

Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC

Your dynamic optical networks require consistent performance across extended distances, widely varying fiber plants, and challenging transmission environments. Get the exceptional transmission performance you need with the Cisco® NCS 2000 100-Gbps DWDM Line Card with Soft Decision Forward Error Correction (FEC). Based on state-of-the-art Cisco nLight™ silicon, the Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC delivers exceptional transmission performance.

Product Features and Benefits

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC (Figure 1) is a module for the Cisco Network Convergence System 2000 Series (NCS 2000 Series) which transports 100 Gigabit Ethernet interfaces and services across metro, regional, and long haul dense wavelength division multiplexing (DWDM) optical networks.

The card features a pluggable client interface, allowing it to map the client or a signal from an optional tributary line card to a single DWDM line interface, providing transponder or muxponder capabilities. The client port supports the Cisco CPAK™ pluggable transceiver.

The card features a software-configurable baud rate between 27.952 and 31.241 Gbaud depending on FEC selection and a G.709v3 OTU-4 wrapped optical interface. Operated within the outlined specifications, the trunk card can operate with a post-FEC bit error rate (BER) of better than 1×10^{-15} .

Figure 1. Cisco NCS 2000 100Gbps DWDM Line Card with Soft Decision FEC



The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC is designed to provide the following benefits:

- Transport of 100-Gbps wavelengths over fully uncompensated networks with very high polarization mode dispersion (PMD), with unregenerated optical reach of up to 6800 km.
- Support for one hundred twenty eight (128) channels at 37.5GHz channel spacing, or up to 150 channels at minimal spacing.

- Continuously tunable laser and Nyquist transmit filtering for creation of multi-carrier DWDM superchannels.
- Exceptional system density of 42 100-Gbps transponders per rack with a 100GBASE-LR4 client interface.
- Support for different configurations - transponder, muxponder, or regenerator.

Modulation Scheme

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC features a coherent polarized differential quadrature phase shift keying (CP-DQPSK) modulation format with active cycle slip management to optimize 100-Gbps transmission in terms of optical signal-to-noise ratio (OSNR), CD, and PMD robustness.

Forward Error Correction

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC supports multiple FEC mechanisms on its trunk and client interfaces. The trunk port supports two FEC modes:

- Soft Decision FEC with 20 percent overhead
- Hard Decision FEC with 7 percent overhead - Standards based ITU-T G.975

The Soft Decision FEC employs an advanced differential encoding and cycle slip-aware algorithm offering excellent performance and robustness against high cycle slip rates. Hard decision FEC is fully interoperable with previous generations of Cisco NCS 2000 Series and Cisco ONS 15454 MSTP 100-Gbps DWDM trunk cards. The client port supports the ITU-T G.975 FEC algorithm when configured as an OTU-4, which can be activated or disabled through software configuration.

Protocol Transparency

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC can transparently deliver 100-Gbps point-to-point services. Table 1 shows transponder client configurations and mapping.

Table 1. Transponder Client Configurations and Mapping

Client		Mapping	Trunk		
Format	Rate (Gbps)		Format	Rate with 7% GFEC or HG-FEC OH (Gbps)	Rate with 20% UFEC OH (Gbps)
100GE LAN-PHY	103.125	Bit transparent through standard G.709v3 mapping	OTU-4	111.809	124.964

Wavelength Tunability

The card supports software-provisionable, continuous tunability across the full C band. The trunk frequency can be tuned in increments of 0.1 GHz.

Protection Mechanisms

The line card supports multiple protection mechanisms commonly used in optical transport networks. Table 2 outlines the available protection options and the associated service-level agreements (SLAs) that can be provided.

Table 2. Protection Formats

Protection Type	Capabilities
1 + 1	Client signal is transported transparently over diverse unprotected optical paths. Protection is provided for the client interface, transponder card, and DWDM line through client-based protocols
Optical Channel (OCH)-trail	A single trunk interface is passively split across two diverse paths using the Protection Switch Module. Protection is provided for the DWDM line signal only.
Y-Cable (Muxponder only)	Client interfaces are passively split into two muxponder client cards using an external module. Protection is provided for the DWDM line, the muxponding client card, and the DWDM trunk card.

