SOLUTION NOTE

Open Optical Networking

Unlock and unleash your optical network with increased innovation velocity

Openness and disaggregation are a natural economic evolution as an industry matures, and they are being increasingly embraced by the telecommunications industry. This type of evolution has occurred across a number of areas in networking, including the separation of compute, storage, and networking in data centers; the separation of hardware, operating system, and apps in smart phones; hardware/software separation in network function virtualization (NFV) and disaggregated routing; and most recently, open RAN initiatives for 5G.

OPTICAL INDUSTRY EVOLUTION TO OPENNESS AND DISAGGREGATION

This evolution is now enabling optical networking to leverage these same principles of openness and disaggregation by separating the two key functions in optical networks: optical line systems and transponders. While this concept is not new, recent developments have emerged that maximize the performance of disaggregated optical solutions and minimize the operational challenges of multi-vendor networks. These enablers include improvements in coherent transceiver technology; the adoption of line systems with flexible grid support and per-wavelength power monitoring; and organizations, including ITU-T, Open ROADM MSA, OpenConfig, Open Networking Foundation (ONF), and Telecom Infra Project (TIP), driving standards and interoperability in terms of optical transmission, open APIs, and standardized YANG data models.

LAYER 1/LAYER 0 DISAGGREGATION BASED ON INNOVATION/RENEWAL CYCLES

In addition to providing network operators more choice, the disaggregation of transponders and line systems better aligns with their respective innovation cycles. Coherent optical transceivers leverage both the silicon performance improvement cycle described by Moore's law and advances in photonic technology. This results in a much faster innovation cycle relative to the optical line system (ROADM/WSS, amplifiers, filters, etc.), which has a typical renewal cycle of five to 10 years. Open optical networking therefore disaggregates the optical network into open Xponders and open line systems. The open Xponder (transponder, muxponder, or switchponder) contains one or more embedded coherent transceivers (A) or pluggable coherent transceivers (B). Alternatively, the functionality of an open Xponder can be provided in a pluggable form factor (C), which plugs into a router or other network device, as shown in Figure 1.

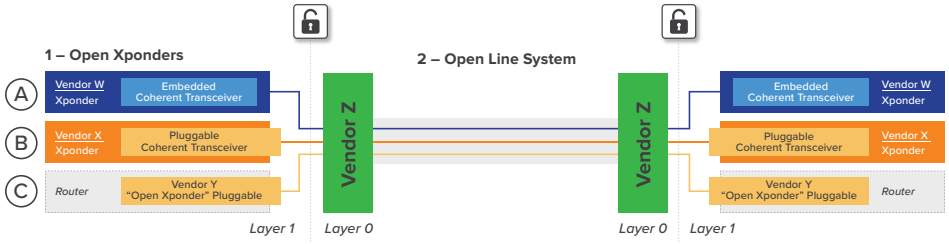

Figure 1: Open optical networking requirements 1 (open Xponders) and 2 (open line system)

Benefits of Open Optical Networking

- **Accelerate innovation** by separating network functions, enabling each function to innovate at its own pace, expanding the innovation ecosystem, and simplifying new technology integration with open APIs, standardized YANG data models, and compact modular platforms with hardware based on self-contained sleds and a modern microservices-based software architecture.
- **Optimize and differentiate** your optical network by selecting the ideal products and technologies for each network layer and domain independently from a broad array of vendors, avoiding the constraints of a single vendor and one-size-fits-all solutions that provide limited scope for competitive advantage.
- **Transform the economics** of your optical network with minimized vendor lock-in, enabling innovations that reduce cost per bit to be quickly deployed throughout the network lifecycle, with customized multi-vendor network designs providing additional scope for cost optimization.

REQUIREMENTS FOR EFFECTIVE IMPLEMENTATION OF OPEN OPTICAL NETWORKS

As shown in Figures 1 and 2, maximizing the value of open optical networking requires the following:

1. **Open Xponders** with performance that is not dependent on specific optical line system features. The ability to tune the center frequency, baud rate/spectrum, and modulation of the wavelength are all highly desirable attributes.

