Cisco NCS 1002

In the data center and between data centers, you need greater capacity to meet ever-increasing bandwidth demands along with a small form factor and low power usage to achieve optimal efficiency. Greater scale, agility and programmability are also needed to rapidly respond to an increasingly dynamic service environment. The Cisco Network Convergence System 1002 (NCS 1002) delivers all this and more. It uses Cisco nLight Silicon to combine multimodulation capability with soft-decision forward error correction (SD FEC) to flexibly trade off transmission rate versus reach for maximum optical performance, giving up to 2Tbps in just 2RU.

Cisco helps service providers capture the digitization opportunity with cloud scale software and hardware innovations that deliver unprecedented automation, visibility and control, and software modularity.

Product Features and Benefits

The Cisco NCS 1002 (Figure 1) is mechanically optimized for controlled operational environments. At 2 RU, the system supports up to 2Tbps of client and 2Tbps of trunk traffic.

The system uses a Linux kernel with the 64 bit IOS XR OS in a Linux Container (LxC) and admin plane operating in a separate LxC. It encompasses carrier-class software with a number of features such as machine-to-machine APIs based on YANG data models, streaming telemetry agent for real time, granular device monitoring and also an infrastructure for 3rd party applications.

The NCS 1002 has 2 redundant and field replaceable AC & DC power supply units and 3 redundant and field replaceable fans. It also provides field replaceable controller and SSD disk. See Figure 1. Each NCS 1002 unit provides 20 QSFP based clients and 8 CFP2-ACO based DWDM trunk ports.

The trunk ports are capable of two modulation formats and three data rates:

- 250-Gbps coherent polarization-multiplexed 16-state quadrature amplitude modulation (16-QAM)
- 200-Gbps coherent polarization-multiplexed 16-state quadrature amplitude modulation (16-QAM)
- 100-Gbps coherent polarization-multiplexed differential quadrature phase shift keying (PM-QPSK)

The NCS 1002 provides four "slices" of I/O management. Each slice contains up to twenty 10Gbe or five 40Gbe/100Gbe client ports. The client ports map to two trunk ports operating at 100G, 200G or 250Gbps DWDM, providing transponder or muxponder functionality. The modulation format of each trunk port is software-configurable per slice.

Figure 1.   Cisco NCS 1002 Front and Rear Views, AC Power Supply Unit, Fan and Controller Card
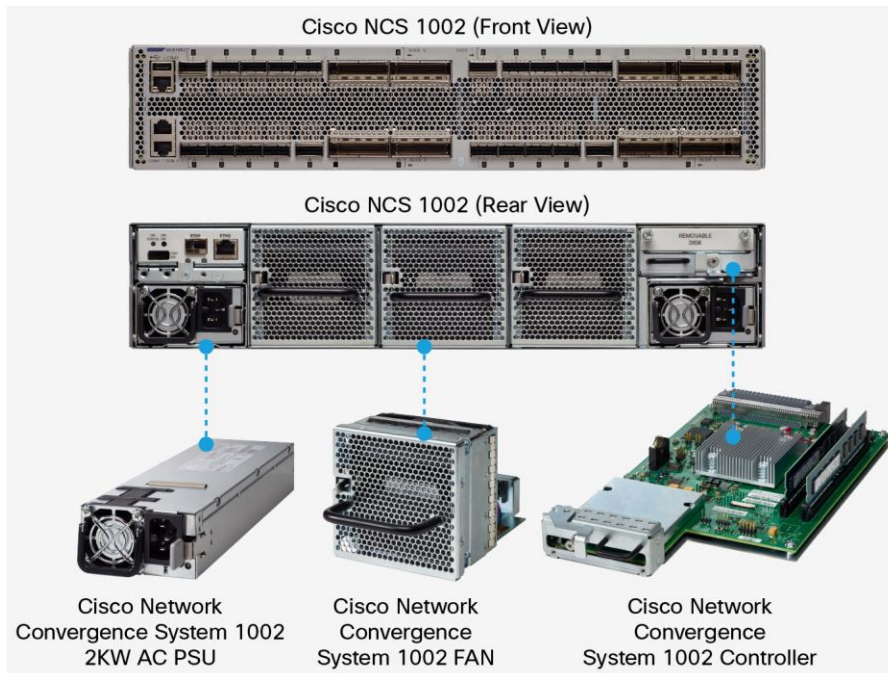
The Cisco NCS 1002 system provides the following hardware benefits:

- Transport of 100, 200, or 250-Gbps wavelengths on the same platform through software provisioning.

- Transport of 10GE, 40GE and 100GE on the same platform through software provisioning.

- 250G DWDM provides unparalleled scale and density. With 96 channels of 250G at 50 Ghz, the NCS 1002 provides 24Tbps in 24RU.

- Grid-less tuning support for flex-grid DWDM support.

