Cisco Network Convergence System 2000 ROADM and Amplifier Line Cards

The NCS 2000 evolves the Cisco ROADM portfolio by introducing Cisco nLight ROADM technology. By supporting touchless reconfigurability through colorless, omnidirectional, and contentionless add/drop, networks built upon nLight ROADM can instantly respond to new bandwidth requests, route around network failures, and dynamically adjust their topology - all without manual intervention.

16-port Flex Spectrum ROADM Line Card

The Cisco 16-port Flex Spectrum ROADM Line Card (16-WXC-FS) is a double-slot unit that provides multidegree switching capabilities not only at the individual wavelength level but also with flexible spectrum allocations. You can use the 16-port Flex Spectrum ROADM Line Card in the core of the network to build ROADM nodes with 96 channels spaced at 50-GHz, FlexSpectrum channels, or a combination of the two. By using a simple software reconfiguration, the same unit can provide colorless multiplexing and demultiplexing to ROADM nodes.

Figure 1. Cisco 16-port Flex Spectrum ROADM Line Card

Features and Benefits

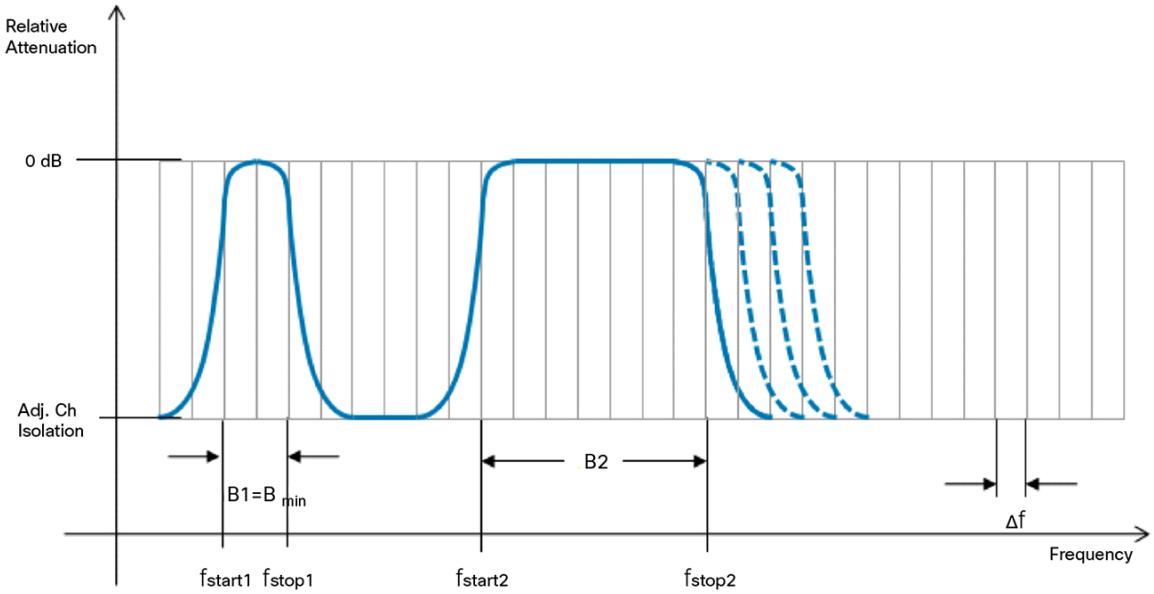
The 16-port Flex Spectrum ROADM Line Card creates an agile DWDM layer forming the foundation for converged transport architectures, delivering many features and innovations that enable significant provisioning and recovery flexibility. Wavelength routing, including direction and frequency changes, are entirely software-driven, easing one of the major contributors to high operating expenses (OpEx) and long provisioning and recovery delays caused by manual operator intervention.

Agile DWDM innovations and benefits supported by the 16-port Flex Spectrum ROADM Line Card include:

- Colorless add/drop ports: In previous generations of ROADM technology, add/drop ports were assigned to a fixed frequency, requiring the frequency of the transmitter to align to that of the add/drop port. Colorless ROADM ports are not frequency-specific. Therefore, in addition to simplifying provisioning, a re-tuned laser does not require a fiber move, allowing the transmitter wavelength to be selected in software, with no manual intervention required.

- Omni-directional add/drop ports: Unlike traditional ROADMs in which an add/drop port is associated with a single, fixed egress direction, omnidirectional ROADM ports are not direction-specific. A wavelength reroute does not require a physical fiber move, and can therefore be executed entirely by software.
- FlexSpectrum: The amount of spectrum allocated to a given wavelength can be flexibly provisioned to allow for growth to 400-gigabit or even 1-terabit bandwidths. The term “FlexSpectrum” indicates the capability of the 16-port Flex Spectrum ROADM Line Card to manage an arbitrary set of continuous portions (or frequency slices) of the optical spectrum, delimited by programmable “start” and “stop” frequencies, as described in Figure 2.

Figure 2. The FlexSpectrum Concept



- High reliability: The 16-port Flex Spectrum ROADM Line Card node architecture enables complete independence between the direction-facing units, including the ability to house units in physically separated shelves.
- Flexibility: The 16-WXC can work either as a core building block of a ROADM node or as a colorless multiplexer/demultiplexer. Consequently, you can use 16-port Flex Spectrum ROADM Line Card ports to manage individual channels (multiplexer/demultiplexer operation) or to terminate optical multiplex sections, allowing network/ring interconnection without optical-electrical-optical (OEO) conversion.

