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## DEVELOPMENT OF A FAULT RECORDER AND PHASOR MEASUREMENT UNIT (RPMF)

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UCI Universidade Corporativa Itaipu

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# Agenda

- Context
- Project Requirements
- Conception and Planning
- Results
- Next Steps

# Context

- Technological upgrade – “DFR” installed in 1998;
- The “DFR´s” are installed in many sites inside ITAIPU:
  - Main dam (20 Generators)
  - GIS (50Hz and 60Hz bus monitoring)
  - Substations
- ITAIPU has an internal network of equipments responsible for acquire data from disturbances

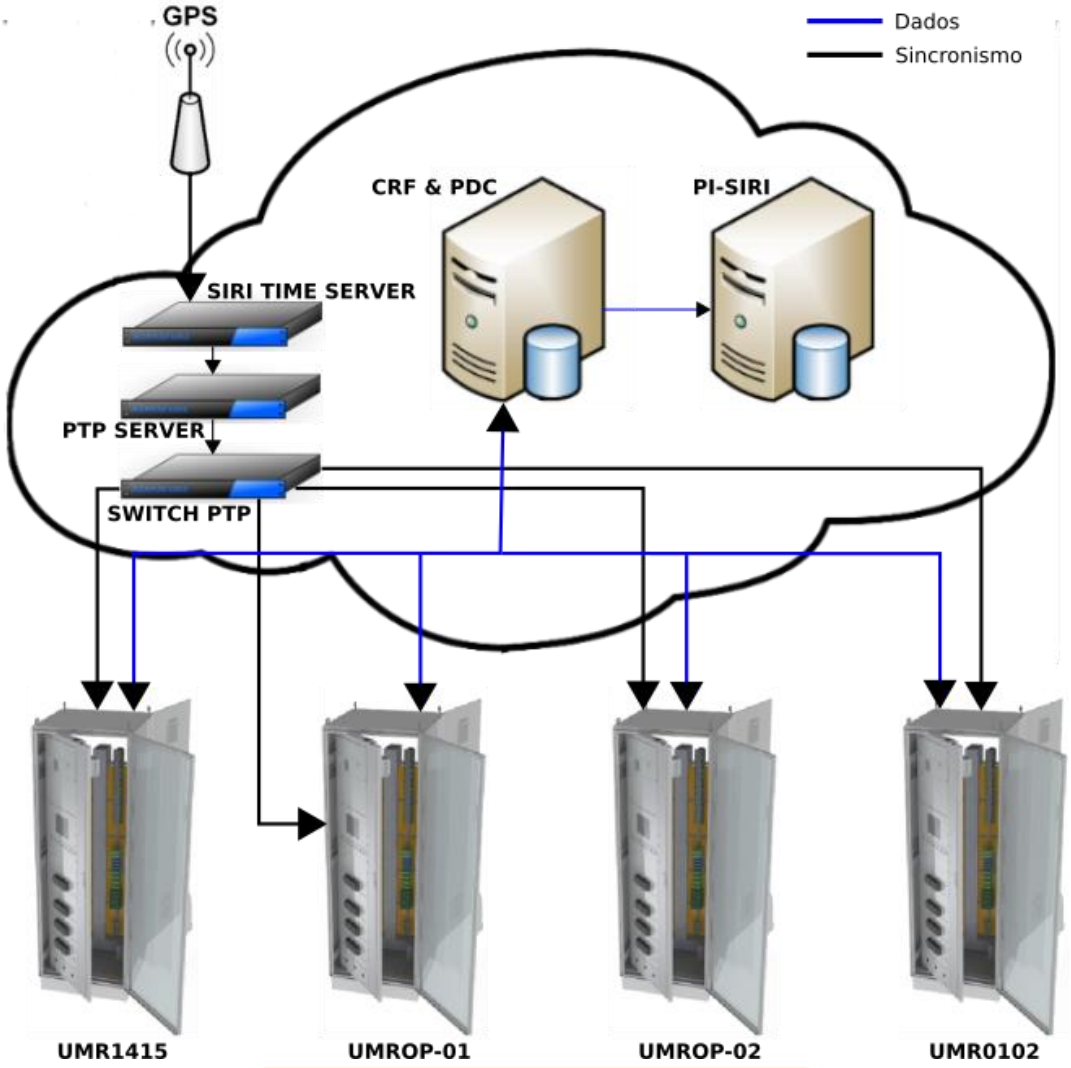
# Project Requirements

- Acquire, convert and verify electrical quantities (voltage, current) and binary states
- Identify disturbances, based on a user configuration of triggers and events
- Time Synchronization supporting synchrophasor measurement according to IEEE C37.118
- Phasor Measurement Unit functions
- Support GOOSE communication (IEC 61850) with other equipments
- Cross-trigger between DFR's (old and new)

