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SP360: Service Provider

Embrace the Future with Open Optical Networking

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Until recently, optical systems have been closed and proprietary. They come as a package that includes optics, transponders, a line system, and a management system. In the traditional optical architecture, these components were provided by a single vendor, and interfaces between those functions were closed and proprietary. While the concept of disaggregated or open optical components is not new, some components can now be optimized and sold separately. This enables providers to assemble a system themselves in the manner they choose.

There are several reasons why an operator would move in this direction. In most cases, it's to enable a multi-vendor solution where you can mix and match devices from different vendors with the expectation that you have access to the latest and greatest innovation that the broad industry provides. This certainly aligns with the disaggregation trends we've seen in networks with software and white boxes and provides the benefits of access to the latest innovative technology for best-of-breed platforms.

By contrast, in an open Dense Wavelength Division Multiplexing (DWDM) architecture, we essentially have a disaggregated system – functional disaggregation, hardware and software, disaggregation to full system disaggregation. In this open model, all the components can potentially be managed (e.g. configured, monitored, and even automated) through a common software layer with the use of standard APIs and data models.

When looking at open architectures, an open line system from a network design point of view must support an "alien wavelength." An alien wavelength is one that is transported transparently over a third-party line system or infrastructure. Alien waves enable the ability to add capacity to address increased bandwidth needs with no disruption of the current network in place. And the most important

benefit of alien waves is the freedom it gives network operators to source their transponders from any vendor based on their business or technical criteria.

This is particularly important when you consider that transponders represent the majority of the cost of a DWDM system and are a key component in determining the overall efficiency of the network. This provides the operator with increased flexibility to deploy the next wavelength from any vendor that's best-in-class.

Whether a provider continues with a fully closed system or a disaggregated approach depends on their network today and where they have a vision to go in the future.

When is a closed optical system beneficial?

- When network operators are looking for a turnkey solution. It's pre-integrated, and the responsibility for fixing problems is very clear.

- When operators are willing to trade first cost (Optical Line System) for transponder cost, resulting in a pay-as-you-grow solution, but with a higher total cost of ownership.

When is an open (multi-vendor) optical system beneficial?

- When operators want to choose from all the industry has to offer. Best-in-breed is based on the operator's definition – best OSNR performance, highest spectral efficiency, lowest power, least amount of space, lowest cost per bit, pluggability for router/switch integration, or standardization.

- By opening the architecture, competition and innovation are stimulated. This provides the operator with more choice.

- When the ability to leverage standardized APIs is available to create a consistent operational model across vendors.

## Use cases for open networking

- The subsea market pushed for "open cables," which enabled any vendor's transponder to operate over a third-party line system already in place. This

helped many operators increase their capacity on the subsea cable by moving to the latest transponder in the market.

- The long-haul market has already implemented open line systems, enabling multi-vendor leverage over a common infrastructure. In some cases, this has resulted in more than three vendors being deployed.

- Metro use cases, like Open ROADM, take standardization a step further with the ability to have multiple line system vendors working with coherent interface vendors on different ends of the same fiber and wavelength.

What about optics?