Product Description

The 16-port Flex Spectrum ROADM Line Card is a 2-slot unit that you can insert into slots 2, 4, or 6 of the NCS 2006 chassis. The unit has 36 input/output fibers among the following connectors:

- Two LC-duplex adapters for COM and UPG ports
- Four MPO connectors for ADD, DROP, and EXP ports

The 16-port Flex Spectrum ROADM Line Card incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status of the card. Printed on each of the faceplates is an icon (an orange circle), which is mapped to shelf-slot icons that indicate the shelf-slot where you can physically install the card. The cards are supported by the integrated Cisco Transport Controller craft manager, which provides the user access to system operations, administration, maintenance, and provisioning (OAM&P). Cisco Transport Controller can also provide a per-channel graphical representation of the optical power levels associated with each path in the ROADM node.

Figure 3 shows the internal layout of the 16-port Flex Spectrum ROADM Line Card, and Figure 4 shows an n-degree ROADM layout where the 16-port Flex Spectrum ROADM Line Card associated with each degree of the node offers a total of 16 ports (plus one upgrade port), which can be connected either toward other directions or toward the local add/drop section.

Figure 3. 16-port Flex Spectrum ROADM Line Card Unit Layout

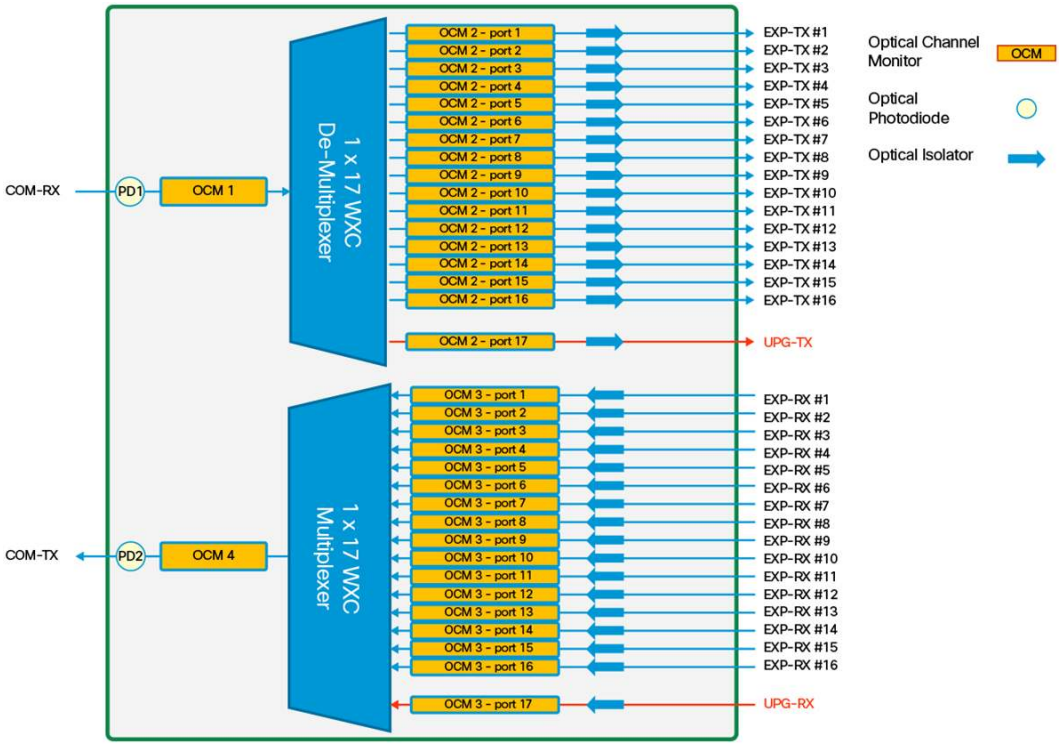
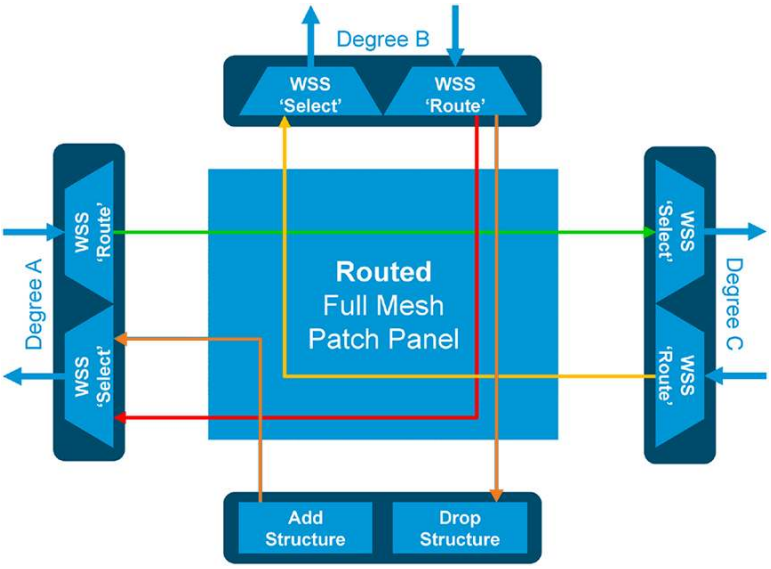


Figure 4. 16-port Flex Spectrum ROADM Line Card N-Degree ROADM Layout



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. Three types of modules are available - patch-panel modules, add/drop modules, and adapter modules - all of which fit into four slots of a 1-rack-unit (1RU) mechanical frame chassis (MF-1RU) (Figure 5). Their passive nature helps ensure extremely high availability in a small, low-power footprint.