- CFP2-ACO trunk DWDM optics with Cisco's on-board coherent DSP provides a flexible Pay As You Grow model.

- 20% Soft Decision (SD) Forward Error Correction (FEC) algorithms for maximum optical performance.

Figure 2.   CFP2-ACO Based Trunk Optics

Enhanced Forward Error Correction Capability

The Cisco NCS 1002 supports multiple FEC mechanisms on its trunk interfaces. The trunk port supports two FEC modes:

- Soft-Decision FEC with 7-percent overhead
- Soft-Decision FEC with 20-percent overhead

The SD FEC employs an advanced differential encoding and cycle slip-aware algorithm offering excellent performance and robustness against high cycle slip rates.

Multiple Modulation Schemes

The Cisco NCS 1002 features a software configurable modulation scheme per slice, allowing the operator to customize the spectral efficiency and reach characteristics of individual wavelengths. Compared to 100-Gbps PM-QPSK, PM-16QAM modulation doubles the spectral efficiency, transmitting 200 or 250-Gbps per wavelength while reducing unregenerated reach. Supported modulation formats are detailed in Table 1.

Table 1.   Supported Modulation Formats

Modulation Type	Bits/Symbol	Symbol Rate (GBaud)		Bit Rate (Gbps)		Approximate Reach (km)
		7% FEC	20% FEC	7% FEC	20% FEC	
PM-QPSK	4	27.952	31.241	111.809	124.964	4000
PM-16-QAM (200G)	8	27.952	31.241	223.616	249.928	800
PM-16-QAM (250G)	8	35.8513	40.2076	286.8104	321.6608	500

Wavelength Tunability

The line interface supports software-provisionable tunability across the full C band, covering 96 channels on the 50-GHz grid. Grid-less tuning support allows for continuous tunability in increments of 0.1 GHz and the ability to create multicarrier superchannels over flex spectrum line systems.

Protocol Transparency

The Cisco NCS 1002 can transparently deliver 10Gbe, 40Gbe and 100Gbe over a 100-Gbps, 200-Gbps, or 250-Gbps wavelength. Table 3 shows transponder/muxponder client options and mapping.

Table 2.   Client Options and Mapping

Client	Rate (Gbps)	Mapping
100GE LAN-PHY	103.125	Bit transparent through MLG2.0 mapping
40GE LAN-PHY	39.813120	Bit transparent through MLG2.0 mapping
10GE LAN-PHY	10.3125	Bit transparent through MLG2.0 mapping

Table 3 lists the allowable combinations of the client to DWDM trunk port mapping per slice.

Table 3.   NCS 1002 Client to Trunk Mapping Configurations Per Slice

Configuration	Client	Trunk
Configuration 1	2x100G	2x100G
Configuration 2	4x100G	2x200G
Configuration 3	5x100G	2x250G
Configuration 4	5x40G	2x100G

Configuration	Client	Trunk
Configuration 5	5x40G	1x200G
Configuration 7	20x10G	2x100G
Configuration 8	20x10G	1x200G
Configuration 9	8x10G + 3x100G	2x200G

Encryption

With increasing asks for data privacy and data protection across the globe, encryption of any data that leaves the Data Center facility is becoming an important requirement for cloud operators. The NCS1002 provides AES256 based MACSec encryption for 10GE, 40GE and 100GE clients. The MACSec Key Agreement protocol runs over a GCC (Generic Communication Channel) between two NCS1000 nodes. Pre Shared Keys (PSK) or EAP-TLS can be used to provide keys to NCS1000 devices in the network.

Management

The Cisco NCS 1002 provides comprehensive management capabilities to support operations, administration, maintenance, and provisioning (OAM&P) capabilities through IOS-XR CLI, SNMP, Syslog, and XML. In addition, iPXE for automated software download and Zero Touch Provisioning (ZTP) for automated configuration download are available for simplified installation. For machine-to-machine configuration and management of NCS 1002, NETCONF, RESTCONF and gRPC transport mechanisms with JSON, XML and GPB encoding are provided. The NCS 1002 provides a set of native YANG models as well as the ability to map into any industry standard or customer defined YANG data models. For monitoring, NCS 1002 provides a streaming telemetry feature that relies on a push mechanism to disseminate user selected PM and status information at user specified frequencies at granular 30 second intervals. This improves monitoring speed and scale compared to traditional pull based mechanisms such as SNMP.

Performance Monitoring

The Cisco NCS 1002 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.

The NCS 1002 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 9.

Headless Operation

The headless operation allows for NCS 1002 data plane to operate errorless during software upgrades and when the controller card is either physically absent or in a failed state. Trunk and client statistics will be accumulated and will be available to the user once the controller is up. In addition, fault propagation will continue to operate for client and trunk failures without the presence of the controller module.

Feature Summary

The following table summarizes the features of the NCS 1002.