Datacenter interconnect, metro, and regional markets will be transformed with 400G OpenZR+ Digital Coherent Optics (DCO), because they have been standardized to insert into any optical, router, or switch platform. This plug-and-play option has never existed before and opens the optical networking market for DCO optics to be deployed in a ubiquitous manner based on the standards. Several options are listed in the diagram below, including the 400G QSFP-DD, which is either the Optical Internetworking Forum (OIF) 400G ZR; or the OpenZR+ (which supports Open Reconfigurable Optical Add-Drop Multiplexer (ROADM) on the line side); or the Open ROADM, which is a CFP2 format.
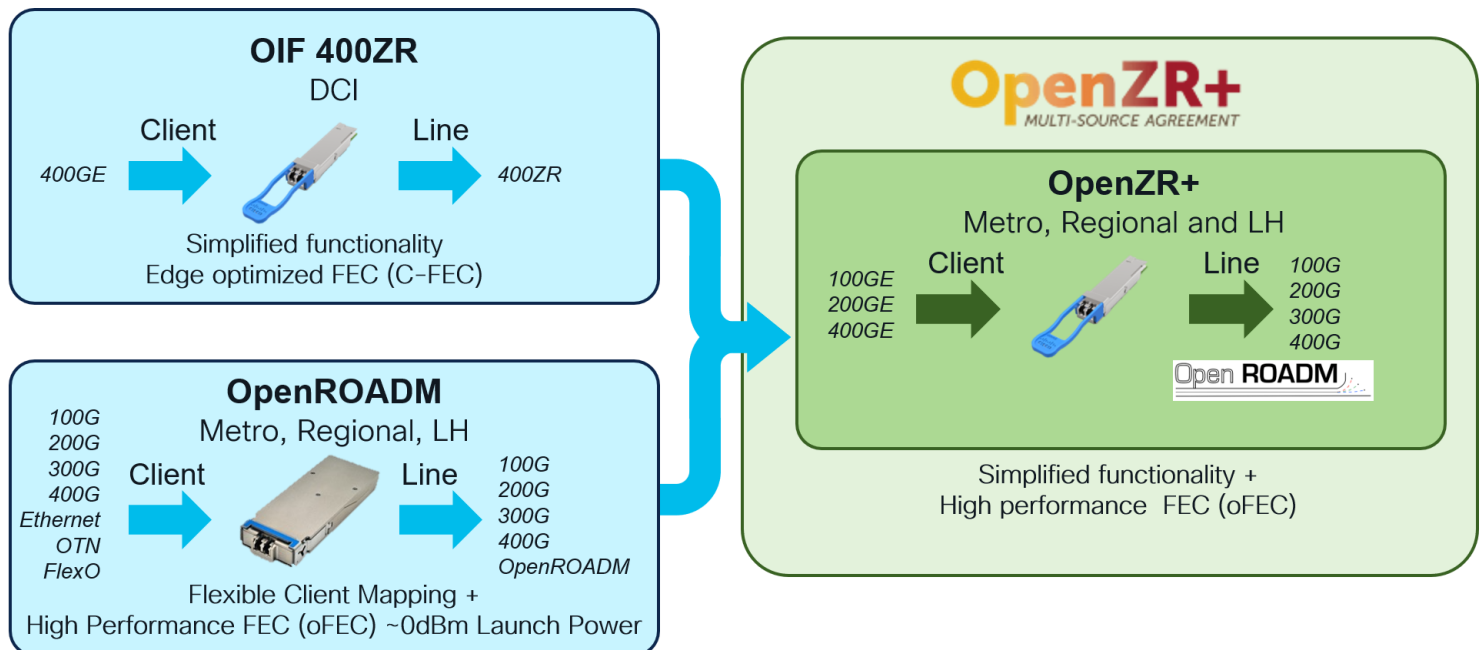
Standardization

There are several industry initiatives that will accelerate the adoption of open networking for optical systems. Open ROADM is a Multi-Source Agreement (MSA), which is an agreement between vendors to follow a common set of specifications. It's supported by a group of 28 companies, including system and component vendors, as well as major operators across the globe.

There's also the Telecom Infra Project (TIP), which is another MSA that focuses on specifications for point-to-point open line systems. TIP also started an initiative to define a common algorithm that can be used for optical network design and path computation, something impossible to do in closed and proprietary systems. There's a group within TIP that's also working on GNPy, which stands for Gaussian Noise modeling in Python and provides algorithms for route feasibility and analysis for optical networks. It does the Optical Signal to Noise Ratio (OSNR) calculations to validate if an optical channel is feasible through a given path in the network. This is a very promising initiative, and there are large carriers worldwide that are using it to model real-life networks.

The next one is OpenConfig, which is an industry working group that focuses on producing common data models based on Yet Another Next Generation (YANG) language for device management and configuration. It's widely used by webscale companies, and it covers multiple technologies – routing, switching, and optical.

Other industry specifications include the ITU Telecommunication Standardization Sector (ITU-T) that defines the DWDM grid and interface specifications, Forward Error Correction (FEC) and digital wrappers, and the OIF, which defines specifications for DWDM interfaces.

Finally, the most important proof point for any industry initiative is network operator adoption. We already see strong interest and deployment of open optical systems, broad support for the industry initiatives mentioned above, and rapid adoption of the industry specifications that they are producing. For more on how networks will be built with open platforms visit our Cisco Routed Optical Networking page.

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