ıı lı ı ı lı
CISCO
The bridge to possible

Cisco Network Convergence System 1004 800G QSFP-DD Transponder Line Card

Contents

Globally, the total number of internet users is projected to grow from 3.9 billion in 2018 to 5.3 billion by 2023. By 2023, the consumer share of total devices, including both fixed and mobile devices, will be 74 percent. Video devices in particular can have a multiplier effect on traffic. Content providers will need to scale their networks at speed to keep up with the demand for more video. Networks needs to be designed with "web scale" in mind. A web-scale network needs to scale at deployment speed while being operationally simple. Cisco® Network Convergence System (NCS) 1004 uses state-of-the-art silicon along with complete automation and real-time visibility to deliver a universal transponder solution that provides best-in-class performance for metro, long-haul, and submarine applications while being simple to deploy and manage.

Product features and benefits

The NCS 1004 800G QSFP-DD transponder can provide up to 8xQSFP slots, out of which 6 can host QSFP-28 and 2 can host QSFP-DD/QSFP-28/ZR/ZR+ client ports. The client ports map to two trunk ports operating any rate between 100G and 400G in 50G increments. The baud rate, modulation format, and FEC of each trunk port is software configurable per slice, where each slice is a combination of a sequence of 4 client ports.

The trunk ports are capable of several line rates with fine control of modulation format, baud rate, and forward error correction, allowing the solution to be used for metro, terrestrial long-haul, or submarine applications:

- The baud rate can be controlled between 24 Gbd/s and 72 Gbd/s.
- The modulation format can be controlled between QPSK, 8-QAM, 16QAM, 32QAM, and 64QAM.
- Hybrids between modulation formats can be configured to achieve 0.001 bits/symbol of granularity.
- Forward Error Correction (FEC) of 27% and 15% overhead.
- Trunk line rate from 50G to 400G in 50G increments.

Figure 1.
Cisco NCS 1004 800G QSFP-DD line card

The Cisco NCS 1004 system provides the following hardware benefits:

- Transport of any trunk rate between 100- and 400-Gbps wavelengths on the same platform through software provisioning.

- Support of granular control of baud rate and modulation format to maximize spectral efficiency.

- One universal transponder that is performance optimized for metro, long-haul, and submarine applications.

- Support for up to 350,000 ps/nm of residual chromatic dispersion compensation.

- Transport of 100GE, OTU4, and 400GE on the same platform through software provisioning.

- 400G DWDM provides unparalleled scale and density. With 64 channels of 400G at 75 GHz, the NCS 1004 provides 25.6 Tbps in 16RU, and with 96 channels of 400G at 50 GHz, the NCS 1004 provides 38.4 Tbps.

- Nonlinear compensation for maximum performance on compensated legacy subsea cables and for nonlinear terrestrial fibers.

- SOP tracking speed of up to 10 million rad/s for aerial fiber applications.

Modulation schemes

The Cisco NCS 1004 1.2T transponder features a software-configurable modulation scheme per slice, allowing the operator to customize the spectral efficiency and reach characteristics of individual wavelengths. Supported modulation formats are detailed in Table 1.

Table 1.   Supported modulation formats

Capacity	Baud rate	Modulation scheme
100 Gbps	24.02 to 69.4 Gbaud in 0.3-Gbd increments	1 to 2.890625 bits/symbol in 0.008-bits/symbol increments
150 Gbps	24.02 to 71.6 Gbaud in 0.3-Gbd increments	1.453125 to 3.9375 bits/symbol in 0.008-bits/symbol increments
200 Gbps	24.02 to 71.8 Gbaud in 0.3-Gbd increments	1.7578125 to 5.25 bits/symbol in 0.008-bits/symbol increments
250 Gbps	26.27 to 72 Gbaud in 0.3-Gbd increments	2.4140625 to 6 bits/symbol in 0.008-bits/symbol increments
300 Gbps	31.52 to 72 Gbaud in 0.3-Gbd increments	2.8984375 to 6 bits/symbol in 0.008-bits/symbol increments
350 Gbps	36.78 to 72 Gbaud in 0.3-Gbd increments	3.0703125 to 6 bits/symbol in 0.008-bits/symbol increments
400 Gbps	46.3 to 72 Gbaud in 0.3-Gbd increments	3.859375 to 6 bits/symbol in 0.008-bits/symbol increments

Wavelength tunability

The line interface supports software-provision able tunability across the full C band, covering 96 channels across 191.25 to 196.10 THz (1528.77 to 1566.72 nm). Grid-less tuning support allows for continuous tunability in increments of 0.1 GHz and the ability to create multicarrier super-channels over flex spectrum line systems.