Table 4.   Feature Summary

Feature	Description
Software Compatibility	• IOS-XR 6.0.0 or later
Port Density	• 20 QSFP+/QSFP28 client side ports • 8 CFP2-ACO DWDM line/trunk ports
FEC feature summary	• 7% SD-FEC (PM-QPSK) Cliff: 1E-2 • 20% SD-FEC (PM-QPSK) Cliff: 3.6E-2 • 7% SD-FEC (PM-16QAM) Cliff: 0.75E-2 • 20% SD-FEC (PM-16 QAM) Cliff: 2.4E-2
OTN feature summary	• Alarm reporting for Loss of Signal (LOS), Loss of Frame (LOF), Loss of Multi-frame (LOM) • Performance Monitoring and • Threshold Crossing Alerts (TCAs) • Local (internal) and line (network) loopbacks • Trunk Trace Identifier
Optical Feature Summary	• 50GHz and flex-grid (0.1GHz) tunable lasers • Nyquist shaping • Electronically compensated CD and PMD • Performance Monitoring and Threshold Crossing Alerts (TCAs) • Tx and Rx power monitoring
Client side Ethernet features	• Alarms and Performance Monitoring • Squelch and Local Fault Propagation • LLDP Snooping • Performance Monitoring and Threshold Crossing Alerts (TCAs) • Local (internal) and line (network) loopbacks • 10GE,40GE and 100GE MACSec AES-256 encryption
Availability	• Online insertion and Removal of the Controller • Headless mode of operation
Network Management	• iPXE and Zero Touch Provisioning (ZTP) • IOS XR CLI • SNMP • Streaming Telemetry • NETCONF, RESTCONF, gRPC with YANG data models
Physical Dimensions (NCS 1002-K9)	• Occupies 2 RU and fits into 2 or 4 post 19inch, 21 inch, 23inch racks • Weight: 40 pounds
Power	• <80W per 100G
Latency	• 20% SD-FEC (7.5us) (E2E)
Physical Summary	• Front to Back Straight-through airflow • 2KW DC PSU • 2KW 200/240Vac 10A AC PSU • 1+1 FRU AC & DC Power • 2+1 FRU FANs • FRU Controller • Removable SSD Flash • 2 consoles • 1 RJ45 and 1 GE SFP management port • 1 USB2.0 3A • System, trunk, client, FAN PSU, locator beacon LEDs
Environmental Conditions	• Operating Temperature: 0 to 40 °C (32 to 104 °F)

Regulatory Compliance

Table 5 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 5. 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 22, Class A • CISPR 22, Class A • EN55022, Class A • ICES-003, Class A • VCCI, Class A • KN 22, Class A • 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 24
• **EMC (ETSI/EN)**	• EN 300 386 Telecommunications Network Equipment (EMC) • EN55022 Information Technology Equipment (Emissions) • EN55024/CISPR 24 Information Technology Equipment (Immunity) • EN50082-1/EN61000-6-1 Generic Immunity Standard • EN61000-3-2 Power Line Harmonics • EN61000-3-3 Voltage Changes, Fluctuations, and Flicker
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 Safety Directive: 2006/95/EC
Laser	
• 21CFR1040 (2008/04) (Accession Letter and CDRH Report) Guidance for Industry and FDA Staff (Laser Notice No. 50), June 2007	• 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

ANSI System	ETSI System
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 6 provides the DWDM specifications, Table 7 details receive-side optical performances, Table 8 lists performance-monitoring parameters, Table 10 provides card specifications, Table 11 gives ordering information.

Table 6.   DWDM Specifications

Parameter	Value
Baud rate	27.952 GBaud/s ±20 ppm (FEC 7% OH)
	31.241 GBaud/s ±20 ppm (FEC 20% OH)
	34.94 GBaud/s ±20 ppm (FEC 7% OH)
	39.05125 GBaud/s ±20 ppm (FEC 20% OH)
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-QPSK modulation format
	PM-16QAM modulation format (200G)
	PM-16QAM modulation format (250G)
Output power (PTmin)	-1.5 to -11.5 dBm in 0.01 dBm increments
Required optical return loss, minimum (ORLmin)	22 dB
Laser safety class	1
Optical Receiver	
Chromatic dispersion tolerance (DLR_{max})	+/- 94,000 ps/nm with PM-QPSK
	+/- 20,000 ps/nm with 16-QAM (200G)
	+/- 20,000 ps/nm with 16-QAM (250G)
Overload	0 dBm
Receiver reflectance (maximum)	30 dB
Input wavelength bandwidth (λ_{c_rx})	Between 1528.77 and 1566.72 nm