# Project Requirements

- Tools to search and download phasors and fault registers
- Integration with SCADA system
- User access control (Maintenance and Operation roles)
- Software for disturbance and event analysis

# Conception and Planning



# Conception and Planning

Acquisition Unit

# Conception and Planning

## Time Synchronization

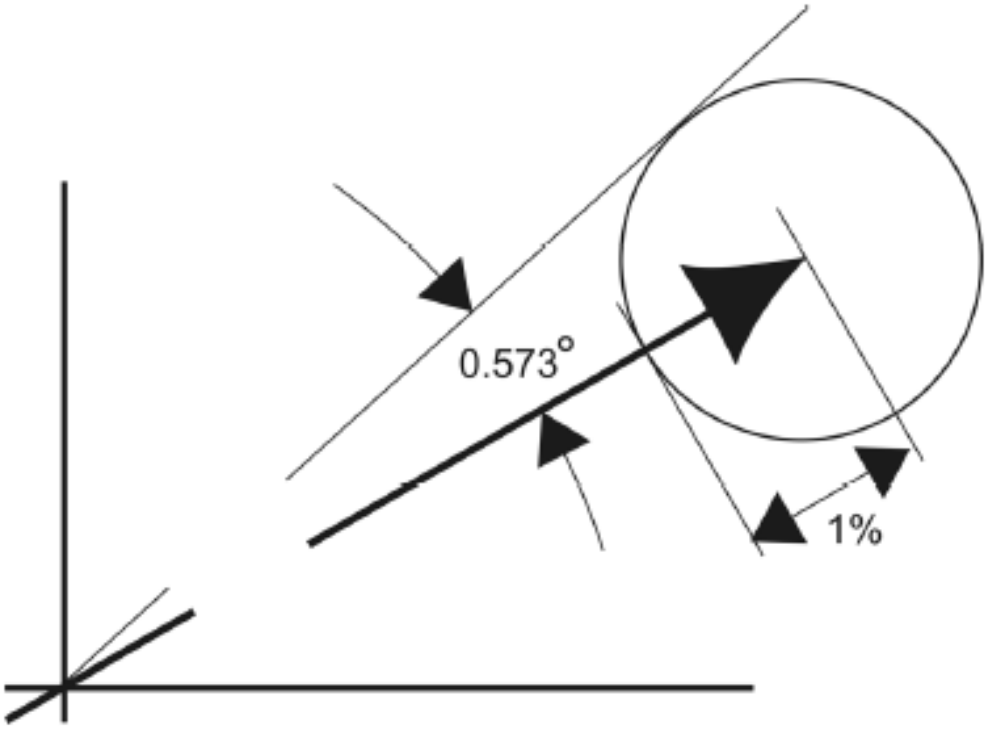



**Figure E.1—The 1% TVE criterion shown on the end of a phasor**

The error of 0.57 degree corresponds to approximately 26us at 60 Hz and 32us at 50 Hz.

* IEEE C37.118.1

# Conception and Planning

## Time Synchronization

| Method | Typical Accuracy in substation with given method | Provides date and time of day indication | Dedicated cabling not required | Cost effective | Scales well with large number of devices |
|---|---|---|---|---|---|
| IRIG-B(AM) | 1ms | • | | | |
| IRIG-B (DC-shifted) | 100us | • | | | |
| 1PPS | 1us | | | | |
| GPS | 1us | • | | | |
| NTP | 1-10ms | • | • | • | |
| IEEE 1588 v1 | 1us | • | • | • | |
| IEEE 1588 v2 | 1us | • | • | • | • |

http://w3.siemens.com/mcms/industrial-communication/en/rugged-communication/technology-highlights/ieee-1588-precision-time-synchronization-solution-for-electric-utilities/pages/ieee-1588-precision-time-synchronization-solution-for-electric-utilities.aspx

