Embracing Openness and Disaggregation: Our Journey with OpenRAN@Brasil

The evolution in network function virtualization, driven by market and regulatory demand seeking more openness and interoperability within Radio Access Networks (RAN) for next-generation cellular networks, motivated the introduction of Open RAN. This innovative framework, comprised of cutting-edge standards, protocols, and open-source software components, addresses the evolving demands of the industry. This openness aims to democratize parts of the telecommunications network and thus not depend on large telecommunications equipment manufacturers, allowing reduced costs and dependency on large manufacturers. The Open RAN architecture combines modular base station software with off-the-shelf hardware, assigning baseband and radio unit components from single vendors for seamless interoperability, whether there are virtualized/disaggregated RAN elements or not.

The Program

Co-executed by the National Education and Research Network (RNP) in Brazil and the Centro de Pesquisa e Desenvolvimento em Telecomunicações (CPQD), the OpenRAN@Brasil Program is the largest research, development, and innovation program in the field of open and disaggregated radio access networks in Brazil. In the first of its three phases, we are providing an open-source experimentation platform for the control and management of programmable network infrastructures composed of open and disaggregated equipment, i.e., built from the integration of multiple components supplied by different hardware and software manufacturers. The testbed provides different experimentation capabilities, such as 5G, programmable networking, resource slicing, artificial intelligence, and services orchestration, among many other technological domains related to the open RAN stack. Currently, six working groups were selected through an open call initiative for academia and are actively engaged in crafting innovative solutions using the program's testbed.

Its second phase is developing a 5G radio unit that adheres to the requirements defined by the O-RAN Alliance (O-RU 5G) for use in macrocells in the sub-6GHz band, achieving a major milestone in terms of research, development, and innovation in the technological components of the open RAN architecture. The O-RU 5G will feature low cost, high programmability, and serve relevant niche markets relevant for the development of the country. The second phase also addresses RD&I in the intelligence layers of the Radio Intelligent Controller (RIC) and the cybersecurity aspects of Open RAN, with the first xApps and rApps already under development.

Finally, the third phase of OpenRAN@Brasil focuses on expanding the testbed to all regions in Brazil. Designing and deploying additional sites covering all regions in Brazil (south, middle-west, north, and northeast) is a major challenge and a key activity to engage more ICTs and startups with the program. We aim to integrate the 5G radio units developed during the second phase in the testbed expansion of the third phase. The program will also promote open calls for both ICTs and startups, offering potential funding and access to the testbed, allowing them to evaluate their research, propose improvements to the infrastructure, and validate new

applications and business models, among other key activities for open RAN research and innovation.
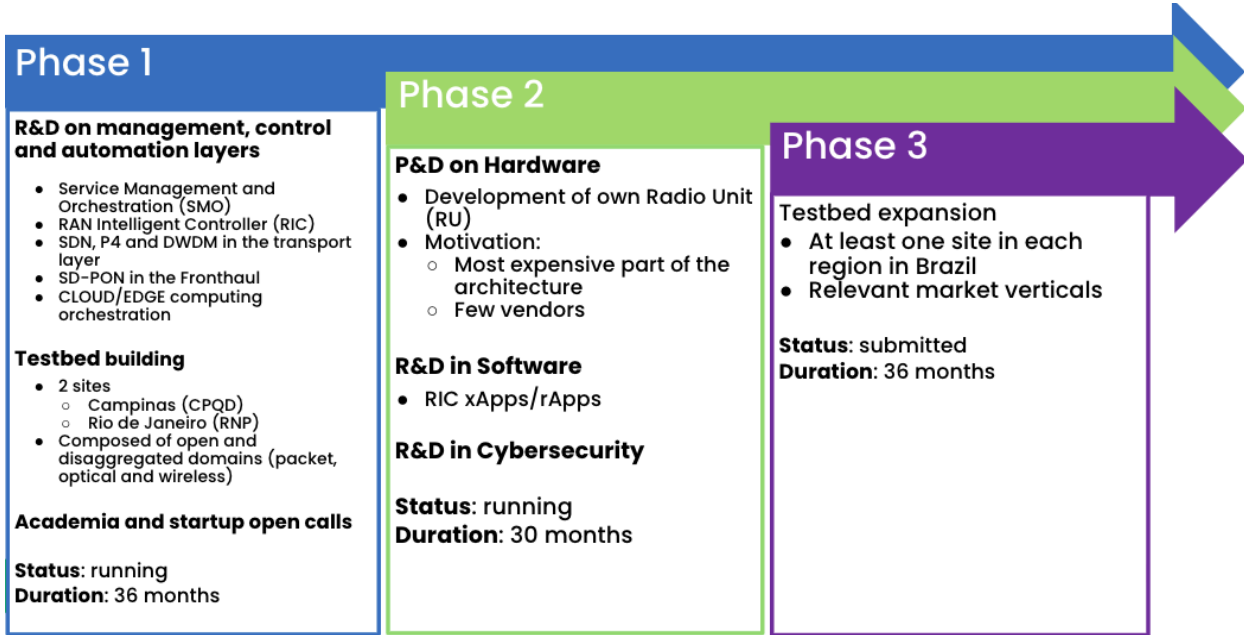

