

Open ROADM MSA: Disaggregated Fiber Optic Transport

<http://OpenROADM.org>

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The future of optical networking and communications is here.

What is Open ROADM MSA?

The Open ROADM Multi-Source Agreement (MSA)

- Disaggregates and opens up the traditionally proprietary ROADM systems,
- Is a model-driven design based on open source YANG data models, and
- Enables open optical specification for multi-vendor interoperability in SDN-controlled fiber optic transport.

ROADM Systems Disaggregation

ROADM systems disaggregation can be accomplished by

- **Hardware Disaggregation**, which defines a common set of hardware provided by different vendors.
- **Functional Disaggregation**, which defines different optical functions.

Due to the complexity, the Open ROADM MSA has first focused on the **functional disaggregation**, by defining three open **optical functions** as follows.

- 1) **ROADM** must be open, interoperable in a multi-vendor optical solution, and individually controllable CD or CDC (Colorless/Directionless/Contentionless).
- 2) **Transponder** must be fully open to pluggable optics on both client and line side, and interoperable with other vendors/pluggables at the other end of the line side.
- 3) **Pluggable Optics** can be used in a ROADM system or packet device, and are independently controllable.

Why Do We Need Open ROADM?

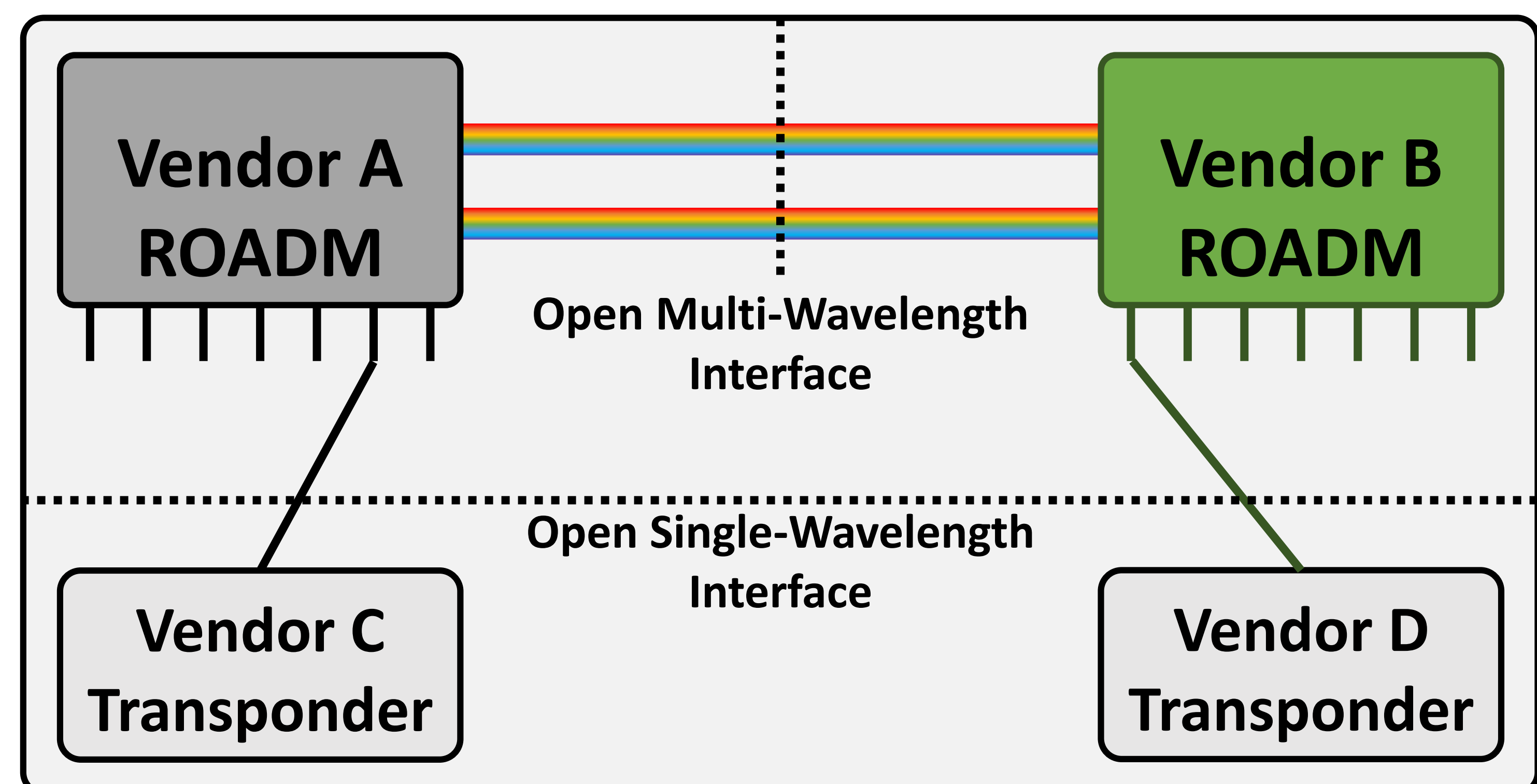
Today's available optical network solutions are limited to single vendor, with strong dependence on proprietary software and interfaces. The resulting vendor and technology lock-in leads to significant software development efforts, every time a new vendor or a new product feature comes into play. A pathway to reducing costly proprietary software development efforts is the definition of open and standard interfaces. The Open ROADM MSA offers the following features, which are well suited to address this requirement.

