Cisco Network Convergence System 5500 Series: 1.2-Tbps IPoDWDM Modular Line Card

NC55-6X200-DWDM-S

Product Overview

Based on the Cisco Global Cloud Index, digitalization is projected to grow global data center and public/private cloud network traffic more than 25 percent annually, resulting in a threefold increase by 2019. To help network providers meet these challenges, the Cisco® Network Convergence System 5500 Series is built with features such as extremely high port densities, deep packet buffering and hardware optimized forwarding supporting these types of deployments.

The Cisco NCS 5500 Series modular chassis provides wide variety of combo line cards to address the customer's need to use flexible interfaces and port densities along with full bandwidth utilization of the forwarding ASIC. The Cisco NCS 5500 Series also offers a cost-effective solution while being able to support up to a 1 million entries Forwarding Information Base (FIB) scale on this base version of the line card. These line cards are capable of advanced packet forwarding, segment routing, programmable network management, and telemetry along with the robust and mature features already present in 64-bit Cisco IOS® XR Software.

The Cisco® NCS 5500 Series IP over Dense Wavelength-Division Multiplexing (DWDM) collapses network layers by tightly integrating DWDM interfaces with the routing platform, thereby helping customers to increase operational efficiency by simplifying management and accelerating service delivery. This 1.2-Tbps throughput capable IPoDWDM line card provides customers with a flexible solution supporting multiple combinations of coherent DWDM interfaces that are software configurable to 100G/150G/200G rates in a single slot of the Cisco NCS 5500 Series Routers. This IPoDWDM line-card solution further reduces transport elements, while supporting advanced multilayer features such as proactive protection and control-plane interaction, dramatically reducing operating expenses and capital cost.

The Cisco NC55-6X200-DWDM-S line card (Figure 1) provides 6 ports of 100G/150G/200G with full line rate MACsec capability. This line card uses CFP2 Analog Coherent Optics (ACO) form factor transceivers and can be used in any of the NCS 5500 Series of modular chassis. This card is designed for base scale configuration needs and is supported starting with Cisco IOS XR Software Release 6.2.2.

Figure 1.   Cisco NCS 5500 Series 6-Port 100G/150G/200G DWDM with MACsec, Base Line Card

Features and Benefits

The Cisco NCS 5500 1.2-Tbps IPoDWDM line card has six coherent CFP2-ACO DWDM ports. The six CFP2 ports can be configured to work in 100G, 150G or 200G mode, providing operators with the flexibility to use the card in multiple-port combinations for up to a total of 1.2-Tbps capacity to suit their network needs.

This IPoDWDM line card is designed to provide the following benefits:

- Transport over fiber with very high Polarization Mode Dispersion (PMD)
- Support for 96 channels with ITU-T 50-GHz channel spacing
- Flexspectrum support for even tighter spacing between channels and continuous tuning of the transmit laser at 0.1-GHz granularity
- Software-configurable Soft Decision (SD) Forward Error Correction (FEC) algorithms for maximum optical performance and compatibility with existing Cisco NCS2K-400G-XP line card.

Enhanced Forward Error Correction Capability

The Cisco NCS 5500 1.2-Tbps IPoDWDM line card supports two types of software-configurable soft decision FEC algorithm on the CFP2-DWDM ports for highly efficient optical performance:

- SD FEC with 25 percent overhead: the default FEC mode
- SD FEC with 15 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. The FEC performance summary is detailed in Table 2.

Advanced Modulation Schemes

The Cisco NCS 5500 1.2-Tbps IPoDWDM Line Card features three software-configurable modulation schemes, allowing the operator to customize the spectral efficiency and reach characteristics of individual wavelengths:

- 200-Gbps coherent polarization-multiplexed 16-state Quadrature Amplitude Modulation (16-QAM) up to 1000 km.
- 150-Gbps coherent polarization-multiplexed 8-state Quadrature Amplitude Modulation (8-QAM) up to 1800 km.
- 100-Gbps Coherent Polarization-multiplexed Quadrature Phase Shift Keying (CP-QPSK) up to 4200 km.

Compared to 100-Gbps CP-QPSK, 16QAM modulation doubles the spectral efficiency, transmitting 200 Gbps per wavelength at the same baud rate while reducing un-regenerated reach. The main benefits of these advanced modulation schemes are:

- Strong OSNR performance
- Outstanding CD robustness, eliminating the need for any optical chromatic dispersion compensation solution
- Extended PMD robustness (three times better than 10-Gbps units)
- Very high spectral efficiency, allowing 100-Gbps wavelengths to be transmitted across a high number of ROADMs with negligible penalty

Supported FECs, speed, and modulation formats are detailed in Table 1 and Table 2.