Protocol transparency

The Cisco NCS 1004 800G transponder can transparently deliver 100 GbE and OTU4 clients over 2x100G-400G DWDM and deliver 400GE clients over 2x400G, 2x200G DWDM.

Fine control of coherent DWDM interface

The Cisco NCS 1004 800G transponder provides the ability to modify baud rate and modulation format with fine control to meet capacity and reach requirements for a range of use cases.

- Use 69-Gbaud/s line rates to maximize capacity at lowest price per bit for metro and long-haul networks.
- Use real-time network bandwidth and performance data to maximize line rate capacity on a coherent DWDM interface.
- Support line rates that can maximize capacity for bandwidth-constrained 50-GHz and 100-GHz spaced legacy ROADM networks.
- Maximize spectral efficiency on a submarine cable line system for the target Q-margin.

Management

The Cisco NCS 1004 800G line card supports all management features as mentioned in the NCS 1004 system data sheet.

Performance monitoring

The Cisco NCS 1004 800G line card supports performance monitoring of optical parameters on the client and DWDM line interface, including laser bias current, transmit, and receive optical power. Ethernet RMON statistics for the client ports and OTN error counters for the trunk are also available. 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, pre-FEC bit error rate, and received Optical Signal-To-Noise Ratio (OSNR), are also included in the set of performance-monitoring parameters. These parameters can greatly simplify troubleshooting operations.

Table 2.   Client and trunk PM parameters

Port	PM parameters
Client	• LBC, OPT, OPR, FREQ_OFF
Trunk	• LBC, OPT, OPR, CD, DGD, SOPMD, OSNR, PDL, PCR, RX_SIG, FREQ_OFF, PREFEC BER, POSTFEC BER, Q, Q_ Margin

The NCS 1004 800G line card provides a set of port and system LEDs for a quick visual check of the operational status. The various LEDs are described in detail in Table 8.

Feature summary

The following table summarizes the features of the NCS 1004 Line card.

Table 3. Feature summary

Feature	Description
Software compatibility	• Cisco IOS® XR 7.3.1 or later with NC 1004 system
Port density	• 8-QSFP28/2-QSFP-DD client-side ports • 2 DWDM line/trunk ports
OTN feature summary	• Alarm reporting for Loss Of Signal (LOS), Loss Of Frame (LOF), Loss Of Multiframe (LOM), Alarm Indication Signal (AIS), Backward Defect Indicator (BDI) • OTUk, ODUk, OPUk Performance Monitoring • Threshold Crossing Alerts (TCAs) • Local (internal) and line (network) loopbacks • Trunk Trace Identifier, Generic Communication Channel • L1 AES-256 encryption
Optical feature summary	• 50-GHz and flex-grid (0.1-GHz) tunable lasers • Nyquist shaping • Nonlinear Equalization • Electronically compensated CD and PMD • Performance Monitoring and Threshold Crossing Alerts (TCAs) • Tx and Rx power monitoring
Ethernet feature summary	• Alarms and Performance Monitoring • Squelch and Local Fault Propagation • LLDP Snooping • Performance Monitoring and Threshold Crossing Alerts (TCAs) • Local (internal) and line (network) loopbacks
Network management	• iPXE and Zero-Touch Provisioning (ZTP) • IOS XR CLI • SNMP • Streaming Telemetry, including event-driven telemetry • NETCONF, RESTCONF, gRPC with YANG data models
Physical dimensions (NCS 1004)	• 1.59" tall x 7.55" wide x 10.90" deep • Weight: 3.2 kg
Power	• Max:220W; Typ:200W (without client optics)

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 that are not listed below.

