openWAMS Project

Operador Nacional do Sistema Elétrico

Use of GPA Synchrophasor Products at ONS

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GPA Synchrophasor User's Group
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Richmond, USA

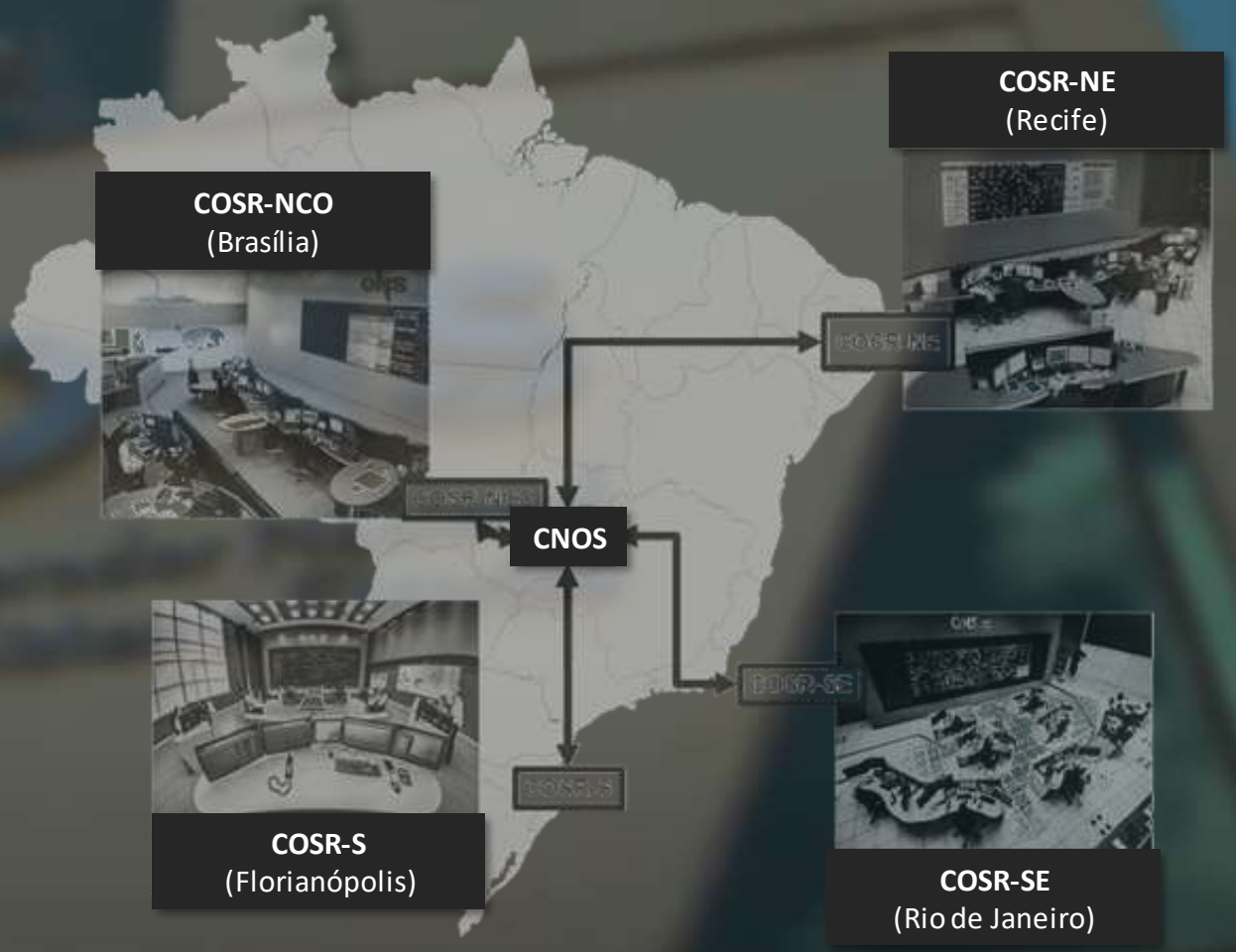
About ONS

www.ons.org.br

We are the National Electric System Operator - ONS

The mission of ONS is to ensure the supply of electricity in the country, with quality and a balance between safety and the overall cost of operation.

The ONS is a private law legal entity, non-profit, under government's regulation and supervision. ONS does not own any generation, transmission, or distribution assets. The centralized management of the system operation guarantees operational security at the lowest possible cost.



HOW BIG IS BRAZIL?

BRAZIL'S MAP SUPERPOSED TO CENTRAL EUROPE

ONS in numbers

www.ons.org.br

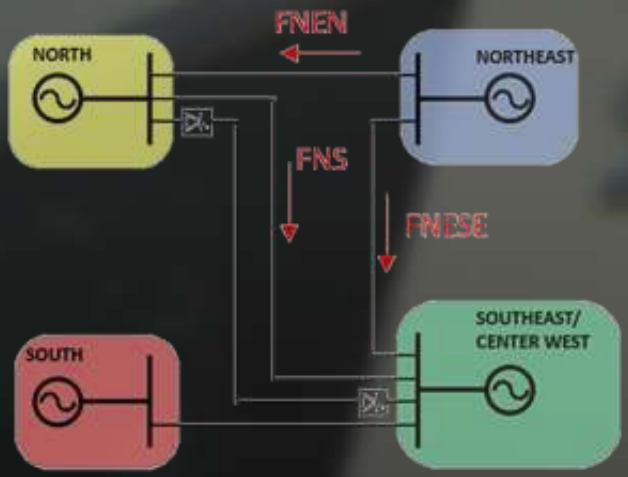
200 000 km(124,000 miles) transmission lines

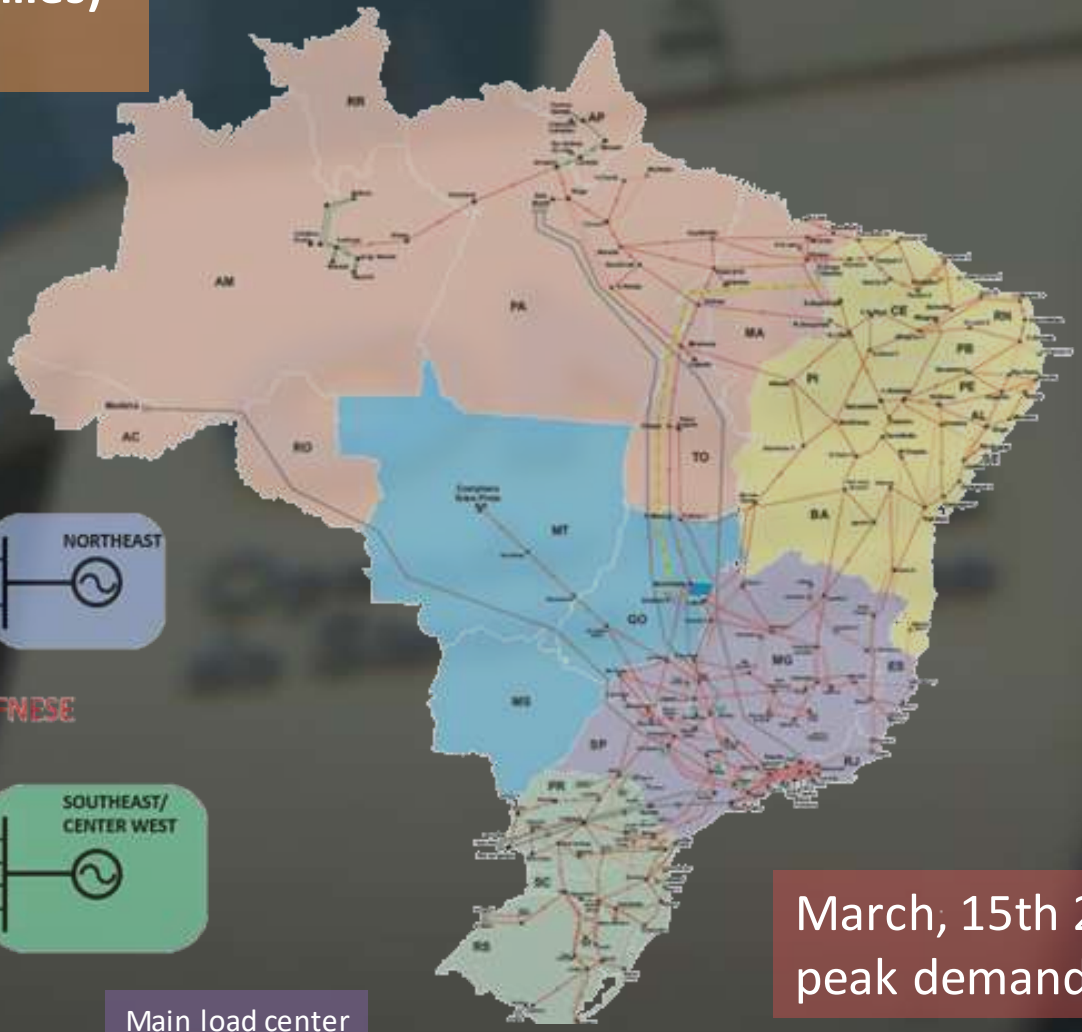
Complex Hydro-Thermal-Renewable Generation grid