Flow-Through Timing

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC allows timing to flow through from client to line optical interface. The received timing from the client interface is used to time the line transmitter interface. This flow-through timing allows multiple trunk cards in the same shelf to be independently timed, independent of the network element timing.

Management

The Cisco NCS 2000 Series provides comprehensive management capabilities to support OAM&P capabilities through the integrated Cisco Transport Controller craft interface with support from the Cisco Prime™ Optical element management system. The trunk card features provisionable digital wrapper (G.709) functions, providing per-wavelength performance-management capabilities, especially for services transported transparently across the network. The generic communication channel (GCC) of the digital wrapper provides a separate communications channel on a per-wavelength basis to be used by the platform when transparent signals are transported. GCC allows the Cisco NCS 2000 Series to extend its advanced network autodiscovery capabilities to DWDM-based services.

Far-End-Laser-Off Behavior

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC can provision the far-end-laser-off behavior when SONET/SDH payloads are present. The remote client can be configured to squelch or to send an Alarm Indication Signal (AIS) following a fault condition. For 100 Gigabit Ethernet signals, the default behavior is squelching.

Performance Monitoring

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC supports both transparent and non-transparent signal transport performance monitoring. The digital wrapper channel is monitored according to G.709 Optical Transport Network (OTN) and G.8021 standards. Performance monitoring of optical parameters on the client and DWDM line interface includes Loss of Signal (LOS), laser bias current, and transmit and receive optical power. Calculation and accumulation of the performance-monitoring data are supported in 15-minute and 24-hour intervals as per G.7710.

Physical system parameters measured at the wavelength level, such as mean polarization mode dispersion, accumulated chromatic dispersion, and received optical signal-to-noise ratio (SNR) are also included in the set of performance-monitoring parameters. These parameters can greatly simplify troubleshooting operations and enhance the set of data that can be collected directly from the equipment.

The trunk card incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status of the card.

Regeneration

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC supports OTU-4 regeneration capabilities. Regeneration terminates OTU-4 overhead while allowing the ODU-4 payload to transparently pass through. GCC0 is terminated, while GCC1 and GCC2 are passed through. No Cisco CPAK client is required, as communication between the two cards in a regeneration group occurs through the chassis backplane.

Muxponding Configurations

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC can be paired with various line cards to provide muxponding capability. Muxponding client cards, listed in Table 3, are placed in an adjacent slot, communicating with the trunk card through the chassis backplane.

Table 3. Muxponding Client Cards

Card	Interface Configuration	Client Protocols Supported
Cisco NCS 2000 Multi-Rate Muxponder	2 x SFP+, 2 x QSFP+, 1 x CPAK	10GE LAN-PHY, 10GE WAN-PHY, OC-192, STM-64, 10-Gbps, and 8-Gbps Fibre Channel (FICON), OTU-2 40 Gigabit Ethernet, OTU-3
Cisco ONS 15454 10-Port 10-Gbps Line Card	10 x SFP+	10 GE LAN-PHY, 10 GE WAN-PHY, OC-192, STM-64, 10-Gbps, and 8-Gbps Fibre Channel (FICON), OTU-2

Transponder Application

The Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC provides a very efficient single-slot solution using the Cisco CPAK pluggable transceiver as the client interface. The Cisco CPAK is available in two variants providing IEEE-compliant 100GBASE-SR10 and 100GBASE-LR4 optical interfaces. Interworking with CXP and CFP 100 Gigabit Ethernet transceivers is supported. Please refer to the [Cisco CPAK 100GBASE Modules Data Sheet](#) for additional information. 100 Gigabit Ethernet LAN-PHY is supported as a client signal.

Regulatory Compliance

Table 4 lists regulatory compliance information for the trunk card. Note that all compliance documentation may not be completed at the time of product release. Please check with your Cisco sales representative for countries other than Canada, the United States, and the European Union.

