)
Operating Environment	
Temperature	23 to 131°F (-5 to 55°C)
Relative humidity	5 to 95%

Table 14. ROADM Passive Mechanical Shelf Physical Specifications

Parameter	Value
Size	MF-1RU (H x W x D): 44 x 483.2 x 248 mm MF-6RU (H x W x D): 263.5 x 483.2 x 248 mm MF-6RU-CVR (H X W X D): 264 x 445 x 2 mm MF10-6RU (H x W x D): 263.5 x 483.2 x 248 mm
Weight	16,23 lb (7.36 kg) for MF-6RU and MF10-6RU 237 g for MF-1RU
Management	
Card LEDs	Each module has two LEDs at front panel: one blue LED and one three-color LED (yellow, green, and red). Both LEDs can also blink at 0.5 Hz and 2.5 Hz on request. The LED is used to: <ul style="list-style-type: none"> • Notify that the module is powered but not associated. LED not blinking, color yellow • Notify that the module is powered and associated. LED not blinking, color green • Help operator identify a specific module, light-up blue LED (blinking)
Operating Environment	
Temperature	23 to 131°F (-5 to 55°C)
Relative humidity	5 to 95%

Table 11 lists ordering information.

Table 15. ROADM Passive Auxiliary Module Ordering Information

Product Name	Description
NCS2K-MF-1RU=	Mechanical frame, 4 slots, 1 RU
NCS2K-MF-6RU=	Mechanical frame for passive units, 14 slots with USB hub, 6 RU
NCS2K-MF-6RU-CVR=	Cover for the 6RU mechanical frame for passive units
NCS2K-MF10-6RU=	Mechanical frame for passive units, 10 slots with USB hub, 6 RU
NCS2K-MF-DEG-5=	Mesh interconnection MF unit, up to 5 degrees
NCS2K-MF-DEG-5-CV=	5 degrees mesh interconnect, with connection verification
NCS2K-MF-UPG-4=	Mesh interconnection MF unit, upgrade, 4 degrees
NCS2K-MF-UPG-4-CV=	4-deg upgrade mesh interconnect, with connection verification
NCS2K-MF-16AD-CFS=	16-ports add/drop MF unit, colorless and FlexSpectrum
NCS2K-MF-4X4-COFS=	4-degree and 4-ports add/drop MF unit, CO and FlexSpectrum
NCS2K-MF-10AD-CFS=	10-port add/drop MF unit - colorless flex spectrum
NCS2K-MF-16AE-CFS=	16-port add/drop + express MF unit - colorless flex spectrum
NCS2K-MF-6AD-CFS=	6-Port Add/Drop MF Unit - Colorless FlexSpectrum
NCS2K-MF-8X10G-FO=	2x4x10G QSFP+ to 10G Fan Out
NCS2K-MF-MPO-8LC=	MPO to 8x LC fan-out MF unit, with integrated monitoring
NCS2K-MF-MPO-16LC=	MPO to 8x LC fan-out MF unit, with integrated monitoring
NCS2K-MF-M16LC-CV=	MPO-16 to 16xLC fan-out, with connection verification
NCS2K-MF-MPO-20LC=	MPO to 8x LC fan-out MF unit, with integrated monitoring
NCS2K-MF-1SL-CVR=	Cover for the Mechanical Frame w/ USB cable holder - 1slot
NCS2K-MF-2SL-CVR=	Cover for the mechanical frame with USB cable holder, 2 slot
NCS2K-MPO-LBK=	8-fiber MPO loopback, male connector
NCS2K-LC-LBK=	LC loopback, male connectors
NCS2K-MPO16-LBK=	16-fiber MPO loopback, male connector

Tables 12 and 13 give regulatory compliance and system requirements for all units included in this data sheet.

Table 16. 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 (2004) • GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011) • 47 FCC part 15 (2011) 	<ul style="list-style-type: none"> • EN 300 386 Telecommunications Network Equipment (EMC): 2008 (Note: EMC-1) • CISPR22 Ed.6 (2008) and CISPR24: Ed.2 (2010) • EN55024 Ed.2 2010: Immunity levels: see EN61000-4-xx • EN55022: 2007 Information Technology Equipment (Emissions) (2006) (EMC-2)
Safety	
<ul style="list-style-type: none"> • UL/CSA 60950-1, Second Ed 2011 • GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011) 	<ul style="list-style-type: none"> • UL/CSA 60950-1, Second Ed 2011 • IEC 60950-1 (2005/12), 2nd Edition and National Differences as per CB Bulletin 112A • + Amendment 1: 2009
Laser	
<ul style="list-style-type: none"> • UL/CSA 60950-1, Second Ed 2011 • IEC 60950-1(2005/12), 2nd Edition and National Differences as per CB Bulletin 112A • + Amendment 1: 2009 • IEC-60825-2 Edition 3.1, 2007/01 	<ul style="list-style-type: none"> • CDRH (accession letter and report) • IEC 60825-1 Ed. 2 2007-03
Environmental	
<ul style="list-style-type: none"> • GR-63-CORE Issue 4, NEBS Physical Protection (April 2012) • ETS 300-019-2-1 V2.1.2 (2000-09) (Storage, Class 1.1) 	<ul style="list-style-type: none"> • ETS 300-019-2-2 V2.2.1 (2011-11): Transportation, Class 2.3 • ETS 300-019-2-3 V2.2.2 (2003-04): stationary use, Class 3.1E

Table 17. System Requirements

Component	Cisco ONS 15454	Cisco NCS 2006
Processor	TNC/TSC/TNC-E/TSC-E	TNC-E/TSC-E
Shelf assembly	15454-M6-SA shelf assembly	NCS2006-SA shelf assembly
System software	Release 10.0 NCS Software	Release 10.0 NCS Software

Warranty

The following warranty terms apply to the Cisco NCS 2006 and NCS 2015 as well as services you may use during the warranty period. Your formal warranty statement appears in the Cisco information packet that accompanies your Cisco product.

- Hardware warranty duration: five years.
- Software warranty duration: one year.
- Hardware replacement, repair, or refund procedure: Cisco or our service center will use commercially reasonable efforts to ship a replacement part for delivery within 15 working days after receipt of the defective product at Cisco's site. Actual delivery times of replacement products may vary depending on customer location.

Product warranty terms and other information applicable to Cisco products are available at <http://www.cisco.com/go/warranty>.

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