GO15

One of the world's largest synchronous networks

Large run-of-river hydropower plants far from load centers at the North (Seasonal Energy)





Main load center in Southeastern Brazil

2024 | 2028
12.1 GW | 21.1 GW

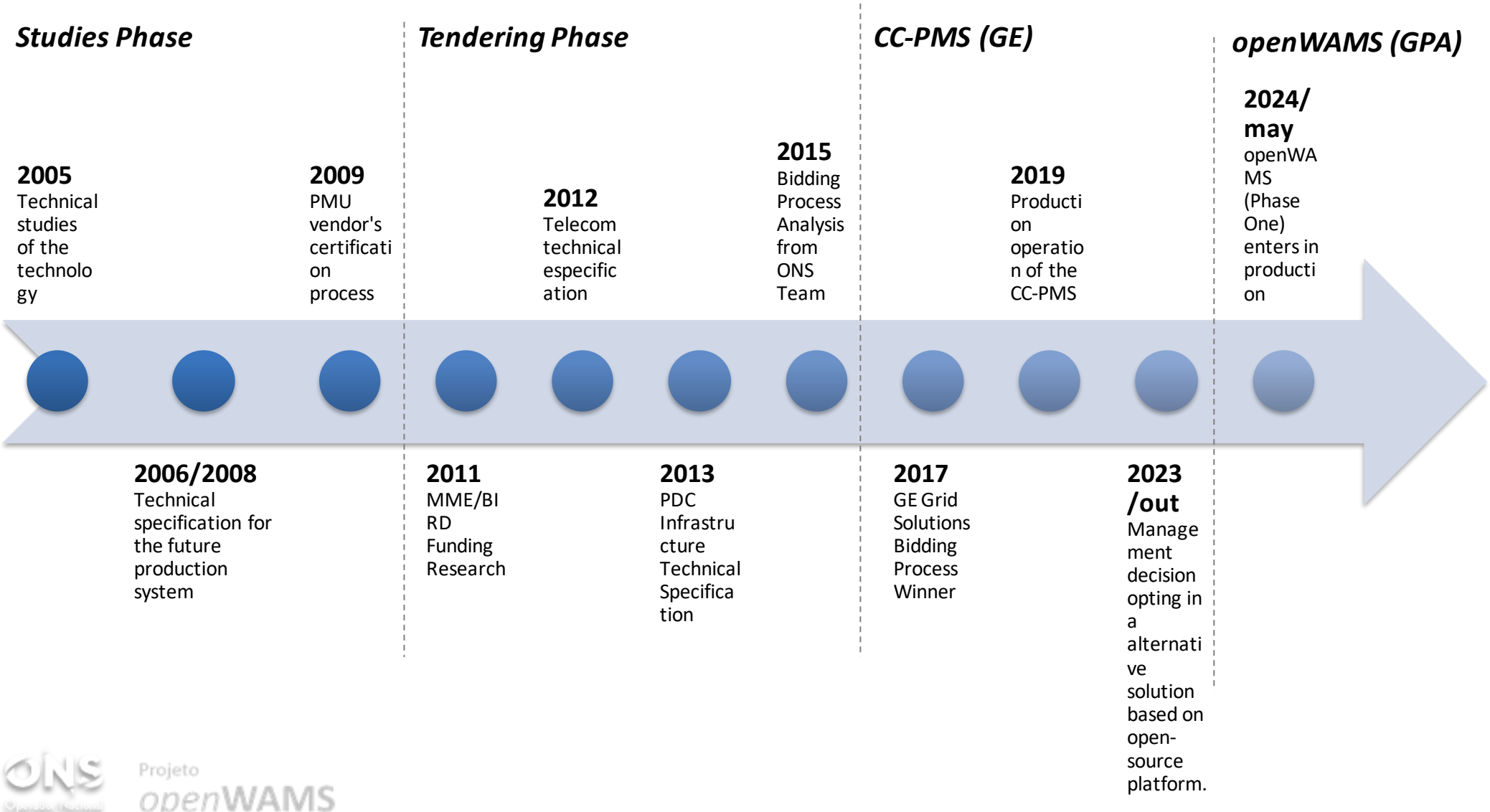
Rapid increase of win and solar Generation (Northeast Region)

2024 | 2028
29.4 GW | 35.2 GW

March, 15th 2024: highest peak demand of **102 GW**

Synchrophasors at ONS

2025: Advanced applications, alarms, simulation and more



Projeto openWAMS

*open***WAMS**: A Cost-Effective and Flexible Solution

- **Problem:** End-of-contract for CC-PMS system necessitated a new, modern and cost-effective solution.
- **Solution:** Adopted GPA solution, leveraging previous experience with openPDC/Historian. Contract signed with GPA for SLA, training and technical support.
- **Benefits:** Aligned with Grafana for a flexible and customizable interface. Initially designed as a short-term solution but quickly gained traction and became the long-term choice. Open-platform approach (hence the name: openWAMS) for scalability and customization.
- **Achievements:** Phase One implemented in just 7 months with good user's feedback (recording breaking time!), reusing existing hardware. Phase Two under development, focusing on advanced real-time applications and database automation.

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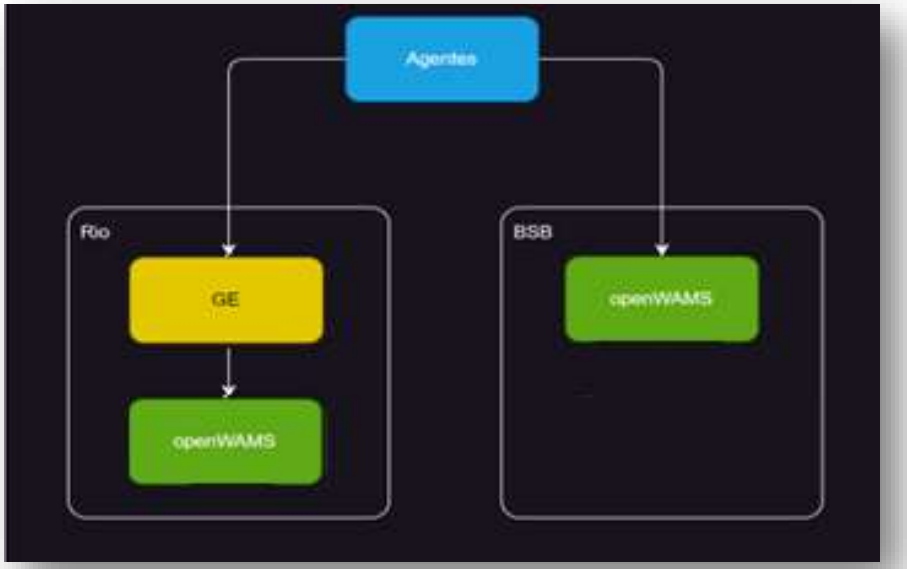
Victor Freiria	Marcio Brasil	Rafael Vilar
Fábio Eloy	Arthur Mouco	Paulo Quintão
Rafael Waddyngton	Cesar Rodrigo	Hector Volskis
Marcelo Cascardo	Demetrius Silva	+++

