400G Transceiver Trends

Introduction

Today, 100 GbE is one of the most widely used technology on the Telecom/Datacom market. But 5G application as well as the upgrade of service like 4K VR, Internet of Things (IoT), and cloud computing increases significantly the demand for bandwidth. Indeed, we can see a 26% annual growth rate of network traffic. Here comes the 400 GbE considered as the next generation mainstream port technology. The 400 GbE technology provides the ability to significantly improve the network bandwidth by using the installed set-up of interconnection helping operators and customers to cope with the massive growth of data traffic.

Today, IEEE, ITU, OIF, and MSA have already released standards for 400 GbE and are working on 800 GbE standards to cover the future growth of data traffic.

Skylane Optics and 400 GbE?

Skylane Optics investigated on the coming trends for 400 GbE transceivers technology and as for 100 GbE application, the 400 GbE transceivers have been developed following two main points of being high density and low power consumption. Three main formats are coming on the market, the CFP8, a bit smaller than CFP2, the OSFP having his own thermal management and the QSFP-DD being backward compatible with the current QSFP28.

Skylane Optics is coming with a full range of transceiver for 400 GbE application to cover all the applications and demand of the Telecom/datacom market.

The below schematics shows the different standards based on distances:

≤3m	3m - 100m	500m – 2km	10km – 40km	80km and above
DAC	AOC	DR4	LR4	coherent ZR
AOC	SR8	DR4+	LR8	
SR8		FR4	ER4	

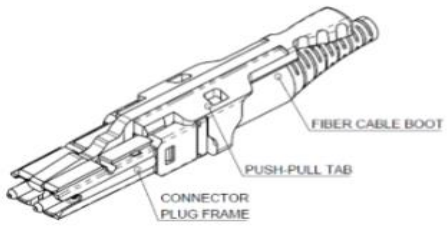
Standard naming based on distance

400GbE Technology

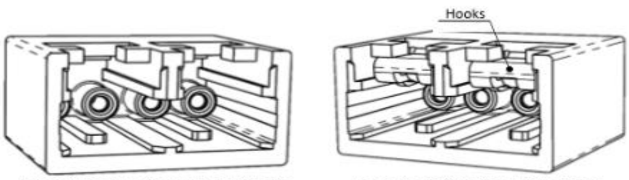
Single Mode Transceivers

Transceivers using 8 × 50G PAM4 like FR8: The “8” indicates the use of eight wavelengths with each one operating at 50G PAM4. The eight wavelengths are multiplexed into one fibre through a duplex LC interface.

Some transceivers as the 2 × FR4 also uses eight lasers but these are divided into 2 groups with four wavelengths each. These two groups are multiplexed each into one fiber and the transceiver offers a 2 × 200G interface on dual CS connectors.