Figure 5. Mechanical Frame Chassis

Modular Patch Panel Modules

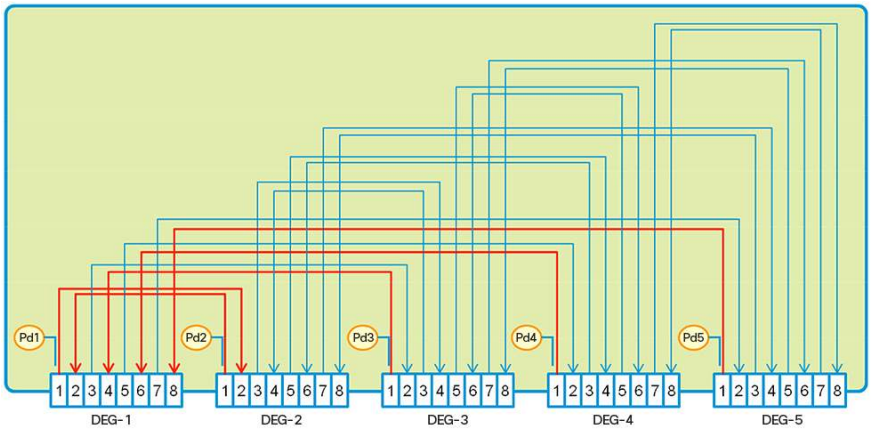
ROADM node architectures built with the 16-WXC feature a modular approach to degree interconnection, offering a pay-as-you-grow model consisting of a combination of just two units: a 5-Degree Patch Panel Module (MF-DEG-5) and a 4-Degree Upgrade Patch Panel Module (MF-UPG-4) (Figure 6).

Figure 6. 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 7. 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 Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

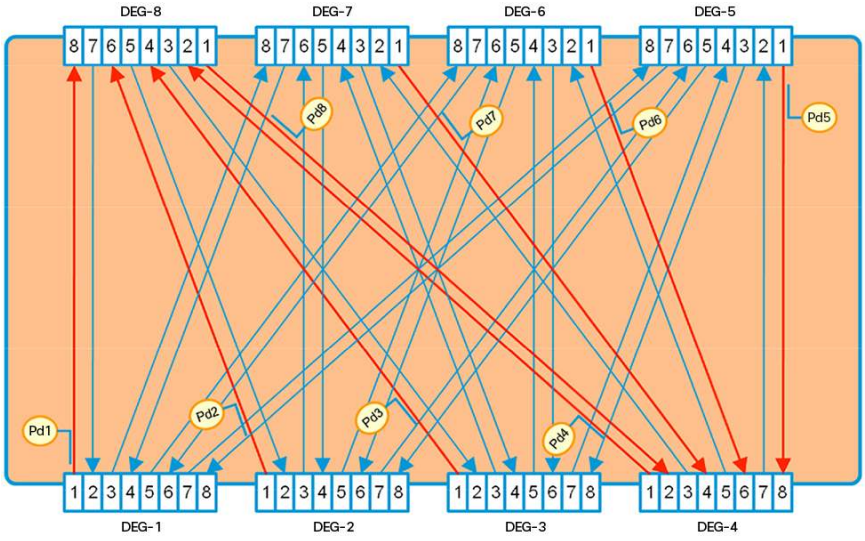
Figure 7. Cisco 5-Degree Patch Panel Module Optical Diagram



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 8. A total of eight 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 Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

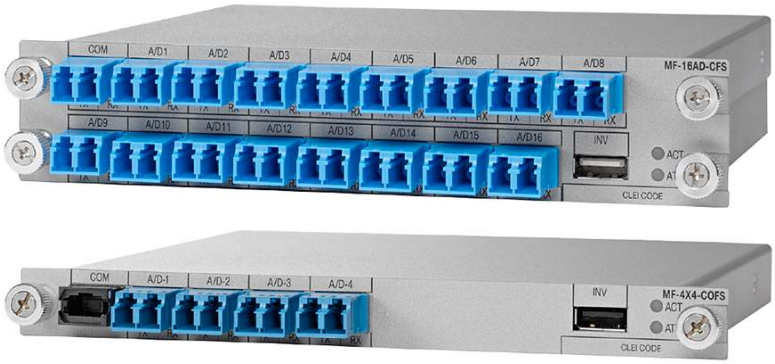
Figure 8. Cisco 4-Degree Upgrade Modular Patch Panel Module



Add/Drop Modules

A set of add/drop modules provides colorless, omnidirectional, and FlexSpectrum add/drop functions to 16-port Flex Spectrum ROADM Line Card -based ROADM nodes. Two different add/drop modules are available: the Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module and the Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module (Figure 9).