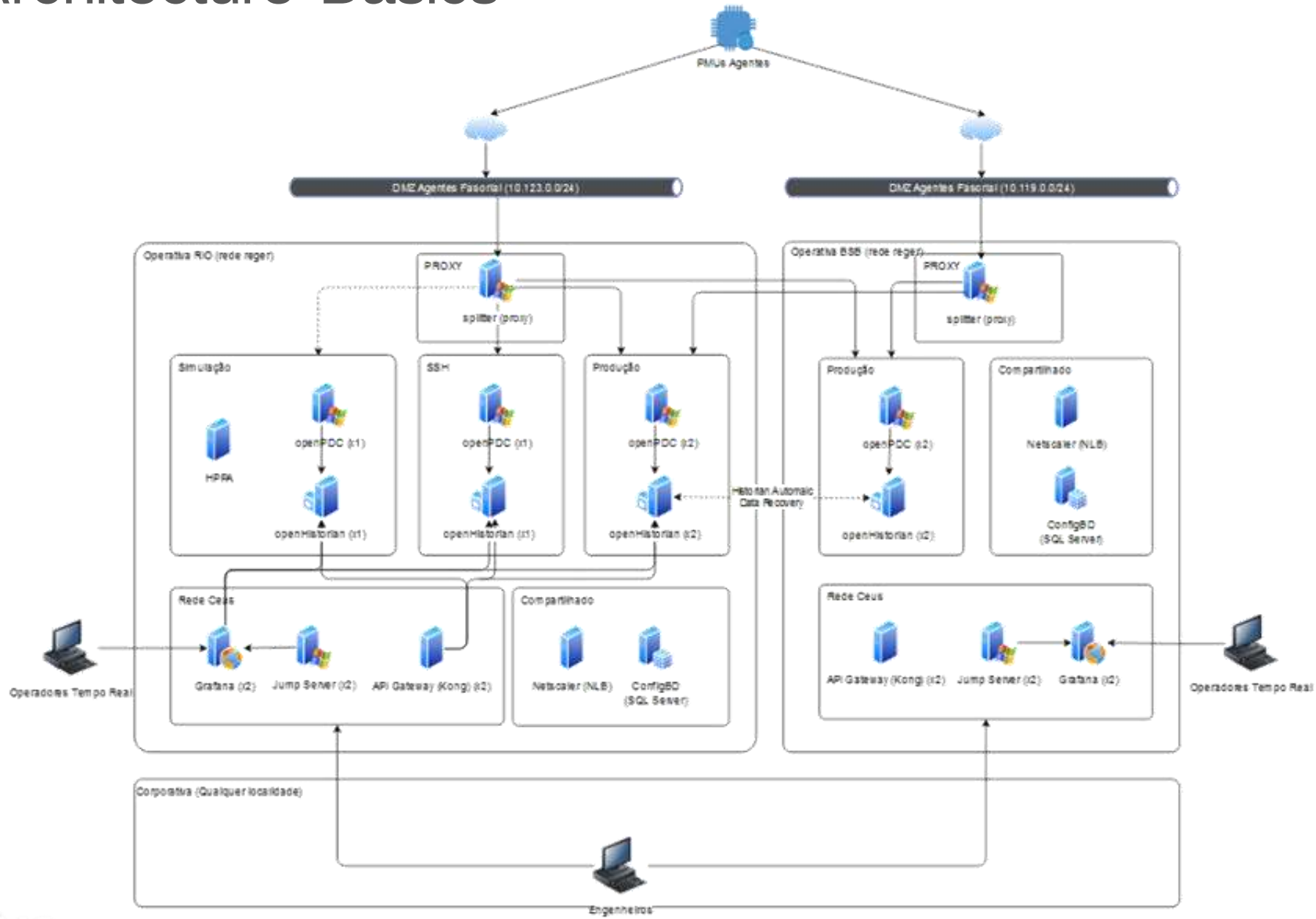
Environments Design

- Redundant critical production systems:
  - **OP-RIO** (Rio de Janeiro): operational
  - **OP-BSB** (Brasília): under commissioning
- Scalability: Designed for up to 1500 PMUs (currently receiving 600 @ 60 FPS, 3-phase V/I).
- Comprehensive Support Environments:
  - **CORP:** Corporate user access for historical data analysis
  - **DEV:** Development environment for in-house application creation
  - **SIM:** Simulation environment (HPPA OTDS) for system validation and training
  - **LAB:** "all-you-can-break" laboratory for testing, exporatory learning, and Grafana editor training
- Grafana visualization UI: comprehensive dahsboards portfolio for control room operations, post-operation activities, and system maintenance.
- Advanced applications in operation and under-development, including alarm management.



ID	Objetivo	Criticidade
OP-RIO	Operação do Sistema	ALTA
OP-BSB	Operação do Sistema	ALTA
CORP	Acesso Geral Corporativo	ALTA
DEV	Desenvolvimento Aplicações e Dashboards	MÉDIA
SIM	Simulação, Treinamento e Homologação	BAIXA
LAB	Laboratório de Testes Livres	BAIXA

Architecture Basics



Projeto openWAMS

In-house Development Applications

Based on the data integration with openHistorian via STTP/Python API

In-house application can be deveped according to ONS needs, harvesting the staff power system expertise.

In-production applications:

- PMU Data Quality Ranking

Under development:

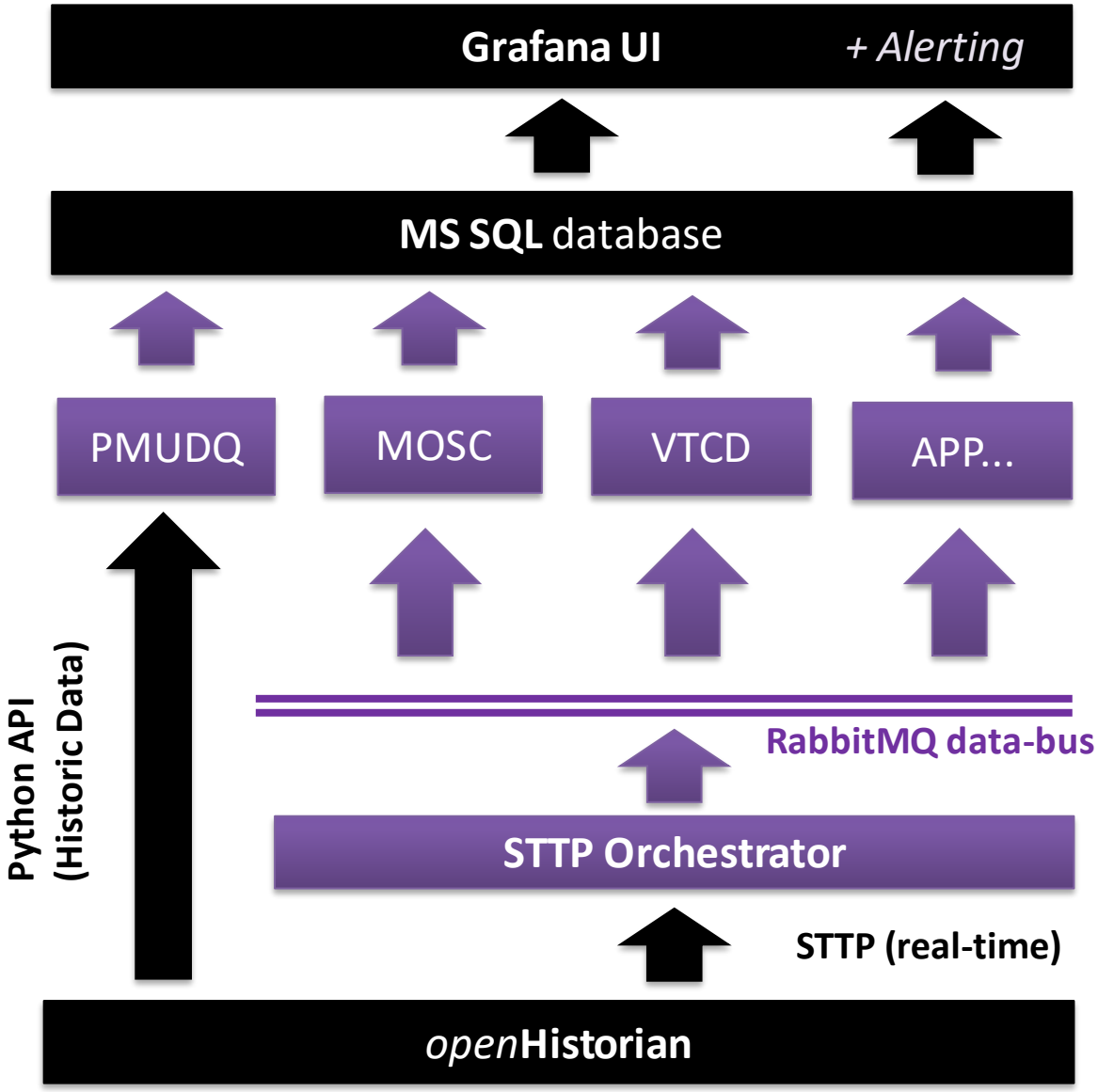
- Oscillation Monitoring
- Energy Quality Monitoring
- PMU Angle Constraints Monitoring (integrated with DSA)

Planned:

- DIsturbance Localization
- Islading Detection and Re-synchronization

Current challanges:

Currently exploring the best approach to guarantee stability in the STTP flow in order to make highly scalable up to 500 analytics.



Leveraging Grafana for Powerful Visualization

Grafana enables modern, flexible and highly customizable platform for dashboard creation. Real-Time/Historic combined.

openWAMS uses an independent Grafana server enabling more flexible and customized deployment. GPA openHistorian connected via openHistorian Data Source plugin.

Grafana community provides several plugins for advanced panels creation, enabling continuous UX enhancement.

ONS' users provided excellent feedback (friendly navigation, easy to access data and modern design).

