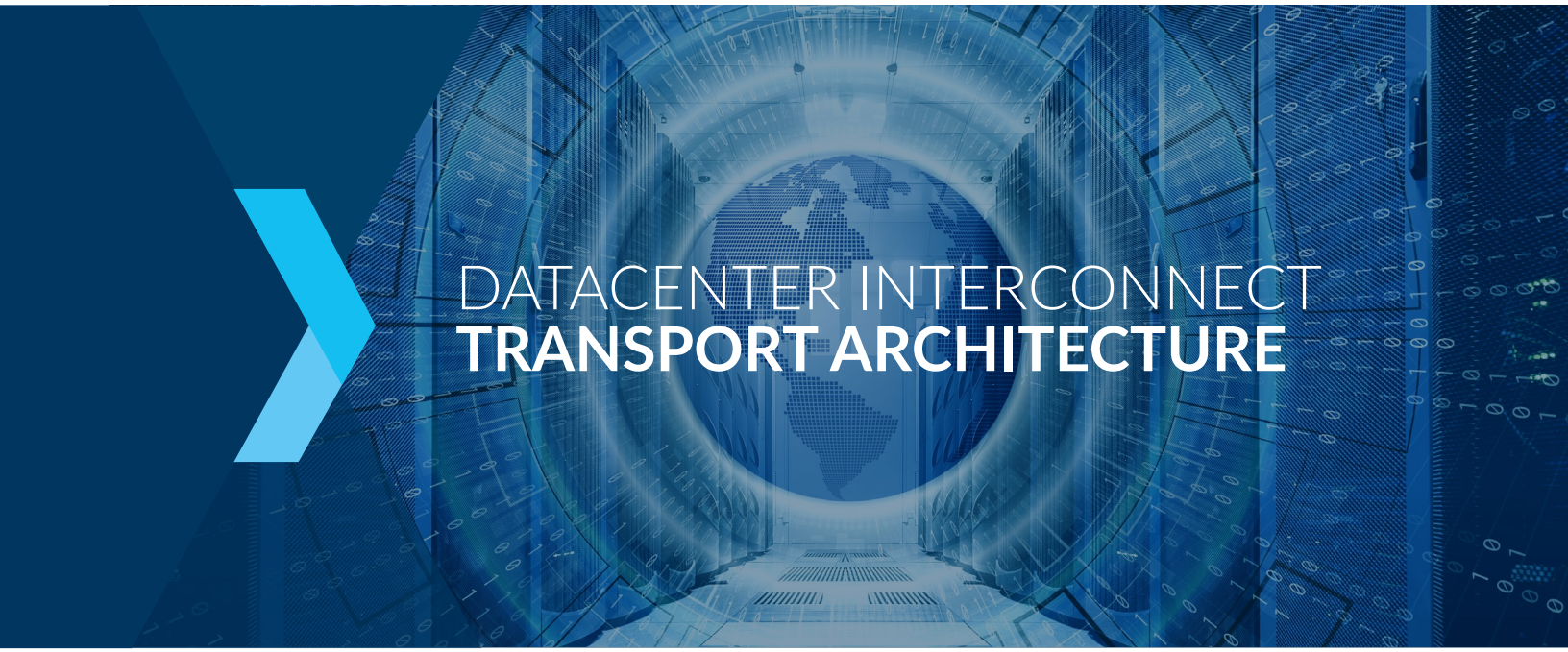

DATACENTER INTERCONNECT **TRANSPORT ARCHITECTURE**

APPLICATION NOTE **SUMMARY**

In the past few years, 'datacenter interconnect' has been one of the largest growing trends for the optical market, pushed by the deployment of new datacenters by major cloud operators. According to optical market analysts, this segment has grown in the double digits.

The introduction of 400ZR modules to the market, in particular with QSFP-DD form factor, is going to change datacenter interconnect architecture in the metro/metro-regional space. In this paper, we will discuss the current architecture and the evolution towards 400ZR interfaces along with some related key technologies.

DATACENTER INTERCONNECT TRANSPORT SOLUTION

One of the applications of coherent interfaces in the optical market is the interconnection between metro regional datacenters through dedicated point-to-point WDM links with higher rate coherent WDM interfaces. This has pushed optical system vendors to introduce specific products dedicated to the transport of this traffic, with reduced form factor (typically one rack unit), very high capacity and in datacenter practice (600 mm rack compliant, DC powered for example).

