OnE! – Machine learning-assisted optical cables supervision in metropolitan networks

Speaker: Clayton Reis da Silva[1]

Authors: Fausto Vetter[1], Camilo Arturo Rodriguez Diaz[2], André Luiz Almeida Marins[1], Lisandro Zambenedetti Granville[1]

[1]Brazilian National Research and Education Network (RNP)

[2]Federal University of Espírito Santo (UFES)

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Abstract

RNP, the Brazilian NREN, has a 22-year-old RD&I program called Working Groups (WGs), whose main goal is to develop technological solutions in collaboration with the Brazilian research community. To deliver value faster, this program has been reformulated in 2019 to include business development aspects. A notable solution emerging from this new program is OnE!, a low-cost hardware and software combined solution that is under development to offer ongoing monitoring of customized optical networks for campus and metropolitan environments. OnE! provides a continuous monitoring solution with IoT capabilities, prioritizing affordability, scalability, and energy independence in communication. Moreover, it aims to advance the integration of innovative features to leverage cloud platforms and machine learning. OnE! is a collaborative effort among RNP, UFES and NOCS Startup[1].

1. Introduction

RNP (Rede Nacional de Ensino e Pesquisa) is the Brazilian National Research and Education Network (NREN). Our pioneering spirit in bringing the Internet to Brazil was accompanied by the need to promote the advanced use of networks, including the

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[1] www.nocsolucoes.com.br

inception of products and services in collaboration with the Brazilian research community through an Open Innovation[2] process.

The Working Groups program, created in 2002, was the primary initiative of RNP in conceptualizing and introducing new products and services. In 2019, this program underwent a transformation and was rebranded *Advanced Services Research, Development and Innovation (RD&I) Program*. This revamped program serves as a prime example of how an NREN can leverage open innovation to quickly deliver new offerings to the market. The updated program not only continues its focus on technological development but also integrates a business development component. In doing so, RNP is working to reduce the time to market of its new products and services.

Within this program, participating groups undergo entrepreneurial training that includes both theoretical knowledge and practical applications, particularly in the Customer Discovery/Validation process. All projects are required to develop a minimal viable product (MVP) within the first year, and in the subsequent year, they must identify early adopters and refine the MVP accordingly. Research groups are actively encouraged to establish partnerships with startups and imbue their teams with entrepreneurial skills. This enables them to validate business hypotheses while also explore potential offers to RNP System[3]. A successful example that a working group is currently running through phase 2 is OnE!, presented in the following session.

2. OnE! solution.

The OnE! solution offers continuous supervision of customized optical networks tailored for metropolitan networks environment, helping to reduce downtime due to broken optical fibers, thus aiming to maintain high levels of availability. OnE! aims to develop a scalable solution and applies monitoring techniques based on optical power by characterizing optical components to estimate failures in optical fiber in the physical layer. In addition, OnE! is developing an initial version of a cloud monitoring interface

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[2] https://bit.ly/4dNtag7 (brazilian portuguese)

[3] https://www.rnp.br/en/rnp-system

for defining link maps and real-time visualization, including attenuation zones in optical fibers and alarms based on monitored power levels. Hardware design is under development in collaboration with RNP Points of Presence (PoPs), maintaining the standard OFD format[4] to facilitate integration into data center racks.

The utilization of commodity optical elements to extract information from the physical layer of the optical network generates a substantial volume of operational data. In the future, OnE! aims to process these data by machine learning (ML) algorithms to enable advanced monitoring with predictive failure functionality.

This approach reduces the costs associated with event identification while improving the ability to discern event causality. MVP underdevelopment with different RNP´s PoPs enables: (i) on-site validation of the proposal, (ii) implementation of ML algorithms for identification and classification of various event types, and (iii) enhancement of the cloud interface to intuitively deliver information regarding the current state of the monitored network, alongside other pertinent parameters concerning hardware operation.

The solution is suitable for adoption by administrators overseeing small- and medium-sized optical networks, including neutral fiber infrastructure operators and small-scale Internet service providers. OnE! offers potential competitive advantages, including continuous cloud monitoring for predictive failure analysis, interoperability with traditional network management systems through SNMP, Syslog, and OAM interfaces, as well as a compact and customizable dashboard that can function independently.

3. Conclusions

The Advanced Services RDI program represents a significant step forward in reducing the gap between academia and the market, and a key aspect of each of the working groups is related to the development of their entrepreneurial capacity. This capacity includes the search for new early adopters that can validate OnE! current ongoing product and market development.

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[4] https://www.optokon.com/product/568-pudos-19-rack-mount-optical-distribution-frame-for-data-centers