USING SYNCHROPHASORS TO SUPPORT ISLANDING RESYNCHRONIZATION IN REAL-TIME OPERATION

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From PMU observability to relay-like decision support in real-time restoration.

ABOUT ONS

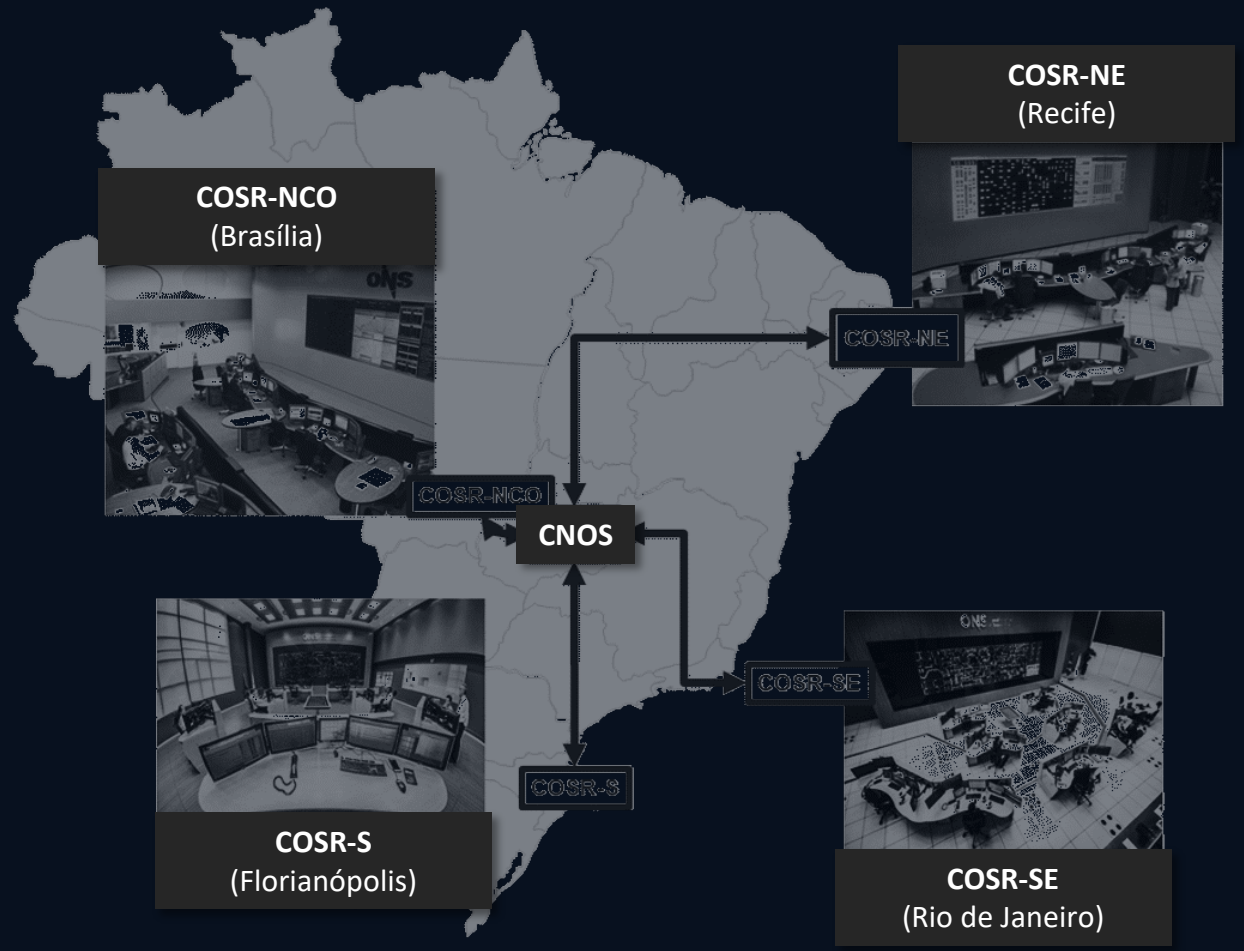
www.ons.org.br

We are the National Electric System Operator - ONS (Brazilian ISO)

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.

PMU infrastructure is owned and maintained by the TSOs guided by ONS standards.



