

Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards

Operators face the challenge of deploying a scalable and agile optical network while reducing footprint and cost. The Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards integrate the programmability and scale of Cisco nLight ROADM with flexible amplification in an exceptionally compact single-slot form factor.

Figure 1. 20-Port Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Card

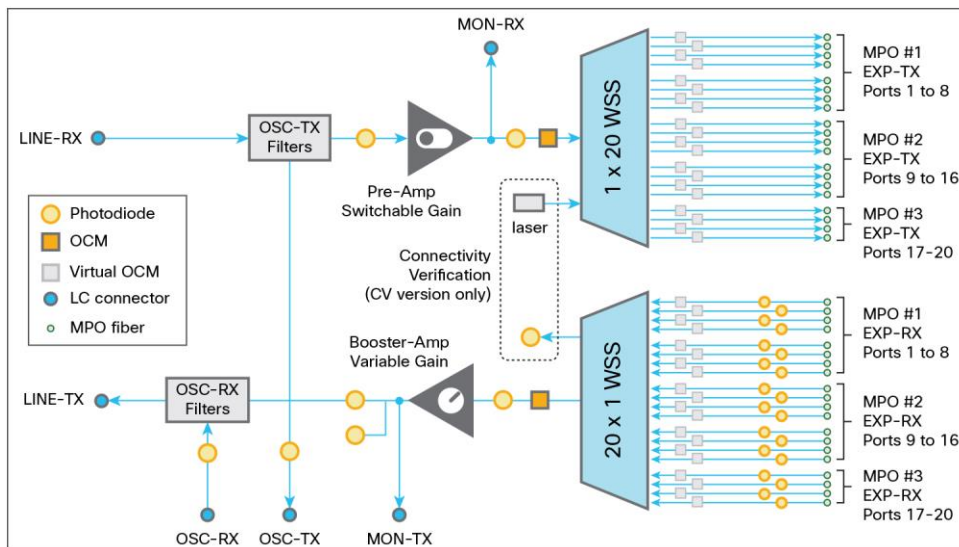


Product Overview

Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards combine twin wavelength selective switches (WSS) with pre- and booster amplifiers in a single-slot line card.

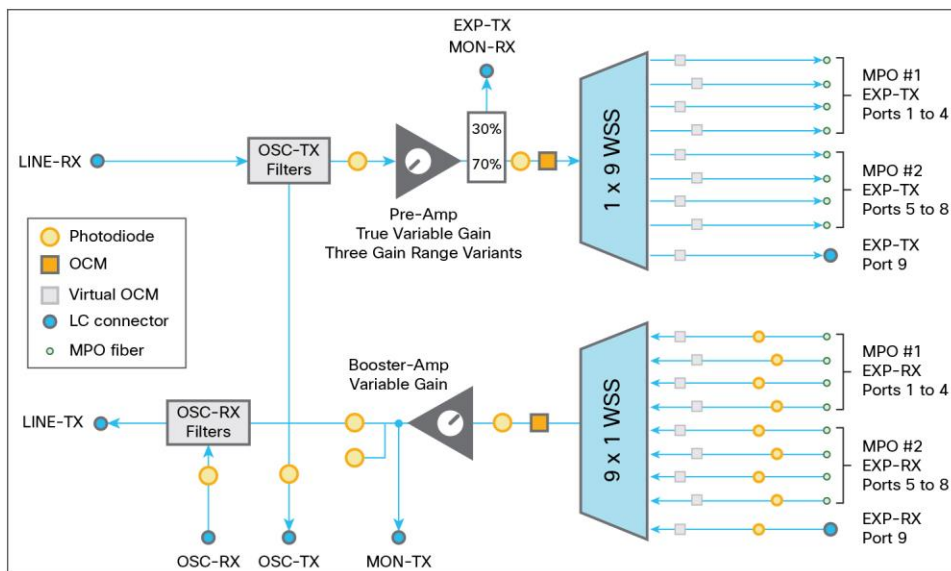
20-port and 9-port versions of the card are available to meet varying scalability requirements. The 20-port line card (Figure 1) features a switchable gain pre-amplifier, allowing optimal operation across two different gain ranges. One card can therefore operate across fiber spans of nearly any length, simplifying ordering, sparing, and deployment. A second variant of the 20-port line card provides connectivity verification of attached add/drop and express patch-panel components, helping ensure error-free node turn-up. The 20-port line card functional diagram is shown in Figure 2.