# Conception and Planning

## Time Synchronization

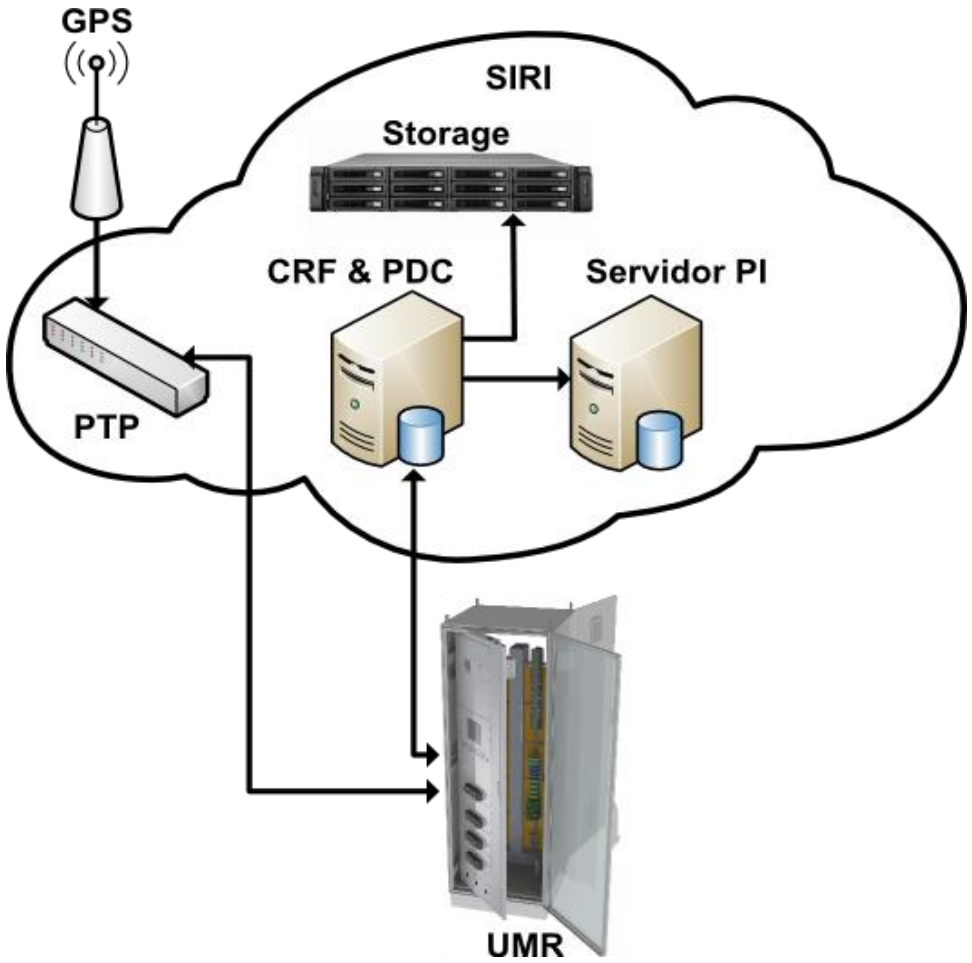
| Method | fulfils IEC 61850 Station Bus requirements | fulfils IEC 61850 Process Bus requirements | fulfils IEEE C37.118 Synchrophasor Data requirements |
|---|---|---|---|
| IRIG-B (AM) | • | | |
| IRIG-B (DC-shifted) | • | | (see note 1) |
| 1PPS | (see note 2) | • | • |
| GPS | • | • | • |
| NTP | (see note 3) | | |
| IEEE 1588 v1 | • | • | • |
| IEEE 1588 v2 | • | • | • |

**Note 1**

It is generally assumed that the unmodulated IRIG-B is good enough for synchrophasor applications. The IEEE C37.118 standard specifies that the accuracy of a synchrophasor measurement system shall not exceed 1% of a 'total vector error', where 1% of 'total vector error' corresponds to a phase angle error of 0.57 degrees, if no other errors are present. A PMU which introduces 100us error on IRIG-B input results in a 2.2 degrees phase angle error at 60Hz.