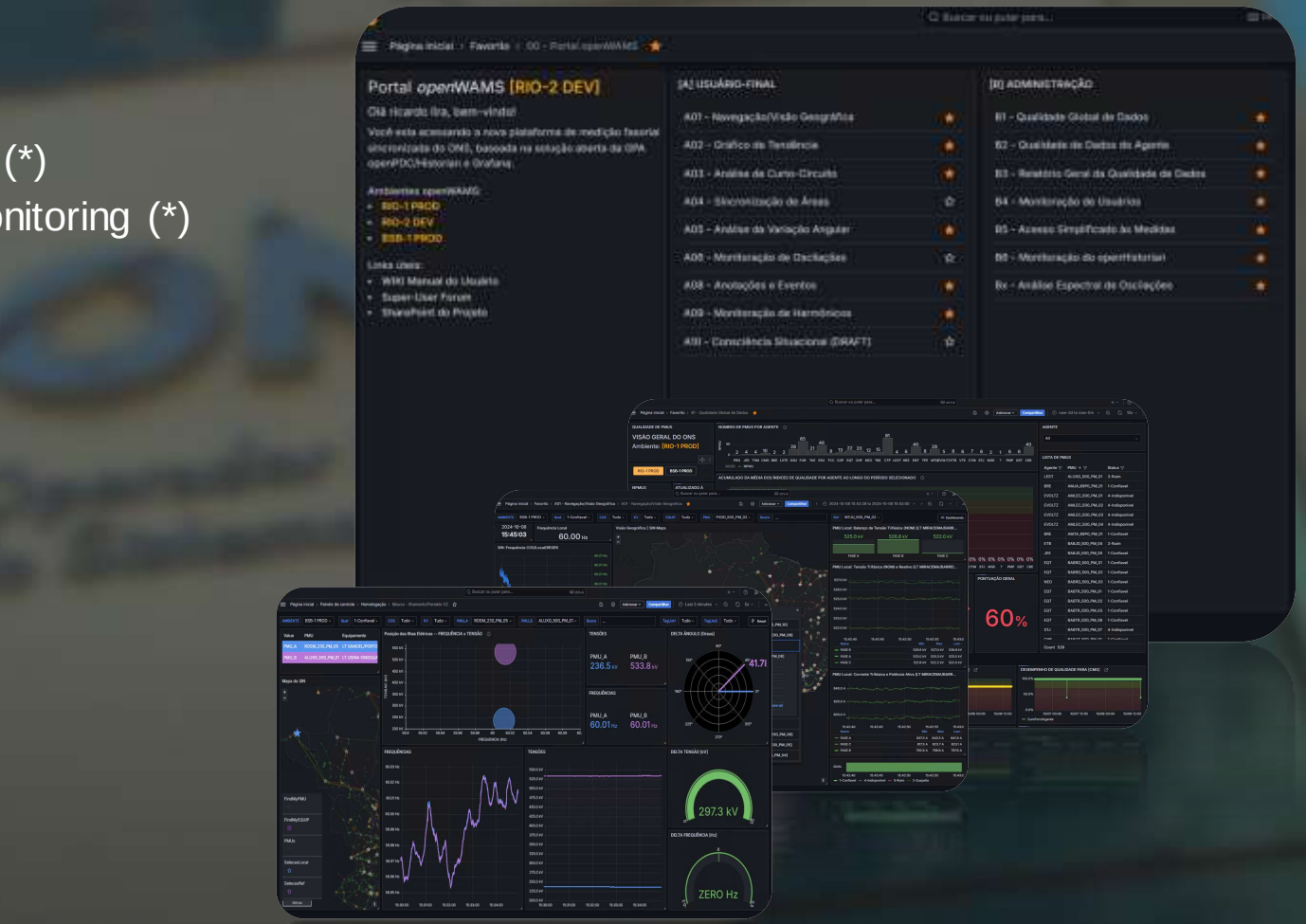
Dashboards Portfolio

[A] Control-Room Operation

- Geographical/Navigation View
- Real-Time/Historic Trending
- Short-Circuit Analysis
- Islanding and Resynchronisation (*)
- Electromechanical Oscillation Monitoring (*)
- Events & Alarms Registry (*)
- Harmonics Monitoring
- System's Situation Awareness
- Energy Quality Acessment (*)

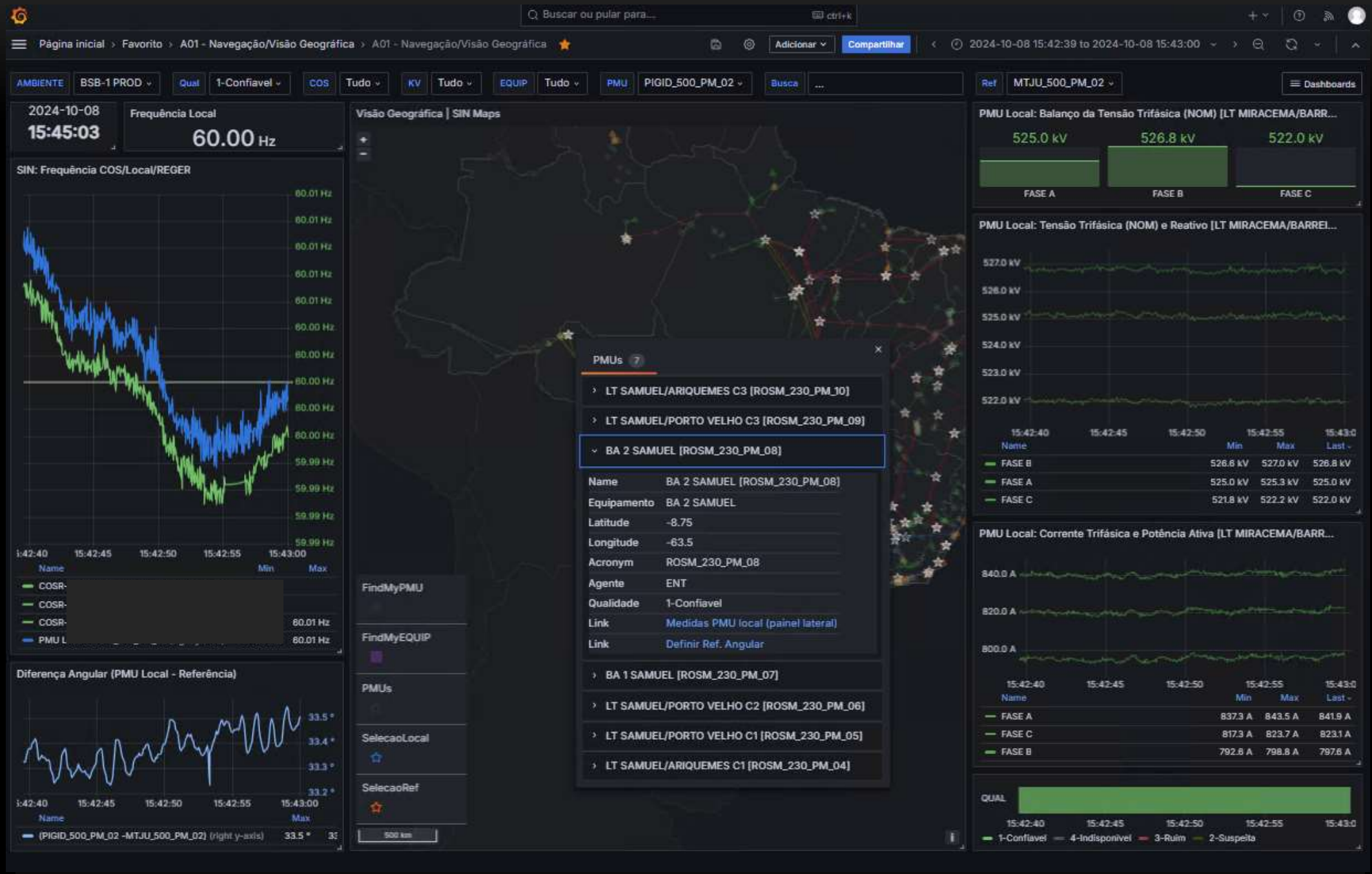
[B] System Administration

- PMU Data Quality (*)
- Multi-site Data Quality Report (*)
- Users Monitoring
- openHistorian Health Monitoring

