

Cisco NCS 2000 1.2 Tbps DWDM Line Module

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The Cisco® Network Convergence System (NCS) 2000 1.2 Tbps DWDM line module enhances dense wavelength-division multiplexing (DWDM) transmission with the new 400G client interface and 400GE client protocol support. The DWDM line module provides 1.2 Tbps of Client and 1.2 Tbps of Trunk capacity occupying 2 slots in NCS 2000 chassis. The line module is capable of mapping Client traffic to 200/300/400 Gbps Trunk wavelengths of ITU-T fixed or super channels providing customers bandwidth of 600G to 1.2T.

Product overview

The evolution of traffic at the access with 4G/5G technologies and 400GE at the data center and the service provider networks have resulted in the need for higher speed of transmission at the optical domain using new modulation scheme formats and the existing super channel capabilities on the optical fiber.



Figure 1.
NCS 2000 1.2T DWDM Line module

The Cisco NCS 2000 1.2 Tbps DWDM line module provides the best mode of transmission of the 100G and 400GE client protocols from access, metro, and core networks. NCS 2000 1.2T licensed version of the line module seamlessly helps to maintain and improve customer agility in turning up bandwidth on-demand considering no additional truck roll on an existing DWDM system or new line system. The DWDM line module is tuned to support both metro and long haul deployments with the necessary modulation formats/ trunk capacity per wavelength. This improves ROI for service providers to offer multiple services such as long haul transmission and metro transmission from the same line module.

Four coherent modulation formats are supported to best suit network requirements:

200G-DP-QPSK, 200G-DP-16QAM*, 300G-DP-8QAM, 400G-DP-16QAM

- 200 Gbps dual polarization-multiplexed Quadrature Phase Shift Keying (QPSK)
- 200 Gbps dual polarization 16-state Quadrature Amplitude Modulation (16-QAM)
- 300 Gbps dual polarization 8-state Quadrature Amplitude Modulation (8-QAM)
- 400 Gbps dual polarization 16-state Quadrature Amplitude Modulation (16-QAM)

*Future Release

The Cisco NCS 2000 1.2 Tbps DWDM line module (Figure 1) simplifies the integration and transport 100/400 Gigabit Ethernet and Optical Transport Unit Level 4 (OTU-4) interfaces and services into enterprises and service provider optical networks to best-in-class DWDM transmission capabilities.

Cisco 400G CFP2-DCO digital optics

Cisco coherent transmission technology greatly enhances the reach and reliability of transport performance while providing the flexibility to select the optimal modulation scheme for a specific application. The primary benefits of Cisco coherent technology are:

- Strong optical signal-to-noise ratio performance
- Outstanding chromatic dispersion robustness, avoiding any additional cost related to optical chromatic dispersion compensation equipment
- Extended polarization mode dispersion robustness
- Very high spectral efficiency, allowing wavelengths to be transmitted across a large number of ROADMs with negligible penalty

The CFP2 digital optical pluggable solution is the combination of the transceiver module and the DSP photonics integrated on a CFP2 form factor. Cisco offers a 400G CFP2-DCO pluggable optics module that addresses a wide range of network optical interconnect applications, including service provider access aggregation, wireless 5G backhaul, metro and long haul networks, and as data center interconnects. With support for Ethernet/OTN clients, and line-side transmission of 200 Gbps QPSK modulation up to 400 Gbps 16QAM, the module offers enhanced flexibility in a pluggable coherent solution. The CFP2-DCO product family features an expansive list of interoperability modes as documented by OpenROADM MSA and the Optical Internetworking Forum (OIF).

Pluggable solutions such as 400G CFP2-DCO are designed to enable network operators to address increasing bandwidth demand through a pay-as-you-grow model that has the potential of reducing both capital and operational expenditures. The 400G CFP2-DCO module incorporates a 7-nm CMOS technology and a silicon Photonic Integrated Circuit (PIC) for an optimized co-packaged design.

The Cisco 400G CFP2-DCO leverages this critical aspect by supporting oFEC for Open ZR and Open ZR+ modes and the standard C-FEC in the 400ZR mode.

Features and benefits

The Cisco NCS 2000 1.2 Tbps DWDM line module provides compelling benefits in the areas of **efficiency, performance, flexibility, and density** improvements.

