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Original

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Physical-Layer Awareness: GNPpy and ONOS for End-to-End Circuits in Disaggregated Networks

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Abstract: This demo shows the automatic end-to-end path provisioning over a multi-vendor fully disaggregated Open Line System by Czech Light using the GNPpy QoT estimator and Cassini transceiver by the Telecom Infra Project integrated with ONOS. © 2020 The Author(s)

1. Introduction

With the dramatic increase in data traffic envisioned for the next years, optical networks will be requested to sustain a large amount of data traffic. Network operators are trying to maximize returns on infrastructures by automating the management and by maximizing capacity in existing networks. Thanks to the coherent optical technologies, such a goal is obtained by a multi-layer abstraction of networks down to the physical WDM layer [1, 2].

The Telecom Infra Project (TIP) Open Optical Packet Transport – Physical Simulation Environment (OOPT-PSE) [3] group is defining and developing a common, open source and vendor-neutral set of algorithms able to assess the optical impairments in an open optical line system.

The core software developed by the OOPT-PSE Team is called Gaussian noise simulation in Python (GNPpy) [4] and relies on a quality-of-transmission estimator (QoT-E) that abstracts the optical transmission by evaluating the accumulation of the amplified spontaneous emission (ASE) noise generated by the amplifiers and of the nonlinear interference (NLI) introduced by nonlinear fiber propagation. So, the QoT-E of GNPpy, given the network status, calculates the Generalized Signal to Noise Ratio (GSNR) [1, 5] over a described network route with validated excellent accuracy [6] and quick computational time

The Open Network Operating System (ONOS) [7] is an open source SDN network controller targeted specifically to Service Providers and mission critical networks. It is developed to provide the high availability, scale-out, and performance in network demanding. Furthermore, ONOS includes Northbound abstractions and APIs that ease application developments.