Table 4.   Regulatory compliance

ANSI system	ETSI system
Countries and regions supported	
• Canada • United States • Korea • Japan • European Union	• European Union • Africa • CSI • Australia • New Zealand • China • Korea • India • Saudi Arabia • South America
• **EMC (Emissions)**	• FCC 47CFR15, Class A • AS/NZS CISPR 32, Class A • CISPR 32, Class A • EN55032, Class A • ICES-003, Class A • VCCI, Class A • KN 32, Class A • EN/61000-3-2/KN61000-3-2 • EN61000-3-3//KN61000-3-3 • CNS-13438, Class A
• **EMC (Immunity)**	• IEC/EN61000-4-2 Electrostatic Discharge Immunity • IEC/EN61000-4-3 Radiated Immunity • IEC/EN61000-4-4 EFT-B Immunity • IEC/EN61000-4-5 Surge AC Port • IEC/EN61000-4-6 Immunity to Conducted Disturbances • IEC/EN61000-4-11 Voltage Dips, Short Interruptions, and Voltage Variations • KN 35
• **EMC (ETSI/EN)**	• EN 300 386 Telecommunications Network Equipment (EMC) • EN55032 Electromagnetic Compatibility of Multimedia Equipment- Emission Requirements • EN55035 Electromagnetic Compatibility of Multimedia Equipment- Immunity Requirements • EN55024 Information Technology Equipment (Immunity) • EN61000-6-1/EN61000-6-2 Generic Immunity Standard • EN61000-3-2 Power Line Harmonics • EN61000-3-3 Voltage Changes, Fluctuations, and Flicker

ANSI system	ETSI system
Safety	
• CSA C22.2 #60950-1 – Edition 7, March 2007 • UL 60950-1 – Edition 2, 2014	• IEC 60950-1 Information technology equipment Safety Part 1: General requirements – Edition 2, 2005 + Amendment 1 2009 + Amendment 2 2013 • EN 60950-1: Edition 2 (2006) Information technology equipment – Safety – Part 1: General requirements + A11:2009 + A1:2010 + A12:2011 + A2:2013 • CE Low Voltage Directive (LVD): 2014/35/EC
Laser	
• 21CFR1040 (2008/04) (Accession Letter and CDRH Report) Guidance for Industry and FDA Staff (Laser Notice No. 56), May 2019	• IEC 60825-1: 2014-05 Ed. 3.0 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 fiber communication systems
Optical	
• ITU-T G.691	• ITU-T G.975
Quality	
• TR-NWT-000332, Issue 4, Method 1 calculation for 20-year Mean Time Between Failure (MTBF)	

Table 5 provides the DWDM specifications, Table 5 details receive-side optical performances, Table 6 lists performance-monitoring parameters, Table 7 provides card specifications, and Table 8 gives ordering information.

Table 5.   DWDM specifications

Parameter	Value
Baud rate	24 to 72 Gbaud/s
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λ_{Tnom})	Fully tunable between 1528.77 and 1566.72 nm
Connector type (TX/RX)	LC, duplex (shuttered)
Optical transmitter	
Type	PM-BPSK modulation format PM-QPSK modulation format PM-8QAM modulation format PM-16QAM modulation format PM-32QAM modulation format PM-64QAM modulation format Hybrids of adjacent modulation allowing 1 to 6 bits/symbol in 0.001-bits/symbol increments
Output power	+3 to –10 dBm in 0.01-dBm increments

Parameter	Value
Required optical return loss, minimum (ORLmin)	24 dB
Laser safety class	1
Optical receiver	
Frequency range	191.25 to 196.10 THz (1528.77 to 1566.72 nm)
Input power range (64QAM)	–8 to +5 dBm
Input power range (32QAM)	–15 to +5 dBm
Input power range (16QAM)	–17 to +5 dBm
Input power range (8QAM, QPSK)	–22 to +5 dBm
Power accuracy	+/–1 dBm
Optical return loss	27 dB
PMD tolerance @ 69 Gbaud/s	64 ps max DGD
Chromatic dispersion tolerance @ 0.5-dBb penalty	+/–100,000 ps for QPSK/8QAM +/–80,000 ps for 16QAM +/–15,000 ps for 32QAM +/–10,000 ps for 64QAM
Chromatic dispersion tolerance @ 1-dB penalty	+/–350,000 ps for BPSK, QPSK, 1.5 bits/sym, 2.5 bits/sym +/–280,000 ps for 8QAM +/–200,000 ps for 3.5 bits/sym +/–150,000 ps for 16QAM
State of polarization change tolerance	100,000 rad/s for QPSK/8QAM 50,000 rad/s for 16QAM, 32QAM, 64QAM

