Cisco QSFP-DD Pluggable Open Line System (QSFP-DD OLS)

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The QSFP-DD OLS is a pluggable open line system solution that can be directly hosted on a Cisco router.

Product overview

The Cisco® QSFP-DD Open Line System (QSFP-DD OLS) is a pluggable optical amplifier module that, together with the channel breakout options (described later), provides a simple yet powerful open line system solution in a QSFP-DD pluggable form factor (also compatible with QSFP28 formfactor) that can be directly hosted on a Cisco router.

Cisco offers a comprehensive range of pluggable optical modules in the Cisco pluggables portfolio. The wide variety of modules gives customers flexible and cost-effective options for all types of interfaces. Thanks to the miniaturization of the technology with a 7-nm manufacturing procedure and innovation in silicon photonic technology, it was possible to squeeze a 400G-capable Digital Coherent WDM interface within a QSFP-DD form factor. Today Cisco 800ZR optics is built with a 4-nm CMOS manufacturing procedure.

In parallel, Cisco's Routed Optical Networking (RON) strategy was born, which envisioned a router-to-router architecture. Routed Optical Networking, part of the Converged SDN Transport solution, is an architecture that delivers improved operational efficiencies and simplicity. The solution works by merging IP and private line services onto a single layer where all the switching is done at Layer 3. Routers are connected with standardized 400G ZR/ZR+ coherent pluggable optics. The Cisco vision for this new solution is to leverage the fundamental lifecycle changes happening in routers and optics and utilize those technologies in a different architecture. These technological advancements result in massive scalability in the Cisco 8000, NCS 5000, and NCS 500 routers, a smaller footprint and higher performances 400G ZR/ZR+ coherent optics, and simpler DWDM line systems, telemetry software, and automation, all leading to a new network paradigm. The QSFP-DD ZR, ZR+ and Bright ZR+ interfaces are the foundation of the Cisco Routed Optical Networking solution.

The transmit / receive power of the Coherent optics wasn't always sufficient to traverse the span effectively (especially when operators required more channels to be integrated introducing patch panel losses). This required operators to deploy an optical amplifier at the end points of a link/fiber span connecting the routers in the Cisco RON solution, to achieve a longer than 40km reach.

Cisco designed an ingenious solution to collapse the optical line system functionalities into a pluggable form factor. The QSFP-DD open line system (QSFP-DD OLS) can be directly deployed in a router alongside other QSFP-DD optics, using any available QSFP-DD port. This "pluggable open line system" perfectly integrates into the Cisco Routed Optical Networking architecture by hosting line system abilities directly on a router.

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The latest generation of Cisco 800ZR+, 400G Bright and 400G ULH QSFP-DD optics are able to launch at a healthy +1dBm transmit power or more. This launch power is sufficient for 80-120Km link operation for a single channel. But if the required reach is beyond this range or if the fiber loss is higher than typically expected or if the operator desires to have a multi-channel solution, then the QSFP-OLS module is able to provide the necessary amplification to make the solution feasible, while being co-hosted with these coherent interfaces directly on the router itself. The ability to extend the reach and capacity of a single fiber span in a Cisco Routed Optical Networking architecture is the standout value of this QSFP-DD OLS solution, immaterial of which interface is being used.



Figure 1.
The QSFP-DD pluggable open line system

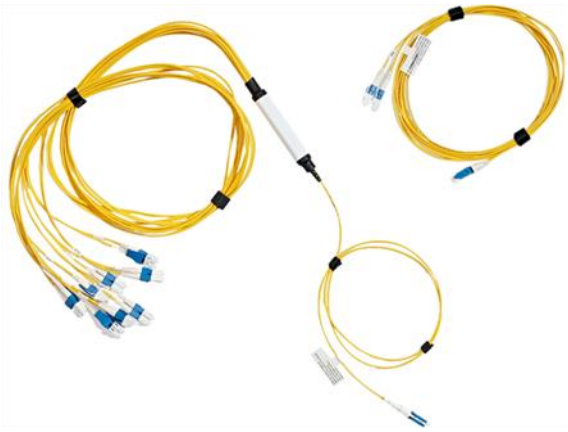


Figure 2.
1x8 breakout cable (left), CS-LC cable (right)

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Features and benefits

The QSFP-DD OLS itself is a pluggable module that integrates two variable-gain amplifiers (a pre-amplifier and a booster amplifier) to amplify both the up and down fiber streams. Various channel breakout options are available to combine or separate each channel from a coherent DWDM optical source. The TX-EDFA acting as a Booster amplifier recovers the loss of the optical Multiplexer unit, and it provides an optical power boost before the link. The RX-EDFA acting as Preamp recovers the link loss, bringing the optical signal to a power level optimized for the receivers after the Demultiplexer unit.