WHY BIPS NEEDS BETTER RESYNCHRONIZATION SUPPORT

System scale, diversification, and restoration complexity

The Brazilian Interconnected Power System combines continental scale, long transmission corridors, HVDC transfers, and a rapidly changing generation mix.

180,000 km
HV transmission lines 230 kV and above

248 GW
Installed capacity

>40%
IBR-based share of the matrix

- Wind ≈14%, solar PV ≈8%, and distributed resources ≈19% of the energy matrix.
- Less robust interconnections can form electrical islands during high-impact events.
- Restoration depends on reconnecting islands under dynamic conditions that evolve faster than SCADA refresh cycles.

WHAT IS OPENWAMS?

OVERVIEW

openWAMS is an open-based platform designed by ONS for real-time monitoring and disturbance analysis based on synchrophasors (PMU) measurements:

Empowers decision-making for control room operators and ONS engineers.

Provides detailed analysis for the engineering team

Custom-built solution tailored to ONS's needs at reduced costs

Supports integration with existing systems to ensure grid stability and development of new applications

AVAILABLE APPLICATIONS

Control-Room/Real-Time:

Geo-Localized Navigation

Real-Time & Historical Trend Graphs

Short-Circuit Visualization

Electric Island Synchronization

PMU Data Quality Reporting

Wallboard Support Panels

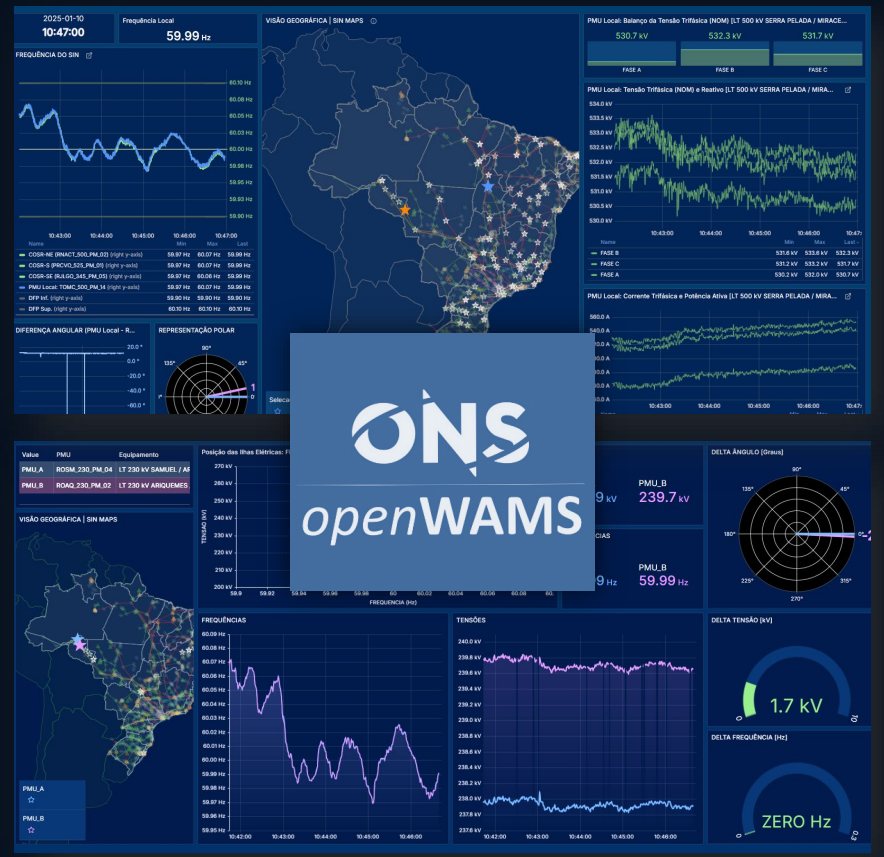
Off-line Analysis (stand-alone application)