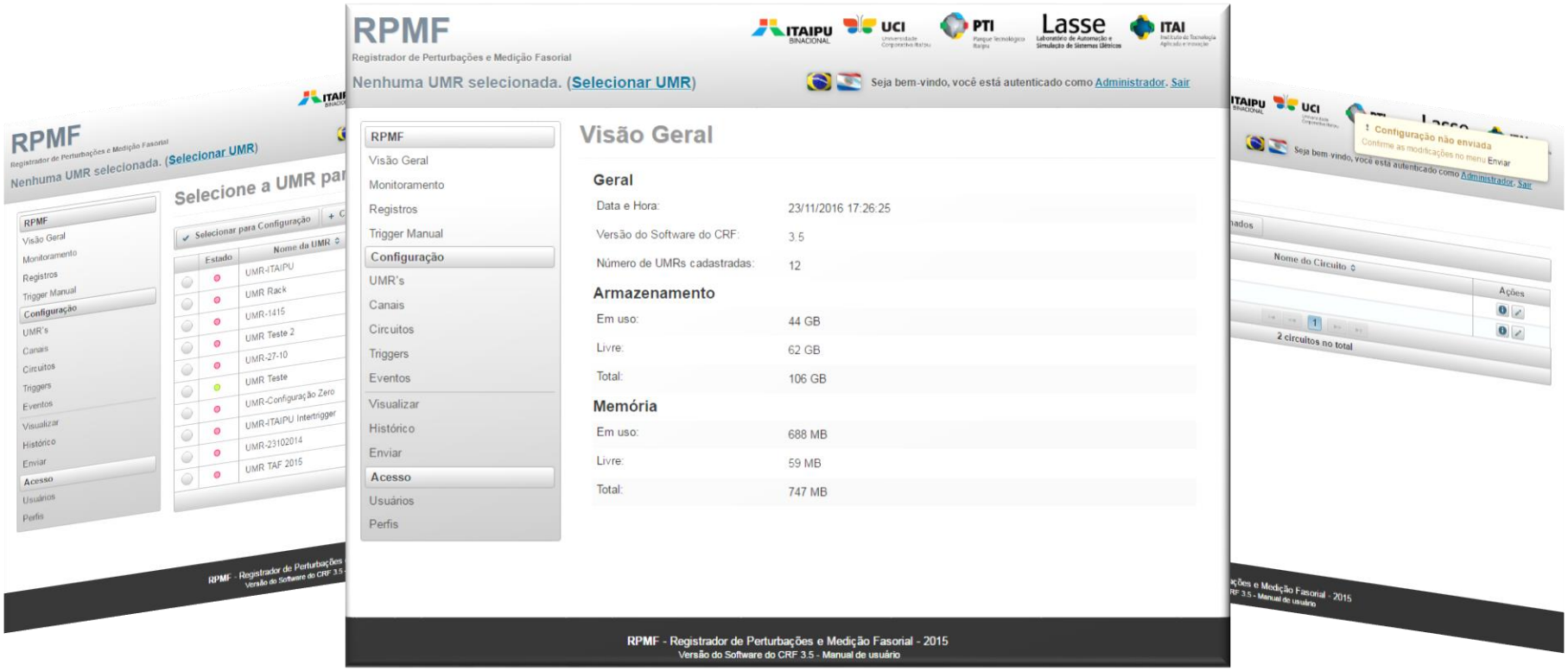
http://w3.siemens.com/mcms/industrial-communication/en/rugged-communication/technology-highlights/ieee-1588-precision-time-synchronization-solution-for-electric-utilities/pages/ieee-1588-precision-time-synchronization-solution-for-electric-utilities.aspx

# Conception and Planning




Synchrophasor Storage

# Results

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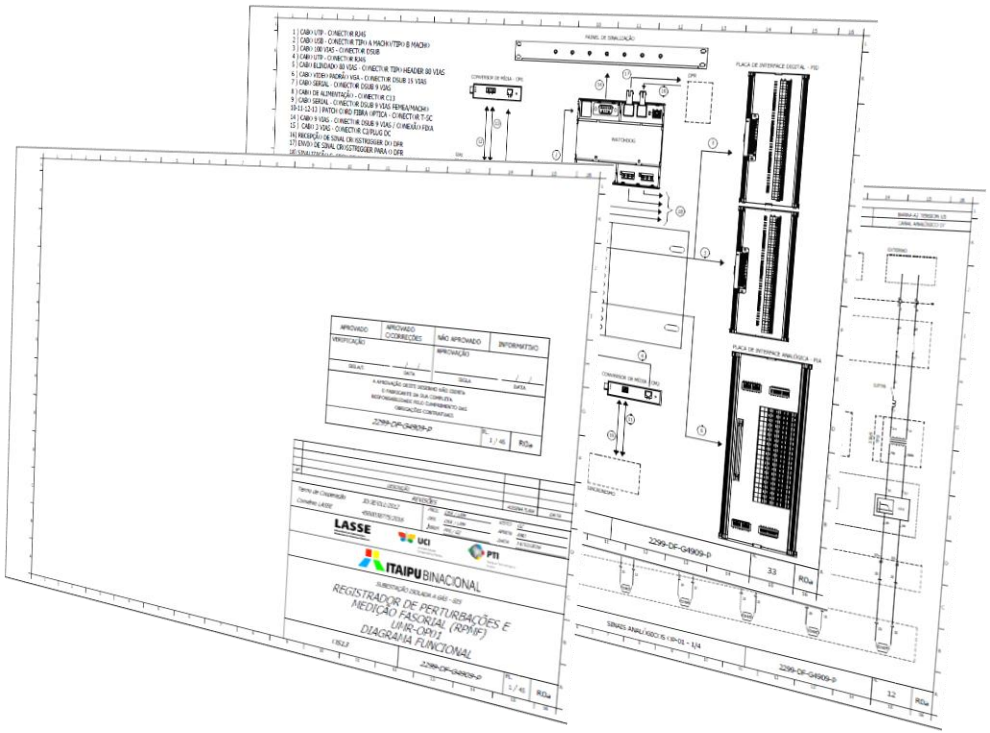
# Results