Table 7.   DWDM Receive-Side Optical Performances

Modulation Type	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	CD Tolerance	DGD	OSNR (0.5 nm RBW)
PM-QPSK (100G)	SD-FEC (20% overhead)	<4x10E (–2)	<10E (-15)	0 to -16 dBm (-20 dBm with 0.3 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
PM-16-QAM (200G)	SD-FEC (20% overhead)	<2.4x10E (–2)	<10E (-15)	0 to -12 dBm (-16 dBm with 0.7 dB OSNR penalty)	0 ps/nm	-	14.3 dB 13.8 dB (typical)
					+/- 20,000 ps/nm	100 ps	15.3 dB 14.8 dB (typical)
PM-16-QAM (250G)	SD-FEC (20% overhead)	<2.4x10E (–2)	<10E (-15)	0 to –12 dBm (-16 dBm with 0.7 dB OSNR penalty)	0 ps/nm	-	17.3 dB 16.8 dB (typical)
					+/- 20,000 ps/nm	100 ps	18.3 dB 17.8 dB (typical)

Table 8. Performance-Monitoring Parameters

Area	Parameter Name	Description
OTUk Monitoring	BBE-SM	Number of background block errors
	BBER-SM	Background block error ratio
	ES-SM	Number of errored seconds
	ESR-SM	Errored seconds ratio
	SES-SM	Number of severely errored seconds
	SESR-SM	Severely errored seconds ratio
	UAS-SM	Number of unavailable seconds
	FC-SM	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. NCS 1002 Specifications

Management		
Beacon LED	Blue	
Client and DWDM port LEDs		
• No alarms	Green	
• Minor alarms	Amber	
• Critical and Major alarms	Red	
Fan LED		
• All 3 FANs are present and running	Green	
• One or more FANs are absent or failed	Red	
PSU LED		
• At least 1 PSU present and operational	Green	
• 2 PSUs are present but, one has no power	Red	
Status LED		
• No active system alarms	Green	
• Presence of major or minor alarms	Amber	
• Presence of critical alarms	Red	
OIR LED		
• Controller is seated but, not ready	Amber blinking	
• Controller card seated and software is ready	Amber solid	
• Controller is absent	Blank	
Power fully loaded (including pluggable)	80x10G Mode	20x100G Mode
• Typical	1050W	1450W
• Maximum	1200W	1600W

Management	
Physical	
Dimensions	NCS 1002-K9 17.4" wide x 23.5" deep x 3.45" tall
	NCS1K-2KW-DC 2.9"wide x 10.4" deep x 1.5" tall
	NCS1K-2KW-AC 2.9"wide x 10.4" deep x 1.5" tall
	NCS1K-FAN 3.5" wide x 5.5" deep x 3.4" tall
	NCS1K-SSD 3.1" wide x 3.3" deep x 0.5" tall
	NCS1K-CNTLR 6.4" wide x 11" deep x 1.1" tall
Weight	NCS 1002-K9 18.38 Kg (including FANs, SSD and CNTLR)
	NCS1K-2KW-DC 1.2 Kg
	NCS1K-2KW-AC 1.2 Kg
	NCS1K-FAN 0.8 Kg
	NCS1K-SSD 0.4 Kg
	NCS1K-CNTLR 1.5 Kg
Reliability and availability	
Mean time between failures (MTBF)	NCS1002-K9 103,320 hours
	NCS1K-CNTLR 510,050 hours
Latency (end to end)	
• SD-FEC - 20%	7.5 microseconds
• SD-FEC- 7%	15.7 microseconds
Storage temperature	-28ºC to 70ºC (-20ºF to 158ºF)
Operating temperature	
• Normal	0ºC to 40°C (32°F to 104°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).

Table 10.   Ordering Information

Part Number	Description
XR-NCS1K-621K9=	NCS 1002 IOS XR Software Release 6.2.1 RTU- USB key
NCS 1002-K9=	Network Convergence System 1002 20 QSFP28/QSFP+ slots
NCS1K-2KW-DC=	Network Convergence System 1002 2KW DC PSU
NCS1K-2KW-DC-CBL=	NCS1K DC cable with connector
NCS1K-2KW-AC=	Network Convergence System 1002 2KW AC PSU
NCS1K-2KW-AC-CBL=	NCS1K AC IEC C15 to NEMA L6-20P cable
NCS1K-FAN=	Network Convergence System 1002 Fan
NCS1K-SSD=	Network Convergence System 1002 SSD
NCS1K-CNTLR=	Network Convergence System 1002 Controller
ONS-CFP2-WDM=	100G QPSK/200G 16-QAM- WDM CFP2 Pluggable
NCS1002-LIC-K9=	Network Convergence System 1002 Licensed hardware
NCS1K-ACC-KIT=	NCS 1002 extended accessory kit

Cisco Capital

Financing to Help You Achieve Business Outcomes

Cisco Capital® can help you acquire the technology you need to achieve your business outcomes and stay competitive. We can help you reduce CapEx, accelerate your growth, optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital is available in more than 100 countries. Learn more.