Historian Trending

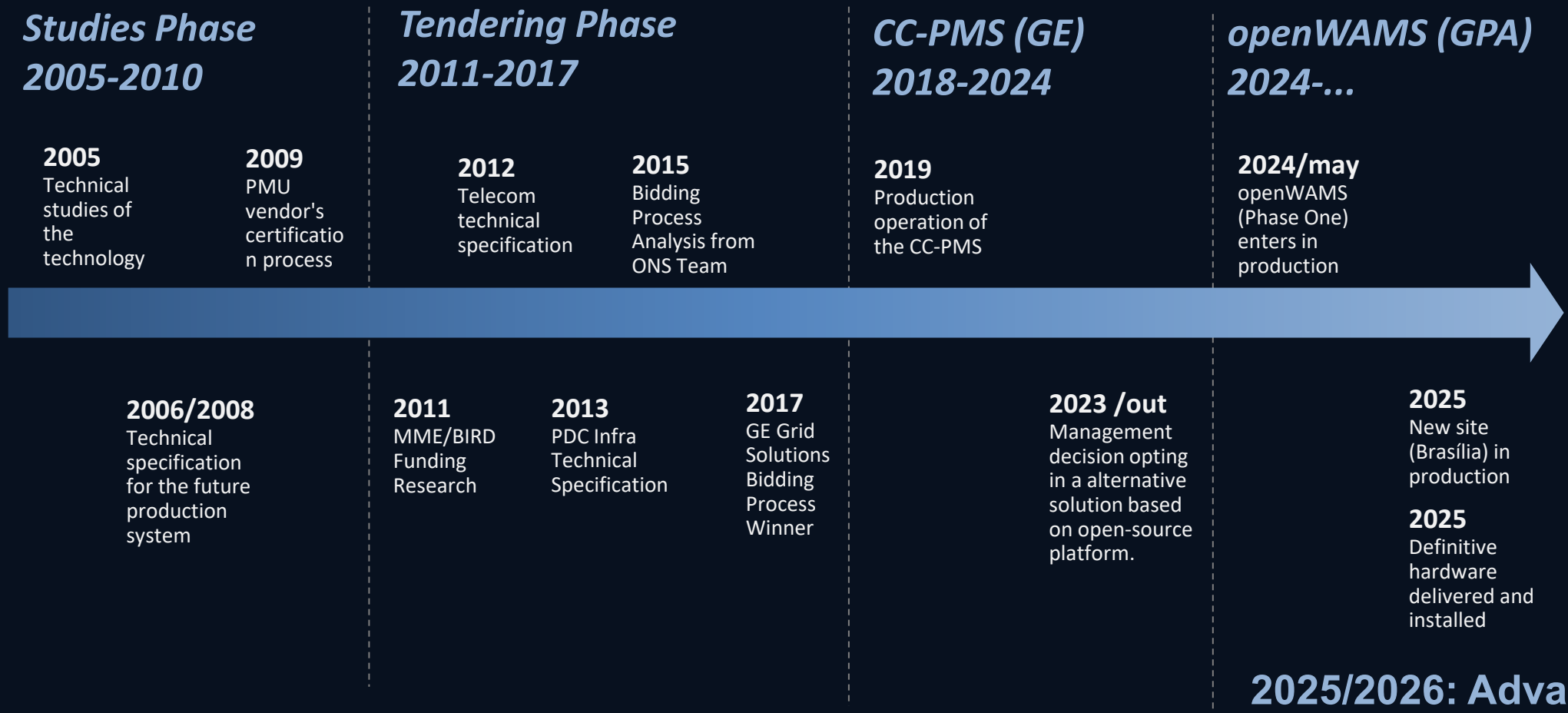
openPLOT (in development)

