HIGHLIGHTS

Newsletter No. 7

The seventh issue of the COMPLETE newsletter features a special technical material regarding emerging technologies and trends in the NREN environment and Optical Networking itself. This issue is dedicated to Open Line Systems, a user- and industry-driven requirement and network infrastructure concept that can bring advanced and flexible services to network users. The material in this newsletter is a result of collaboration between COMPLETE partners and market vendors.

Dear Readers,

In the last two issues of COMPLETE newsletter we focused on technical aspects in optical networking. In the seventh issue of the project newsletter we describe a networking concept that is becoming widely adopted in the networking domain: Open Line Systems. The COMPLETE Partners are heavily involved in testing and shaping new developments in this field by active collaboration with leading market vendors. The concept of Open Line Systems will significantly change optical networking and create new areas for services and development that can be established under the PCP/PPI scheme.

The Open Line System in its principle is targeted to reduce Vendor Lock-in and speed innovation by disaggregating Wave Division Multiplexing transport equipment. Separation of hardware, operating systems, applications, compute, storage and networking in data centers is starting to impact the broader communications equipment market. We believe this emerging technology is promising and important for public network operators, therefore we have dedicated the whole issue to this topic.

Yours sincerely,

Bartosz Belter, the Project Coordinator

Open Line Systems

As a complete solution, Open Line Systems (OLS) are focused on reducing Vendor Lock-in and speed innovation by disaggregating Wave Division Multiplexing transport equipment. Separation of hardware, operating systems, applications, compute, storage and networking in data centers is starting to impact the broader communications equipment market. In terms of Wave Division Multiplexing transport equipment disaggregation is coming in the form of Open Line Systems.

OLS is the separation of the line system (Mux/Demux, ROADMs, amplifiers, etc.) from the adaptation process/ transponders. OLS is designed to carry any wavelength service independently from the modulation format, data rate, or vendors and allows for these wavelength services to be created/modified programmatically [Aglie Open Line Systems, Rodney Dellinger, ALU, ECOC 2014]. OLS support open and standardized northbound management/communication protocols and make the system available to third party management and control plane. It should be noted that OLS could be delivered by only one vendor. In the traditional, legacy transport networks the line system and the client-adoption part is delivered by the same vendor. Consequently, the control and management part of such system is also vendor-specific and closed. The same applies to the management system.

The Open Line system can be constructed using the optical white boxes. White boxes are positioned as generic optical equipment building blocks that can be addressed and managed independently and using standardized interfaces. This approach allows to construct various types of optical links: DCI, open line, ROADM network. Gray Boxes offer a possibility of hosting user specific node/network control software that integrates units with user-specific NMS solutions or SDN controllers/orchestrators.

White Boxes/Gray Boxes equipment line consists of DWDM transport system elements: terminal and transport line amplifiers, ROADM units, transport multiplexers/demultiplexers and Optical Fiber Monitor unit. Using this equipment it is possible to design and establish monitored optical transport links. The added value of this equipment line is full access to configurability options. Each component of this system is open and can be monitored and managed using the NETCONF network interface. For example, the optical link that consists of DWDM White Boxes/Gray boxes can be monitored and managed through the NETCONF interface and equipment drivers in networking systems such as ONOS (Open Network Operating System) and, as such, connected with other services and equipment monitored and managed in ONOS. DWDM White Boxes/Gray Boxes open new opportunities in terms of DWDM link configuration, scalability and integration with new higher level services. Fig. 1 presents open network components and associated industry-driven initiatives.