The QSFP-DD OLS can extend the reach of a 400G QSFP-DD ZR/ZR+ link (from 40 to 130 km or longer, depending on fiber characteristics), the channel count, and the line rate of the wavelength.

To integrate a pair of ingress and egress ports on the QSFP-DD OLS pluggable faceplate, industry-standard CS-UPC connectors are used. The QSFP-DD-OLS has two bidirectional optical ports: the COM-RX/TX that shall be connected to the Multiplexer / Demultiplexer units, and the LINE-TX/RX that shall be connected to the fiber link. The optical connectors are 2x CS-UPC, each providing the characteristics and simplicity of the duplex LC connector into a smaller footprint, hence allowing four physical ports to fit on the faceplate of the QSFP-DD form factor. Since the other optical units (Coherent Interfaces modules, DWDM Add/Drop multiplexers, and fiber patch panels) normally use LC connectors, a hybrid adaptation patch cord with a CS dual connector on one side and 2x LC connector on the other side is available to interconnect the QSFP-DD-OLS module with other optical equipment.

Optical safety is enabled by default to:

- Switch off each optical amplification section independently in case Optical LOS is detected at its input
- Set the TX-EDFA in Automatic Power Reduction (APR) at 8dBm in case a LOS is cleared at the COM-RX port, but LOS is still present at LINE-RX (this prevents the launch of high optical power on an open line)

An N-channel WDM line system can be built using the QSFP-DD OLS and its associated components:

A single channel system

It requires no special components to add and drop. A 5 meter long CS-LC cable (ONS-CAB-CS-LC-5) is available to interconnect the LC ports of the QSFP-DD coherent source or the span fibers with the CS ports of the QSFP-DD OLS. Two of these cables are needed for each end point of a single channel system. All the gain of the amplifiers is available for the single channel to be transported in this case. The channel can be of any size.

A 4-channel system

To achieve a 4-channel transmission, an FLD-4 (fixed 4 channel OADM) can be used. This passive optical Add/Drop unit is able to multiplex/demultiplex 4 channels over the 100GHz ITU grid. There are 10 different Cisco FLD-4s (each managing 4 adjacent channels) available, each identified by the xy.x numbers and covering the whole C-band. Only 6 of the 10 FLD-4 PIDs are compatible with the QSFP-DD-OLS optical operating bandwidth as listed in Table 1. A 5 meter long CS-LC cable (ONS-CAB-CS-LC-5) is available to interconnect the LC ports of the A/D or the span fibers with the CS ports of the QSFP-DD OLS. The channel can be of any size.

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An 8-channel system

To achieve an 8-channel transmission, an 8 channels breakout cable can be used. This breakout cable (ONS-BRK-CS-8LC) is a dual fanout 1x8 cable with an embedded passive splitter and coupler. The cable has one dual CS/UPC connector on the common port that can be directly connected to the COM port of the QSFP-DD-OLS and 8 dual LC/UPC (labelled CHi-RX/TX) that can be connected to a Coherent Optical Interface modules port. **The cable is grid-less so any port can support any optical frequency without any constraint of frequency or channels spacing (typically 200GHz channels).**

A 16-channel system

To achieve a 16-channel transmission, a 16 channels breakout cable can be used. This breakout cable (ONS-BRK-CS-16LC) is a dual fanout 1x16 cable with an embedded passive splitter and coupler. The cable has one dual CS/UPC connector on the common port that can be directly connected to the COM port of the QSFP-DD-OLS and 16 dual LC/UPC (labelled CHi-RX/TX) that can be connected to a Coherent Optical Interface modules port. **The cable is grid-less so any port can support any optical frequency without any constraint of frequency or channels spacing (typically 100GHz channels)**

A 32-channel system

To achieve a 32-channel transmission, a 64-channel mux/dmx can be used (of which 32 channels are used). The NCS1K-MD-64-C is a passive optical Add/Drop unit able to multiplex/demultiplex up to 64 channels over the 75GHz grid. The operating bandwidth of the QSFP-DD-OLS allows a subset of the MD-64 channels to be used: form port CH-19 (194.75 THz) to port CH-50 (192.425 THz).