Table 1. Supported FEC and Modulation Formats in NCS55001.2T IPoDWDM

EC Mode	Supported Speed	Modulation
SD FEC with 15% overhead	100G 150G 200G	CP-QPSK CP-8QAM CP-16QAM
SD FEC with 25% overhead	100G 150G 200G	CP-QPSK CP-8QAM CP-16QAM

Table 2. DWDM Receive-Side Optical Performance Summary

	15% SD FEC	25% SD FEC
100G CP-QPSK Modulation		
Pre-FEC BER	< 1.5x10E(-2)	< 2.5x10E(-2)
Post-FEC BER	< 1x10E(-15)	
OSNR (0.1nm RWB)	11.8 dB	11.3 dB
Input Power Sensitivity	-6 dBm to -14 dBm	
Extended Input Power Sensitivity	0 dBm to -20 dBm with 0.3 dB OSNR penalty	
CD Tolerance	< +/- 25,000 ps/nm with 0.5 dB OSNR penalty	
	< +/- 70,000 ps/nm with 3 dB OSNR penalty	
DGD Tolerance	< +/- 100 ps with 0.3 dB OSNR penalty	< +/- 100 ps with 0.5 dB OSNR penalty
150G CP-8QAM Modulation		
Pre-FEC BER	< 1.5x10E(-2)	< 2.5x10E(-2)
Post-FEC BER	< 1x10E(-15)	
OSNR (0.1nm RWB)	16.6 dB	16.1 dB
Input Power Sensitivity	-6 dBm to -14 dBm	
Extended Input Power Sensitivity	0 dBm to -20 dBm with 0.4 dB OSNR penalty	
CD Tolerance	< +/- 15,000 ps/nm with 0.5 dB OSNR penalty	
	< +/- 35,000 ps/nm with 2 dB OSNR penalty	
DGD Tolerance	< +/- 60 ps with 0.3 dB OSNR penalty	
200G CP-16QAM Modulation		
Pre-FEC BER	< 1.5x10E(-2)	< 2.5x10E(-2)
Post-FEC BER	< 1x10E(-15)	
OSNR (0.1nm RWB)	20.3 dB	19.6 dB
Input Power Sensitivity	-6 dBm to -14 dBm	
Extended Input Power Sensitivity	-6 dBm to -20 dBm with 0.7 dB OSNR penalty	
	0 dBm to -20 dBm with 1 dB OSNR penalty	
CD Tolerance	< +/- 10,000 ps/nm with 0.5 dB OSNR penalty	
	< +/- 23,000 ps/nm with 2 dB OSNR penalty	
DGD Tolerance	< +/- 60 ps with 0.3 dB OSNR penalty	< +/- 60 ps with 0.5 dB OSNR penalty

Performance Monitoring

The Cisco NCS 5500 1.2-Tbps IPoDWDM module provides support for both transparent and nontransparent signal transport performance monitoring. The digital wrapper channel is monitored according to G.709 (OTN) and G.8021 standards. Performance monitoring of optical parameters on the DWDM line interface includes 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 30-seconds,15-minute and 24-hour intervals as per G.7710.

Physical system parameters measured at the wavelength level, such as mean PMD, accumulated CD, or received OSNR, 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 module incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status of the card.

A detailed list of performance monitors is given in Table 3.

Table 3.   Performance Monitoring Parameters

Area	Parameter Name	Description
OTN	OTUk SM	
	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 PM	OPT	Transmit optical power
	LBC	Transmitter laser bias current
	OPR	Receiver optical signal 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 Polarization Mode Dispersion

MACsec Functionality

MACsec is a Layer 2 IEEE 802.1AE standard for encrypting packets between two MACsec-capable routers. MACsec secures the data on physical media, making it impossible for data to be compromised at higher layers. As a result, MACsec encryption takes priority over any other encryption method for higher layers, such as IPsec and SSL. MACsec provides encryption at the Layer 2, which is provided by the Advanced Encryption Standard (AES) algorithm that replaces the DES algorithm. MACsec uses the MACsec Key Agreement protocol (MKA) to exchange session keys, and manage encryption keys.