- **SDN Software Control:** Deploy flexible ROADMs that are SDN controlled for network optimization and multi-layer control.
- **Multi-Layer Synergy:** Data plane collapse using pluggables wherever applicable, and multi-layer resource coordination using SDN control plane.
- **Open Optical Specifications:** Interoperability in the fiber optic data plane across multiple suppliers.
- **Model-driven Design:** Open source YANG data models for Device API, Network abstraction and Service API.
- **No Proprietary Tools:** The whole life cycle and all maintenance functions covered by Open ROADM APIs as defined.
- **Ecosystem:** Generate an open ecosystem around disaggregated fiber optic transport by publishing specifications for data plane and control plane interoperability, as well as open source SDN controller platform.

Open Optical Specifications

Based on the optical functions, two open optical specifications are defined.

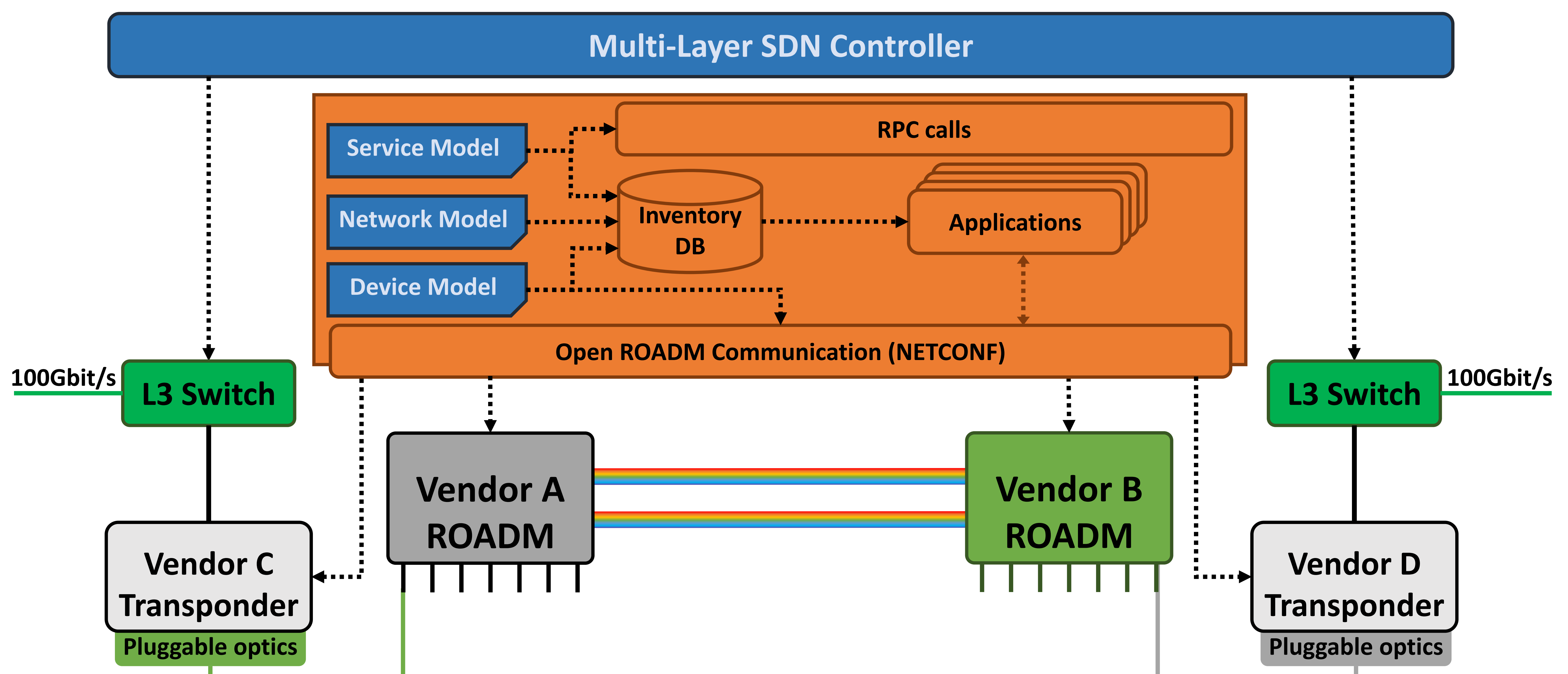
- 1) **Single-Wavelength** (or W) open interface, which defines how **pluggable optics** or **transponders** interoperate. The optical specifications for Single-Wavelength include the definition of