Figure 2. 20-Port Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Card Functional Diagram



The 9-port version of the line card is offered in three variants corresponding to three different pre-amplifier gain ranges. It also offers an optimized two-degree configuration by including a broadcast express port (TX) and a high isolation select (RX) port (Figure 3). This design reduces loss and filtering penalties.

Figure 3. 9-Port Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Card Functional Diagram



Both the 20-port and 9-port line cards support the cascading of multiple cards to increase port count.

Features and Benefits

Programmability and Agility

Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards create an agile DWDM layer forming the foundation for converged transport architectures, delivering features that allow programmability and agility in provisioning and recovery operations. Wavelength add/drop and routing are entirely software-driven, which eliminates manual operations, helps decrease operating expenses (OpEx), and reduces provisioning and recovery times.

The following agile DWDM innovations are supported by the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards:

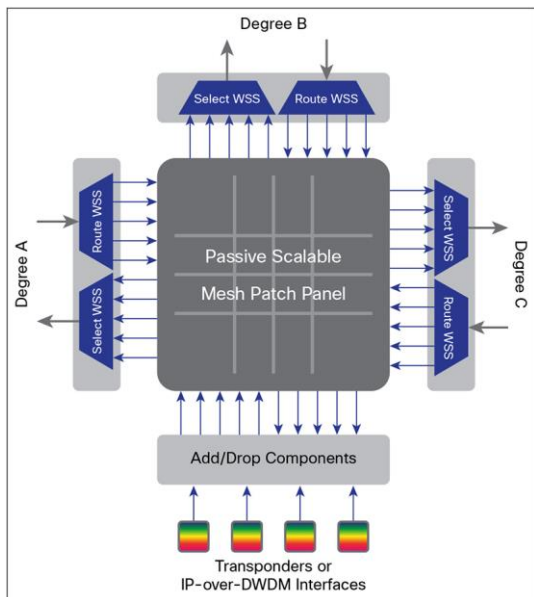
- **Colorless:** Colorless ROADM ports are not frequency-specific. This simplifies provisioning and allows dynamic restoration, because the frequency of an ingress channel can be retuned by software without requiring its fiber to be relocated.
- **Contentionless:** Contentionless add/drop refers to the ability of an N-degree ROADM node to accommodate N wavelengths of the same frequency from a single add/drop device.
- **Omnidirectional:** Omnidirectional ROADM ports are not associated to specific ROADM degree, therefore a wavelength reroute does not require a physical fiber move, and can thus be executed entirely by software.
- **Flex spectrum:** The amount of spectrum allocated to a wavelength can be flexibly provisioned to allow for multicarrier superchannels or single wavelengths exceeding today's 50-GHz channel spacing.

Together, colorless, contentionless, omnidirectional, and flex spectrum (CCOFS) functionalities bring programmability to the optical layer, allowing direct and complete control by packet-layer devices and centralized network orchestrators.

Scale and Flexibility

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 4). 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 multi-degree ROADM nodes, plus CCOFS add/drop, at large scale.

Figure 4. Cisco nLight ROADM Architecture



Cisco nLight ROADM ports can be used for any combination of the following:

- Express connections to other degrees in a multi-degree ROADM node
- Add/drop connections to Cisco NCS 2000 Passive Auxiliary Modules
- Add/drop connections to Cisco NCS 2000 Contentionless Add/Drop Line Cards
- Direct add/drop of individual wavelengths

Nodes with a modest number of degrees can still benefit from a large quantity of ROADM ports. Increasing add/drop channel count by using multiple ROADM ports reduces the fan-out requirements of the add/drop layer. This lowers cost, reduces loss, and improves performance.