Table 4. 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, December 2011 GR-1089-CORE Issue 6, NEBS EMC and Safety, May 2011 	<ul style="list-style-type: none"> IEC 60950-1 Information technology equipment Safety Part 1: General requirements - Edition 2, 2005 + Amendment 1 2009 EN 60950-1: Edition 2 (2006) Information technology equipment - Safety - Part 1: General requirements + A11:2009 + A1:2010 + A12:2011. CE Safety Directive: 2006/95/EC
Laser	
<ul style="list-style-type: none"> 21CFR1040 (2008/04) (Accession Letter and CDRH Report) Guidance for Industry and FDA Staff (Laser Notice No. 50), June 2007 	<ul style="list-style-type: none"> IEC 60825-1: 2007 Ed. 2.0 Safety of laser products Part 1: Equipment classification, requirements and users guide IEC60825-2 Ed.3.2 (2010) Safety of laser products Part 2: Safety of optical fibre communication systems.
Environmental	
<ul style="list-style-type: none"> GR-63-CORE Issue 4, Network Equipment Building Standards (NEBS) Physical Protection, April 2012 	<ul style="list-style-type: none"> ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1) ETS 300-019-2-2 V2.1.2 (1999-09): Transportation, Class 2.3 ETS 300-019-2-3 V2.2.2 (2003-04):Operational, Class 3.1E
Optical	
<ul style="list-style-type: none"> GR-253-CORE - Issue 04 ITU-T G.691 	<ul style="list-style-type: none"> ITU-T G.709 ITU-T G.975
Quality	
<ul style="list-style-type: none"> TR-NWT-000332, Issue 4, Method 1 calculation for 20-year mean time between failure (MTBF) 	
Miscellaneous	
<ul style="list-style-type: none"> GR-1089-CORE Issue 4, NEBS EMC and Safety (June 2006) (Note: NEBS-1) GR-63-CORE Issue 3, NEBS Physical Protection (March 2006) (Note: NEBS-2) ATT-TP-76200: 2008 ANSI T1.315-2001 GR-499: 2004 Transport Systems Generic Requirements (TSGR): Common Requirements 	

Other Specifications

Table 5 lists system requirements for the Cisco NCS 2000 100-Gbps DWDM Line Card with Soft Decision FEC. Table 6 provides the DWDM specifications. Table 7 details receive-side optical performances. Table 8 lists performance monitoring parameters. Table 9 provides card specifications, and Table 10 gives ordering information.

Table 5. System Requirements

Component	Cisco NCS 2006 or ONS 15454 M6	Cisco NCS 2002 or ONS 15454 M2
Processor	15454-M-TNCE, 15454-M-TSCE, 15454-M-TSC, 15454-M-TNC	15454-M-TNCE, 15454-M-TSCE, 15454-M-TSC, 15454-M-TNC
Shelf Assembly	NCS2006-SA, 15454-M6-SA	NCS2002-SA, 15454-M2-SA
Shelf Door	NCS2006-DDR, 15454-M6-DDR	NCS2002-DDR, 15454-M2-DDR
Fan Tray	15454-M6-FTA2, NCS2006-FTA	15454-M2-FTA2, NCS2002-FTA
Power Supply	NCS2006-DC40 NCS2006-DC NCS2006-DC20 (four cards supported) NCS2006-AC, 15454-M6-AC2 15454-M6-AC (three cards supported)	NCS2002-DC, NCS2002-DC-E 15454-M2-DC, 15454-M2-DC-E NCS2002-AC, 15454-M2-AC (one card supported)
System Software	Release 10.1 or later	Release 10.1 or later
Slot Compatibility	2 through 7	2 through 3

Table 6. DWDM Specifications

Parameter	Value
Bit rate	27.952 Gbaud \pm 20 ppm (OTU4 with 7% OH) 31.241 Gbaud \pm 20 ppm (OTU4 with 20% OH)
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λTnom)	Fully-tunable between 1528.77 and 1566.72 nm in 0.1 nm increments
Connector type (TX/RX)	LC, duplex (shuttered)
Optical Transmitter	
Type	CP-DQPSK modulation format
Output power (PTmin)	-10 to -1.5 dBm in 0.01 dBm increments
Required optical return loss, minimum (ORLmin)	22 dB
Laser safety class	1
Optical Receiver	
Chromatic dispersion tolerance (DLRmax)	+/- 94,000 ps/nm
Overload	0 dBm
Receiver reflectance (maximum)	30 dB
Input wavelength bandwidth (λc_rx)	Between 1528.77 and 1566.72 nm (C-Band)