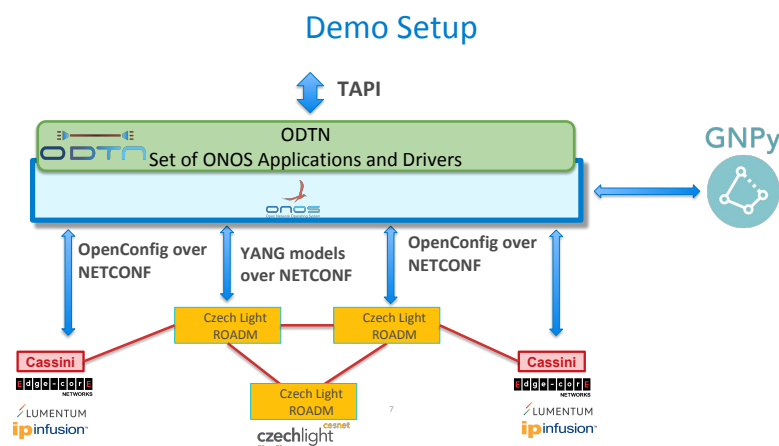


Fig. 1: Demo schema



Fig. 2: Hardware setup at the TIP Summit

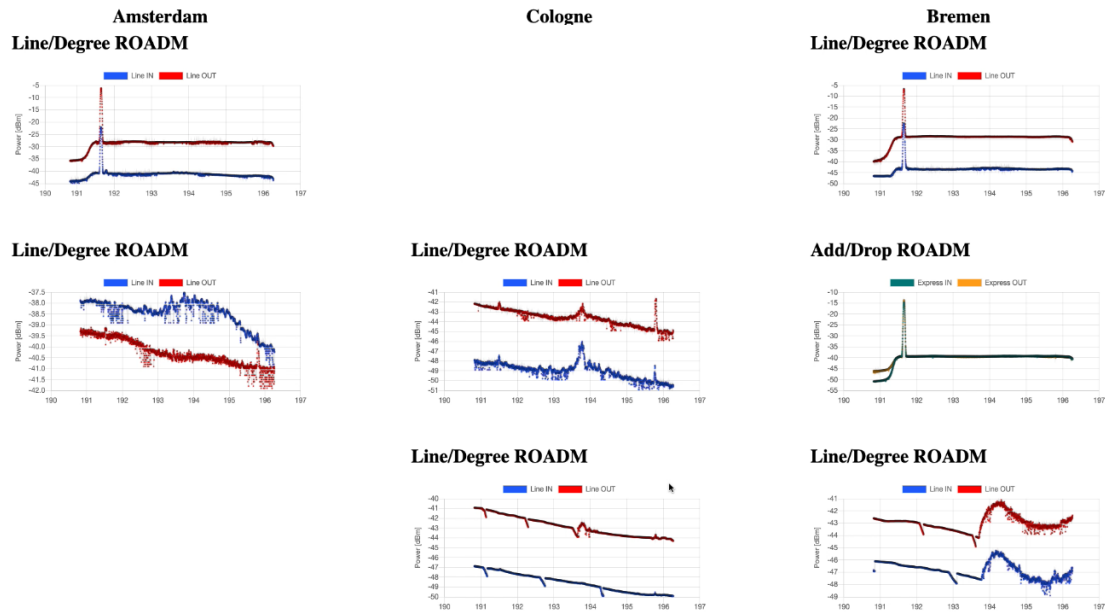


Fig. 4: Optical spectrum traces of different fiber lines as captured by ROADM devices

for root cause analysis and distributing the power control loop. GNPY's optimization features [13] can be used for iterative performance improvements on a per-media-channel basis as well.

References

1. V. Curri, M. Cantono, and R. Gaudino, "Elastic all-optical networks: A new paradigm enabled by the physical layer. how to optimize network performances?" *J. Light. Technol.* **35**, 1211–1221 (2017).
2. T. Zhang, A. Samadian, A. Shakeri, B. Mirkhazadeh, C. Shao, M. Razo, M. Tacca, A. Ferrari, M. Cantono, V. Curri, G. Martinelli, G. M. Galimberti, T. Xia, G. Wellbrock, and A. Fumagalli, "A WDM network controller with real-time updates of the physical layer abstraction," *J. Light. Technol.* **37**, 4073–4080 (2019).
3. TIP, "Open optical packet transport," <https://telecominfraproject.com/oopt/> (2019).
4. "GitHub repository of GNPY," <https://doi.org/10.5281/zenodo.3541090>. DOI: 10.5281/zenodo.3541090.
5. V. Kamalov, M. Cantono, V. Vusirikala, L. Jovanovski, M. Salsi, A. Pilipetskii, D. K. M. Bolshtyansky, G. Mohs, E. R. Hartling, and S. Grubb, "The subsea fiber as a shannon channel," in *In Proceedings of the SubOptic*, (2019).
6. M. Filer, M. Cantono, A. Ferrari, G. Grammel, G. Galimberti, and V. Curri, "Multi-vendor experimental validation of an open source QoT estimator for optical networks," *J. Light. Technol.* **36**, 3073–3082 (2018).
7. ONF, "ONOS network operating system," <https://onosproject.org/> (2014).
8. J. Kundrát, O. Havliš, J. Jedlinský, and J. Vojtěch, "Opening up ROADMs: Let us build a disaggregated open optical line system," *J. Light. Technol.* **37**, 4041–4051 (2019).
9. T. Tanaka, A. Hirano, S. Kobayashi, T. Oda, S. Kuwabara, A. Lord, P. Gunning, O. Gonzalez de Dios, V. Lopez, A. M. Lopez de Lerma, and A. Manzalini, "Autonomous network diagnosis from the carrier perspective [invited]," *IEEE/OSA J. Opt. Commun. Netw.* **12**, A9–A17 (2020).
10. L. Alahdab, C. Ware, E. L. Rouzic, J. Meuric, and A. Triki, "Interoperability issues in optical transport networks," in *2019 21st International Conference on Transparent Optical Networks (ICTON)*, (2019), pp. 1–4.
11. H. Wessing, P. Skoda, M. N. Petersen, A. Pilimon, P. Rydlichowski, G. Roberts, R. Smets, J. Radil, J. Vojtech, R. Lund, Z. Zhou, C. Tziouvaras, and K. Bozorgebrahimi, "Alien wavelengths in National Research and Education Network infrastructures based on Open Line Systems: Challenges and opportunities," *J. Opt. Commun. Netw.* **11**, 118–129 (2019).
12. I. Busi, S. Belotti, V. Lopez, O. G. de Dios, A. Sharma, Y. Shi, R. Vilalta, and K. Sethuraman, "YANG model for requesting path computation," <https://tools.ietf.org/html/draft-ietf-teas-yang-path-computation-05> (2019).
13. J. Auge, G. Grammel, E. le Rouzic, V. Curri, G. Galimberti, and J. Powell, "Open optical network planning demonstration," in *2019 Optical Fiber Communications Conference and Exhibition (OFC)*, (2019), pp. 1–3.