Advantages of Using MACsec Encryption

- **Client-Oriented Mode**: MACsec is used in setups where two routers that are peering with each other can alternate as a key server or a key client prior to exchanging keys. The key server generates and maintains the CAK between the two peers.
- **Data Integrity Check**: MACsec uses MKA to generate an Integrity Check Value (ICV) for the frame arriving on the port. If the generated ICV is the same as the ICV in the frame, then the frame is accepted; otherwise it is dropped.
- **Data Encryption**: MACsec provides port-level encryption on the line card of the router. This means that the frames sent out of the configured port are encrypted and frames received on the port are decrypted. MACsec also provides a mechanism where you can configure whether only encrypted frames or all frames (encrypted and plain) are accepted on the interface.
- **Replay Protection**: When frames are transmitted through the network, there is a possibility of frames getting out of the ordered sequence. MACsec provides a configurable window that accepts a specified number of out-of-sequence frames.
- **Support for Clear Traffic:** If configured accordingly, data that is not encrypted is allowed to transit through the port.

Cisco IOS XR Software Overview

The Cisco NCS 5500 Series is powered by the industry-leading carrier-class 64-bit version of Cisco IOS XR Software designed for operational efficiency, optimized utilization, and service agility (evolved programmable network). Cisco IOS XR Software offers rich features such as iPXE boot, autoprovisioning, native support for third-party application hosting, machine-to-machine interface, telemetry, and flexible software package delivery.

For a complete list of supported features, refer to Cisco Feature Navigator.

Software Requirements

This NCS 5500 Series IPoDWDM line card will be supported on Cisco IOS XR Software Release 6.2.2, 6.3.1or later.

Specifications

Tables 4 through 6 list primary specifications for the Cisco NCS 5500 Series modular chassis.

Table 4.   Features and Benefits of Cisco NCS 5500 Series Line Cards (Cisco IOS XR Software 6.2.2 or Beyond)

Feature	Specification
Integrated interface	100G QPSK/150G 8QAM/200G 16QAM CFP Ports
Industry-leading carrier-class Cisco IOS XR Software	Visibility and telemetry Machine-to-machine interface Application hosting Flexible platform and packaging Modularity Automation
Management ports	Provides easy access to system console
External USB port	Helps simplify image and file management

Feature	Specification
Embedded USB (eUSB) storage	Flash memory devices for storing software image, configuration, logging, and recovery
Power consumption	Ultralow power per Gigabit Ethernet
Redundancy	Redundant fan tray Redundant AC or DC power supply

Table 5.   NCS 5500 Series 6 Ports of 200GE Base Scale Line Card

Feature	Specification
PID	NC55-6X200-DWDM-S
Specifications	• 6 ports 100G/150G/200G CFP2 IPoDWDM line card at base scale with MACsec • 2 forwarding ASICs • A minimum of 256k IPv4 or 64k IPv6 routes in the FIB. (350k IPv4 or 160k IPv6 Internet prefix distribution) and 786k IPv4 /32 and /24 routes shared with MPLS labels and MAC addresses below • On-chip tables for 786K IPv4 host routes, MAC, and MPLS labels • On-chip Ternary Content-Addressable Memory (TCAM) for network Access Control Lists (ACLs) and QoS
Power consumption	Typical: 863 watts Maximum: 1060 watts
Physical specifications	Height: 1.68 in (42.65mm) Width: 16.89 in (429.0mm) Depth: 17.05 in (433.17mm) Weight: 14.0 lbs (6.35 kg) without optics

Table 6.   Software Feature Support on NCS 5500 Modular Chassis in Cisco IOS XR Software Release 6.2.2, 6.3.1. or beyond

Note: List of supported features is not exhaustive, and some features are supported in later software releases.