Table 7. DWDM Receive-Side Optical Performances

FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	CD Tolerance	DGD	OSNR (0.5 nm RWB)
SD-FEC (20% overhead)	<4x10E (-2)	<10E (-15)	0 to -16 dBm (-20 dBm with 0.2 dB OSNR penalty)	0 ps/nm	-	5.1 dB
				+/- 70,000 ps/nm	180 ps	6.6 dB
				+/- 94,000 ps/nm	180 ps	7.6 dB
G-FEC (7% overhead)	<1.0x10E (-5)	<10E (-15)	0 to -14 dBm (-16 dBm with 0.4 dB OSNR penalty) (-20 dBm with 0.8 dB OSNR penalty)	0 ps/nm	-	13.5 dB
				+/- 20,000 ps/nm	100 ps	14.5 dB

Table 8. Performance Monitoring Parameters

Area	Parameter Name		Description
OTN	OTUk SM	ODUk PM	
	BBE-SM	BBE-PM	Number of background block errors
	BBER-SM	BBER-PM	Background block error ratio
	ES-SM	ES-PM	Number of errored seconds
	ESR-SM	ESR-PM	Errored seconds ratio
	SES-SM	SES-PM	Number of severely errored seconds
	SESR-SM	SESR-PM	Severely errored seconds ratio
	UAS-SM	UAS-PM	Number of unavailable seconds
	FC-SM	FC-PM	Number of failure counts
FEC	Bit errors		Number of corrected bit errors
	Uncorrectable words		Number of uncorrectable words
Trunk optical performance monitoring	OPT		Transmitter optical power
	LBC		Transmitter laser bias current
	OPR		Receiver optical power
	RCD		Residual chromatic dispersion
	PMD		Mean polarization mode dispersion
	OSNR		Optical signal-to-noise ratio, calculated with 0.5 nm RBW
	SOPMD		Second Order PMD (SOPMD Estimation)
	SOPCR		Polarization Change Rate Estimation
	PDL		Polarization Dependent Loss (PDL) Estimation

Table 9. Card Specifications

Management	
Card LEDs	
Failure (FAIL)	Red
Active/standby (ACT/STBY)	Green/yellow
Signal fail (SF)	Yellow
Client port LEDs (per port)	
Active input signal	Green
DWDM port LEDs	
Active input signal	Green
Output wavelength	Green
Power (including pluggable)	
Typical	127W (25C and -48VDC)
Maximum	143W (55C and -38VDC)
Physical	
Dimensions	Occupies 1 slot
Weight	4 lb (1.8 kg)
Reliability and availability	
Mean time between failures (MTBF)	153,009 hrs

Management	
Latency (end to end, Cisco CPAK client)	
G-FEC 7%	5 microseconds
SD-FEC 20%	9 microseconds
Storage temperature	-40°C to 70°C (-40°F to 158°F)
Operating temperature	
Normal	0°C to 40°C (32°F to 104°F)
Short-term ¹	-5°C to 55°C (23°F to 131°F)
Relative humidity	
Normal	5% to 85%, noncondensing
Short-term ¹	5% to 90% but not to exceed 0.024 kg water/kg of dry air
¹ Short-term refers to a period of not more than 96 consecutive hours and a total of not more than 15 days in 1 year (a total of 360 hours in any given year, but no more than 15 occurrences during that 1-year period). The values shown are valid for M6 or M2 chassis.	

Table 10. Ordering Information

Part Number	Description
NCS2K-100GS-CK-C=	100G - CPAK Multi-Rate Line Card -SD FEC - C-Band
CPAK-100G-LR4=	100GBASE-LR4 CPAK Module for SMF
CPAK-100G-SR10=	100GBASE-SR10 CPAK Module for MMF

Warranty

The following warranty terms apply to the Cisco Network Convergence System 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:

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