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For More Information:
Andrea Fumagalli
The University of Texas at Dallas
+1-972-883-6853 | andreaf@utdallas.edu

Open ROADM Transport Network Capabilities Supporting IP-over-WDM and B400G Bookended Muxponders Demonstrated at OFC'24 March 26-28

A group of Open ROADM Multi-Source Agreement (MSA) members will demonstrate optical network equipment elements from multiple suppliers that seamlessly interoperate at data rates up to 1.1Tbps. Participants include Anritsu, AT&T, Ciena, Cisco-Acacia, Fujitsu, Infinera, NEC, Nokia, NTT, Orange, and Ribbon in close collaboration with the neutral host facility OpenLab @ UT Dallas.

The Open ROADM MSA defines interoperability specifications for disaggregated optical transport networks. These specifications, which also include YANG data models, address Reconfigurable Optical Add/Drop Multiplexers (ROADM), transponders, and pluggable optics. Multi-vendor Open ROADM compliant equipment can be integrated into the same network solution and controlled by the open source OpenDaylight Transport PCE (TPCE) controller.

The collaborative effort at OFC'24 will showcase functionalities and multi-vendor interoperability features in an optical network testbed that makes use of interconnected Open ROADM compliant equipment including ROADM nodes, 100G flexponders, Optical Transport Network (OTN) switches, 100G transponders, 400G transponders, 200G/300G/400G muxponders, a 400G single-node 3R regenerator, and interoperable CFP2-DCO and QSFP-DD 400G pluggable devices from multiple vendors.

Open ROADM MSA has worked on various use-cases, recently including the "alien wave over Open ROADM line system." The advent of digital coherent optics (DCO) in QSFP-DD form-factor makes these devices compatible with IP routers. The following distinct IP-over-WDM use cases based on this new capability defined by the Open ROADM MSA members will be showcased.

- Using disaggregated whitebox-routers from UfiSpace (UFI) and 400Gb/s ZR+ QSFP-DD DCOs we will demonstrate multiple interoperable IP-over-WDM services routed over an Open ROADM line system and concurrently managed by the open-source TransportPCE controller and an IP controller. Through these controllers we will manage the 400G coherent optics in the UFI NCP2 whiteboxes and set up an optical-tunnel across an Open ROADM line system to add 400G of capacity to a Layer-3 bundle. This demonstration will leverage multiple suppliers' equipment, including hardware and software, showcasing inter-operability, openness, and disaggregation in a unified and most comprehensive manner.

- Using commercial routers hosting 400Gb/s ZR+ QSFP-DD optics we will demonstrate a Software Defined Networking (SDN) interoperable IP-over-WDM service routed over an Open ROADM line system. The Open ROADM transport network will be managed by the open-source TransportPCE controller under the supervision of a Hierarchical Controller which implements both the Open ROADM MSA-defined APIs and the router Netconf model to coordinate and orchestrate end-to-end service creation between the optical and IP layers. A custom operational mode is defined to characterize the ZR+ devices used in this demonstration, to properly validate quality of transmission based on the enhanced performances of these pluggable coherent optical interfaces.
- Using a commercial Ethernet test set hosting 400G OpenZR+ pluggable modules connected via the Add/Drop line positioned at each end of an Open ROADM system we will demonstrate a completely automated setting to monitor line quality data providing a unified single system for monitoring communication channel changes based on quality data and for evaluating ROADM path changes. This demo will leverage both Open ROADM MSA and IETF-defined YANG models applied to control the test set and the optical devices.

We will demonstrate for the first-time interoperability for the highest commercial transmission speeds available. This demo conforms to the Open ROADM bookended model for transponder and muxponder interoperability while uniquely extending this model for multiple vendors. Through a 150GHz tunnel the demo achieved single hop next-generation 1.2T interoperability in the lab and will publicly show 1.1T multihop interoperability at OFC, where the client stream flowing end-to-end will highlight full interoperability at both coherent optical and digital mapping layer. The demo will prove that a multivendor ecosystem for high performance optical transmission is viable, beyond the simpler power-optimized transmission interoperability that has been the industry's focus until now.

Open ROADM MSA and the IOWN Networking Hub have collaborated to demonstrate an emerging use case that provides wavelength services to a remotely located facility, e.g., a data center connected to an Open ROADM network. This use case offers high-speed, low-latency, and low-power consumption connections between geographically distributed data centers.

IOWN booth #912 will connect to the Open ROADM booth #916 using a 400G Open ROADM data signal, a 400G OpenZR+ data signal, and two next-generation 800G data signals, enabling these signals to be routed through the multi-vendor Open ROADM transport network staged at booth #916. This use case will prove that wavelength connections can be extended to remotely located facilities without any electrical termination, thus achieving further energy efficiency and latency reductions in open networking. An optical supervisory channel configuration for the Open ROADM system will be showcased at the IOWN booth in which the supervisory channel is overlaid on the data signal without any electrical overhead termination. This approach enables controllability of Open ROADM equipment located at remote sites paving the way to new open networking architectures and ecosystems for distributed inter-data center connectivity based on Open ROADM system.