Project installed




Technical Documentation following Itaipu standards

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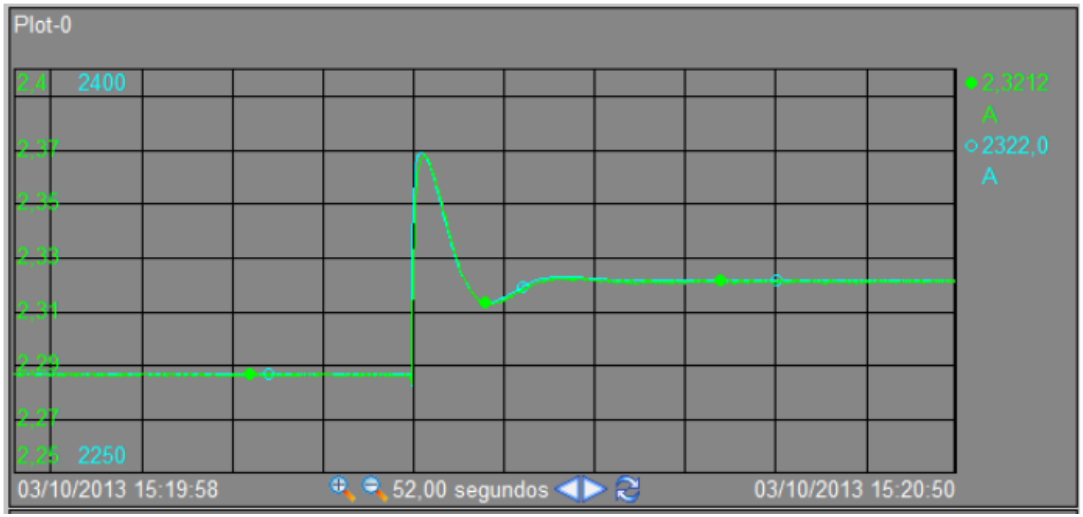
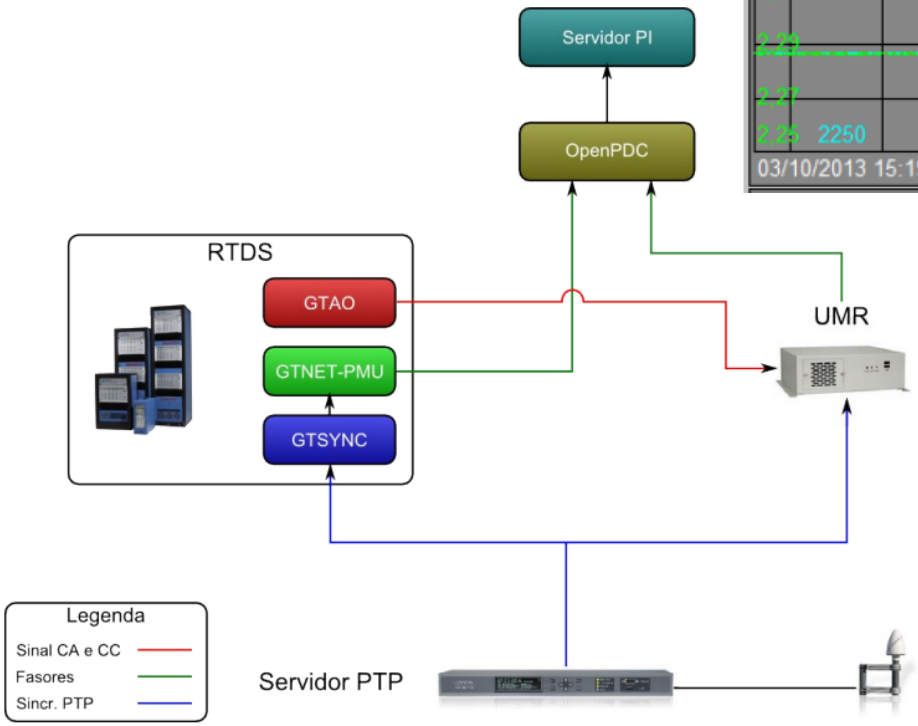
# Results