Figure 1 Datacenter interconnect optical solution (disaggregated solution)

In this architecture, datacenters provide high speed optical 'grey' interfaces (for example: 100GbE, 400GbE and, in the future, 800Gb/s). The task of the 'disaggregated transponder' is to mux the client signals over a single 'colored' wavelength at the highest possible rate to maximize the spectral efficiency via coherent optical interfaces.

Each single coherent signal is then transferred to a WDM system that provides the MUX/DEMUX and amplification functions. This last building block is also called 'Open Line System' in the disaggregated architecture.

Typically, the network architecture is simple point-to-point and the majority of the applications are now in metro/regional areas with the distance between the two datacenters usually below 100Km.

Activity has also been run in open consortium (e.g. Telecom Infra Project) to define white boxes for 'disaggregated transponders.' The latest example is the Phoenix platform. [1]

400ZR SOLUTION

OIF has developed an implementation agreement for a coherent interface to satisfy the requirements of datacenter interconnection in the metro/metro-regional space, with a distance of 120Km or less (minimum 80Km) and 400Gb/s rate. The 400ZR specification is now available [2].

The DWDM link will be amplified, point-to-point and noise limited.

The main scope of the implementation agreement was to open the market to different players, including transceiver vendors and system vendors, achieving the most optimized architecture for the requested limited distance, with clear target of reducing the price per Gb/s respect to the current coherent interfaces (that have been designed to cover higher distances).

Different form factors are allowed by OIF's implementation agreement (QSFP-DD, OSFP, COBO, CFP2, CFP8), but with port densities equivalent to grey client optics that are to be inserted directly into client systems currently hosting 400Gb/s client pluggables.

Figure 3 Impact of 400ZR in Datacenter Interconnect architecture

This implies that the 400ZR optical coherent interfaces hosted in datacenter switches will be connected directly to MUX/DEMUX inputs of the Open Line System, without the need for an intermediate disaggregated transponder.

IMPACTS ON OPEN LINE SYSTEMS

Coherent 400ZR optical interfaces bring plugged directly inside client nodes (e.g. switches inside datacenter) will affect the architecture of the Open Line System and its evolution in the 400ZR era. The first scenario is simple and is applicable when a very limited number of 400ZR channels (e.g. 8) must be aggregated over a fiber.

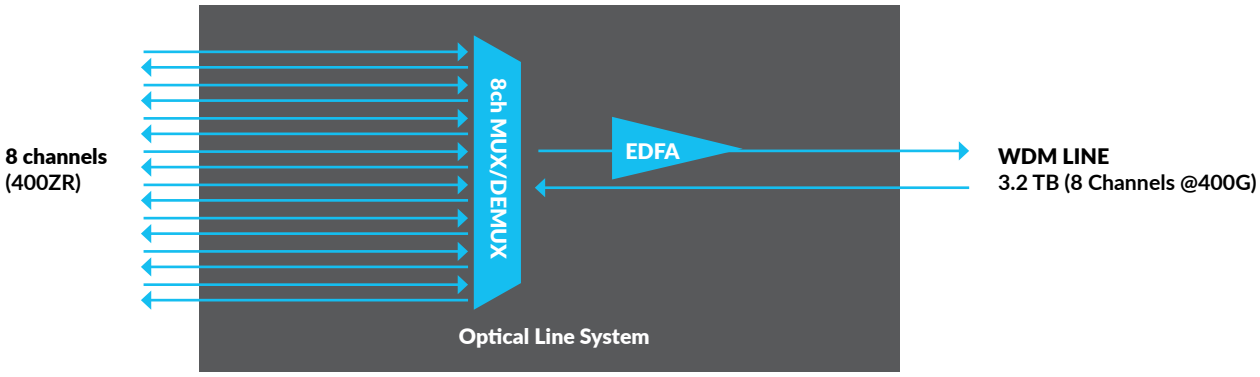

Figure 4 Open Line System architecture for 8 channel link.