Figure 1: Overview of all OpenRAN@Brasil Phases

The Open Calls

The OpenRAN@Brasil program is fostering innovation through two open calls, targeting academia and startups. The first call aimed at researchers, seeking proposals for research and development (R&D) working groups to experiment with the program's testbed, while also contributing to its evolution. From 14 submissions, 6 proposals were chosen, receiving a total of 132.000 BRL to fund R&D teams for 12 months, starting in November 2023. Currently, these teams are integrating their experiments into the testbed with assistance from OpenRAN@Brasil's technical team.

Working Group Name	Topic
GT ORAN-QOS	QoS for open RAN
PLATEOU	Slicing orchestration
OIRAN	High availability, low power orchestration
GT-FAIR-5G	5G security
GT-AGIR	Intent-based management for open RAN
IQoS	Smart Management for QoS

Table 1: Selected Working Groups of the OpenRAN@Brasil Program

To drive innovation in open RAN, the second open call specifically sought startups with solutions that could exploit the strengths of the testbed. From the 50 proposals received, 6 promising startups progressed to the second phase, where they will present their ideas to a

panel of experts. These chosen startups will receive a grant of 100,000 BRL alongside access to the testbed for validating their developments. At Fyuz 2024, we'll not only showcase some of the results achieved by the selected startups but also share our experiences collaborating with them.

Technological Overview

This presentation also delves into the program's significant advancements over the last three years. We'll showcase the cutting-edge technologies integrated within the OpenRAN@Brasil testbed across its two ongoing phases.

Unveiling the OpenRAN@Brasil Testbed's Technological Landscape

First, we will provide a comprehensive overview of the diverse technological domains harnessed within the OpenRAN@Brasil testbed:

- 5G Open RAN integration;
- Programmable P4 switches for network programmability;
- Programmable optical transponders for dynamic network optimization;
- Programmable passive optical network (PON) for flexible infrastructure;
- Cloud and edge computing capabilities for distributed processing power;
- Cutting-edge orchestration solutions including KVM, Kubernetes, EMCO, and NEPHIO;
- PTP/SyncE synchronization for precise timing across the network.

Deep Dive into the O-RU 5G Development

The second part of our presentation focuses on the O-RU (Open Radio Unit) 5G, a key innovation under development in Phase 2. Our O-RU is highly based on Meta's Evenstar project, considering the following mandatory and desirable requirements:

Mandatory Requirements:
- Operating frequency ranges for SMP: N78 TDD (3.3 ~ 3.8 GHz);
- Transceiver configuration: 4T4R;
- Transmission power per antenna: 20W;
- Modulation Modes: DL:QPSK, 16QAM, 64QAM, 256QAM / UL: π/2-BPSK, QPSK, 16QAM, 64QAM
- Fanless mechanics;
- Operating temperature range: -10°C to 55°C
- Resistant to outdoor environments (IP65): sun, rain, dust.

Desirable Requirements (under development):
- Transceiver configuration: 8T8R;
- Antenna transmission power: 40W

We'll explore the O-RU 5G's core functionalities and technical specifications, current prototypes under development, the integration of the O-RU 5G within the testbed environment, and management and control software specifically designed for the O-RU 5G.

Takeaways

The Fyuz audience will delve into the challenges faced by the OpenRAN@Brasil Program, especially regarding the building of the nationwide open RAN testbed, a resource offered to the industry, government, and academia for experimentation. We want to share our experience dealing with state-of-the-art technologies regarding wireless communication, cloud/edge computing, and programable networks, as well as the details regarding the development of an O-RU 5G with national technology. The audience will also learn how to get involved with the program and the ways to prospect partnerships with other testbeds available nationally and internationally. We will also present the evolution of the research performed by the working groups and startups regarding innovative applications and solutions for open RAN and our experience building open calls for working groups.

For more information, please visit https://openranbrasil.org.br.