Efficiency

In a single, 2-slot-wide line card, the 1.2 Tbps DWDM supports 100GE, 400GE, and OTU4* client protocols, providing the ability to groom the services into 3 wavelengths capable of up to 400 Gbps each.

Performance improvement

The latest generation of Digital Signal Processors (DSPs) provide a dramatic boost to the optical performance of 200 Gbps QPSK, 200 Gbps 16-QAM*, 300 Gbps 8-QAM, and 400 Gbps 16-QAM, allowing to support multiple deployment scenarios where throughput plays a key role in achieving maximum transmission capacity on fiber.

Flexibility

The service type of both Client and Trunk optics are based on pluggable modules, allowing a true pay-as-you-grow investment profile, where card personality is defined and redefined at the pluggable level. Due to the port-by-port service-type flexibility, this also radically reduces the variety of line cards an operator is required to inventory. The Cisco NCS 2000 1.2 Tbps DWDM line module provides 3 ports of QSFP-DD and 5 ports of QSFP 28 form factor, where the 3 ports of QSFP-DD can be used with QSFP28 for 100G client services.

Density

The Cisco NCS 2000 1.2 Tbps DWDM line module is able to triple the slot density compared with the previous generation of transponder cards.

Software configurable FEC option

The Cisco NCS 2000 1.2 Tbps DWDM line module features the new C-FEC and O-FEC adoption, providing the best performance based on the requirements on the network.

Management

The Cisco NCS 2000 system provides comprehensive management capabilities to support Operations, Administration, Maintenance, and Provisioning (OAM&P) capabilities through the integrated Nodal craft interface with support from the Cisco Evolved Programmable Network Manager (EPN-M) network management system. The 1.2 Tbps DWDM line card features ZR+ framing as well as ITU-T G.709 functionality, providing per-wavelength performance management capabilities, especially for services transported transparently across networks. Without the digital wrapper functions, a carrier transporting a service transparently would be unable to identify network impairments that may degrade the transported signal and violate the SLA agreements. The digital wrapper's Generic Communication Channel (GCC) provides a separate communications channel on a per-wavelength basis to be used when transparent signals are transported. GCC allows the Cisco NCS 2000 system to extend its advanced network auto discovery capabilities to DWDM-based services.

Performance monitoring

The Trunk ports on the Cisco NCS 2000 1.2 Tbps DWDM line card provide support for transparent signal 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 interfaces include Loss of Signal (LOS), laser bias current, transmit optical power, 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, or received optical signal-to-noise ratio, are also included in the set of performance monitoring parameters. These can greatly simplify troubleshooting operations and enhance the set of data that can be collected directly from the equipment.

The DWDM card incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status of the card. An orange circle is printed on the faceplate, indicating the shelf slot in which you can install the card.

Network applications

1.2 Tbps muxponder application (metro, long haul)

The Cisco NCS 2000 1.2 Tbps DWDM line card with QSFP28 and QSFP-DD provides a very efficient two-slot solution to transport on 16-QAM 400 Gbps traffic by using both 100/400 Gbps optical client ports, directly managed by the QSFP28 (both LR4, SR4, CWDM-4, SM-SR, FR-S) and QSFP-DD (DR-4, FR-4, LR-8, AOCxM) pluggable interface.

Multi-haul transport

By leveraging the trunk capabilities to configure each trunk with 200/300/400G DWDM, customers can get the benefit to cater to different needs in the network where 200G on one trunk caters to the Metro transmission and 400G on another trunk supporting Metro or DC-DC connectivities depending on the distance.

System requirements

Platform	Cisco NCS 2000
Processor	TNC-E/TSC-E/TNC-S/TNCS-O/TNCS2/TNCS-20
Shelf assembly	Cisco NCS2002, NCS2006, NCS2015
System software	Release 12.2 or later

Licensing

The Cisco NCS 2000 1.2 Tbps DWDM line module features a licensing scheme allowing users to purchase only the functions they require.

The line card is available in two versions: an unlicensed version that includes all functions, and a licensed version that includes a subset of functions and bandwidth and is upgradable with feature-specific licenses.