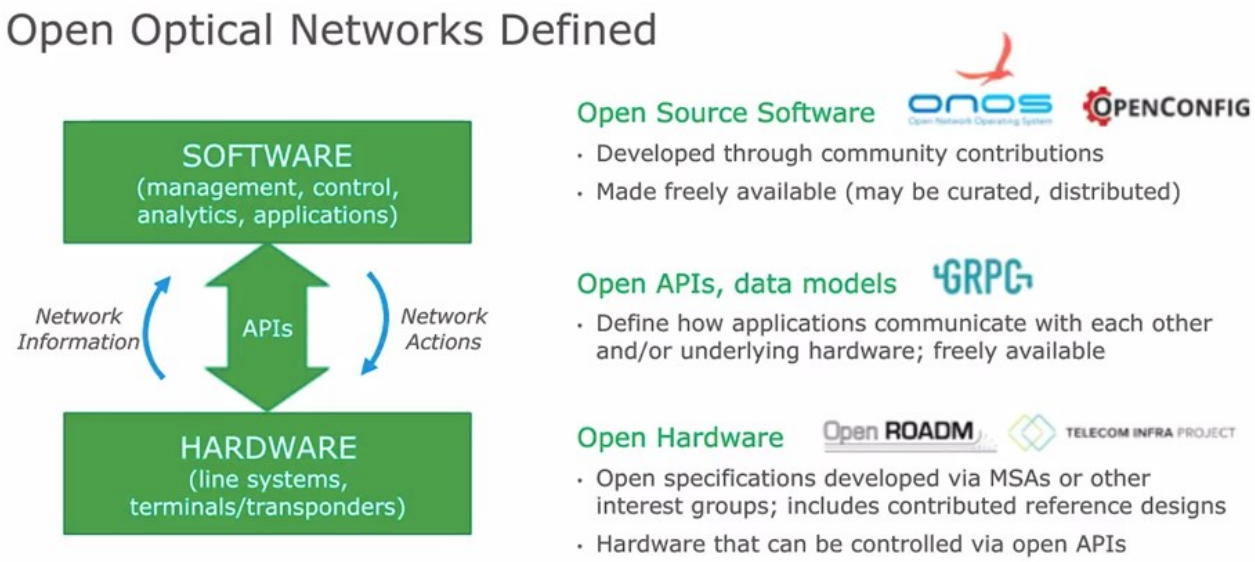

Fig. 1. Open network components and initiatives.

As a concept, the Open Line System needs strong support from the industry and vendors in order to standardize its elements and interfaces. The Complete Consortium Partners and NREN environment actively take part in the standardization activities and collaborate with market vendors to bring NRENs and its users experience to OLS concepts and standardization proposals.

Optical networks are constructed from hardware (line system, transponders) and software (management and control software, applications and operating systems). The connection between these elements is API (northbound and southbound) that enables and allows for selecting information from the network itself and providing actions needed to perform specific task schedule. At the current stage of development three different kinds of initiatives can be observed in the industry. They are focused either on hardware or software side. Other activities are focused on APIs and underlying data-models. In this scope the work of IEEE regarding the NETCONF and YANG standards can be categorized.

TIP initiative

The Telecom Infra Project (TIP) is an initiative started and driven by the operators, infrastructure providers, system integrators, other technology companies and is engineering focused. The aim is to rethink and redesign the traditional approach to building and deploying telecommunication network.

This initiative was started originally by Facebook and together with an Open Packet DWDM approach philosophy. This concept includes discussed open line system and control, transponder and network management, and packet-switch and router technologies. Open Packet DWDM includes packet and DWDM technology for metro and long-haul optical transport networks infrastructure. This approach enables separation of hardware and software and, as such, is based on open specifications so each Party can contribute to every system component and element. The target and main driver is to decouple hardware and software in existing vendor systems (black box) that include transponders, filters, line systems, and control and management software. TIP established internally two project groups, the Access projects and the Backhaul projects. The Backhaul project group works toward defining Dense Wavelength Division Multiplexing (DWDM) open packet transport architecture that triggers and initiates a new pace of technology innovation and flexibility, and avoids implementation lock-ins by vendors. The Open DWDM system includes open line system & control, transponder & network management and packet-switch and router technologies. Since TIP initiative started it can be observed that several products supporting this approach have reached market — Voyager, the first white -box transponder and IP/MPLS routing solution. Several vendors also announced support for TIP and release compatible products and solutions. ADVA delivers Voyager boxes along with supporting network management software and services to provide customers with a complete product solution. Coriant is expanding its networking software portfolio to include support for Voyager solutions in its Light IP architecture, which disaggregates routing functions. TIP has also started an internal group that works on universal open optical network modelling tool that will enable to design and simulate multiple open optical network hardware configurations and, as such, will further integrate open optical network individual, different components.

ONOS

The Open Network Operating System (ONOS) is a software defined networking (SDN) Operating System targeted for service providers that has scalability, high availability, high performance and abstractions to make the process of creating applications and services easier. The ONOS platform is based on a proven architecture and has quickly reached a mature stage to be feature attractive and production ready. The community, scientific and industry, has grown to include over 50 partners and collaborators that contribute to all elements and aspects of the project including interesting use scenarios such as CORD.