Description	Specification
Layer 2	• Layer 2 switch ports • IEEE 802.1Q VLAN encapsulation/Q-in-Q encapsulation • IEEE 802.1ad • IEEE 802.1ae • Cisco bundle Ethernet technology (up to 32 ports per Ethernet bundle) • Link Aggregation Control Protocol (LACP): IEEE 802.3ad • Jumbo frames on all ports (up to 9216 bytes) • L2 ingress Access Control List (ACL) • L2 AC-AC cross-connect • Integrated Routing and Bridging (IRB) • Ethernet Flow Point (EFP) and VLAN trunks • Virtual Router Redundancy Protocol (VRRP)
Layer 3	• IPv4 and IPv6 unicast • Layer 3 interfaces: physical and subinterfaces • Routing protocols: static, Open Shortest Path First (OSPFv2), OSPFv3, Intermediate System to Intermediate System (ISIS), ISISv6, and Border Gateway Protocol (BGP) • 32-way Equal-Cost Multipath (ECMP) • L3 ingress and egress IPv4 ACL and IPv6 ACL • Bidirectional Forwarding Detection (BFD) • Cisco bundle Ethernet technology (up to 32 ports per Ethernet bundle) • Link Aggregation Control Protocol (LACP): IEEE 802.3ad • Jumbo frame support (up to 9216 bytes) • Virtual Router Redundancy Protocol (VRRP) • Layer 3 Virtual Private Network (L3VPN)

Description	Specification
MPLS	• Label switching • LDP • MPLS traffic engineering • Ethernet over MPLS (EoMPLS)
Segment routing	• Segment routing–based transport • ISIS extensions to segment routing • OSPF extensions to segment routing • BGP egress peering engineering • Segment Routing Traffic Engineering (SR-TE) • Segment routing Topology Independent Loop-Free Alternatives (TI-LFA)
Quality of Service (QoS)	• Quality of Service (QoS) • Ingress classification based on class of service (L2), IP differentiated services code point (L3), IP ACL (L3/L4), IP precedence (type of service) (L3) • DSCP marking • 8 number of queues for user traffic • Support for priority queuing
Automation	• Zero-Touch Provisioning (ZTP), iPXE • Configuration management • Network Configuration Protocol (NETCONG/YANG model)
Security	• Provides comprehensive network security features, including ACLs; control-plane protection; management plane protection; routing authentications; Authentication, Authorization, and Accounting (AAA) and Terminal Access Controller Access-Control System Plus (TACACS+); Secure Shell (SSH) Protocol; SNMPv3; and RPL support • Layer 2 ingress ACLs • Layer 3 ingress ACLs
Management	• MIB, XML, JSON, GPB, and SNMP • MPLS OAM (Label Switched Path [LSP] ping, LSP traceroute) • Ethernet OAM

Supported Transceiver Modules

The supported Transceiver Module is the well-known Cisco ONS-CFP2-WDM.

Environment

Table 7.   Environmental Properties

Property	Cisco NCS 5500 Series
Operating temperature	32 to 104°F (0 to 40°C)
Nonoperating (storage) temperature	–40 to 158°F (–40 to 70°C)
Operating humidity	5% to 95% (noncondensing) Note: Not to exceed 0.024 kg water or dry air
Storage (relative) humidity	5% to 95% at 40°C per NEBS GR-63-Core Note: Not to exceed 0.024 kg water or dry air
Altitude	0 to 10,000 ft (0 to 3000m)
Power inputs	Worldwide ranging AC (90–265V; 50–60 Hz) Worldwide ranging DC (–40V to –72V)
Air flow	Front to back

Regulatory Standards Compliance

Table 8.   Regulatory Standards Compliance: Safety and EMC

Specification	Description
Regulatory compliance	Products should comply with CE markings according to directives 2004/108/EC and 2006/95/EC

Specification	Description
Network Equipment Building Standards (NEBS)	Designed to meet GR-63-CORE and GR-1089-CORE 55C short term operation per GR63-CORE not supported when running 16QAM with Encryption on all ports
Safety	• UL 60950-1 Second Edition • CAN/CSA-C22.2 No. 60950-1 Second Edition • EN 60950-1 Second Edition • IEC 60950-1 Second Edition • AS/NZS 60950-1 • GB4943
EMC standards	• 47CFR Part 15 (CFR 47) Class A • AS/NZS CISPR22 Class A • CISPR22 Class A • EN55022 Class A • ICES003 Class A • VCCI Class A • EN61000-3-2 • EN61000-3-3 • KN22 Class A • CNS13438 Class A
EMC immunity	• EN55024 • CISPR24 • EN300386 • KN 61000-4 series
RoHS	The product is RoHS-6 compliant with exceptions for leaded-Ball Grid-Array (BGA) balls and lead press-fit connectors.

Get additional information related to NCS 5500 regulatory compliance and safety standards.