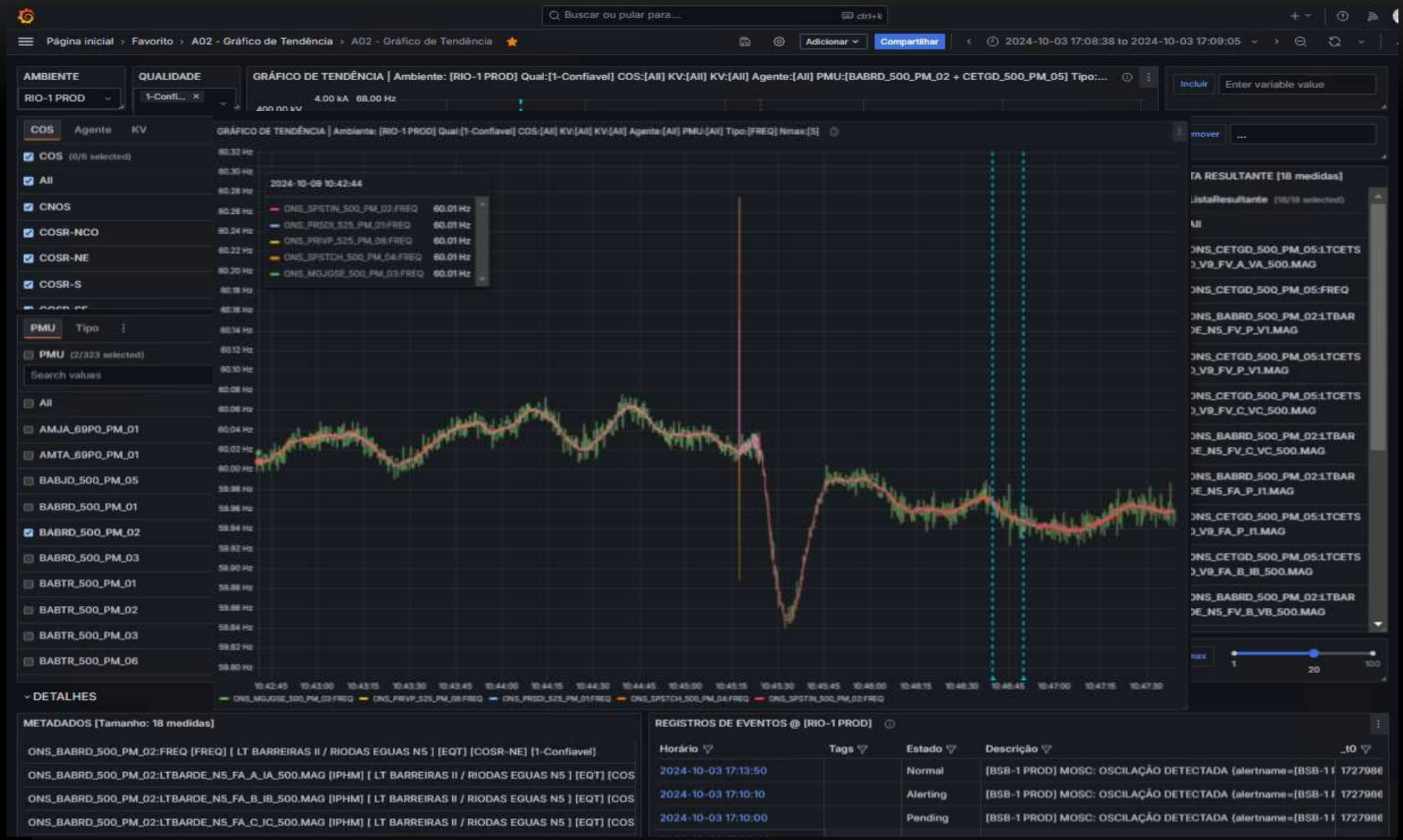


** powered by ONS in-house developments (GPA/Python APIs)*

Geographical/Navigation View

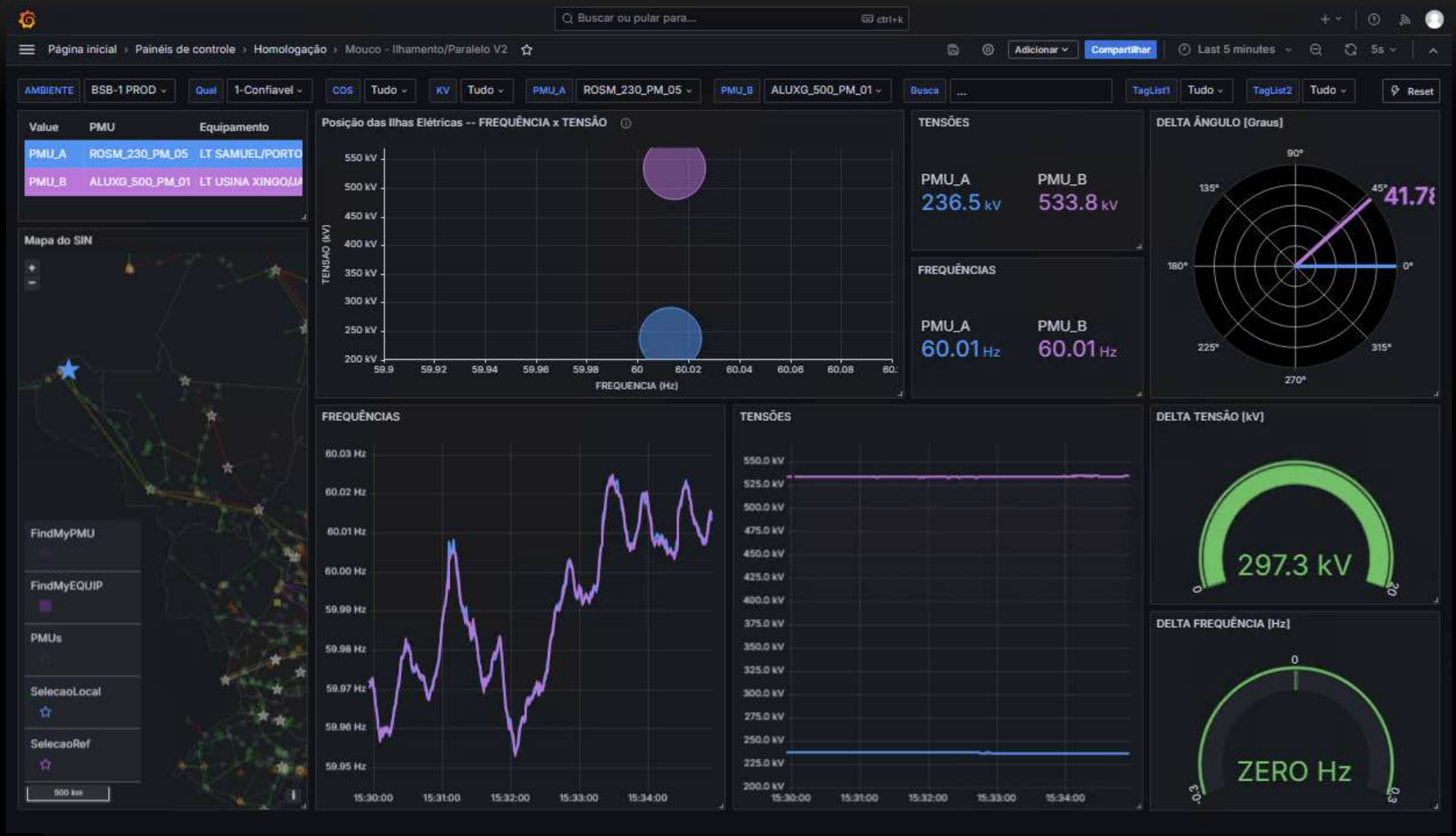


Live/Historical Trending

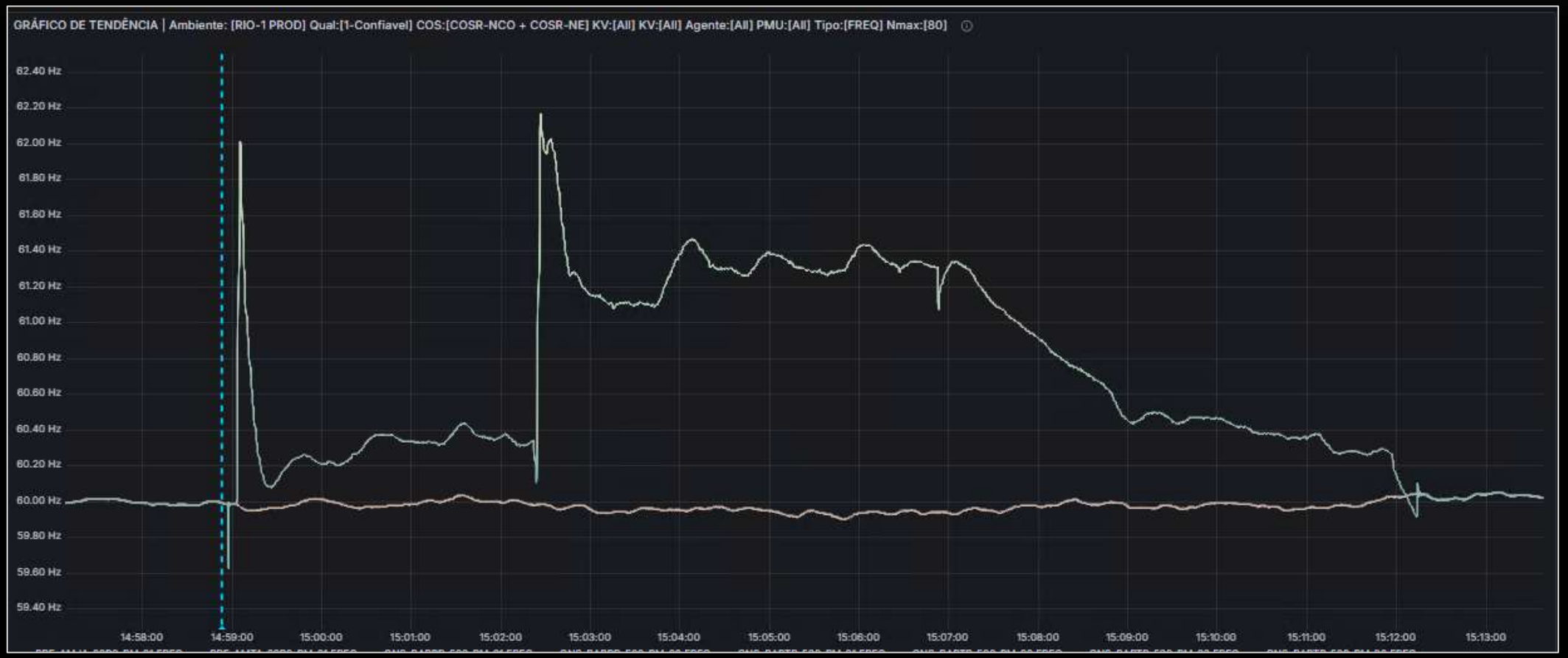


Live Trend: Frequency Excursions

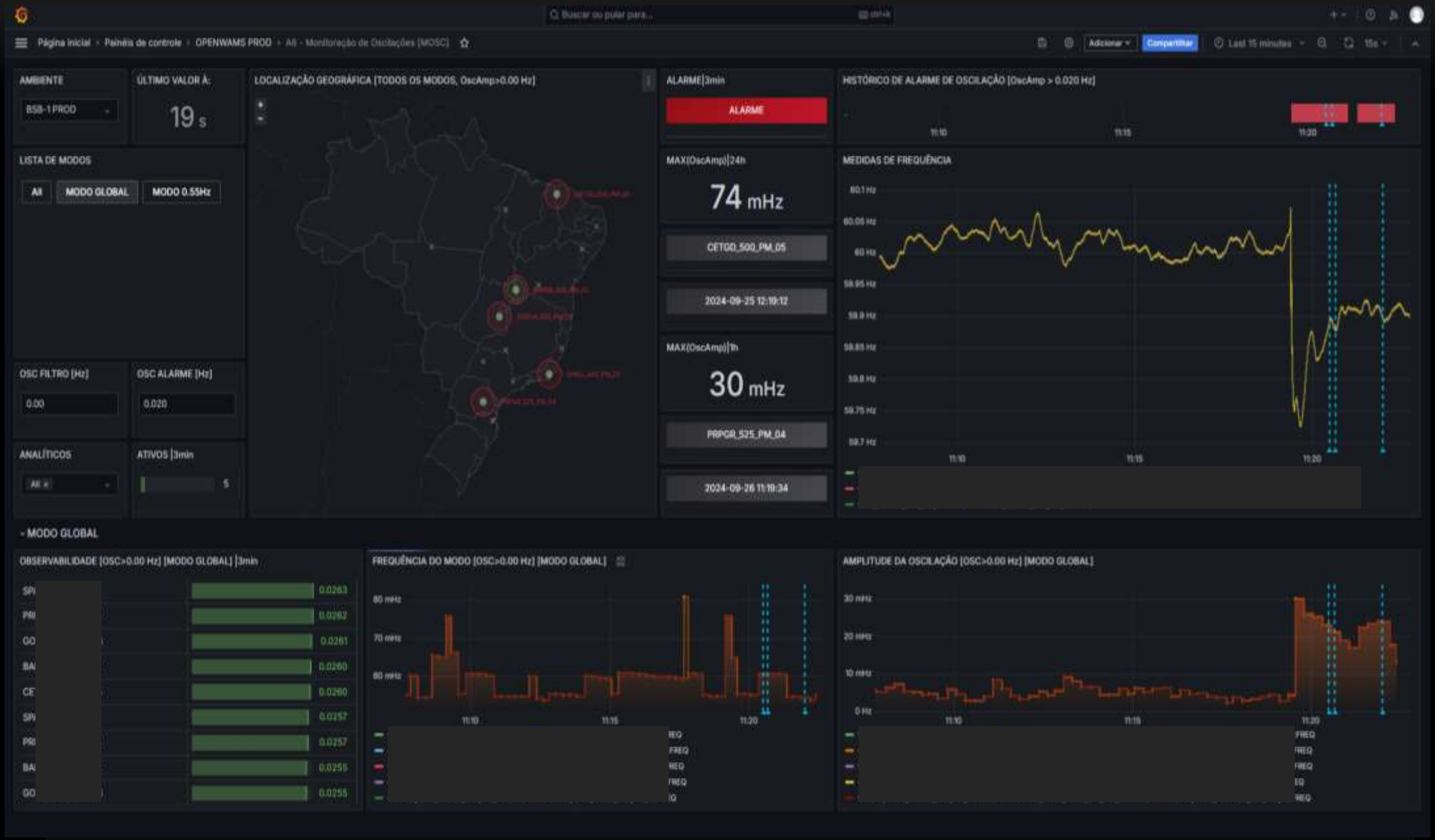
Islanding & Resynchronization



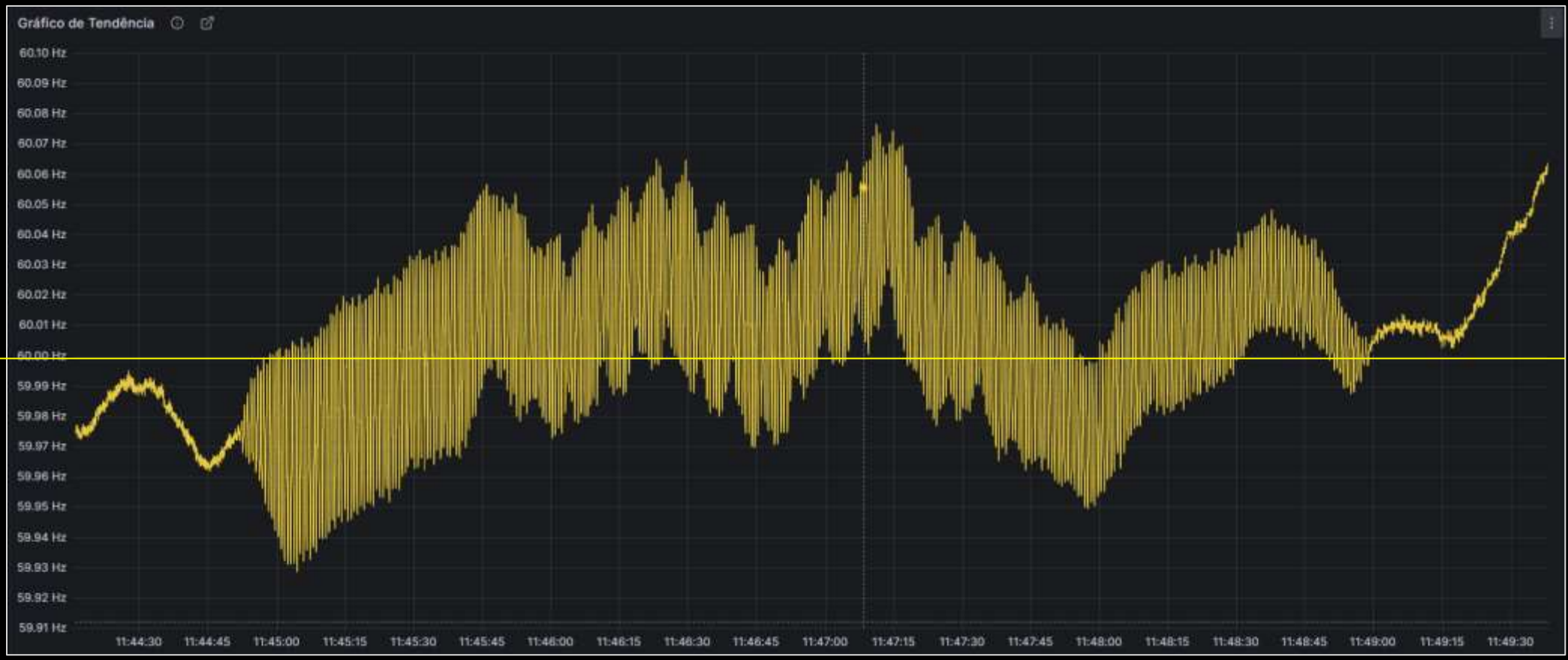