2. **Open (optical) line systems** able to support a wide range of third-party open Xponders. Per-channel power monitoring and attenuation for third-party wavelengths, link control algorithms that can support third-party Xponders without compromising performance, and flexible grid support are needed attributes.

3. **Compact modular platforms** with a wide range of functions enabled by self-contained sled-based hardware and a robust and flexible microservices-based software architecture. In addition to offering footprint, power, and cost benefits, this minimizes the number of platforms for each vendor and further speeds the deployment of new functions and technologies from that vendor.

4. **Open APIs and YANG data models** – NETCONF, RESTCONF, and gRPC/gNMI APIs and data models compliant with Open ROADM and/or OpenConfig, supported natively on compact modular platforms. This enables the management and control of multi-vendor optical networks and of multi-layer networks. It also enables faster onboarding of new optical technologies and smooth integration with industry tools for streaming telemetry, dashboard, analytics, machine learning, and automation.

INCREASE THE INNOVATION VELOCITY OF YOUR OPTICAL NETWORK

A key benefit of open optical networking is increased innovation velocity. With a traditional integrated DWDM network, a single vendor is chosen once every five to 10 years or more. Upgrades to the network are based on the innovation capabilities of this single vendor. By disaggregating the optical network into functional blocks based on their innovation/renewal cycle, network operators can leverage the innovation capabilities of the entire optical ecosystem, selecting the best-in-class technology from any vendor, including smaller focused specialists, as soon as this technology becomes available. Moreover, with open APIs, new technologies and vendors can be onboarded much more quickly and cost-effectively, while compact modular platforms further enable new innovations from the same vendor to be added more quickly and cost-effectively.

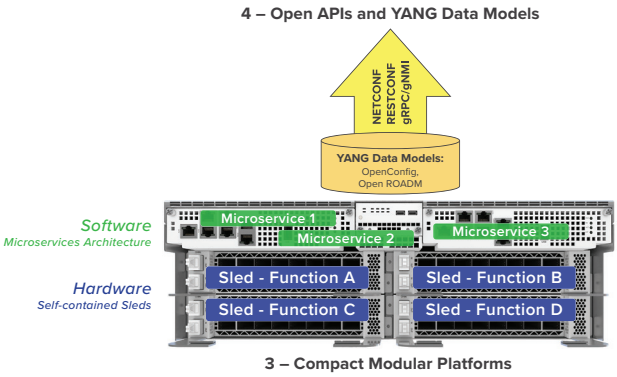

Figure 2: Open optical networking requirements 3 (compact modular) and 4 (open APIs/YANG)

OPTIMIZE AND DIFFERENTIATE WITH MULTI-VENDOR SOLUTIONS

Open optical networking greatly increases the scope for operators to build a network that optimally meets their specific needs and provides a platform for differentiating their services. With a traditional integrated DWDM network, a single vendor (A) is chosen based on its overall solution, even if vendor B had a superior long-haul coherent optical engine, vendor C had more cost-effective coherent pluggables for metro distances, vendor D had a superior line system, and vendor E had a better management solution. It would also be hard to differentiate the network from other network operators using the same vendor. With open optical networking, network operators can build a more tailored network combining the best technology from each vendor to give them a competitive advantage.

TRANSFORM THE ECONOMICS OF YOUR OPTICAL NETWORK

Open optical networking provides significant economic benefits, enabling network operators to scale capacity within budget limitations. Accelerated innovation is the primary driver for cost-per-bit reductions, with each generation of coherent technology offering a step change increase in capacity-reach, while also reducing footprint and power consumption. Minimized vendor lock-in enables the economic benefits of ecosystem-level innovation to be quickly realized throughout the network lifecycle. The flexibility to select the best products for each layer and domain independently rather than being locked in to a one-size-fits-all solution from a single vendor is an additional enabler of superior economics.

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