Ordering Information

Table 9. Ordering Information for NCS5500 Series Line Cards

Part Number	Subcomponent	Product Description
Hardware		
NC55-6X2H-DWDM-BM		NCS 5500 6X200G DWDM MACsec Base
	NC55-6X200-DWDM-S	NCS 5500 6x200G DWDM MACsec Base Line Card
	NC55-6P-DWDM-RTU	NCS 5500 6X200G DWDM MACsec Base Right To Use License
NC55-6X2H-DWDM-BM=		NCS 5500 6X200G DWDM MACsec Base Spare–
	NC55-6X200-DWDM-S	NCS 5500 6x200G DWDM MACsec Base Line Card
	NC55-6P-DWDM-RTU	NCS 5500 6X200G DWDM MACsec Base Right To Use License
NC55-2H-DWDM-BM		NCS 5500 6X200G DWDM MACsec PAYG Base
	NC55-6X200-DWDM-S	NCS 5500 6x200G DWDM MACsec Base Line Card
	NC55-2H-DWDM-RTU	NCS 5500 200G Bandwidth DWDM Base Right To Use License

Part Number	Subcomponent	Product Description
NC55-2H-DWDM-BM=		NCS 5500 6X200G DWDM MACsec PAYG Base Spare
	NC55-6X200-DWDM-S	NCS 5500 6x200G DWDM MACsec Base Line Card
	NC55-2H-DWDM-RTU	NCS 5500 200G Bandwidth DWDM Base Right To Use License
Software		
XR-NC55-P-06.02		Cisco IOS XR Software 6.2.2 Release software image
XR-NC55-PK9-06.02		Cisco IOS XR Software 6.2.2 Release software crypto image
Optional Licenses		
NC55-50G-DWDM-LIC		NCS 5500 Series 50G Bandwidth MACsec license
NC55-50G-MAC-LIC		NCS 5500 Series 50G Bandwidth DWDM license
Optics		
ONS-CFP2-WDM		100G QPSK/200G 16-QAM - WDM CFP2 Pluggable

Part number	Product description
Flexible Consumption Model Software Licenses	
ESS-100G-RTU-1	NCS 5500 Core & Aggregation Essentials SW RTU v1.0 100G
ADV-100G-RTU-1	NCS 5500 Core & Aggregation Advantage w/o Essentials SW RTU v1.0 100G
ADN-100G-RTU-1	NCS 5500 Core & Aggregation Advantage w/ Essentials SW RTU v1.0 100G
ESS-100G-SIA-3	NCS 5500 Core & Aggregation Essentials SIA per 100G 3-5 Year Subscription
ADV-100G-SIA-3	NCS 5500 Core & Aggregation Advantage w/o Essentials SIA per 100G 3-5 Year Subscription
ADN-100G-SIA-3	NCS 5500 Core & Aggregation Advantage w/ Essentials SIA per 100G 3-5 Year Subscription
ESS-100G-SIA-5	NCS 5500 Core & Aggregation Essentials SIA per 100G 5-10 Year Subscription
ADV-100G-SIA-5	NCS 5500 Core & Aggregation Advantage w/o Essentials SIA per 100G 5-10 Year Subscription
ADN-100G-SIA-5	NCS 5500 Core & Aggregation Advantage w/ Essentials SIA per 100G 5-10 Year Subscription

For details on the Cisco Network Convergence System 5500 Series Perpetual Software Licenses, refer to this data sheet and details on the flexible consumption model for the NCS 5500 Series are available in the data sheet for the IOS XR Software flexible consumption model.

Warranty

The Cisco NCS 5500 Series has a 1-year limited hardware warranty. The warranty includes hardware replacement with a 10-day turnaround from receipt of a Return Materials Authorization (RMA).

Service and Support

Cisco offers a wide range of services to help accelerate your success in deploying and optimizing the Cisco NCS 5500 Series. These innovative Cisco Services offerings are delivered through a unique combination of people, processes, tools, and partners, and they are focused on helping you increase operating efficiency and improve your data center network. Cisco Advanced Services uses an architecture-led approach to help you align your data center infrastructure with your business goals and achieve long-term value. Cisco SMARTnet™ Service helps you resolve mission-critical problems with direct access at any time to Cisco network experts and award-winning resources. With this service, you can take advantage of the Cisco Smart Call Home service, which offers proactive diagnostics and real-time alerts on your Cisco NCS 5500 Series. Spanning the entire network lifecycle, Cisco Services offerings help increase investment protection, optimize network operations, support migration operations, and strengthen your IT expertise.

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For More Information

For more information about the Cisco NCS 5500 Series, visit Cisco Network Convergence System 5500 Series.

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