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Interoperability of Programmable Data Rates Up to 400G Enabled by Open ROADM MSA to be Demonstrated at OFC 2022 March 8-10

At this year's Optical Fiber Communication (OFC) conference and exposition, a group of Open ROADM Multi-Source Agreement (MSA) members are demonstrating optical network equipment elements from multiple suppliers that seamlessly interoperate at data rates up to 400G. These public Open ROADM MSA standards are defined for both the optical data plane and control plane. Participants include AT&T, Ciena, Cisco, Fujitsu, Infinera, Juniper, Nokia, Orange, and Ribbon in collaboration with the researchers at the OpNeAR laboratory at the University of Texas at Dallas (UT Dallas).

This collaborative effort showcases a federated edge computing infrastructure that takes advantage of the latest functionalities defined by the open-source Open ROADM MSA. Bare metal Kubernetes is applied for automating deployment, scaling and management of the containerized software applications over the optical network equipment from six suppliers featuring four ROADM nodes and a combination of 100G flexponders, Optical Transport Network (OTN) switches, 100G transponders, and 400G transponders/muxponders.

The federated edge computing architecture is experimentally demonstrated over the largest public Open ROADM optical network testbed to date. The fiber connectivity is provided by OFS, jointly leveraging a number of repurposed TACC Stampede servers connected to Ethernet switches through custom designed cables from Approved Networks that provide 40G connectivity to each server.

The Open ROADM demo at OFC 2022 publicly showcases, for the first time, end-to-end 200G, 300G, and 400G wavelength connectivity and interoperability of lower rate services. Last year, we were first to showcase 400G Open ROADM compliant products based on the initial version of the Open ROADM 400G W Specifications and Open ROADM's support for flexgrid capabilities.

Building on last year's successful demo, this year we demonstrate the flexibility and programmability of these products to operate at intermediate data rates (such as 200G and

300G) to provide more robust signal integrity in the presence of adverse transmission conditions. Along with B100G services, this demonstration also showcases full interoperability of other services using Open ROADM models such as: 1G and 10G (OTN), 100/400G (WDM), and Nx100G (N=2,3,4) services.

All combined, a rich set of options can now be leveraged in the federated edge computing use case. While moving towards higher bit rates (and baud rates) continues to pose significant challenges to open standards, this demonstration is a concrete step towards a flexible and programmable Open ROADM solution that offers more options for operating a transport network.

The implemented optical data plane specifications are available on the Open ROADM.org download page, www.openroadm.org, along with the YANG data models that define the control plane interoperability Application Programming Interfaces (APIs). Combined, these features enable easy plug-and-play of different supplier's hardware.

In order to make this work possible, the Open ROADM MSA forum brought together experts from different operators and suppliers to collaborate on a common goal. The multi-vendor environment creates an opportunity to work with the best minds in the optical transport network industry to define specifications and build innovative solutions and products that can interoperate and provide choices to network operators.

“AT&T is ramping our active deployment of Open ROADM MSA compliant optical network equipment in metro areas with 400G capable nodes utilizing 100G client and 400G client signals” says Lynn Nelson, AT&T’s Director of Optical Platform Development. “We expect to have over 200 nodes carrying customer traffic by end of year 2022. For AT&T, a key value proposition of Open ROADM is flexibility, which encourages competitive costs, accelerates technology introduction, reduces life-cycle costs, and allows networks to remain viable longer.”

MSA members are working to push beyond the initial 100G multi-vendor interoperable network. The MSA has to address challenges to balance between the need for more robust specifications by operators and the extent of inter-op requirements that inherits the constraints and limits of each design/implementation within the inter-op group.

“As a founding member and key contributor to Open ROADM MSA, Ciena is committed to supporting our customers on their digital journey, enabling open, scalable, and automated networks that can easily evolve to 400G, 800G, and beyond,” says Nick Benvenuti, Ciena’s Senior Director of Product Line Management. “We are proud to continue our leadership in evolving the specifications and breaking new ground with the inclusion of performance optics into the MSA, improving optical performance with the MW specifications, and creation of an interoperable coherent 800Gb/s specification.”