Table 1 summarizes the features and benefits of Cisco NCS 2000 Single Module ROADM Line Cards. Specific feature support is hardware and software dependent.

Table 1. Features and Benefits

Feature	Benefit
Colorless, contentionless, and omnidirectional add/drop	Delivers a fully programmability DWDM layer, allowing automated provisioning and orchestrated multilayer restoration, reducing operating and capital expenses.
Flexible spectrum allocation	Improves spectral efficiency by allowing the creation and switching of multicarrier superchannels. Prepares networks for future modulation formats exceeding 50 GHz.
Single-slot form factor for combined ROADM and amplification	Reduces footprint and simplifies cabling of multidegree ROADM network elements.
Support for up to 20 ports	Allows highly scalable mesh nodes, while offering flexibility in allocating ROADM ports to either degree interconnection or add/drop.
Switchable gain pre-amplifier (20-port line card only)	Simplifies planning and deployment by allowing a single ROADM line card to accommodate fiber spans of nearly any length.
Pay-as-you-grow licensing	Allows operators to deploy highly scalable hardware while minimizing upfront cost.
Integrated optical spectrum analysis	Provides valuable insight into the spectral characteristics of system channels, facilitating planning and troubleshooting.
Connectivity verification (20-port CV line card only)	Aids in the installation of high-degree-count mesh nodes by verifying that components have been properly fibered and are functioning within specified insertion losses.

Licensing

The Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards are available with optional pay-as-you-grow licensing. This allows network operators to deploy highly scalable hardware while reducing upfront costs. Licensed variants of the 20-port and 9-port line cards are available with four and three ports activated, respectively. Available ports can be used for express or add/drop connectivity, and they support ninety-six 50 GHz-spaced channels. Port expansion licenses are available in increments of two or four ports, and another license activates flex spectrum capability.

Product Specifications

Table 2 lists the optical specifications for the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards. Table 3 lists the pre-amplifier specifications, and Table 4 provides the booster amplifier specifications.

Table 2. Optical Specifications for the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards

Parameter	All Cards
Channel grid	97 channels, 50 GHz-spaced ITU grid
Center wavelength - Channel 0	191.300 GHz (1567.13 nm, for Connectivity Verification only)
Center wavelength - Channel 1	191.350 GHz (1566.72 nm)
Center wavelength - Channel 96	196.100 GHz (1528.77 nm)
Flex spectrum "slice" width	12.5 GHz
Minimum settable channel bandwidth	25 GHz, 2 slices
Maximum settable "super-channel" bandwidth	4850 GHz, 388 slices
Total number of slices	388 slices, 4850 GHz
f_start of first slice	191.325 GHz
f_stop of last slice	196.125 GHz
Optical port isolation	Typical 28 dB (for 0-15 dB attenuation) Typical 25 dB (for 15-25 dB attenuation) Typical 30 dB (0-15 dB attenuation, EXP-RX Port #9 of 9-port line card only)
Minimum insertion loss (0 dB VOA setting)	Typical 6 dB
Variable optical attenuator (VOA) dynamic range	15 dB (operative) 25 dB (during channel start-up)
VOA attenuation setting accuracy	±0.5 dB (0-5 dB attenuation) ±1.0 dB (5-15 dB attenuation)
Per-channel maximum input power	15 dB
Maximum polarization dependent loss (PDL)	0.5 dB

Table 3. Pre-Amplifier Specifications for the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards

Pre-Amplifier Specifications	20-Port Line Card		9-Port Line Card		
	Low Gain Range	High Gain Range	17 dB Gain	24 dB Gain	34 dB Gain
Input power range - total	-25 to 21 dBm	-40 to 9 dBm	-25 to 21 dBm	-32 to 9 dBm	-45 to 1 dBm
Input power range - per channel (with 1 dBm per channel output power)	-16 to 1 dBm	-23 to -11 dBm	-16 to 1 dBm	-23 to -11 dBm	-33 to -19 dBm
Output power (POUT maximum)	21.2 dBm	21 dBm	21 dBm	21 dBm	21 dBm
Standard gain range	0 - 17 dB	12 - 35 dB	0 - 17 dB	12 - 24 dB	20 - 34 dB
Extended gain range	17 - 20 dB	24 - 35 dB	17 - 20 dB	24 - 27 dB	34 - 40 dB