Control-Room

Engineering Analysis



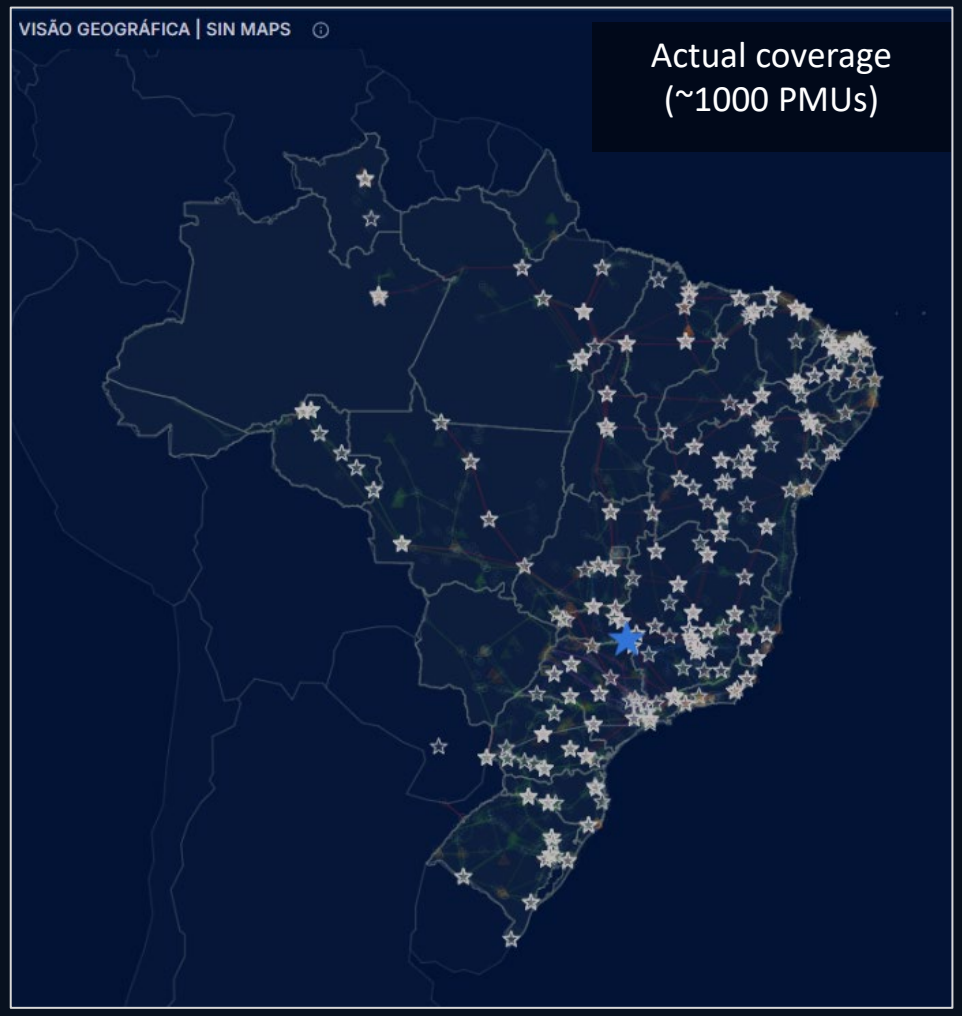
SYNCHROPHASORS AT ONS

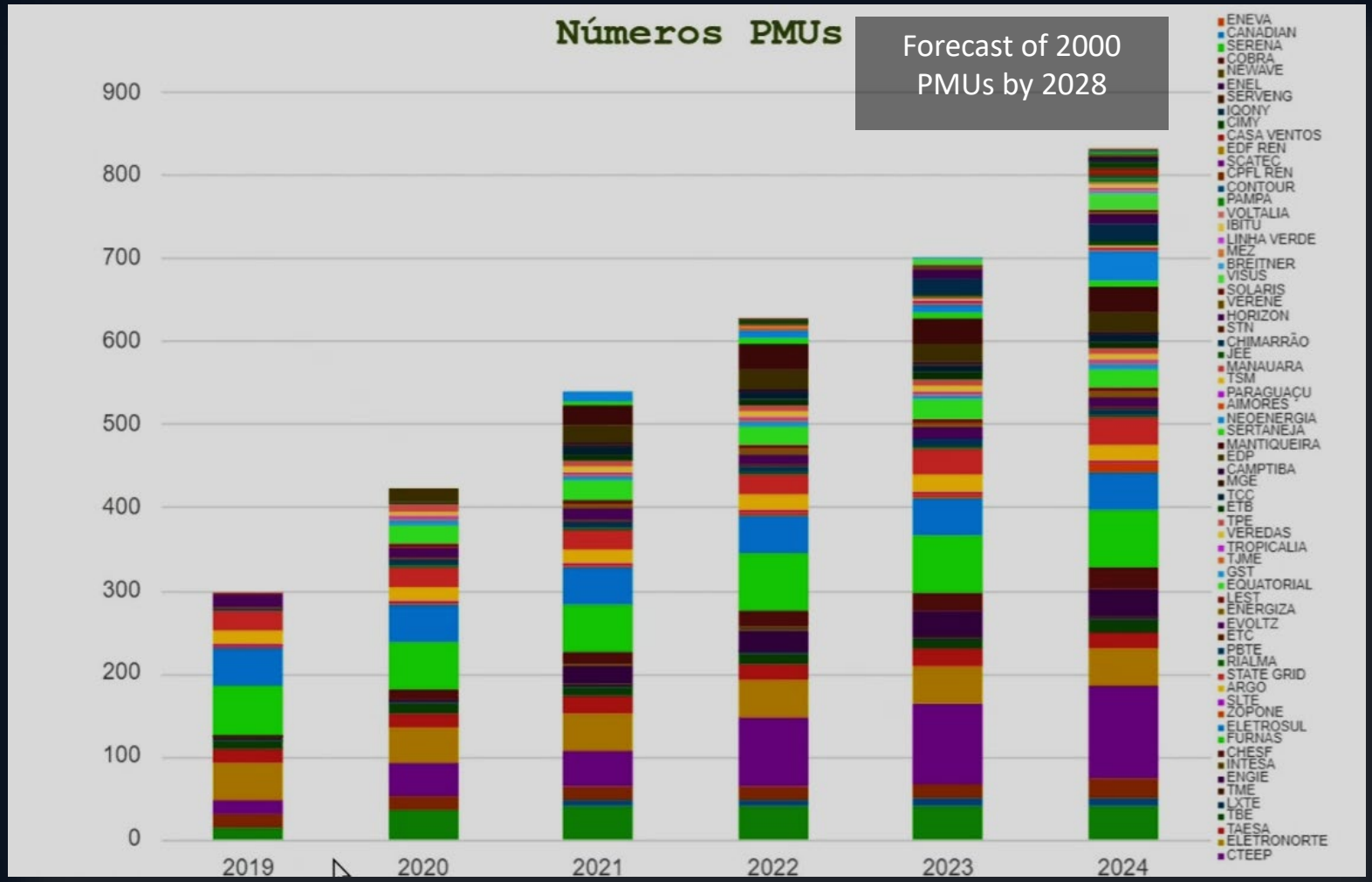


2025/2026: Advanced applications, alarms and more

PMU NETWORK SCALE

3 phase Voltage and Current Phasors
60 frames per second
+ Harmonics (analogs) for selected PMUs