“As a member of Open ROADM, Cisco believes simplification and open networking are essential to deploying scalable and programmable networks” says Lorenzo Ghioni, Cisco’s Senior Director

for Product Line Management. “Cisco has been leading in the routed optical networking market which is standards based across all the layers and offers better operational efficiencies for multivendor interoperability by creating open elements at each point of the network.”

“Open networking technology is the key to unlocking the true potential of digital transformation,” says Rod Naphan, Chief Technology Officer at Fujitsu Network Communications. “In keeping with our position as a founding member and key contributor to Open ROADM MSA, Fujitsu is lighting the path toward greater interoperability and high-speed connectivity beyond 400G.”

"Open ROADM is evolving along with the industry,” says Julia Larikova, Director, Product Line Management at Infinera. “With the support of AT&T, DT, NTT, and Orange, the Open ROADM community has recently accomplished a significant amount of work that enables a path from its traditional least-common-denominator approach to a more advanced and more flexible data-streaming model enabling future data rates and multi-generational support.”

“Nokia is pleased to be delivering to the Open ROADM community upgrades to our P-OTN solutions, including increased switching capacity, fifth-generation coherent WDM uplinks, and 400GE service interfaces, providing Open ROADM operators the ability to offer a wide range of services from 1G to 400G while scaling their networks” says James Watt, Vice President, Nokia Network Infrastructure - Optical Networking Division. “This demo with 100G uplinks validates Nokia’s OTN switching capabilities for providing the services and solutions needed by operators to maximize the value of the open and disaggregated network.”

“Service providers should be able to tailor their optical networks to meet their unique needs, using best-of-breed disaggregated building blocks, with an ability to separate network functions,” says Rafi Leiman, Vice President of Product Management for Ribbon. “Being part of the Open ROADM MSA movement aligns with our leadership in offering customers multiple levels of flexibility in the design, planning and management of their optical networks.”

“The constantly growing offer of equipment compliant with the Open ROADM standards shows that interoperability and openness in the optical transport domain is no longer a myth,” says Gilles Bourdon, Vice President, Wireline Networks and Infrastructure at Orange. “In the OFC 2022 demonstration, path computation in the optical domain is performed by TransportPCE, with GNPy to optimize the performances. This highlights how different open initiatives and projects converge towards the same goal of automating optical infrastructure.”

Introduced in OpenDaylight (ODL) Fluorine, TransportPCE, the optical domain SDN (Software Defined Networking) controller used in this demonstration, provides in the new ODL Sulfur release network automation for both the WDM and OTN layers, and offers a reference implementation for Open ROADM based optical networks.

Through its northbound RESTCONF interface, the TransportPCE controller communicates with the UT Dallas Programmable Optical Network (PROnet) SDN orchestrator, which provides a

single point of control and coordination of resources across the Open ROADM optical layer and the client layer – consisting of Ethernet switches and data center/edge compute nodes.

The UT Dallas Network Operations Platform (NOP), entirely built with open-source modules and originally introduced at OFC 2021, is used to handle Kafka message-based status information to enhance programmable use of the Open ROADM transport network. Key metrics, such as bandwidth utilization and equipment alarm status, are also visualized using NOP.

“Leveraging their flex-grid capability and programmability of intermediate transmission rates available in the latest Open ROADM products, we demonstrate how quality of transmission (QoT) is taken into account while creating wave services” says Tianliang Zhang, Ph.D. Candidate and Research Assistant at UT Dallas. “Signal robustness against varying transmission impairment constraints is maintained by reprogramming the 400G Muxponder to operate at 300G or 200G. We also showcase a new NOP feature – specifically designed to handle alarms generated by Open ROADM compliant equipment in real-time – and an automatic procedure to check and resolve potential state inconsistencies that may originate in the transport network due to procedural failures. These recent upgrades are enabling us to more efficiently carry out testing and debugging of product releases that implement the latest functionalities defined by Open ROADM MSA.”