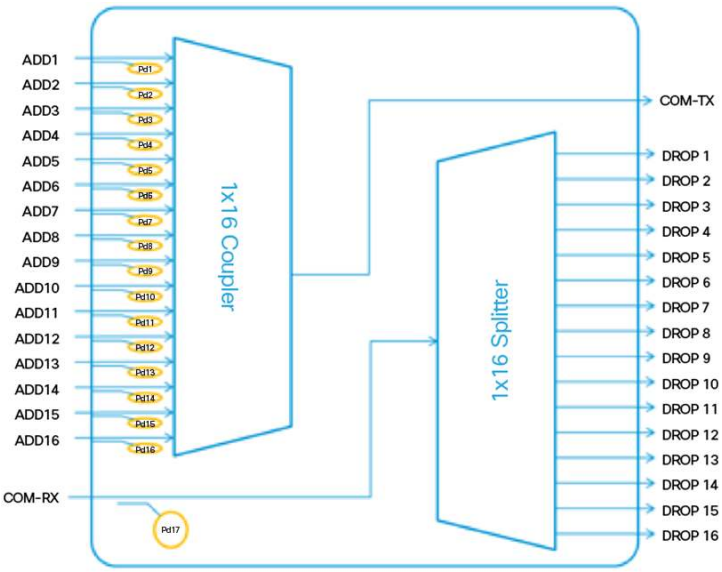
Figure 9. Cisco 1 x 16 CFS Add/Drop and 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Modules



1 x 16 Colorless FlexSpectrum Add/Drop Module

The Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module (16AD-CFS) is a passive unit comprising one 1 x 16 splitter and one 16 x 1 combiner, plus 17 photodiodes arranged as shown in Figure 10. 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 Cisco Transport Controller through the USB connection.

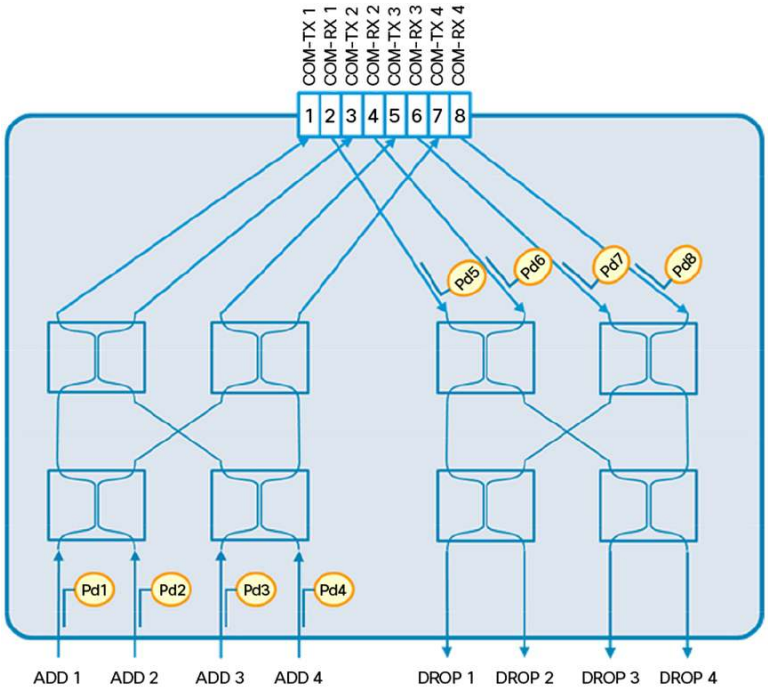
Figure 10. Cisco 1 x 16 Colorless FlexSpectrum Add/Drop Module



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 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.

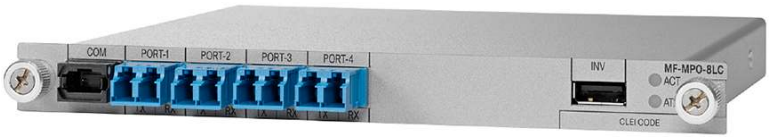
Figure 11. Cisco 4 x 4 Colorless Omnidirectional FlexSpectrum Add/Drop Module



MPO-8xLC Adapter Module

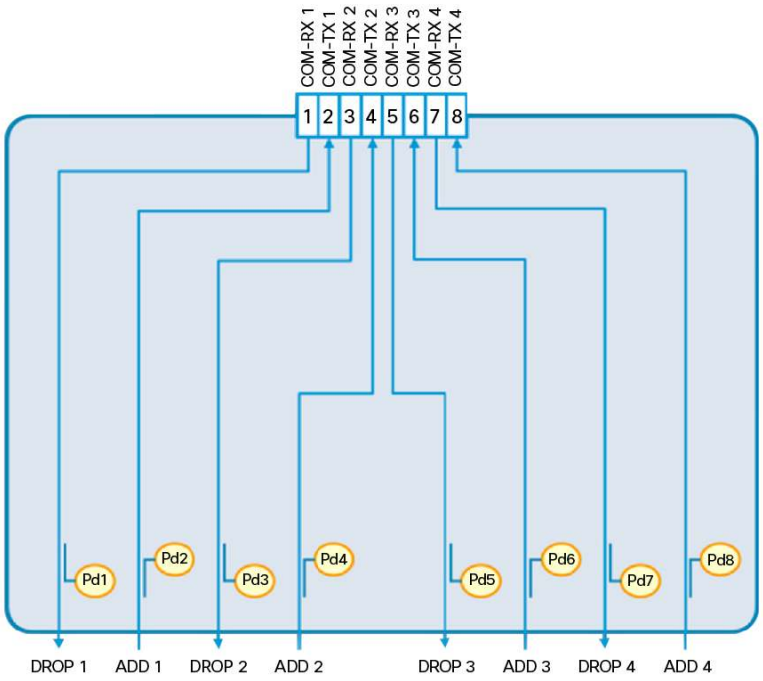
The Cisco MPO-8xLC Adapter Module provides mechanical adaptation from units offering LC connections to those with MPO connectors, such as the 16-WXC-FS (Figure 12).

Figure 12. Cisco MPO-8xLC Adapter Module



A total of eight photodiodes provide power monitoring of channel input and output port, as shown in Figure 13.