Islanding Case



Oscillatory Monitoring



Oscillation Case



Angle Profile and Bootle Necks Monitoring

Alarm & Events

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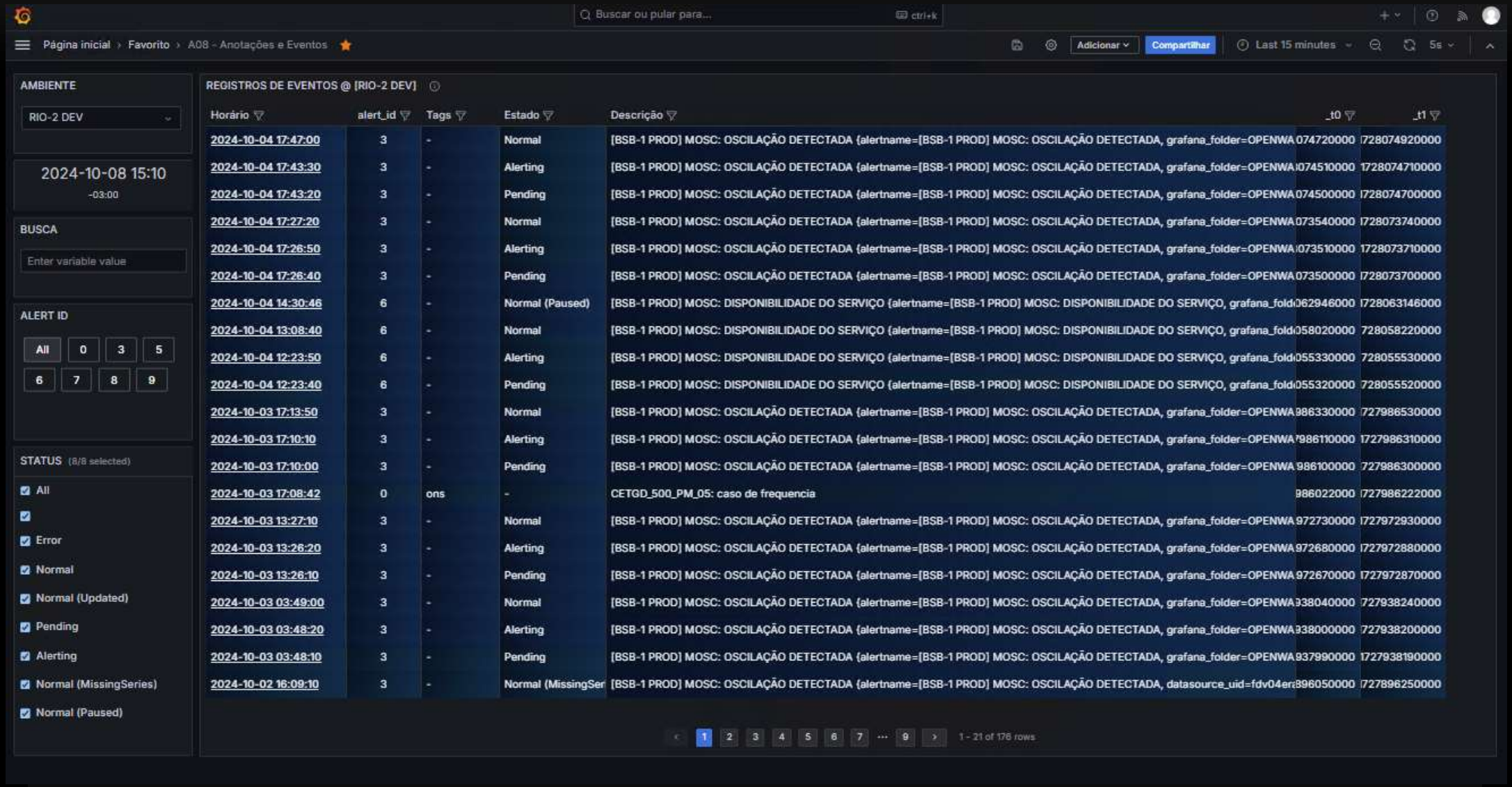


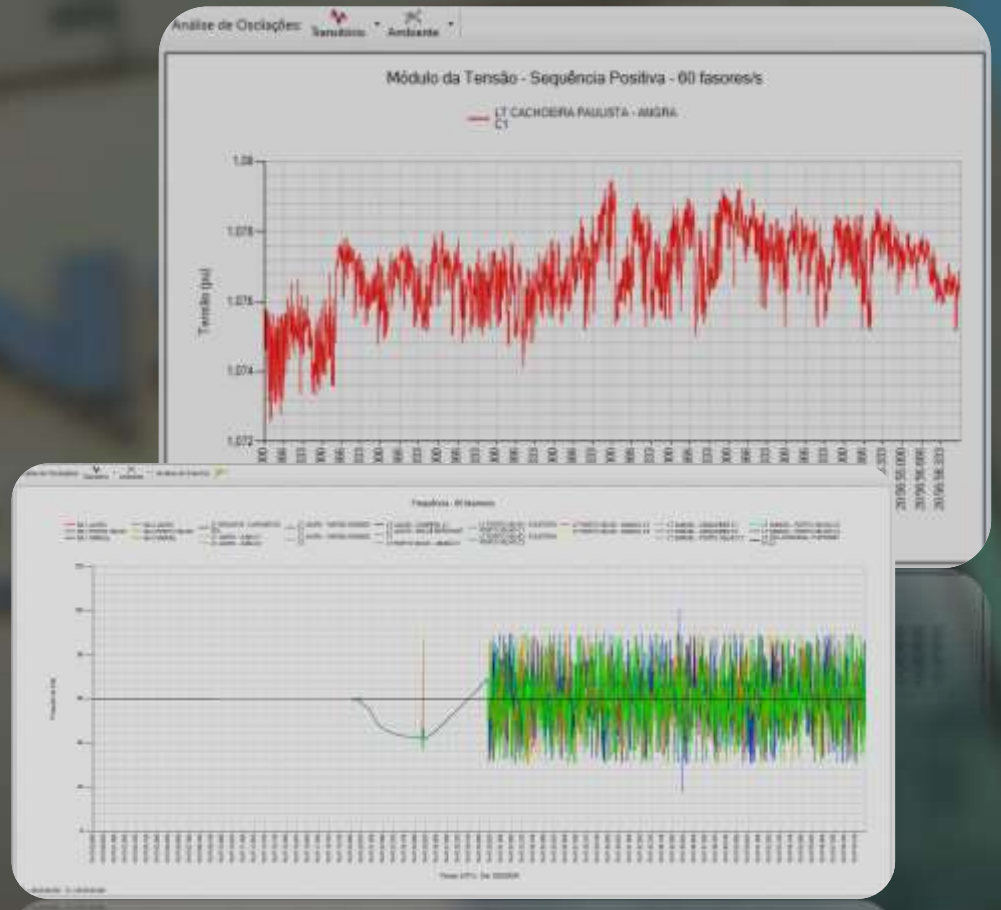
Standalone Offline Analysis

MedPlot Software

- Partnership with Universidade Federal de Santa Catarina (UFSC)