electrical framing, digital signal processor interop, forward error correction definition, transmit optical definition, definition of optical path, and optical definition of the receiver.
- 2) **Multi-Wavelength** (or MW) open interface, which defines how **ROADMs** interoperate. The optical specifications for Multi-Wavelength include characteristics of operating ranges, parameters for optical amplifier operation, parameters for ROADM operation, optical service channel, optical power control, and power shutdown for safety.



Open ROADM Network Architecture

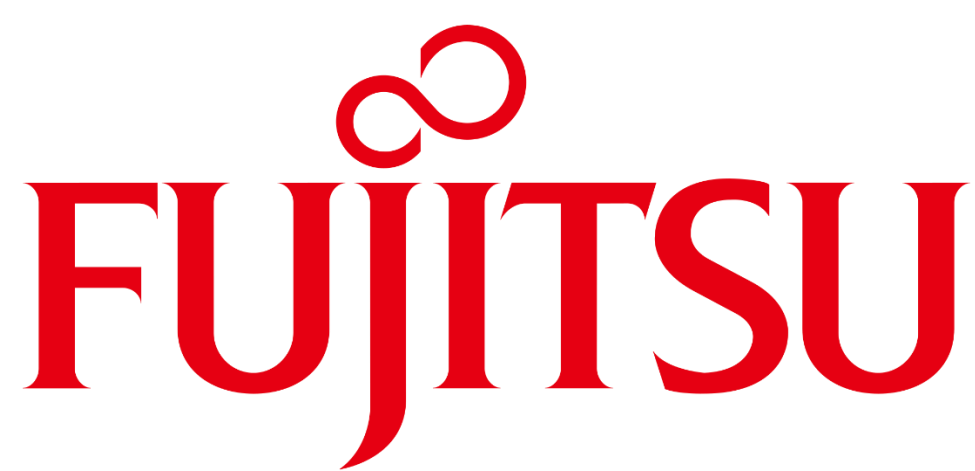
Key components of the Open ROADM Network Architecture are:

- ROADMs from different suppliers that interoperate across an open Multi-Wavelength (MW) link.
- Transponders from different suppliers that interoperate across an open Single-Wavelength (W) link.
- Open APIs for control and maintenance of ROADMs and transponders.
- L0 SDN controller plug-in (e.g., the OpenDaylight TransportPCE) that enables multi-vendor operations using common YANG/NETCONF defined interfaces.
- Multi-layer SDN controller (e.g., the ONAP project) to perform multi-layer SDN control.