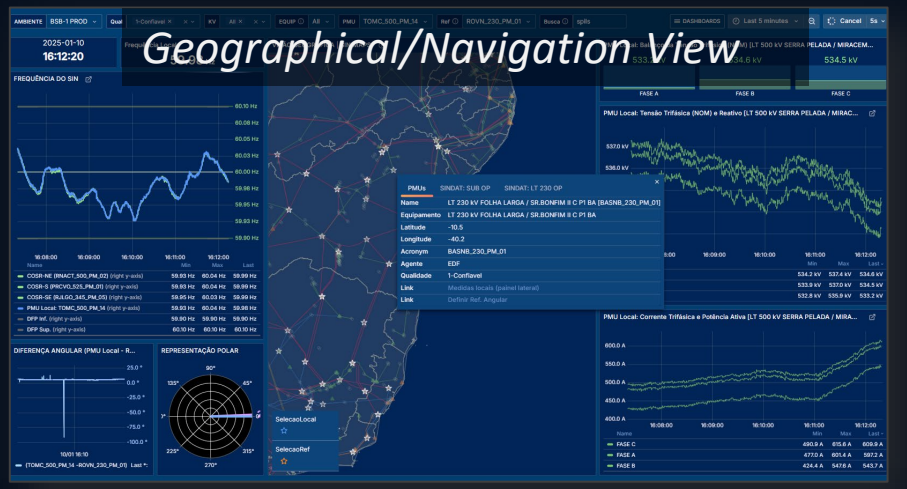
OPENWAMS: ADVANCED USER INTERFACE

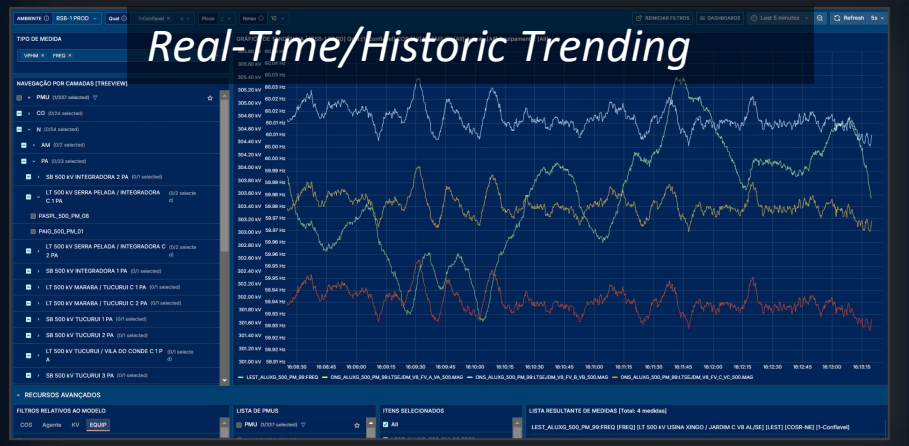
GRAFANA DASHBOARDS

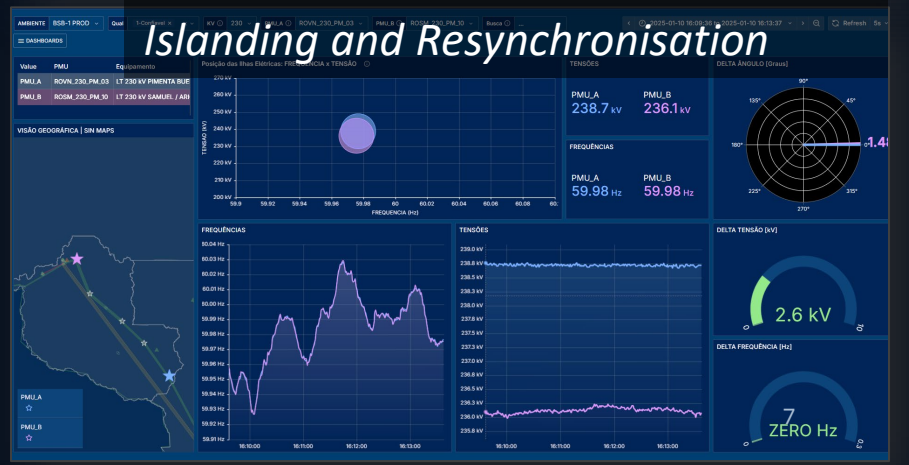
Grafana enables modern, flexible and highly customizable platform for dashboard creation. Real-Time/Historic combined.

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.







WHY SCADA ALONE IS INSUFFICIENT DURING ISLANDING

Resynchronization depends on synchronized, high-rate observability

Conventional SCADA

≈4 s
Field data update rate

Async
Measurement correlation

Low
Dynamic visibility

- Measurements arrive too slowly for fast island dynamics.
- Asynchronous correlation obscures angle and frequency evolution.
- Operators do not get a relay-like view of synchronism conditions.

WAMS with synchrophasors

60/s
Measurements per second

<1000 ms
Control-room delivery

Synced
Voltage, current, angle, f, ROCOF

- PMUs provide synchronized three-phase voltage and current phasors.
- Frequency and angle trends indicate whether the islands are converging or drifting apart
- Situational awareness improves fast enough to support real-time corrective action.

Operational implication: the control room can diagnose synchronism conditions before the breaker-close window is missed.

WHAT MUST BE TRUE BEFORE CLOSING THE TIE

The application mirrors the synchronism-check logic used in the field

Island A

Active and reactive controls may be applied here, if available

Close only when all three conditions hold

Island B

Active and reactive controls may be applied here, if available

1 Frequency aligned

Islands must converge to the same frequency.

2 Voltage magnitudes matched

Bus voltages must be close enough at the tie point.