When such a simple architecture is requested, it is possible to aggregate all line system functionalities (MUX/DEMUX and Amplifier) in a pluggable that could be also inserted directly in the datacenter switch (like a 400ZR module). In this case, no other functions are needed (for example, OSC is not necessary). This architecture has been recently announced by some system vendors [3] in OSFP form factor.

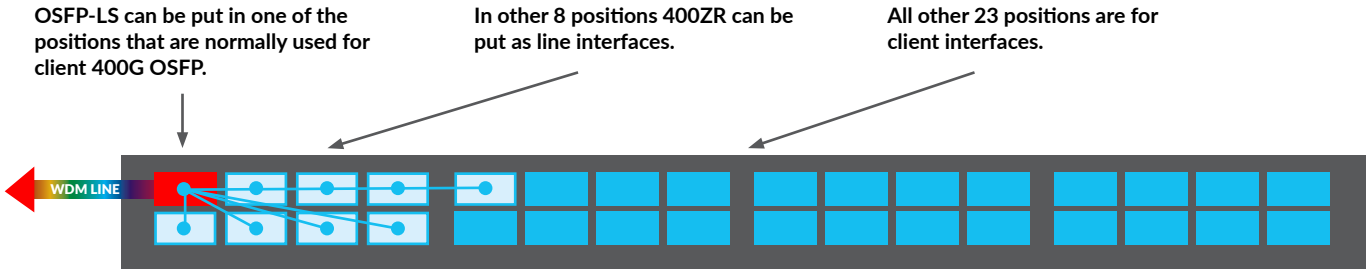

Figure 5 Example of pluggable Open Line System in a shelf.

This architecture is limited by the physical space available in a single pluggable 'drawer' and cannot grow beyond an eight-channel point-to-point system.

An alternate architecture, able to support up to 40 channels (with 100GHz grid) is for the service provider application. One of the main impacts of this architecture is that each single channel will be considered as an 'alien lambda' from the open line system perspective, with likely few possibilities to manage optical parameters directly in the client system. In a disaggregated architecture where the coherent interfaces are hosted by an optical device, like a disaggregated transponder, which is capable of managing all of the optical parameters, an Ethernet switch would not be able to heavily manage the optical 400ZR coherent parameters.

This opens the window for development of new products or sub-systems dedicated to monitoring of incoming wavelengths, with the capacity to measure incoming optical power, verifying the SLA and balancing the channels (for example via battery of VOA functions).

Figure 6 Open Line System architecture in 400ZR era with Monitoring

KEY TECHNOLOGIES

Open Line Systems in the 400ZR era require the following main WDM building blocks:

- Passive filters to add/drop the specific wavelengths in the access nodes and to terminate all the wavelengths in the hub node. ROADM architecture is also an option but is likely less applicable to pure datacenter interconnect scenarios. FlexGrid will play important role in maximizing the fiber usage (400ZR is compatible with 75GHz grid).
- Amplification is needed to exceed the pure passive network optical power budget. Mini amplification or pluggable amplifiers could play important roles for simple scenarios.
- Monitoring systems based on filters, monitoring and attenuators could be new required systems in the new datacenter interconnect architecture for 400ZR.

ABOUT JABIL PHOTONICS

Jabil Photonics is a business unit within Jabil with extensive photonics expertise and a comprehensive portfolio of optical products, including optical components, passive and active fiber optical components, EDFA amplifiers and complex optical modules. With Jabil's reputation as a leading global EMS provider, in conjunction with the company's growing focus and investment in the photonics space, Jabil Photonics provides an unparalleled set of solutions and capabilities for the photonics industry, including market-proven advanced photonics packaging services (APPS) to support silicon photonics technologies and an in-house developed 100G/200G CFP2 Coherent pluggable (DCO).

In addition to product offerings and manufacturing services, Jabil Photonics has a strong focus on R&D and provides value-add services including HW and SW design, testing and verification.

Jabil Photonics offers its expertise for the main optical building blocks for cable network evolution, in both subsystems and customized design, which can be integrated in products or utilized as stand-alone systems:

Figure 7 Jabil Photonics Portfolio

References

[1] Telecom Infra Project - Phoenix Technical Specification

[2] OIF Implementation Agreement 400ZR OIF-400ZR-01.0

[3] Arista Networks Open Line System for 400G