Figure 13. Cisco MPO-8LC Optical Block Diagram



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 via USB with the External Connection Unit (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

Next-Generation Amplification

The Cisco NCS 2000 introduces hybrid Raman-EDFA amplifiers known as erbium doped Raman amplifiers, or EDRAs. EDRAs are compact and easy to deploy, and they support an ultra-low noise figure critical for long-distance, high-bit-rate transmission. Supporting 96 channels in the C-band, Cisco NCS 2000 Erbium Doped Raman Amplifiers are plug-in modules that provide the reach and optical performance required to meet the most demanding distance requirements of service provider and enterprise DWDM networks (Figure 14).

Figure 14. Cisco NCS 2000 Erbium Doped Raman Amplifier

Raman amplifiers employ the intrinsic properties of silica fiber to obtain signal amplification such that the transmission fibers themselves are used as a medium for amplification, allowing the attenuation of data signals transmitted over the fiber to be mitigated within the fiber itself. An amplifier working on the basis of this principle is commonly known as a distributed Raman amplifier (DRA) or simply a Raman amplifier.

The card has four versions:

- EDRA1-26 includes an erbium doped pre-amplifier, EDFA1, with a nominal gain of 14 dB. It supports a maximum span of 26 dB on standard single-mode fiber (Figure 15).
- EDRA1-35 includes an erbium doped pre-amplifier, EDFA1, with a nominal gain of 21 dB. It supports a maximum span of 35 dB on standard single-mode fiber (Figure 15).
- EDRA2-26 includes an erbium doped pre-amplifier, EDFA1, and an erbium doped booster amplifier, EDFA2, where EDFA1 has a nominal gain of 14 dB. It supports a maximum span of 26-dB on standard single-mode fiber (Figure 16).
- EDRA2-35 includes an erbium doped pre-amplifier, EDFA1, and an erbium doped booster amplifier, EDFA2, where EDFA1 has a nominal gain of 21 dB. It supports a maximum span of 35 dB on standard single-mode fiber (Figure 16).

Each EDRA card can manage (on each port) up to 96 channels, 50-GHz-spaced from 196.1 GHz (1528.77nm) to 191.35 GHz (1566.72 nm). The optical channel monitor (OCM) ports are used to read the per-channel power level continuously from all optical ports using an external OCM card. The optical time domain reflectometry (OTDR) ports are used to perform OTDR measurements using an external OTDR card.

Features and Benefits

Each EDRA performs the following functions:

- Amplifies the ingress line signal through a true variable gain EDFA (EDFA1) without midstage access
- Amplifies the egress line signal through a true variable gain EDFA (EDFA2) in EDRA-2 amplifiers
- Provides a 1-watt counter-propagating Raman pump
- Provides Raman pump back-reflection detection and remnant Raman pump detection
- Provides optical service channel (OSC) add/drop and the ability to perform OTDR, chromatic dispersion (CD), and OCM functions using an external card

Figure 15. EDRA-1 Block Diagram

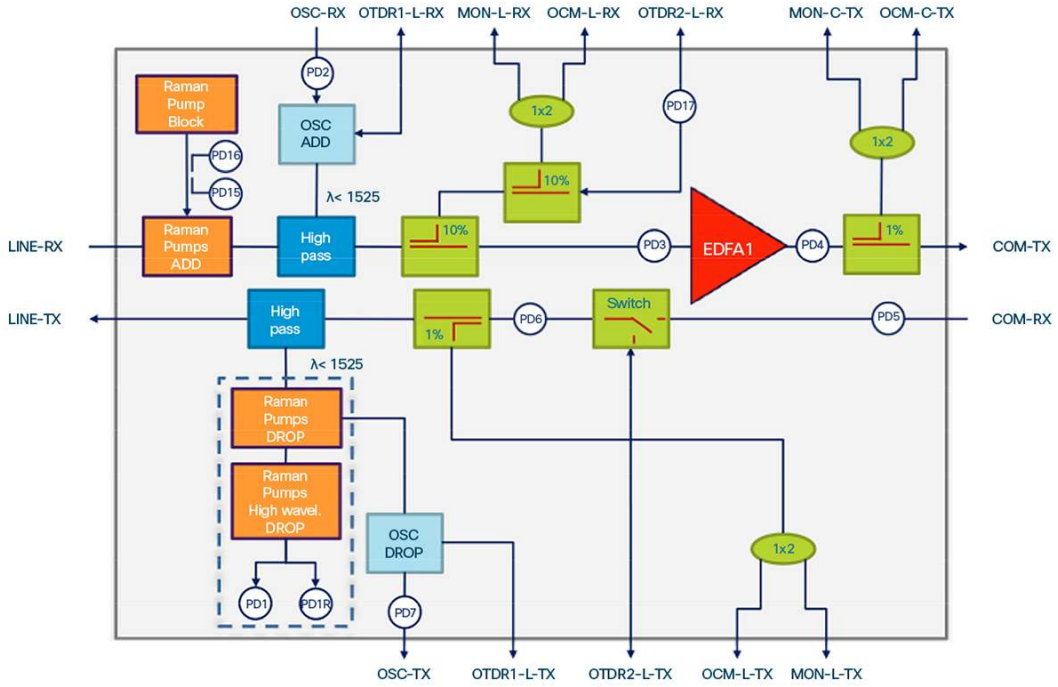
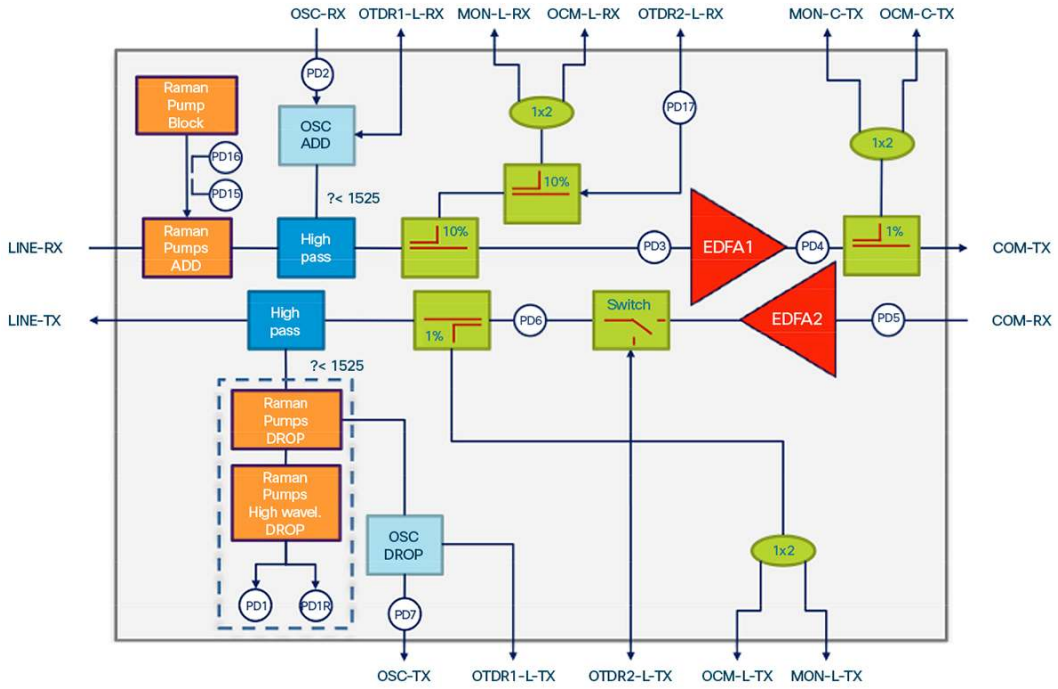


