Disaggregated Packet Transponder field demonstration exercising multi-format transmission with multi-vendor, open packet optical network elements

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Abstract: We demonstrate a field trial of 100G/200Gbps alien wavelength transmission and management onto a deployed line system (Telefónica del Perú nation-wide field network) with disaggregated packet transponder, adopting multi-vendor CFP2-ACO / CFP2-DCO transceivers.

1. Introduction

Open networking and disaggregation are common trends in the industry. Open Compute Project (OCP) [1] and Telecom Infra Project (TIP) [2] are the two main activities that are impacting the industry. While OCP started with more focus on the data center, TIP is focused on TELCOs environments. Within the Open Optical & Packet Transport (OOPT) working group in TIP the Disaggregated Optical Systems sub-group has defined the network elements to achieve the goal of disaggregation offering wider choice to operators. The definition of packet/optical white boxes such as Voyager and Cassini enables the creation of a vendor neutral abstraction framework such as Transponder Abstraction Interface (TAI) [3], where pluggable manufacturers can test and integrate their solutions. Building on this foundation is the NOS layer which provides a uniform control, management interface for end-end service management.

Coherent optics for metro and long-haul transmission traditionally have been integrated almost exclusively into proprietary network equipment manufacturers (NEM) systems, from L0/L1 optical transport systems, to L2/L3 Ethernet/IP switches/routers. As the trend continues towards commercially available packet optical network systems, supported by an evolving ecosystem of open source software OS and management toolsets, coupled with the increasing capabilities of Small Form Factor (SFF) pluggable coherent modules, we see a clear path toward achieving the architecture objectives of Open Optical Packet Transport (OOPT).

With the emergence of ODM whitebox platforms such as Cassini from Edgecore, Galileo from Wistron, and more to follow, we set out to test the capabilities of this ecosystem to identify opportunities to integrate these systems to fulfill the increasing demands for flexible, reliable and scalable capacity in the network. This paper describes the test criteria and results.

2. Field Trial Configuration

The field trial deployed Edgecore Cassini packet optical switches running IP Infusion's OcNOS equipped with CFP2-ACO modules from Lumentum and Fujitsu Optical Components and CFP2-DCO modules from Lumentum in Lima, Peru and Trujillo, Peru. The Cassini packet optical switch is Edgecore's flagship whitebox platform for provider edge and core networks. OcNOS supports service provider applications for long-haul and metro transport use cases using TAI as the south bound interface to the optical modules and Netconf/Openconfig north bound interface for integration to SDN controllers. During the trial a subset of the openconfig interfaces [4] was used to manage/configure the optical link parameters - specifically modulation, frequency and power.

The DWDM transport links used during the field trial are part of Telefónica's Network in Peru, running between Lima and Trujillo (Fig. 1), with a working path distance of approximately 641 km that includes Optical Line Protection (OLP) along the entire route, and a protection path distance of 1252 km. The working path consists of 4 terrestrial fiber spans, with four in-line EDFAs, three intermediate ROADMs and two ROADMs with DWDM multiplexers at the endpoints (Fig. 2). The protection path consists of eight terrestrial and seven aerial fiber spans with eight in-line EDFAs, eight intermediate ROADMs, and two ROADMs with DWDM multiplexers at the endpoints.

Each transmission link consists of fiber type G.652D and is not dispersion compensated. The 100G and 200G DWDM channels are transported as alien wavelengths over a 3rd-party transport system that was simultaneously carrying production and test traffic during the field trial. The DWDM channels-under-test were located at 194.25THz for working and 192.65THz for protection. We performed the tests using coherent optical modules from different vendors (Lumentum and FOC) to demonstrate multi-vendor optical interoperability.

Fig. 1: Bi-directional transmission: working and protection fiber

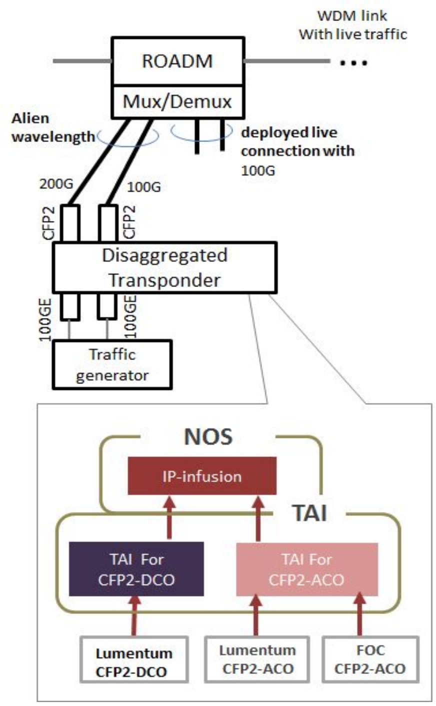

Fig. 2: Field trial system configuration

3. Field Trial Results

Fig. 3 shows the summary of transmission test results for each configuration. RFC 2544 test was passed for 100G DP-QPSK 1250km transmission and 200G DP-16QAM 640km transmissions.

Site	Application	Module	Reach	Mod Format	Baud Rate	Tx OSNR	Rx OSNR	pre FEC BER	RFC 2544
WA2	LH - 100Gbps Protection Path	ACO	1250km	QPSK	33 Gbd	30.5 dB	15.8 dB	4.20E-04	Pass
TRU						31.5 dB	18.9 dB	1.05E-03	Pass
WA2	LH - 200Gbps Working Path	DCO	640km	8QAM	42 Gbd	30.5 dB	20.5 dB	6.50E-03	Pass
TRU						31.5 dB	20.1 dB	6.60E-03	Pass

Fig. 3: 100G DP-QPSK line-side interoperability transmission results over 1252 km measured between Lumentum and FOC CFP2-ACO, and 641 km measured via Lumentum CFP2-DCO.