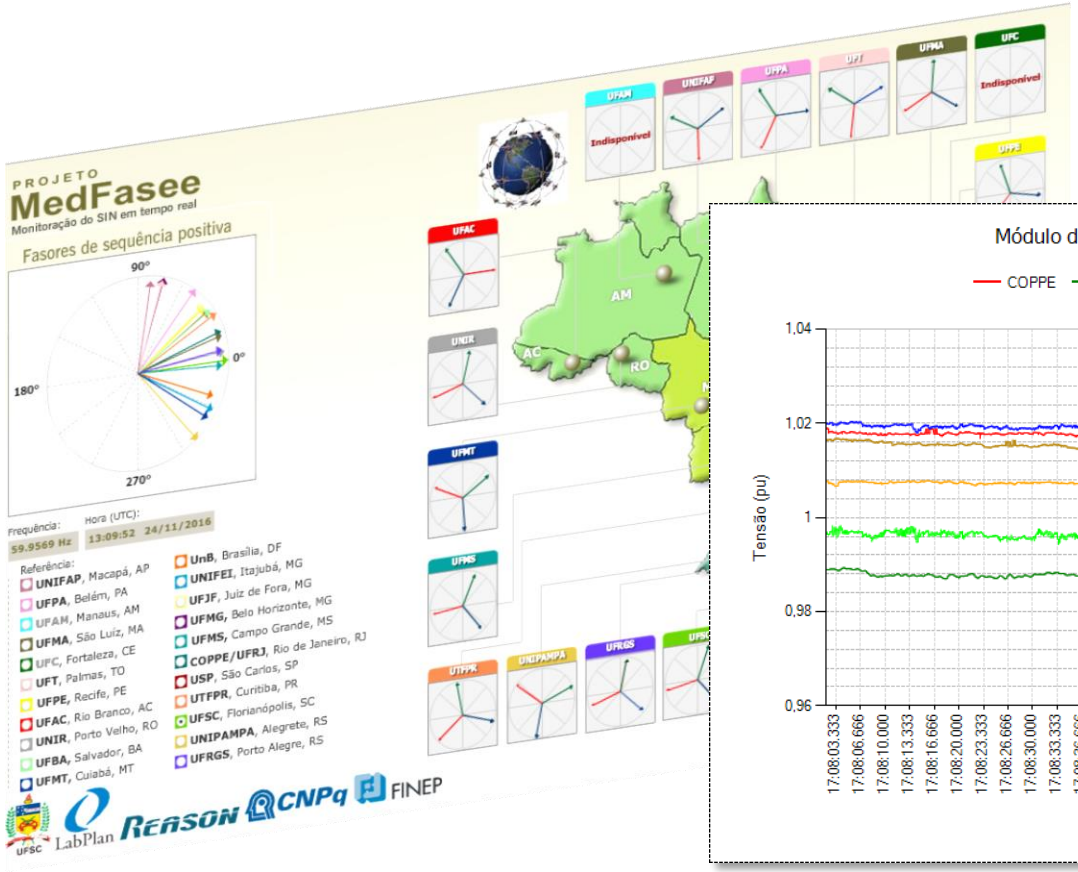
## RTDS Integration/Tests

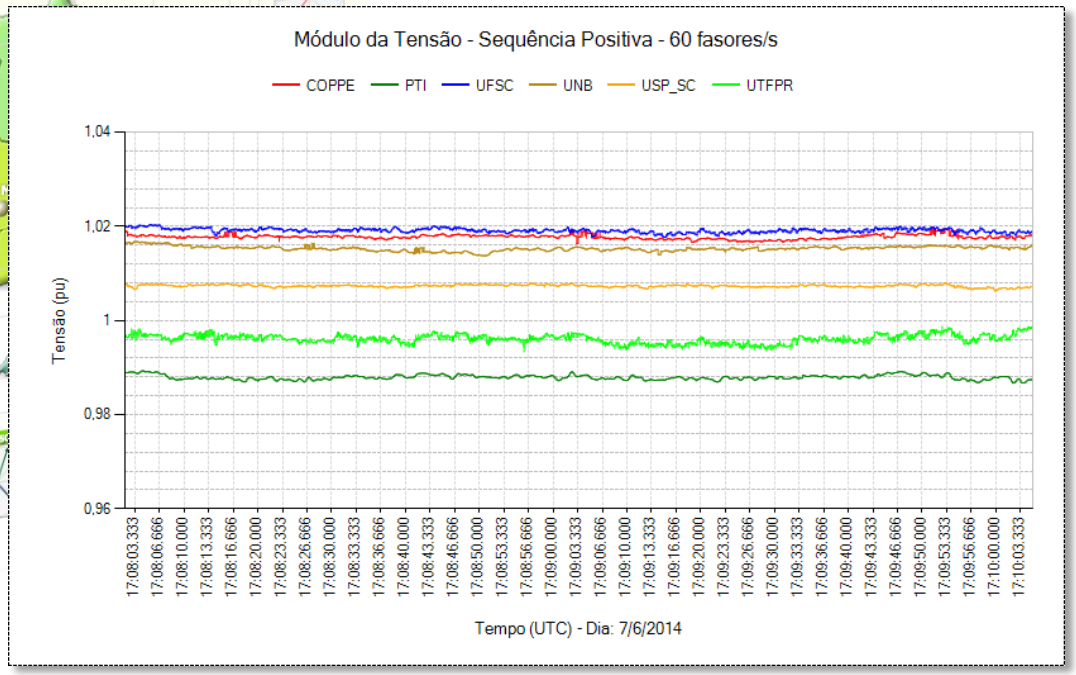


# Results

## MedFasee Integration

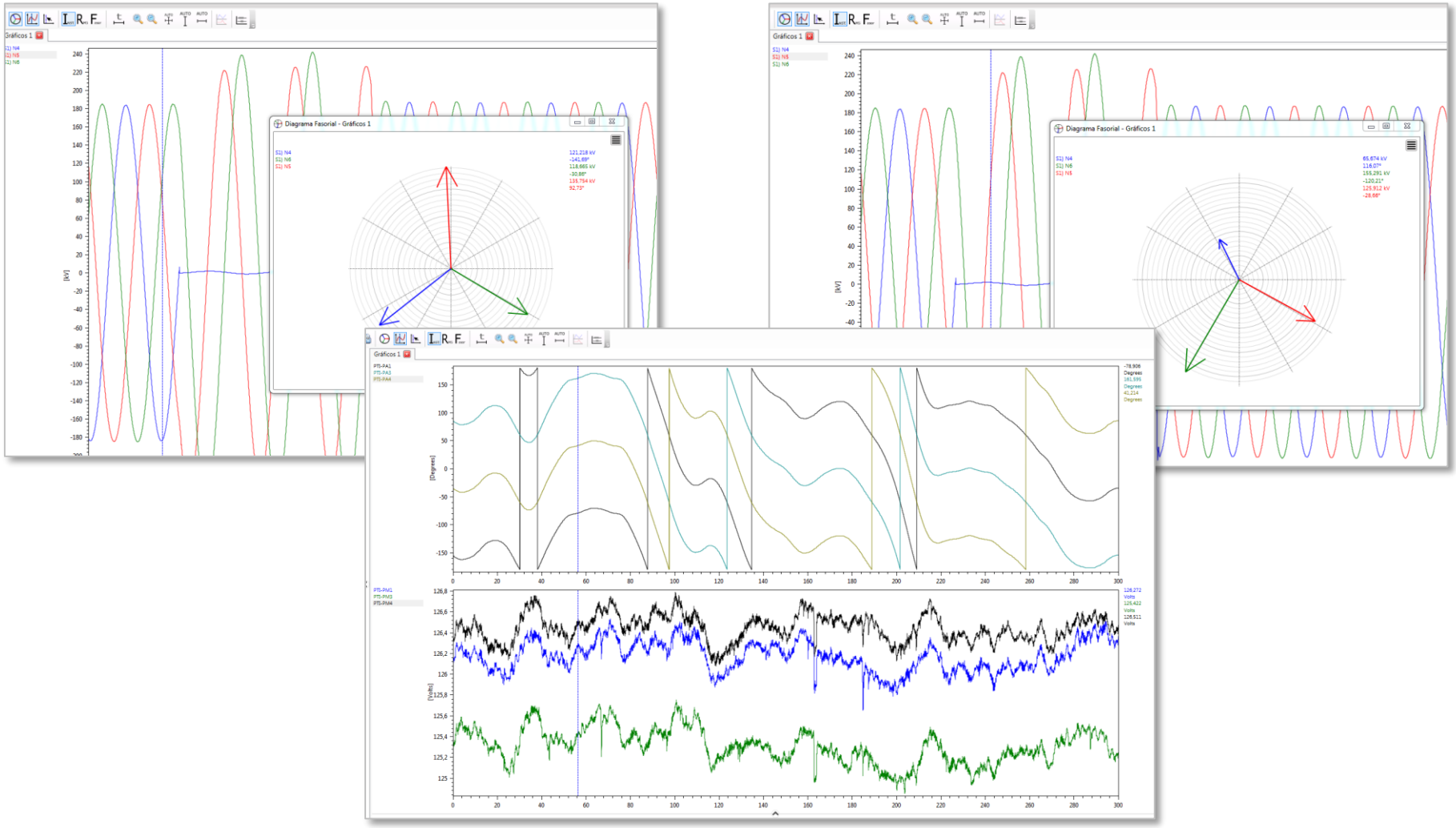