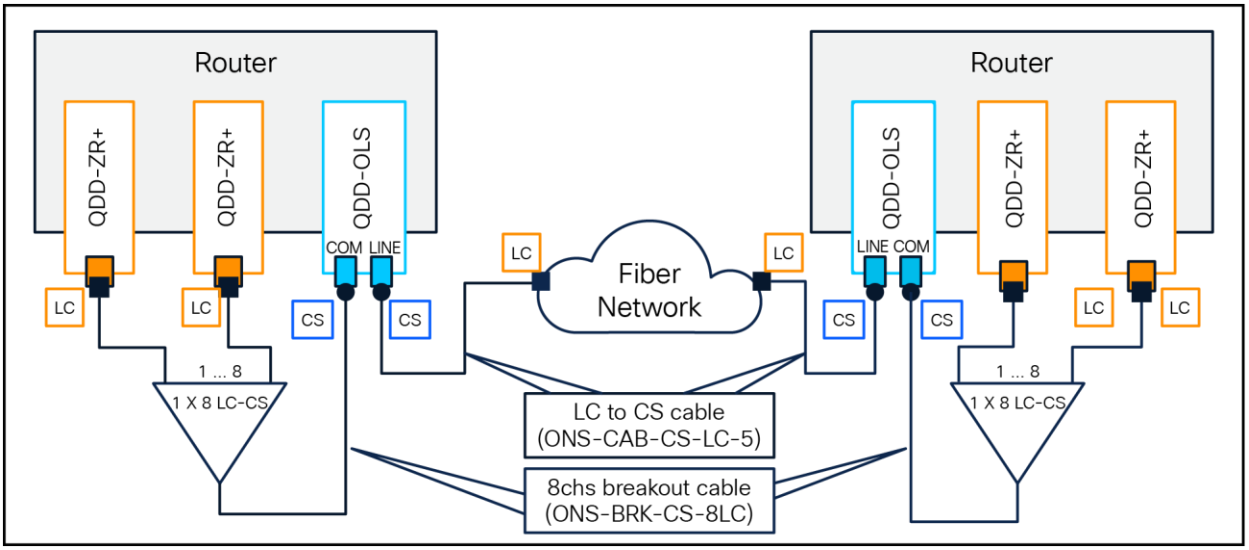


Figure 3.
An 8-channel point-to-point configuration with the QSFP-DD OLS

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Product specifications

A simple on-paper calculation considering the QSFP-DD OLS gain, power in/out of the fiber, the N-channel Add/Drop device, and the sensitivity of the QSFP-DD optical source can yield a link design. Cisco is readily available to support customers for links design.

The following table lists out the Add/Drop options to achieve an N-channel system.

Table 1. Add/Drop options for QSFP-DD line system solution

N-channel system	Add/Drop device (per end point)
1 channel	2x ONS-CAB-CS-LC-5 cables (5 m long)
4 channels	1x of the FLD-4 modules within this list: 15216-FLD-4-39.7=, 15216-FLD-4-42.9=, 15216-FLD-4-46.1=, 15216-FLD-4-49.3=, 15216-FLD-4-52.5=, 15216-FLD-4-55.7= 2x ONS-CAB-CS-LC-5 cables (5 m long)
8 channels (200 GHz spacing recommended)	1x ONS-BRK-CS-8LC cable (2 m long) 1x ONS-CAB-CS-LC-5 cables (5 m long)
16 channels (100 GHz spacing recommended)	1x ONS-BRK-CS-16LC cable (2 m long) 2x ONS-CAB-CS-LC-5 cables (5 m long)
32 channel (75 GHz)	1x NCS1K-MD-64-C multplexer / demultiplexer 2x ONS-CAB-CS-LC-5 cables (5 m long)

The following table lists out the specification of various components that form the QSFP-DD Open Line system solution.