- Software developed for offline analysis of synchrophasors
- Integration with openHistorian database

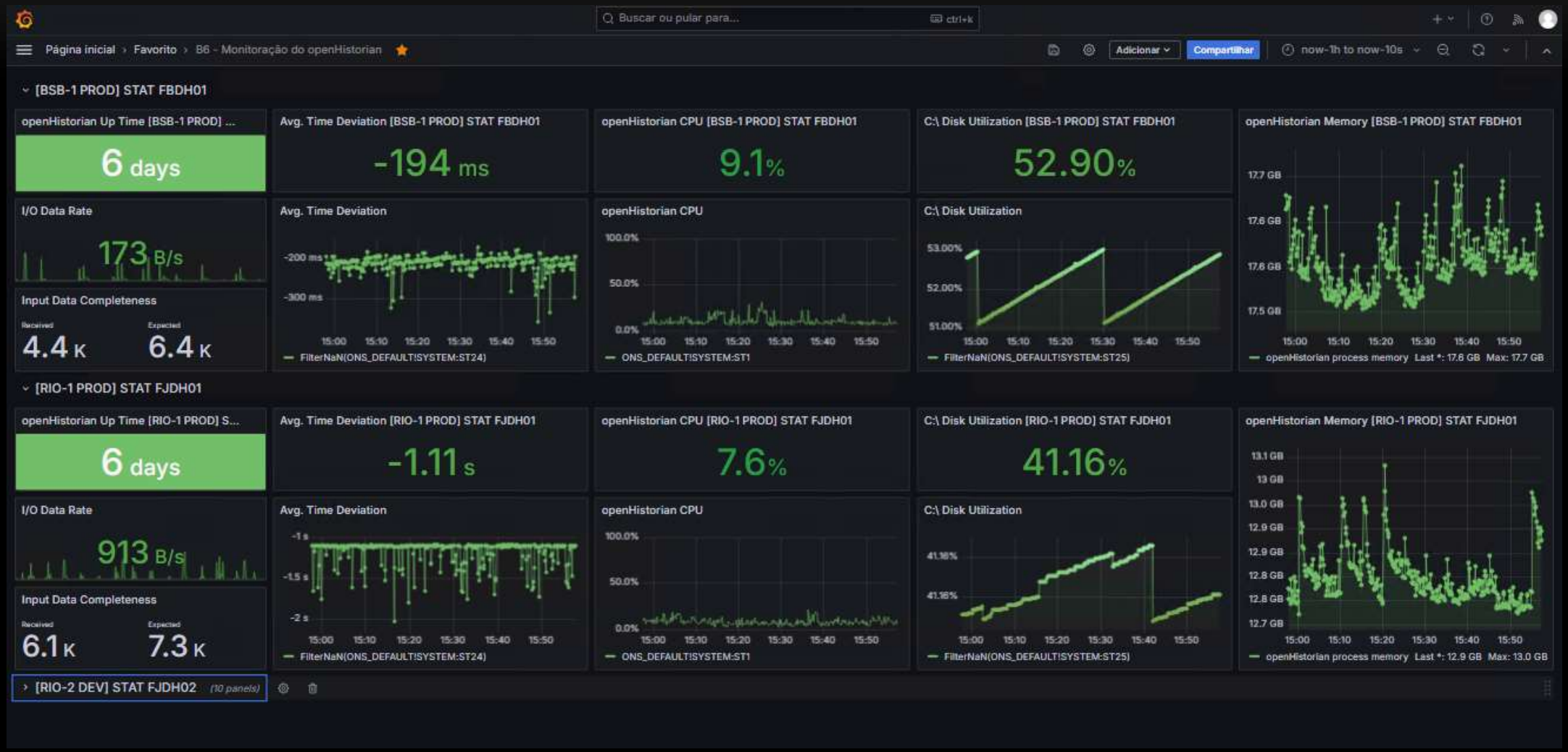
Features

- Historian Trending
- Prony Analysis
- DFT Analysis
- CVA Analysis
- Detecion, identification, and geolocation of disturbances



PMU Data Quality

openHistorian Monitoring



Our perception so far...