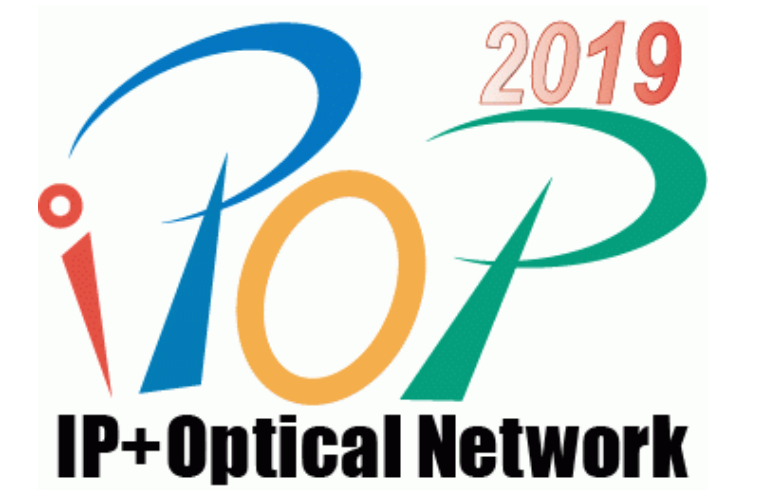


Fujitsu Open ROADM Solution

<https://www.fujitsu.com/us/products/network/applications/open-roadm/>



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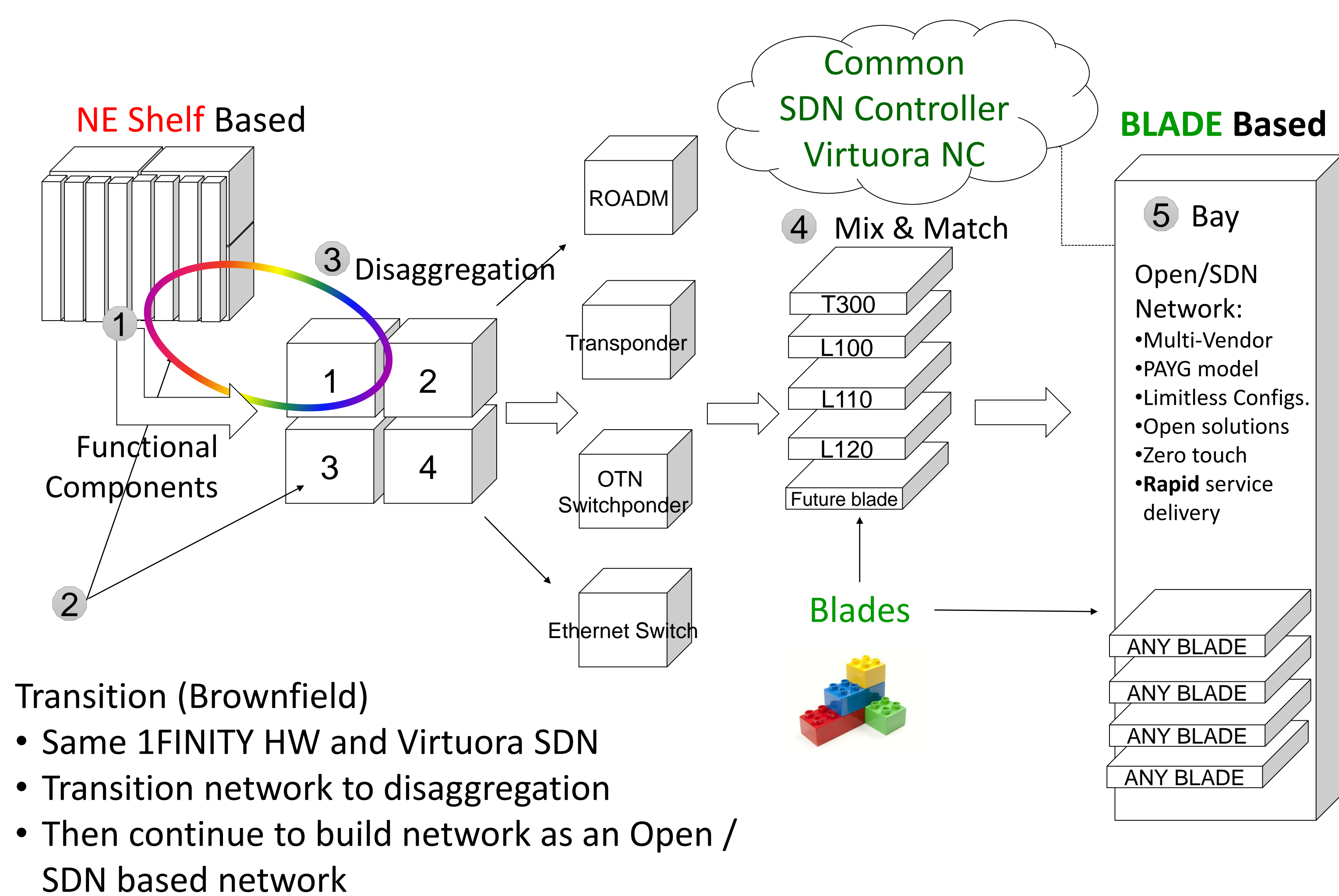
Introduction of the Fujitsu Open ROADM Solution

