Cisco Network Convergence System 4000 Series DWDM Line Cards

Incorporating nLight Silicon innovations, the Cisco NCS 4000 supports a range of line cards offering aggregation and transport of high density packet and OTN client interfaces over a DWDM infrastructure.

2 x 100G CP-DQPSK - Full C Band Tunable Line Card

The NCS 4000 2 x 100G DWDM Line Card can transport two 100 Gigabit Ethernet or OTU-4 signals over a 50-GHz spaced, 50-GHz stabilized, ITU-compliant wavelength with more than 4500 km of unregenerated reach (Figure 1). The card also features two pluggable client interfaces that can be used to provide transponder functionality, mapping each client signal to a single DWDM line interface. This trunk interface is fully compatible with the 100 Gigabit DWDM interfaces available on the Cisco NCS 2000 and Cisco ONS 15454 MSTP, as well as the 100 Gigabit IP-over-DWDM module on the Cisco Carrier Routing System (CRS).

Figure 1.   NCS 4000 2x100G DWDM Line Card

The trunk DWDM ports support an ITU-compliant, 50-GHz spaced optical interface tunable to 96 wavelengths across the C band. They feature a software-configurable baud rate between 27.952 and 31.241 Gbaud, depending on FEC selection, plus a G.709v3 OTU-4 digital wrapper. When operated within the outlined specifications, the CP-DQPSK DWDM Trunk Interface can operate with a post-FEC bit error rate (BER) better than 10E-15.

The trunk ports support three different software-configurable FEC coding options, which cannot be disabled:

- GFEC: Standard G.975 Reed-Solomon algorithm with 7-percent overhead.
- Ultra FEC (UFEC): Standard G.975.1 (Sub-clause I.7) with 20-percent overhead. This FEC scheme uses two orthogonally concatenated BCH super FEC codes. The constructed code is decoded iteratively to rebuild the original frame.
- High-gain FEC (HG-FEC): HG-EFEC with 7-percent overhead provides better performance than standard G.975.1 7-percent overhead enhanced FEC. This EFEC, thanks to the reduced overhead and lower bit rate, is suitable for applications where 100 Gigabit wavelengths pass through a large number of ROADM nodes with limited pass-band performance.

The two trunk interfaces and the two client interfaces can be configured independently with different FEC schemes. The client ports support a standard G.975 Reed-Solomon FEC algorithm, which can be enabled or disabled through software configuration.

Extending nLight Silicon to the client-facing interface, the client ports use Cisco CPAK pluggable transceivers supporting 100GBASE-SR10, 100GBASE-LR-4, and the OTU-4 equivalent interfaces. The extremely compact dimensions and low power consumption of CPAK enable superb system density of greater than one 100 Gigabit Ethernet transponder per rack unit.

Figure 2.   Cisco CPAK 100GBASE-LR4 Module (left) 100GBASE-SR10 Module (right)

The NCS 4000 2 x 100G DWDM Line Card offers multiple configuration capabilities:

- Two 100 Gigabit Ethernet DWDM transponders: Each client is mapped to one of the two 100 Gigabit Ethernet DWDM interfaces providing up to thirty-two 100 Gigabit DWDM transponders in a Cisco NCS 4016 chassis.
- One 100 Gigabit DWDM regenerator: The two 100 Gigabit DWDM interfaces are connected back-to-back in the card to provide 3R regeneration of 100 Gigabit DWDM signals.
- Two 100 Gigabit DWDM interfaces for OTN line cards: The two 100 Gigabit DWDM interfaces are connected through the chassis backplane directly to the 100 Gigabit framers of an OTN line card placed in a paired slot within its quadrant of the chassis, providing DWDM conversion of OTN traffic.

In regenerator mode, an IP-over-DWDM configuration can be enabled to support proactive protection messaging between IP-over-DWDM router interfaces. If failure occurs on one side of the regenerator, ODUk Alarm Indication Signal (ODUk-AIS) is generated and propagated on the other side, while an OTUk Backwards Defect Indicator (OTUk-BDI) is sent back on the same side as defined by the ITU G.709 standard.

In transponder mode, protection of 100GBASE-LR4 client signals is provided via a Y-cable mechanism, whereby client signals are passively split among two separate line cards via an external module. The service is thus protected against both fiber and line card failures, with recovery in less than 50 milliseconds.

Product Specifications

Table 1.   Cisco NCS 4000 2 x 100G Physical Specifications

Unit	Maximum Power (W)	Typical Power (W)	Weight	Dimensions (H x W x D)
2 Port	370	315	5.5 lbs (2.5 kg)	10 x 12.5 x 1.55 in. (254 x 317.5 x 39.37 mm)

Table 2. DWDM Specifications

Parameter	Value
Bit rate	27.952 Gbaud ±20 ppm (OTU4 with GFEC or HG-FEC 7% OH) 31.241 Gbaud ±20 ppm (OTU4 with UFEC 20% OH)
Automatic laser shutdown and restart	ITU-T G.664 (06/99)
Nominal wavelengths (λTnom)	Full-tunable between 1528.77 and 1566.72 nm (C-Band - 50 GHz)
Connector type (TX/RX)	LC, duplex (shuttered)
Optical Transmitter	
Type	CP-DQPSK modulation format
Output power (PTmin)	-2 to +0.5 dBm (metro edge performance) -1 to +1.5 dBm (extended performance)
Required optical return loss, minimum (ORLmin)	27 dB
Laser safety class	1
Optical Receiver	
Chromatic dispersion tolerance (DLRmax)	+/- 70,000 ps/nm
Overload	0 dBm
Receiver reflectance (maximum)	30 dB
Input wavelength bandwidth (λc_rx)	Between 1528.77 and 1566.72 nm (C-Band - 50 GHz)

Table 3. DWDM Receive-Side Optical Performances

CD Tolerance	FEC Type	Pre-FEC BER	Post-FEC BER	Input Power Sensitivity	DGD	OSNR (0.5 nm RWB)
0 ps/nm	UFEC (20% OH)	<1x10E (-2)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	7.5 dB
0 ps/nm					180 ps	8.0 dB
+/- 70,000 ps/nm					180 ps	9.0 dB
0 ps/nm	HG-FEC (7% OH)	<4.0x10E (-3)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	8.0 dB
0 ps/nm					180 ps	8.5 dB
+/- 70,000 ps/nm					180 ps	9.5 dB
0 ps/nm	GFEC (7% OH)	<1.0x10E (-3)	<10E (-15)	0 to -14 dBm (-20 dBm with 0.5 dB of OSNR penalty)	-	9.5 dB
0 ps/nm					180 ps	10.0 dB
+/- 70,000 ps/nm					180 ps	11.0 dB

Table 4. 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

Area	Parameter Name	Description
	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

Warranty Information

Find warranty information on Cisco.com at the Product Warranties page.

Ordering Information

To place an order, visit the Cisco Ordering Home Page and refer to Table 5. To download software, visit the Cisco Software Center.

Table 5.   Ordering Information

Part Number	Description
NCS4K-2H-W	NCS 4000 2 x 100G CP-DQPSK - Full C band Tunable
ONS-CPAK-LR4=	100GE/OTU4 Multi-Rate CPAK Pluggable - LR4
ONS-CPAK-SR10=	100GE/OTU4 Multi-Rate CPAK Pluggable - SR10

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