Figure 16. EDRA-2 Block Diagram



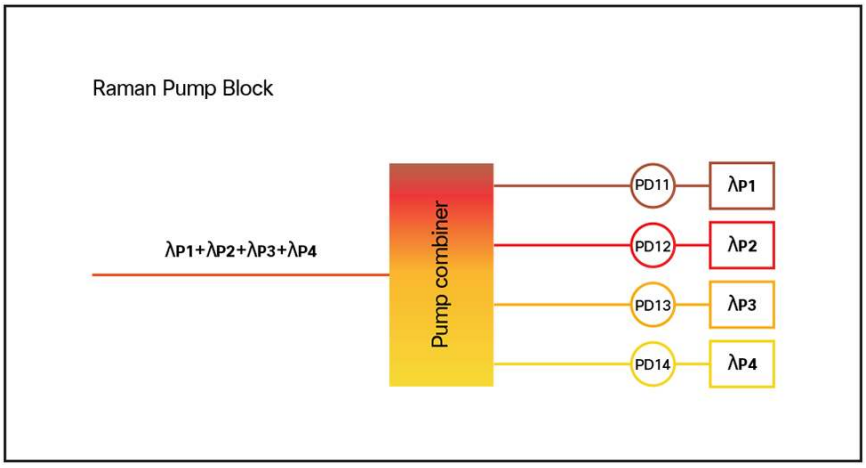
Each integrated optical amplifier provides the following features:

- Embedded gain flattening filter
- Constant pump current mode (test mode)
- Constant output power mode
- Constant gain mode
- Nondistorting low-frequency transfer function
- Amplified spontaneous emission (ASE) compensation in constant gain and in constant output power mode
- Fast transient suppression
- Programmable tilt
- Hardware-based optical safety functions through signal loss detection and alarm at any input port, fast power-down control, and reduced maximum output power in safe power mode
- Hardware limit to support system safety Class 1M at any optical port

The Raman pump provides the following features (Figure 17):

- Total pump power of 1000 mW, consisting of four pumps over four wavelengths
- Raman pump back-reflection detector to detect the amount of Raman pump power back-scattered by the LINE-RX connector and by the transmission fiber
- Remnant Raman pump detection at the end of the counter-pumped span
- Hardware-based optical safety functions through signal-loss detection and alarm at any input port, fast power-down control, and reduced maximum output power in safe power mode
- Hardware limit to support system safety Class 1M at LINE-RX

Figure 17. Raman Pump Block Diagram



Other features applicable to EDRA cards follow:

- OCM and OTDR ports for measurements through an external card; a switch is used for OTDR and CD measurements to add external signal on LINE-TX section; the switch is also used on EDRA1-XX for optical safety purposes (automatic laser shutdown of C-band signals on LINE-TX)
- Full monitoring and alarm handling capability of Raman pump, EDFAs, and signal power
- Non-traffic-affecting firmware upgrade
- High reliability, which enables complete independence between specific direction-facing units with the ability to house units in physically separate shelves

Product Description

The EDRA cards are 2-slot units that can be inserted into slots 2, 4, or 6 of the NCS 2006 chassis. The unit has 16 input/output fibers among the following connectors:

- Eight LC-UPC/2 connectors
- One high-power connector E-2000 PS PC (0°)
- One MPO 8-fiber connector for OCM, CD, and OTDR functions

EDRA units incorporate faceplate-mounted LEDs to provide a quick visual check of the operational status of the card. Printed on each of the faceplates is an icon (an orange circle), which is mapped to shelf-slot icons that indicate the shelf slot where you can physically install the card. The cards are supported by the integrated Cisco Transport Controller craft manager, which gives you access to system OAM&P.