The Fujitsu Open ROADM solution is specifically developed to meet the standards set forth by the Open ROADM MSA community and is compliant with Open ROADM MSA. The solution brings together the 1FINITY™ disaggregated optical networking platforms; the Virtuora® suite of SDN/NFV software tools and applications; and expert multivendor integration services.

What is the Fujitsu 1FINITY™ disaggregated optical networking platform concept?

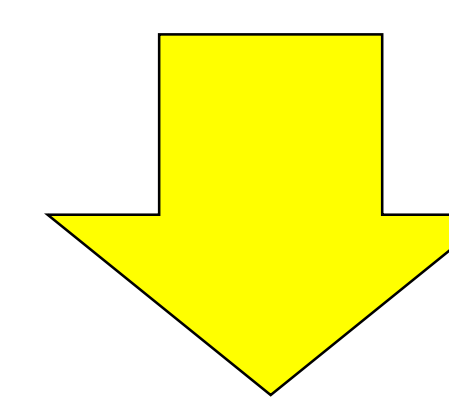
The Fujitsu 1FINITY platform leverages functionally disaggregated hardware components and reaggregates their functionality through enhanced software. The blade-centric 1FINITY architecture delivers unprecedented flexibility, scalability, and efficiency, providing a pay-as-you grow approach and evergreen technology design, supporting open pluggable optics, open APIs and open-standard protocols.

5 Step to 1FINITY™ platform and Open SDN based network



Physically Aggregated (NE Shelf Based)

- Shelf Form Factor is set and decided as:
 - Space, Power, Thermal, I/O interface over backplane
- Multifunctional shelves are constrained by the form-factor, system software, & dependencies among the other functions incorporated into the multifunction shelf



Logically Aggregated (BLADE Based)

- Software logically aggregates and allows functions to be located separately and retain centralized control
- Each Blade has its own independent physical design
- Independent functions provide freedom of innovation not possible in multifunctional equipment

Fujitsu Virtuora Network Controller Package

Virtuora Network Controller (Virtuora NC) is a software-defined network controller platform that is modular, open, and scalable. This multi-vendor, multi-layer software solution delivers unified operations and resource control from a Web-based GUI. The platform connects the southbound network elements to the northbound apps to deliver service provisioning, network management, planning and design, and service assurance.

The Virtuora Network Controller package includes:

- The Virtuora Network Controller. Built on OpenDaylight, a Linux Foundation open-source SDN platform, the Controller provides a layer of abstraction that includes REST Application Interfaces for northbound applications and southbound device drivers.
- Virtuora Topology. Automatically discovers all topology elements, including equipment and links.
- Virtuora Path Computation. The path computation engine dynamically computes an optimal path based on routing constraints.
- Virtuora supports all 1FINITY blades, as well as Open ROADM architecture

Fujitsu 1FINITY™ Hardware Platform and Fujitsu Virtuora® Software Platform