Table 2. Specifications of the QSFP-DD OLS components

Parameter	Specification
QSFP-DD OLS – TX Booster EDFA	
Optical Gain range	7 to 25 dB
Input Power range	–25 to 10 dBm
Max Output Power	0 to 17 dBm
QSFP-DD OLS – RX Preamplifier EDFA	
Optical Gain range	3 to 25 dB
Input Power range	–24 to 14 dBm
Max Output Power	1 to 17 dBm

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Parameter	Specification
QSFP-DD OLS – Common	
Wavelength range	192.375 to 194.775 THz
Power dissipation	3.5 W
Voltage Specification	Nominal Operating Voltage 3.3V
Temperature Specification	Operating case temperature range (min-max): 0 to +70 C Storage temperature tange (min-max): -40 to +85 C
ONS-BRK-CS-8LC Insertion Loss	9.5 to 11 dB
ONS-BRK-CS-16LC Insertion Loss	12 to 13.5 dB

Platform support

The Cisco QSFP-DD OLS can be directly configured and managed by the IOS® XR SW on board Cisco routers. Below are the router platforms/products and software release that are currently supported.

Table 3. Supported platforms

Product Family	Products Supported	IOS Images (Feature Sets) Supported
NCS 540	N540-24Q8L2DD-SYS	IOS XR 24.1.1
NCS 55xx	NCS-55A2-MOD-S	IOS XR 24.4.1
NCS 55xx	NC55-MOD-A-S(E)-S With 2x400G MPA-2D4H	IOS XR 24.1.1
NCS 57xx	NCS-57C3-MOD-S	IOS XR 7.10.1
NCS 57xx	NCS-57B1-6D24/5DSE	IOS XR 7.10.1
Cisco 8000	8201-32FH	IOS XR 24.1.1
Cisco 8000	8201-24H8FH	IOS XR 24.1.1
Cisco 8000	8201	IOS XR 24.1.1
Cisco 8000	88-LC0-36FH	IOS XR 24.2.1
Cisco 8000	8202-32FH-M	IOS XR 24.2.1
Cisco 8000	88-LC0-34H14FH	IOS XR 24.2.1
Cisco 8000	8608	IOS XR 24.2.1
Cisco 8000	88-LC0-36FH-M	IOS XR 24.2.1

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Ordering information

Table 4. List of orderable PIDs associated with the QSFP-DD OLS solution

Product ID	Description
ONS-QDD-OLS=	QSFP-DD Open Line System, Pre and Bst EDFA, 2.4 THz C-Band
ONS-CAB-CS-LC-5=	Duplex optical patchcord, LC to CS connectors, 5m
ONS-BRK-CS-8LC=	8-chs Colorless Flex-spectrum Mux/Dmx - LCs to CS connector
ONS-BRK-CS-16LC=	16-chs Colorless Flex-spectrum Mux/Dmx - LCs to CS connector
15216-FLD-4-39.7=	Edge 4-Ch Bi-Directional OADM Mod 1539.77 to 1542.14
15216-FLD-4-42.9=	Edge 4-Ch Bi-Directional OADM Mod 1542.94 to 1545.32
15216-FLD-4-46.1=	Edge 4-Ch Bi-Directional OADM Mod 1546.12 to 1548.51
15216-FLD-4-49.3=	Edge 4-Ch Bi-Directional OADM Mod 1549.32 to 1551.72
15216-FLD-4-52.5=	Edge 4-Ch Bi-Directional OADM Mod 1552.52 to 1554.94
15216-FLD-4-55.7=	Edge 4-Ch Bi-Directional OADM Mod 1555.75 to 1558.17
NCS1K-MD-64-C=	NCS 1000 64 chs Odd Mux/Demux Patch Panel - C-band

Table 5. List of associated typical 400G coherent optical sources

Product ID	Description
QDD-400G-ZR-S=	QSFP-DD transceiver module, coherent DCO, 400G-ZR
QDD-400G-ZRP-S=	QSFP-DD transceiver module, coherent DCO, 400G-ZR+
DP04QSDD-HE0=	QSFP-DD 400G ZR+ - High Tx Power
DP04QSDD-HK9=	QSFP-DD 400G ZR+ - High Tx Power - OTN
DP01QSDD-LK9=	QSFP-DD 400G ZR+ - High Tx Power - OTN - 100G BW

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Warranty

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, Social, and Governance (ESG) initiatives and performance is provided in Cisco's CSR and sustainability reporting.

Table 6. 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
Material	Product packaging weight and materials	Contact: environment@cisco.com

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Document history

New or Revised Topic	Described In	Date
1st draft at the launch of the QSFP-DD OLS	Whole datasheet	July 11, 2023
Updates to original draft	Product Overview and Platform Support	June 26, 2024

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