Fig. 4 shows DWDM optical spectrum measured at monitor port in DWDM line system. 192.65TH optical signal for 42Ggbd 8QAM was successfully established using available channel already deployed 50GHz grid 100G DWDM line system. Fig. 4 (left) represents the LH demultiplexed monitoring port, with 200G 8-QAM signal highlighted. Fig 4. (right) represents the 8QAM modulated signal spectrum, applying 6-point measurement analysis to derive OSNR. Finally, Fig. 5 shows the long haul RFC2544 results for throughput, latency and jitter for the link TRU-WA (1252Km).

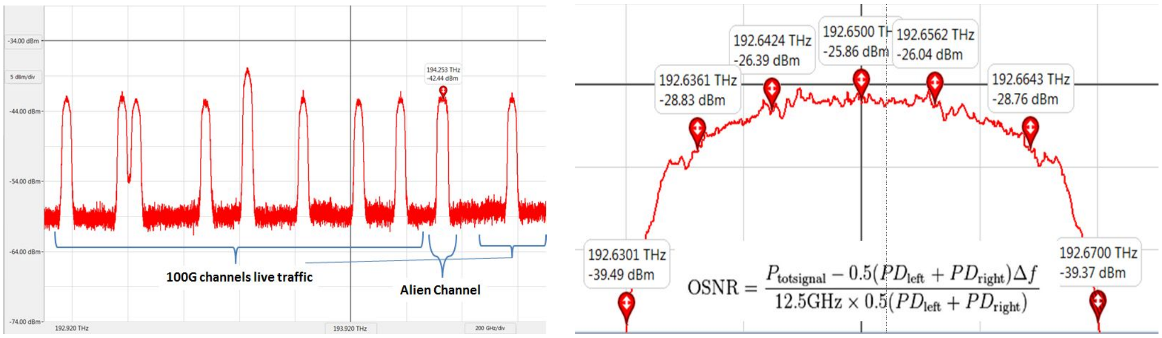

Fig. 4: 200G DP-8QAM line-side interoperability transmission results over 641 km measured on Lumentum CFP2-DCO

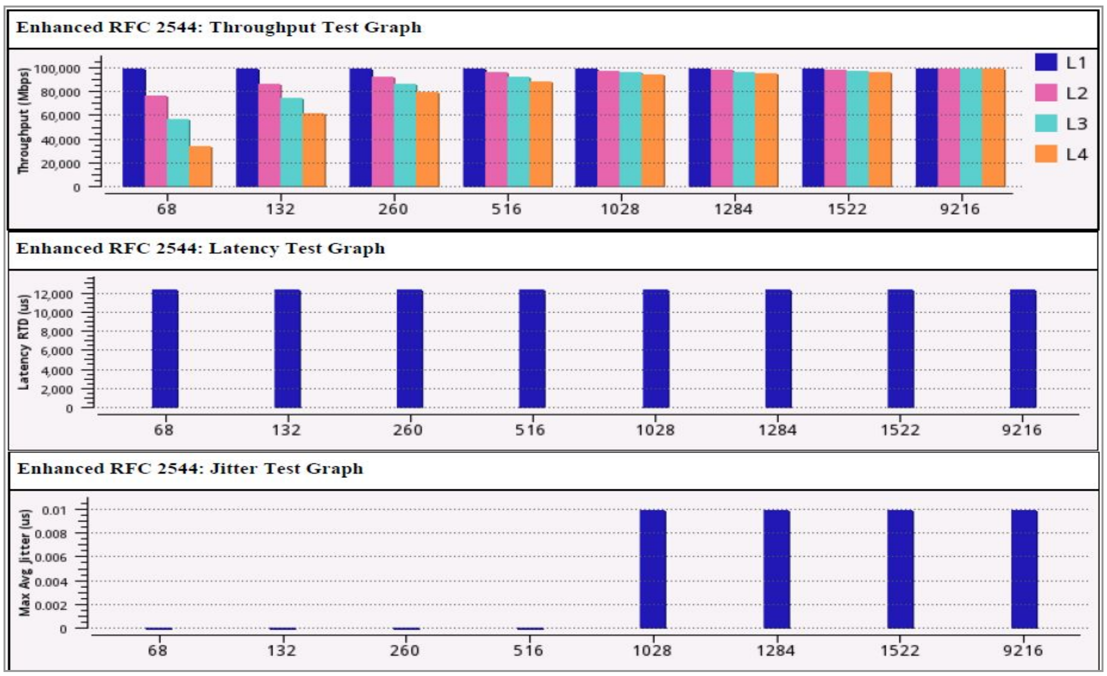

Fig. 5: Long haul RFC2544 Results <Throughput, Latency, Jitter> - TRU-WA 1252Km

4. Conclusions

We have demonstrated 100G and 200G coherent DWDM alien wavelengths over a deployed ROADM enabled line system through spans of 1252 km and 641 km, respectively. The Optical System trial has verified multi-vendor Coherent Transceiver modules as an enabling product solution to service a disaggregated Packet Optical Transponder, running an Open Management Interface. We have verified error-free transmission across a dynamic operating range of optical power, modulation format and a disparate optical infrastructure within Telefónica Perú.

5. References

[1] Open Compute Project, https://www.opencompute.org
[2] Telecom Infra Project, https://telecominfraproject.com
[3] Transponder Abstraction Interface, https://github.com/Telecominfraproject/oopt-tai
[4] Optical Transport Openconfig models, https://github.com/openconfig/public/tree/master/release/models/optical-transport