You can use the units in optical line amplification (OLA) nodes (Figure 18), in ROADM nodes (Figure 19), and in dynamic gain equalizer (DGE) sites in combination with 16-port Flex Spectrum ROADM Line Card units (Figure 20).

Figure 18. OLA Node Layout

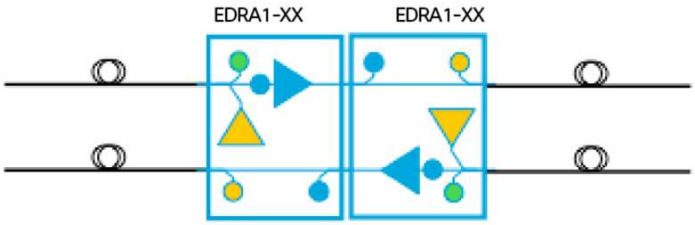


Figure 19. ROADM Node Layout

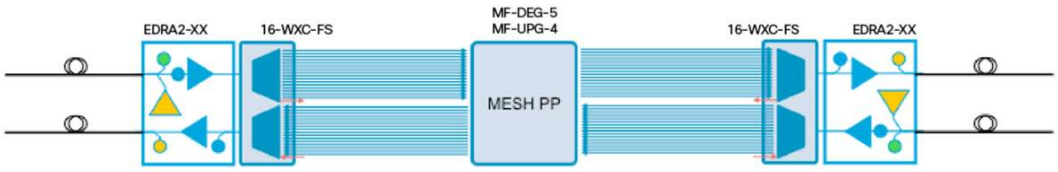
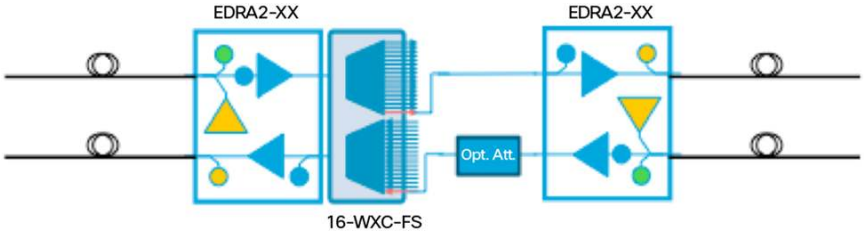


Figure 20. DGE Node Layout



In OLA nodes, EDRAs can work with other EDRAs, with Cisco ONS 15454 MSTP OPT-EDFA-17 and OPT-EDFA-24 amplifiers, or with Cisco ONS 15454 MSTP High-Power Counter-Propagating and Co-Propagating Raman Amplifiers.

16-port Flex Spectrum ROADM Line Card Product Specifications

Tables 1 and 2 list the optical and physical specifications, respectively, for the 16-port Flex Spectrum ROADM Line Card.

Table 1. Optical Specifications

Parameter	Condition	Value
Channel grid		96 channels, 50 GHz-spaced ITU grid
Central wavelength - Channel 1		191.350 THz (1566.72 nm)
Central wavelength - Channel 96		196.100 THz (1528.77 nm)
FlexSpectrum "slice" width		12.5 GHz
Minimum settable channel bandwidth		**50 GHz - 4 slices**
Maximum settable "super-channel" bandwidth		**500 GHz - 40 slices**
Total number of slices		384 slices - 4800 GHz
f_start of first slice		191’325 GHz

Parameter	Condition	Value
Insertion loss		Minimum 4 dB, maximum 8 dB
Optical port isolation	COM <-> EXP path; all SOP, within entire operating temperature range and within OWB	20 dB (for 15-25 dB of extra attenuation) 23 dB (for 0-15 dB of extra attenuation)
Polarization Dependent Loss (PDL)	All paths	Maximum 0.7dB (0-10 dB attenuation) Maximum 0.9dB (10-15 dB of attenuation)
Variable optical attenuator (VOA) attenuation setting accuracy	Attenuation 10-15 dB	1.5 dB maximum
Per-channel maximum input power		13 dBm

Table 2. Physical Specifications

Parameter	Value
Power	Maximum 100W
Size	2 slots; (H x W x D): 13.1 x 4.90 x 9.84 in. (33.27 x 24.99 cm)
Weight	9.92 lb (4.5 kg)
Mean time between failure (MTBF) (predicted)	162,273 hours
Management	
Card LEDs • **Failure (FAIL)** • **Active/standby (ACT/STBY)** • **Signal fail (SF)**	 Red Green/yellow Yellow
Operating Environment	
Temperature	23 to 131℉ (-5 to 55℃)
Relative humidity	5 to 85%

Table 3. Amplifiers Compatible with the 16-port Flex Spectrum ROADM Line Card

Compatible Amplifier Part Numbers
NCS2K-EDRA2-26
NCS2K-EDRA2-35
NCS2K-EDRA1-26
NCS2K-EDRA1-35
15454- OPT-EDFA-17
15454- OPT-EDFA-24
15454-M-RAMAN-CTP
15454-M-RAMAN-COP

Table 4. 16-port Flex Spectrum ROADM Line Card Ordering Information

Product Name	Description
NCS2K-16-WXC-FS=	16-ports Wavelength X-Connect and Mux/Demux - Flex Spectrum

ROADM Passive Auxilliary Modules Product Specifications

Tables 5 through 9 list the optical specifications of the modules.