From
[www.medfasee.ufsc.br/temporeal/](www.medfasee.ufsc.br/temporeal/)

Internal report about PMU-PTI functions and behaviors.
Authors: Ildemar Decker, Fábio Mantelli (UFSC).

# SARF Development

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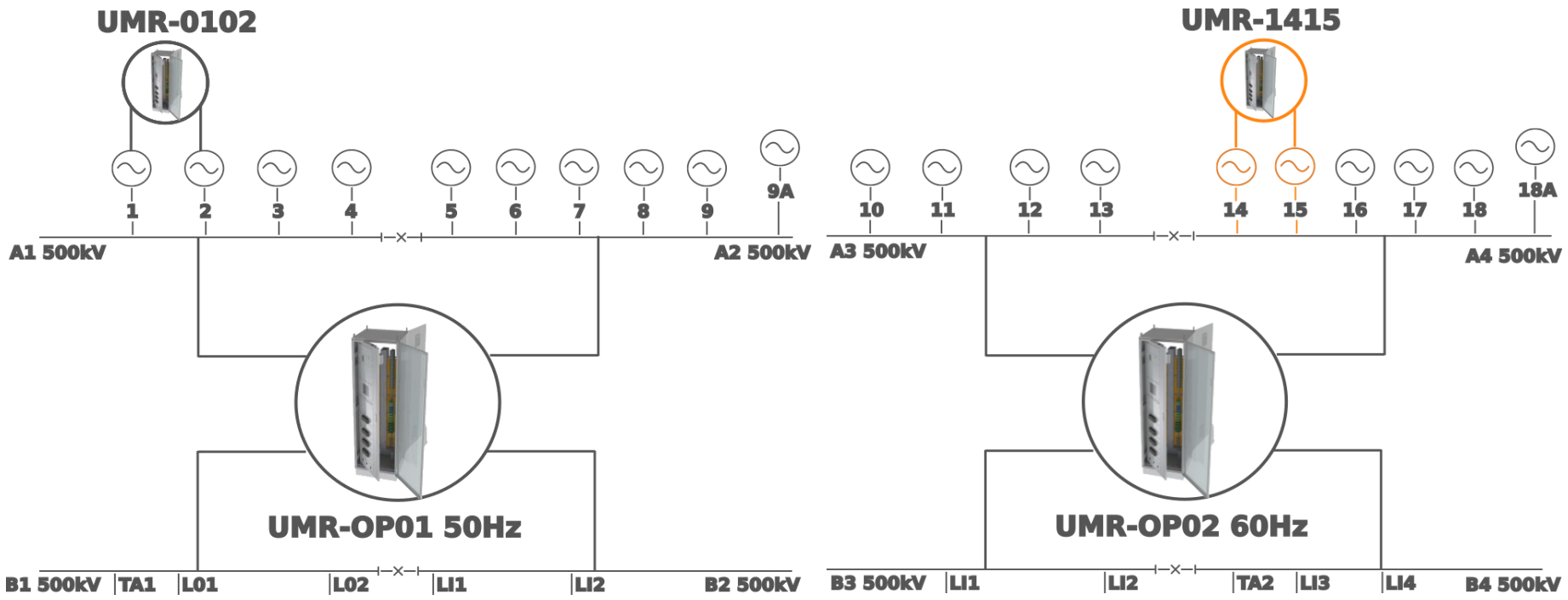
# Next Steps

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