Pre-Amplifier Specifications	20-Port Line Card		9-Port Line Card		
	Low Gain Range	High Gain Range	17 dB Gain	24 dB Gain	34 dB Gain
Noise figure at nominal gain	5.5 dB (17 dB gain)	5.5 dB (24 dB gain)	5.5 dB (17 dB gain)	5.5 dB (24 dB gain)	5.5 dB (34 dB gain)
Noise figure at minimum gain	-	11.7 dB (12 dB gain)	-	11.7 dB (12 dB gain)	7.1 dB (20 dB gain)

Table 4. Booster Amplifier Specifications for the Cisco NCS 2000 Flex Spectrum Single Module ROADM Line Cards

Booster-Amplifier Specifications	All Cards
Input power range - total	-29 to 9 dBm
Input power range - per channel	-20 to -11 dBm (with 1 dBm per channel output power)
Output power (POUT maximum)	21.2 dBm
Standard gain range	12-21 dB
Extended gain range	21-24 dB
Noise figure at nominal gain	5.5 dB (at 21 dB gain)
Noise figure at minimum gain	9.6 dB (at 12 dB gain)

Table 5. Physical Specifications for the Flex Spectrum Single Module ROADM Line Cards (All Variants)

Parameter	Value
Power	Typical 60W Maximum 84W
Size	1 slot
Management	
Card LEDs	
• Failure (FAIL)	Red
• Active/standby (ACT/STBY)	Green/yellow
• Signal fail (SF)	Yellow
Operating Environment	
Temperature	23 to 131°F (-5 to 55°C)
Relative humidity	5 to 95%

Regulatory Compliance

Table 6 summarizes regulatory standard compliance and agency approvals.

Table 6. Regulatory Compliance

ANSI System	ETSI System
Countries and Regions 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 • China • Korea • India • Saudi Arabia • South America

ANSI System	ETSI System
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
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, Network Equipment Building Standards (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) 	

Ordering Information

To place an order, visit the [Cisco Commerce homepage](#) and refer to Table 7. To download software, visit the [Cisco Software Center](#).

Table 7. Ordering Information

Product ID	Description
NCS2K-9-SMR17FS	9-port Single Module ROADM - 0-17dB Gain - Flex Spectrum
NCS2K-9-SMR24FS	9-port Single Module ROADM - 12-24dB Gain - Flex Spectrum
NCS2K-9-SMR34FS	9-port Single Module ROADM - 20-34dB Gain - Flex Spectrum
NCS2K-20-SMRFS	20-port Single Module ROADM - Switchable Gain Flex Spectrum
NCS2K-20-SMRFS-CV	20-port Single Module ROADM - Switchable Gain Flex Spectrum - Connectivity Verification
NCS2K-9-SMR17FS-L	9-port Single Module ROADM - 0-17dB Gain - FS - Licensed
NCS2K-9-SMR24FS-L	9-port Single Module ROADM - 12-24dB Gain - FS - Licensed
NCS2K-9-SMR34FS-L	9-port Single Module ROADM - 20-34dB Gain - FS - Licensed

Product ID	Description
NCS2K-20-SMRFS-L	20-port Single Module ROADM - Switchable Gain FS - Licensed
L-NCS2K-SMR-FS	NCS 2K/MSTP Lic SMR - Flex Spectrum Activation e-Delivery
L-NCS2K-SMR-2P	NCS 2K/MSTP Lic SMR - 2-port Activation e-Delivery
L-NCS2K-SMR-4P	NCS 2K/MSTP Lic SMR - 4-port Activation e-Delivery

Warranty

The following warranty terms apply to the Cisco 20-Port NCS 2000 Flex Spectrum Single Module ROADM Line Cards 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 the Cisco 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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