These demonstrations will also prove that the open-source Transport PCE (TPCE) controller can now be used to establish alien wavelength services over a heterogeneous network consisting of equipment from different vendors if these optical devices offer Open ROADM compliant interfaces. This feature greatly simplifies network operation and accelerates application development.

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

"While AT&T continues to expand our footprint of Open ROADM MSA-compliant optical network equipment in metro markets across the US, we are exploring additional use-cases within the Open ROADM ecosystem," says John Gibbons, AT&T's AVP for Packet and Optical Networks. "The advent of digital coherent optics (DCO) in QSFP-DD form-factor not only makes them compatible with routers, but also has significantly improved the economics of IP-over-WDM architectures. In the demo at OFC 2024 we are managing 400Gb/s ZR+ QSFP-DD DCOs in disaggregated whitebox routers to demonstrate interoperable IP-over-WDM over an Open ROADM line system. This demonstration leverages multiple suppliers' equipment, including hardware and software, showcasing inter-operability, openness, and disaggregation in a unified and comprehensive manner."

"As a founding member of the Open ROADM MSA, Ciena continues to evolve the specifications and break new ground with the inclusion of performance optics, and creation of an interoperable, coherent 800Gb/s specification including the industry's first interoperable PCS modulation which becomes available in state-of-the-art 3nm CMOS this year," said Nick Benvenuti, Ciena's Vice President of Product Line Management. "Excitement and deployments continue for Open ROADM-compliant ZR+ router-optimized QSFP-DD and OSFP pluggables, expanding operator deployment options over ROADM line systems."

"Open networking platforms are becoming prolific, and are showcased by the Open ROADM initiative, which enables true multivendor networking for scalable and high-performance transport from 400G coherent pluggable optics to 1.2Tbps coherent pluggable modules," says Lorenzo Ghioni, Senior Director for Product Line Management, Cisco.

"As a key contributing member of both the Open ROADM MSA and IOWN, Fujitsu is pleased to add our 1FINITY Ultra Optical System T950 transponder to this year's demonstration, showing multi-vendor 400Gbps/800Gbps interoperability," said Francois Moore, optical strategist for the photonics business at Fujitsu. "This future-ready platform, which delivers the highest long-haul and metro transport performance at lowest cost, is engineered to help operators meet the high capacity, scalability, and latency demands of data center networking, while helping reduce overall carbon footprint through liquid cooling and other sustainability features."

"As a member of Open ROADM, the creation and expansion of open optical networks are essential to enabling next-generation optical transport network," says So Satou, Senior Director, Network Solutions Business Division, NEC Corporation. "NEC is pleased to deliver optical transport products to the Open ROADM community. We are proud to continue our activities to accelerate the open optical network commercial deployment."

"We are delighted to witness the groundbreaking collaboration between Open ROADM MSA/OpenLab and the IOWN Global Forum during the live demonstration at OFC24. This event marks a significant step forward for the community dedicated to open optical networking. The partnership between Open ROADM and the IOWN Global Forum amplifies the potential of all-photonic networks and illuminates the path for its expanded applicability, ensuring further power efficiency and innovative technology advancements. Our efforts are coherently aligned with achieving the vision of open optical networking," says Yoshiaki Kisaka, Director of Transport Innovation Laboratory at NTT.

"Our mission at OFC is to showcase an open, multivendor disaggregated architecture that pushes the industry forward, and the 1.2TBps third party interoperability demo we're implementing with Cisco delivers speed and flexibility that are unavailable in today's multi-vendor environments," said Rafi Leiman, Vice President of Product Management for Ribbon.

"IPoWDM demonstrations performed at OFC 2024, leveraging TransportPCE, emphasize how the standardization of APIs carried out in Open ROADM has simplified the integration of these technologies, contributing to shorter development cycles," says Jean-Louis Le Roux, Executive Vice President of Orange International Networks (OINIS). "This exhibits the benefits of disaggregation and interoperability, which open up new horizons for operators to implement flexible and cost-effective solutions while allowing fair competition between vendors."

"The Open ROADM transport network testbed hosted by the OpenLab @ UT Dallas has seen an increase in collaboration from industry partners, resulting in unprecedented opportunities for us students to engage with cutting-edge technology firsthand," says Muhammad Ridwanur Rahim, PhD Candidate and Research Assistant at the University of Texas at Dallas. "This year the hosted testbed achieves new heights with multi-hop long-haul transmission of 400-1200G via fiber spools and Open ROADM devices. Implementation of IP-over-WDM for enhanced service orchestration, along with full-fledged interoperability of 400G ZR+ devices from four different vendors are also amongst the latest additions. Lastly, a distributed data packet traffic at or above 400G flowing through these services corroborates the validity of these solutions."