CS Connector appearance

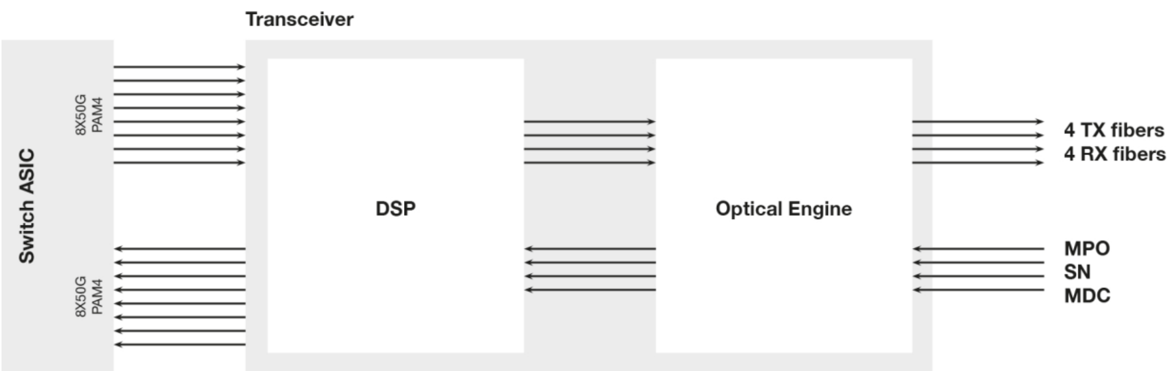


Receptacle interface without hooks | Receptacle interface with hooks

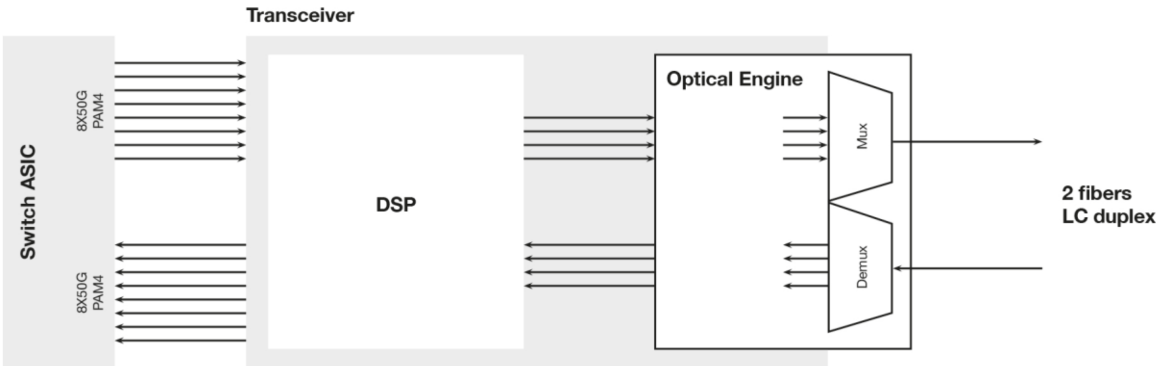
Dual CS Receptacle appearances

Transceivers using 4 × 100G PAM4: Those are the current market focus and use four lanes with 100G PAM4. Here we can group the transceivers into “Multi Fibre” and “Two Fibre” types. The key element in these transceivers is the DSP with its gearbox function.

For instance, in the DR4 transceivers the DSP converts the 8 × 50G PAM4 electrical host signals into 4 × 100G electrical lanes towards the optical engine. At the same time, the DSP acts as a CDR.
In a DR4 the optical engine (EML lasers or Silicon Photonics SIP based) generates and terminates the optical lanes. Each lane operates at 1310 nm and requires one fibre. In other words, the transceiver interface needs to have eight fibres.



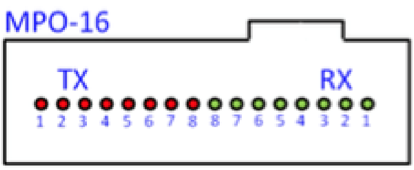
In the case of FR4 and LR4, the basic function of the DSP is the same as in the DR4, but now four wavelengths (CWDM4 grid) are being used instead of 4 × 1310 nm signals and a multiplexer is added to combine these CWDM signals together. By this, the number of required fibres is reduced to two (TX + RX) fibres. The transceivers have duplex LC interfaces.

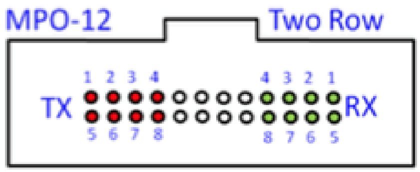


Multimode Short Reach (SR) Transceivers

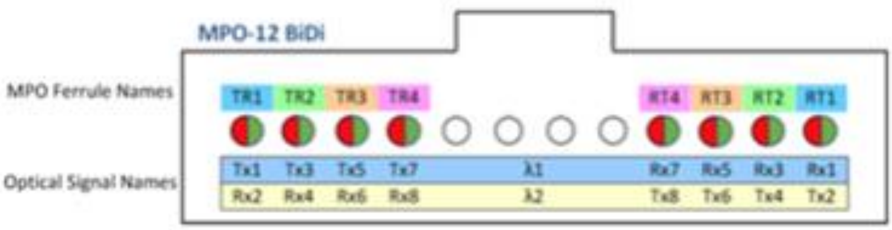
The main trend goes to SR8 (IEEE802.3cm) and SR4.2 (MSA BD4.2).

In case of the SR8, the “8” implies there are eight optical channels on eight separate fibres. A total of 16 fibres (eight Tx + eight Rx) are needed as each optical channel operates at 50G PAM4. The SR8 module uses either an MPO-16 connector or a two row MPO-12 connector to connect to eight fibre pairs. The most common implementations use two row MPO-12.





When talking about the SR4.2, the “4” implies here are four optical channels using four separate fibres and the “2” means that each channel uses two different wavelengths. A total of eight fibres are needed as each optical channel operates at 2 × 50G PAM4. The wavelengths are bi-directional and multiplexed. The SR4.2 module uses an MPO-12 connector.



The big interest of the SR4.2 is to be able to re-use the existing cables placed in the current installations.

400G Optics Summary

Description	Electrical Interface	Operating Wavelength	Optical Lane	Connector	Distance
SR8	8x50G	850	8x50G	MPO-16	100 m
SR4.2	8x50G	850/910	8x50G Bidi	MPO-12	100 m
DR4	8x50G	1310	4x100G	MPO-12	500 m
DR4+	8x50G	1310	4x100G	MPO-12	2 km
2x FR4	8x50G	2x (1271/1291/1311/1331)	8x50G	CS	2 km
FR4	8x50G	1271/1291/1311/1331	4x100G	LC	2 km
FR8	8x50G	1275/1277.5/1282.5/1285/ 1295/1300/1305/1310	8x50G	LC	2 km
LR4	8x50G	1271/1291/1311/1331	4x100G	LC	10 km
LR8	8x50G	1275/1277.5/1282.5/1285/ 1295/1300/1305/1310	8x50G	LC	10 km
ER4	8x50G	1295/1300/1305/1310	4x100G	LC	40 km
ER8	8x50G	1275/1277.5/1282.5/1285/ 1295/1300/1305/1310	8x50G	LC	40 km

Source:
Skylane Optics