The licensed version of the card supports the following functions:

- 100 Gbps of client bandwidth
- Capability to use one trunk CFP2-DCO WDM with any trunk modulation format and line rate

Additional functions are offered through bandwidth license

- Additional 100G client bandwidth (up to a total of 1200G maximum available client bandwidth)

Product specifications

The table below provides the DWDM specifications for the Cisco NCS 2000 1.2 Tbps DWDM line module for both Trunk, Client, and Performance monitoring aspects of the system. CFP2-DCO Specifications can be referred at Cisco ONS Pluggable Datasheet: <https://www.cisco.com/c/en/us/products/collateral/optical-networking/network-convergence-system-2000-series/pluggable-optical-modules-ds.html>.

Table 1. DWDM specifications

Parameter	Value
Baud rate	63 Gbaud ± 20 ppm
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λ_{Tnom})	Full-tunable between 1528.77 and 1567.13 nm (C-Band)
Optical Transmitter	-10 to +1 dBm
Type	DP-QPSK modulation format DP-8QAM modulation format DP-16QAM modulation format

Table 2. 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 3. Line module specifications

Management	
Card LEDs	Red
Failure (FAIL)	Green/yellow
Active/standby (ACT/STBY)	Yellow
Signal Fail (SF)	
Client port LEDs (per port)	Green
Active input signal	
DWDM port LEDs	Green
Active input signal	Green
Output wavelength	
Power (including pluggable)	
Typical	320 W
Physical	
Dimensions	Occupies 2 slot
Weight	2.78 kg
Reliability and availability	
Mean Time Between Failures (MTBF)	425,560 hrs
Latency (end to end)	
100GE to 400G Trunk	7 us
400GE to 400G Trunk	10us
Storage temperature	-40° C to 70° C (-40° F to 158° F)
Operating temperature	0° C to 40° C (32° F to 104° F)
Normal	-5° C to 50° C (23° F to 131° F)
Short-term¹	
Relative humidity	5% to 85%, noncondensing
Normal	5% to 90% but not to exceed 0.024 kg water/kg of dry air
Short-term¹	

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.

Ordering information

Part Number	Description
NCS2K-1.2T-MXP=	NCS2K 3x DDQSFP56, 5x QSFP28, 3x CFP2 WDM 1.2Tbps Muxponder
NCS2K-1.2T-MXP-L=	NCS2K 1.2Tbps Muxponder Licensed for 100G Client Bandwidth
E-NCS2K-100G-CL=	100G client bandwidth
ONS-CFP2D-400G-C=	400G CFP2 DCO Multi-rate WDM C Band Tuneable
ONS-QSFP28-LR4=	100Gbps multirate QSFP28, LR
QSFP-100G-FR-S	100GBASE FR QSFP Transceiver, 2km over SMF
QSFP-100G-SR4-S=	100GBASE SR4 QSFP transceiver, MPO, 100m over OM4 MMF
QSFP-100G-SM-SR=	100GBASE CWDM4 Lite QSFP Transceiver, 2km over SMF, 10 - 60C
QDD-400G-DR4-S (Breakout with MPO-LC)	400G QSFP-DD Transceiver, 400GBASE-DR4, MPO-12, 500m parallel SMF
QDD-400G-FR4-S	400G QSFP-DD Transceiver, 400G-FR4, Duplex LC, 2km Duplex SMF
QDD-400G-LR8-S	400G QSFP-DD Transceiver, 400GBASE-LR8, Duplex LC, 10km Duplex SMF
QDD-400G-AOCxM x=1,2,3,5,7,15	400G QSFP-DD Transceiver, Active Optical Cable, 1, 2, 3, 5, 7, 10, 15 meters

Warranty information

The following warranty terms apply to the Cisco NCS 2002, 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: 5 years
- Software warranty duration: 1 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 <https://www.cisco.com/go/warranty>.

Product sustainability

The table below lists regulatory compliance information for the Cisco NCS 2000 1.2 Tbps DWDM line 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
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

ANSI System	ETSI System
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) 	
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 	

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For more information

For more information about the Cisco NCS 2000, visit <https://www.cisco.com/c/en/us/products/optical-networking/network-convergence-system-2000-series/index.html>.

Document history

Table 5. Document history

New or Revised Topic	Described In	Date
New Datasheet with information on 1.2T DWDM line module		June 2021
Revised Optical specs and MTBF information	Receiver optical performance, Line module specification	August 2021

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

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