ONOS is an operating system that manages network infrastructure resources and provides the abstractions and APIs for managing, monitoring, and programming network devices, greatly simplifies the creation of innovative and beneficial network applications and services and use case scenarios that operate across a wide range of hardware platforms.

Open ROADM MSA

Open ROADM MSA is another initiative proposal which combines a number of vendors and operators. The philosophy behind is to open the closed ROADM infrastructure architecture. Currently ROADM hardware and software solutions are proprietary complex systems which rely on and are restricted one specific vendor. The vendor delivers the software at the network elements, planning tools, management and maintenance systems. Connecting different equipment and across different vendors is a challenge. As defined in the "Open ROADM MSA", "the integration process is time consuming and the technology life cycle and market presence of ROADMs inside the network infrastructure is relatively long, reducing competition and innovation path". "The Open ROADM project defines at its core the need and path towards faster innovation pace and competition, as well as increased infrastructure volumes through mass market adoption, joined by optical layer flexibility and software control to overcome all the disadvantages of today's ROADM infrastructure systems discussed above.

The Open ROADM MSA proposes a functional disaggregation architecture with three optical functions layers: pluggable optics, transponder and ROADM (the optical switch part with amplifiers, couplers, WSS, monitoring, etc.). These three layers will be controlled using the YANG an open standards-based API that can be accessed through any SDN Controller using NETCONF interface. The Open ROADM MSA vision is to implement the NETCONF interface for provisioning, as well as power monitoring, alarms, etc.

Fig. 2 shows the overall architecture of "Open ROADM MSA". The ROADMs are flexible and software controlled and the whole network infrastructure is managed also using any SDN controller.

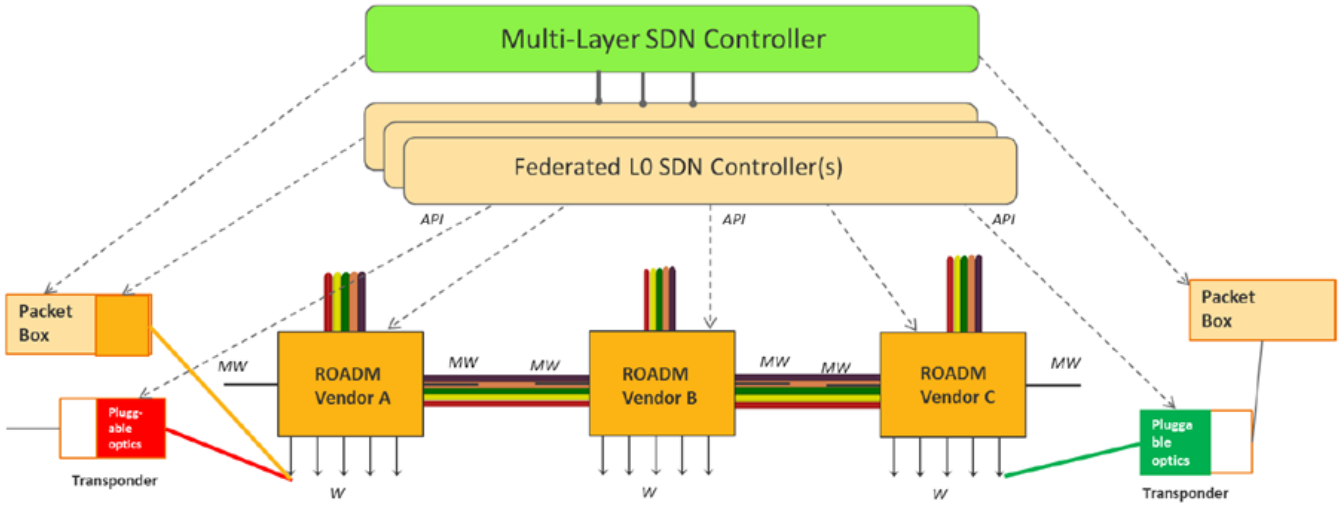

Fig. 2. Open ROADM architecture.

PARTNERS

CESNET grnet PCSS

This project has received funding from the EU Framework Programme for Research and Innovation H2020 under Grant Agreement No 645568, Copyright 2015 @COMPLETE