Table 5. 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 6. 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 LossWDL
PDL		0.1	dB	
PMD		0.05	ps	
Return loss	40		dB	Any port

Table 7. 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
I.L. 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 8. 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
I.L. 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 9. Optical Specifications for Cisco MPO-8xLC Adapter Module MPO-8LC 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 LossWDL
PDL		0.1	dB	
PMD		0.1	ps	
Return loss	40		dB	Any port

Table 10. 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, 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
Weight	1.28 lb (0.58 kg) for DEG-5, UPG-4, MPO-8LC, and 4x4 COFS-AD 1.76 lb (0.8 kg) for 16AD-CFS
MTBF (predicted)	NCS2K -MF-16AD-CFS 5,422,405 NCS2K -MF-4X4-COFS 21,739,130 NCS2K -MF-MPO-8LC 49,019,607 NCS2K-MF-DEG-5 35,087,719 NCS2K -MF-UPG-4 50,000,000
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: • 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℉ (-5 to 55℃)
Relative humidity	5 to 95%

Table 11. ROADM Passive Auxiliary Modules Ordering Information

Product Name	Description
NCS2K-MF-1RU=	Mechanical Frame - 4 slots - 1 RU
NCS2K-MF-DEG-5=	Mesh Interconnection MF Unit - Up to 5 Degrees
NCS2K-MF-UPG-4=	Mesh Interconnection MF Unit - Upgrade - 4 Degrees
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-MPO-8LC=	MPO to 8x LC Fan-Out MF Unit - With Integrated Monitoring

EDRA Product Specifications

Tables 12 and 13 give optical specifications for the Raman and EDFA sections of the amplifiers and Table 14 gives physical specifications.

Table 12. Optical Specifications for Raman Section

Parameter	Condition	Minimum	Typical	Maximum	Units
Pump 1 wavelength			1423		nm
Pump 2 wavelength			1434		nm
Pump 3 wavelength			1455		nm
Pump 4 wavelength			1470		nm
Pump spectral width			± 1	± 3	nm
Operating range of Raman pump power		100		1000	mW
Raman pump unit class at operative power	With system optical safety single hardware failure included (worst-case fault)			1M	-

Table 13. Optical Specifications for EDFA Section

Parameter	Unit Type	Condition	Minimum	Typical	Maximum	Unit
Operative input power range	EDRA1-26 EDRA2-26	Full channel load with maximum value of signal output power	6		16	dBm
		Single channel with minimum value of signal output power	-22		-12	dBm
	EDRA1-35 EDRA2-35	Full channel load with maximum value of signal output power	-1		14	dBm
		Single channel with minimum value of signal output power	-29		-14	dBm
EDFA1 class		Single hardware failure included (worst-case fault)			1M	
Signal output power range		Full channel load			23.2	dBm
		Single channel			20.2	dBm
Standard gain range	EDRA1-26 EDRA2-26 EDRA1-35 EDRA2-35	Output gain tilt = 0 dB			23	dBm
		Single channel	-5			dBm
Extended gain range	EDRA1-26 EDRA2-26 EDRA1-35 EDRA2-35	Output gain tilt ≠ 0	7		14	dB
		Single channel	9		21	dBm

Table 14. EDRA Physical Specifications

Parameter	Value
Power	150W maximum
Size	2 slots, (H x W x D): 13.1 x, 1.93 x 9.84 in. (33.27 x 4.90 x 24.99 cm)
Weight	3 kg
MTBF (predicted)	149,254 hours (EDRA 1) 140,845 hours (EDRA 2)

Parameter	Value
Management	
Card LEDs • **Failure (FAIL)** • **Active/standby (ACT/STBY)** • **Signal fail (SF)**	 Red Green/yellow Yellow
Operating Environment	
Temperature	23 to 131℉ (-5 to 55℃)
Relative humidity	5 to 85%

Table 15. EDRA Ordering Information

Product Name	Description
NCS2K-EDRA1-26C	21dBm Erbium Doped Raman Amplifier 26dB Span - C-Band
NCS2K-EDRA1-35C	21dBm Erbium Doped Raman Amplifier 35dB Span - C-Band
NCS2K-EDRA2-26C	21dBm Erbium Doped Raman Amplifier + Bst 26dB Span - C-Band
NCS2K-EDRA2-35C	21dBm Erbium Doped Raman Amplifier + Bst 35dB Span - C-Band

Tables 16 and 17 give regulatory compliance and system requirements for all units included in this data sheet.

Table 16. Regulatory Compliance[1]

Countries Supported	
ANSI System	**ETSI System**
• Canada • United States • Korea • Japan • European Union	• European Union • Africa • CSI • Australia • New Zealand • China • Korea • India • Saudi Arabia • South America
EMC (Class A)	
• ICES-003 (2004) • GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011) • 47 FCC part15 (2011)	• 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/CSA 60950-1,Second Ed 2011 • GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011)	• 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/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	• CDRH (accession letter and report) • IEC 60825-1 Ed. 2 2007-03

Countries Supported	
Environmental	
• GR-63-CORE Issue 4, NEBS Physical Protection (Apr 2012) • ETS 300-019-2-1 V2.1.2 (2000-09) (Storage, Class 1.1)	• 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 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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