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Remote Management Agent Supporting Open Optical Transponder and Real-time Network Telemetry of 400G Channel in Open ROADM Transport Network Demonstrated at SC 2023

At the recent Super Computing (SC) conference and exposition in November, a group of Open ROADM Multi-Source Agreement (MSA) members demonstrated optical transport network equipment elements from multiple suppliers that seamlessly interoperate at data rates up to 400G while showcasing the latest all optical network management and monitoring technologies. The public Open ROADM MSA standards are defined for both the optical data plane and control plane. Participants included Anritsu, Cisco, Fujitsu, NEC, NTT, and Ribbon in collaboration with the researchers at the OpNeAR laboratory at the University of Texas at Dallas (UT Dallas).

Open ROADM MSA has been defining interoperability specifications for disaggregated optical transport networks since 2015. These specifications, which also include YANG data models, address Reconfigurable Optical Add/Drop Multiplexers (ROADMs), transponders, and pluggable optics. Multi-vendor Open ROADM compliant equipment can be integrated into the same network solution and controlled by the open-source Transport PCE (TPCE) controller. In addition, the Open ROADM MSA specifications have been expanded to enable interoperability with other standard bodies such as ITU-T and Innovative Optical and Wireless Network Global Forum (IOWN GF). Through this expansion open software and disaggregated hardware approaches can enable new architectures such as the open All-Photonics Networking (APN).

The collaborative effort at SC'23 showcased the maturity level of multi-vendor interoperability features in an optical transport network testbed that makes use of three ROADM nodes and a combination of 100G flexponders, Optical Transport Network (OTN) switches, 100G transponders, 400G transponders, and 200G/300G/400G muxponders. These devices can be managed by the open SDN controller, Transport PCE (TPCE).

In line with the IOWN GF long-term vision, the frontier of photonics networking has been further extended with the successful demonstration of an end-to-end All-Photonics Network (APN), enabled by both Open ROADM and open muxponder devices – the latter compliant with TIP Phoenix/MUST – provided by industry leaders. Surpassing the capabilities of traditional metro Dense Wavelength Division Multiplexing (DWDM) networks, this approach achieves

direct, high-speed optical connections between data centers, thus eliminating the need for electrical termination (between user and network provider) and enhancing end-to-end service delivery performance. Low latency and flexible high-speed optical circuits – routed through the programmable open ROADM transport network – can therefore directly interconnect data centers through hosted open muxponders which are managed by remote agents running as container software within Kubernetes environments.

Dr. Koichi Takasugi, Vice president of Frontier Communication Laboratory at NTT, highlighted the breakthrough's importance: “Our SC23 demonstration has set a new benchmark, underscoring our commitment to a resilient communication infrastructure. This strategic milestone aligns with the IOWN Global Forum's vision and further establishes our leadership in driving the evolution of open optical networks.”

For the first time, two 400G Ethernet testers hosting 400G ZR pluggable devices connected to the add/drop ports of Open ROADM nodes were leveraged to collect various network performance indicators in real-time. Performance indicators included physical metrics such as receiver power, OSNR, SOP/ROC, etc., as well as one-way network latency with a 5-nanosecond resolution achievable through timestamping of packets transmitted at 400G line rate. Measurement data was immediately delivered to the host system without delay, thus enabling captures of transient failures and root-cause analysis in real-time. Once automated, this procedure will be used to improve network Quality of Service (QoS) and reduce maintenance and management labor cost while supporting today’s most advanced network functions which are increasingly sophisticated and virtualized, e.g., All-Photonics Networking (APN) and 5G disaggregated modules.

“The Open ROADM MSA continues to generate increasing interest from the industry demonstrating its flexibility while accommodating new technologies, such as the 400G ZR over DWDM solution leveraged to collect network performance indicators from our Open ROADM transport network testbed,” says Aparaajitha Gomathinayakam, PhD Candidate and Research Assistant at the University of Texas at Dallas. “In addition to showcasing interoperability among multi-vendor devices, our demonstration also highlighted full interoperability between 400G CFP2-DCO pluggables from three different vendors. Utilizing compute resources to generate network traffic, real-time network monitoring was achieved through Grafana, displaying performance metrics such as OSNR, pre-FEC BER, input and output power, among others.”