Table 6.   DWDM receive-side optical performances

Modulation type	FEC type	Pre-FEC BER	Post-FEC BER	Input power sensitivity	CD tolerance	DGD	Required worst-case OSNR (0.1-nm RBW)
PM-BPSK (100G)	SD-FEC (27% overhead)	<3.75x10E (−2)	<10E (−15)	0 to −16 dBm	0 ps/nm	-	10.5 dB
					+/-100,000 ps/nm	64 ps	11 dB
					+/-350,000 ps/nm	64 ps	11.7 dB
PM-QPSK (200G)	SD-FEC (27% overhead)	<3.75x10E (−2)	<10E (−15)	0 to −16 dBm	0 ps/nm	-	13.5 dB
					+/-100,000 ps/nm	64 ps	14 dB
					+/-350,000 ps/nm	64 ps	14.7 dB
PM-8QAM (300G)	SD-FEC (27% overhead)	<3.75x10E (−2)	<10E (−15)	0 to −13 dBm	0 ps/nm	-	17.5 dB
					+/-100,000 ps/nm	64 ps	18 dB
					+/-280,000 ps/nm	64 ps	18.7 dB
PM-16QAM (400G)	SD-FEC (27% overhead)	<3.75x10E (−2)	<10E (−15)	0 to −10 dBm	0 ps/nm	-	21 dB
					+/-80,000 ps/nm	64 ps	21.5 dB
					+/-150,000 ps/nm	64 ps	22.2 dB

Table 7. Trunk performance-monitoring parameters

Area	Parameter name	Description
OTUk monitoring (near-end, far-end, OTUk-SM, ODUk-PM)	BBE	Number of background block errors
	BBER	Background block error ratio
	ES	Number of errored seconds
	ESR	Errored seconds ratio
	SES	Number of severely errored seconds
	SESR	Severely errored seconds ratio
	UAS	Number of unavailable seconds
	FC	Number of failure counts
FEC	Bit errors	Number of corrected bit errors
	Uncorrectable words	Number of uncorrectable words
	Q	Q-factor
	Q-Margin	Q-factor margin
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 8. NCS 1004 800G line card specifications

Management	
Attention LED	Blue
Client and DWDM port LEDs • No alarms • Minor alarms • Critical and major alarms	Green Amber Red
Storage temperature	–40°C to 85°C (–40°F to 185°F)
Operating temperature • Normal • Short term	0°C to 40°C (32°F to 104°F) –5°C to 55°C (23°F to 131°F)
Relative humidity • Normal • Short term[1]	5% to 85%, noncondensing 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).

Table 9. Ordering information

Part Number	Description
NCS1K4-2-QDD-C-K9=	Network Convergence System 1004 2x QSFP-DD C-Band Line Card

Warranty

The following are the warranties:

- 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.

Your formal warranty statement appears in the Cisco Information Packet that accompanies your Cisco product.

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

Product Sustainability

Information about Cisco's environmental sustainability policies and initiatives for our products, solutions, operations, and extended operations or supply chain is provided in the "Environment Sustainability" section of Cisco's Corporate Social Responsibility (CSR) Report.

Reference links to information about key environmental sustainability topics (mentioned in the "Environment Sustainability" section of the CSR Report) are provided in the following table:

Table 10.   Cisco Environmental Sustainability Information

Sustainability Topic		Reference
General	Information on product-material-content laws and regulations	Materials
	Information on electronic waste laws and regulations, including our products, batteries and packaging	WEEE Compliance
	Information on product takeback and reuse program	Cisco Takeback and Reuse Program
	Sustainability Inquiries	Contact: csr_inquiries@cisco.com
	Countries and Regions Supported	Table 5: Regulatory Compliance
Power	Power	Table 3: Feature summary
	Weight	Table 3: Feature summary

Cisco makes the packaging data available for informational purposes only. It may not reflect the most current legal developments, and Cisco does not represent, warrant, or guarantee that it is complete, accurate, or up to date. This information is subject to change without notice.

Cisco Capital

Flexible payment solutions to help you achieve your objectives

Cisco Capital makes it easier to get the right technology to achieve your objectives, enable business transformation and help you stay competitive. We can help you reduce the total cost of ownership, conserve capital, and accelerate growth. In more than 100 countries, our flexible payment solutions can help you acquire hardware, software, services and complementary third-party equipment in easy, predictable payments. Learn more.

Document history

New or revised topic	Described In	Date
Updated OSNR values	Table 6	July 30, 2023

Printed in USA

C78-2463203-02   08/23