One Year Partnership!

Great partnership between ONS and GPA on technical support and problem solving.

Project's Mission: from temporary to permanent system

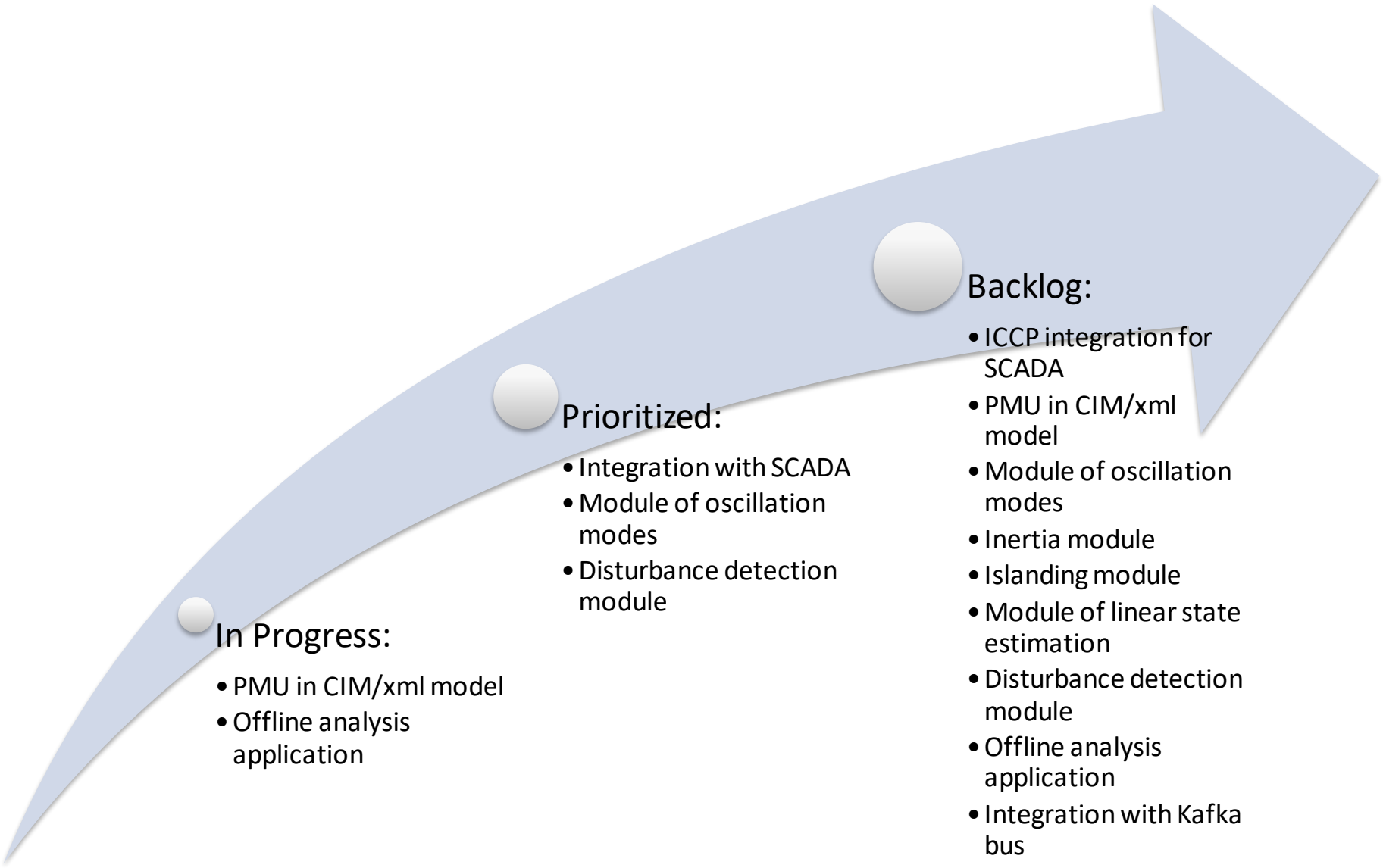
Good feedback about the easy assesbility and tools navigation due to Grafana intuitive dashboards design and web-based.

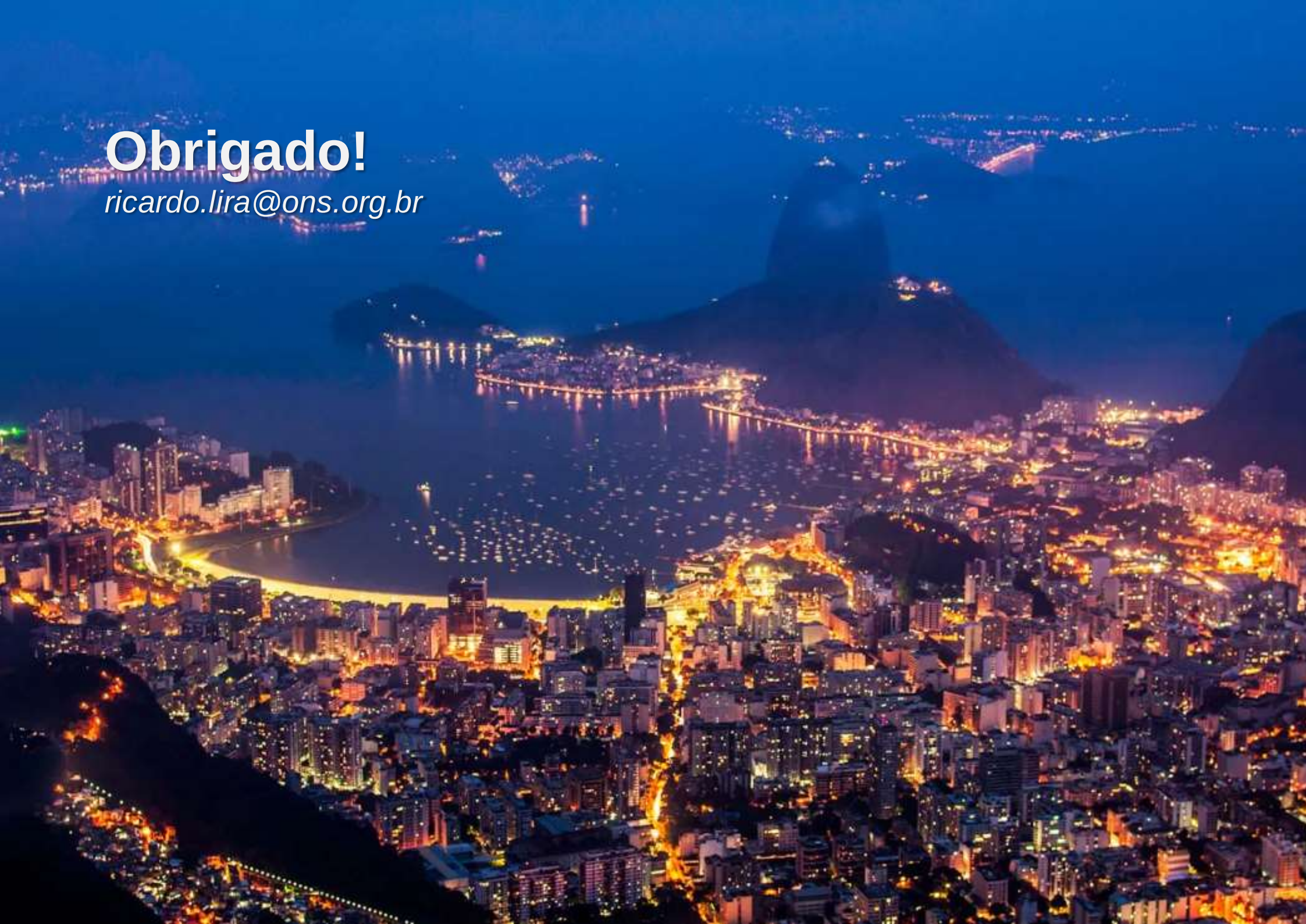
Increase in the data use confidence due to data quality real-time ranking applications

Open-platform enabling easy access to the real-time data for custom application developments.

User-interface highly customizable

We have a long way to go!





Obrigado!

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