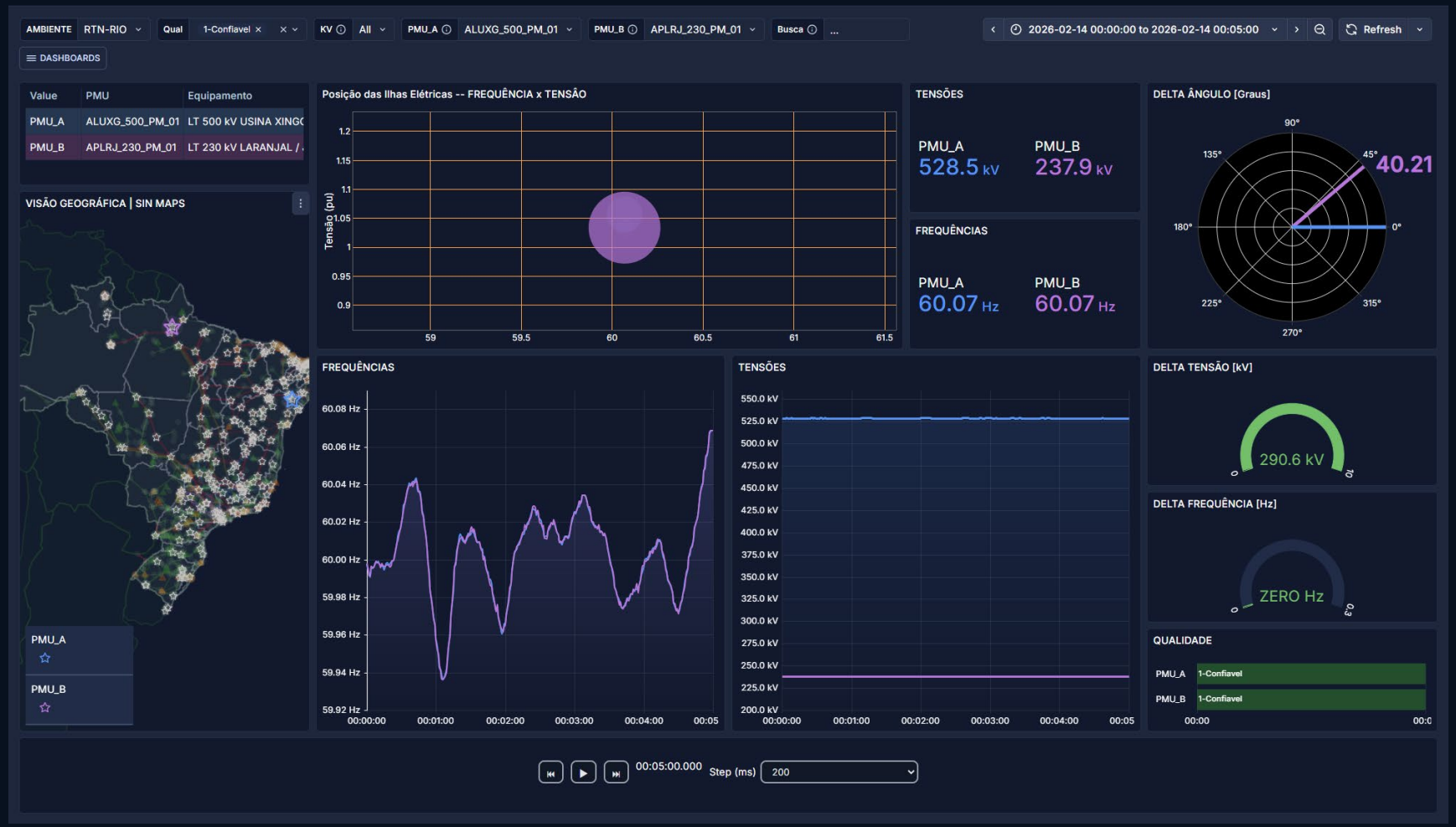
3 Angle crosses zero slowly

The zero crossing must be slow enough for relay operation.

Control actions may be taken on either island, depending on available resources and the operating strategy. Available control : load-generation balance, reactors, capacitors, generation MVAr adjustment, and synchronous compensators.

REAL-TIME APPLICATION BUILT FOR THE CONTROL ROOM

An intuitive display correlates both islands in a single operational view



Capabilities highlighted

- Relay-like situational view at the synchronism point.
- Correlation of frequency, voltage magnitude, and angle conditions.
- Trend monitoring during islanding conditions.
- Replay support for operational review.

Operator workflow

1. Detect islanding
2. Compare both sides
3. Adjust frequency, angle and voltage
4. Close at the window

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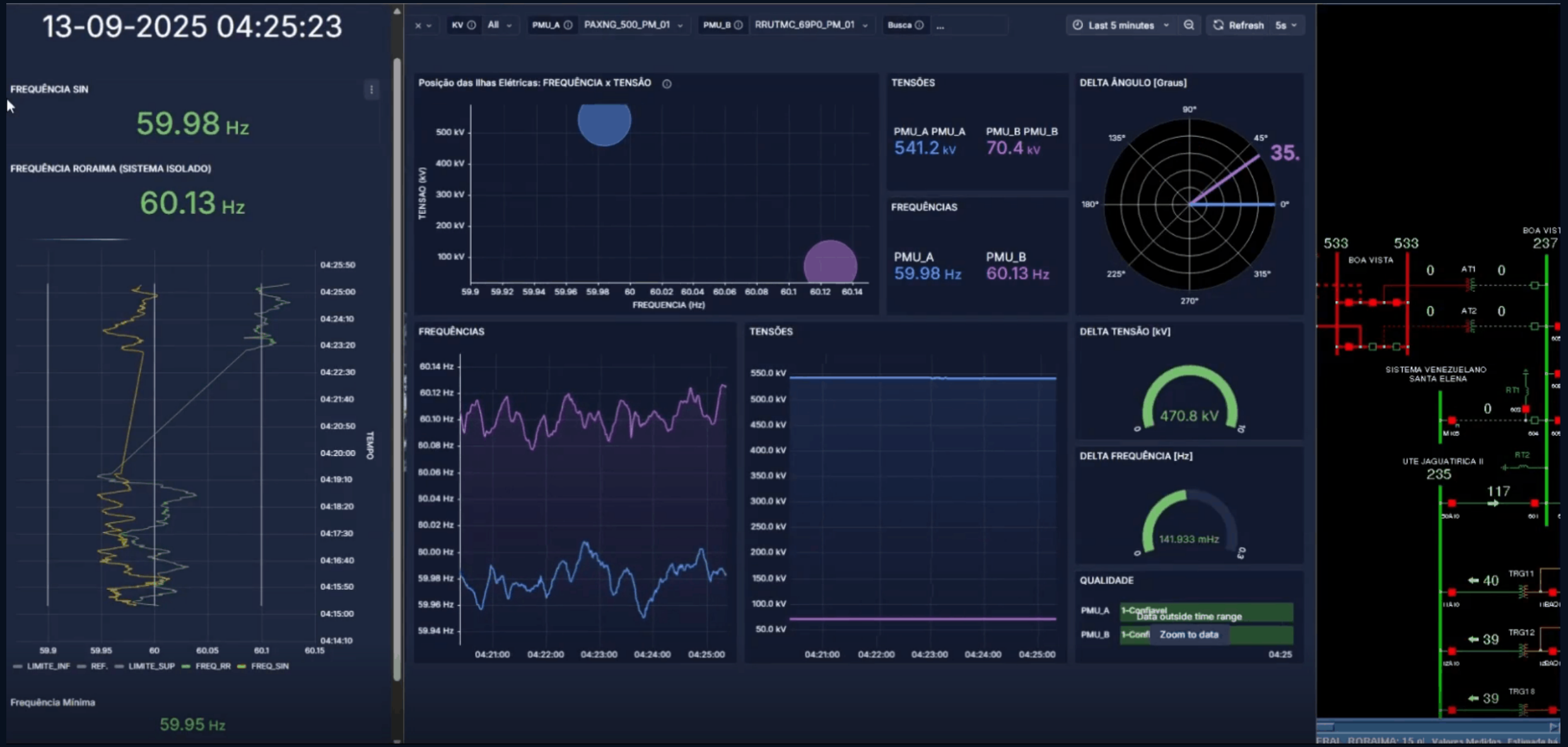

KEY BENEFITS

- Improves operator decision support during islanding and resynchronization
- Reduces dependence on low-speed, asynchronous SCADA data
- Brings synchronized PMU measurements into a single actionable view
- Supports safer and more timely reconnection of electrical islands
- Creates a practical path for new real-time synchrophasor applications at ONS

ACKNOWLEDGMENTS & CONTACT

Thank you for your attention

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