Initial approach for monitoring online angular coherence between State Estimator and Syncrophasor measurements

NASPI Work Group meeting
March 22-23, 2017
Gaithersburg, MD.

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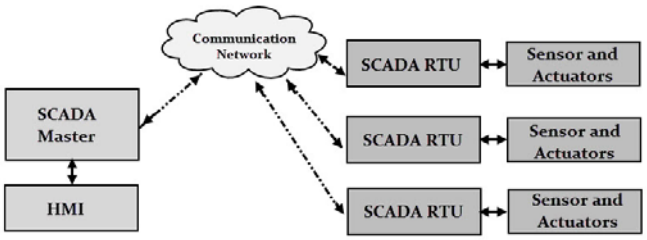
Two complementary IT systems?

SCADA

Traditional State Estimator

Angles are calculated

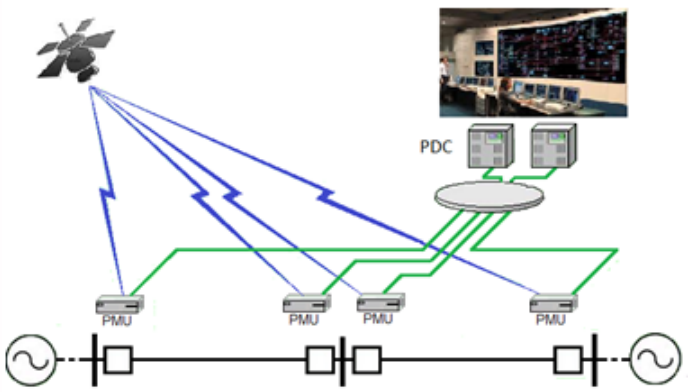


http://www.electronicshub.org/wp-content/uploads/2015/10/What-is-SCADA.jpg

WAMS

Syncrophasor Measurement

Angles are measured



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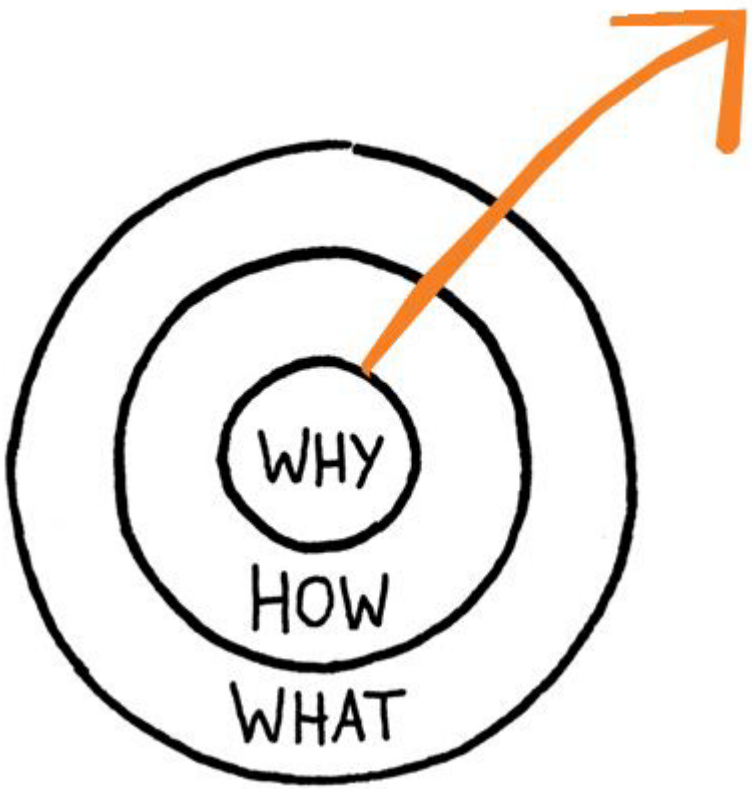
Methodology



Why?

- To validate that the measured data represents the reality of the electrical system.
- To provide reliable data to operators.

How?

- Identifying coherence between both systems
- Verifying data quality
- Filtering & conditioning corrupted data
- Indicating abnormal situations between systems

What?

DQ-Prototype: Coherence EMS/WAMS

Simon Sinek: How great leaders inspire action | TED Talk | TED.com

http://www.collegefactual.com/about/why-how-what/

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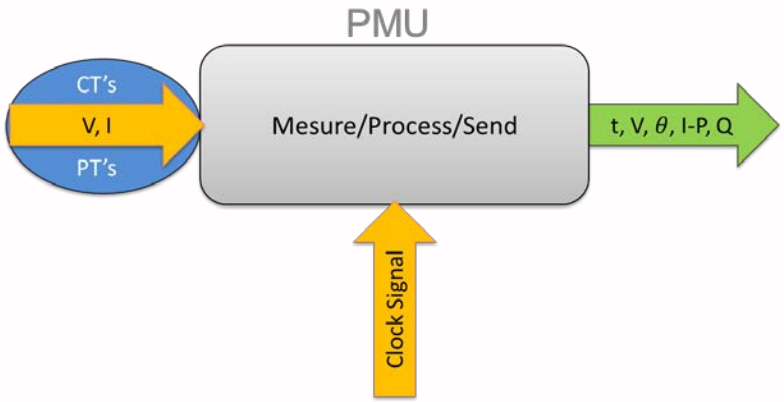
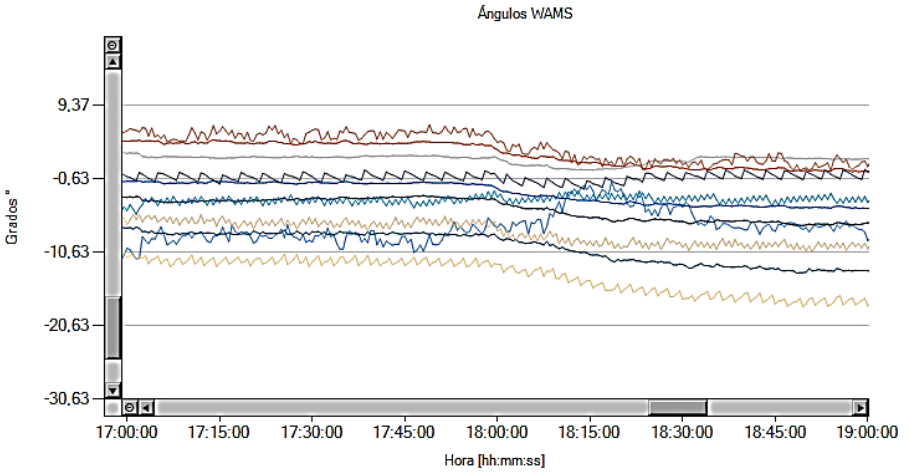
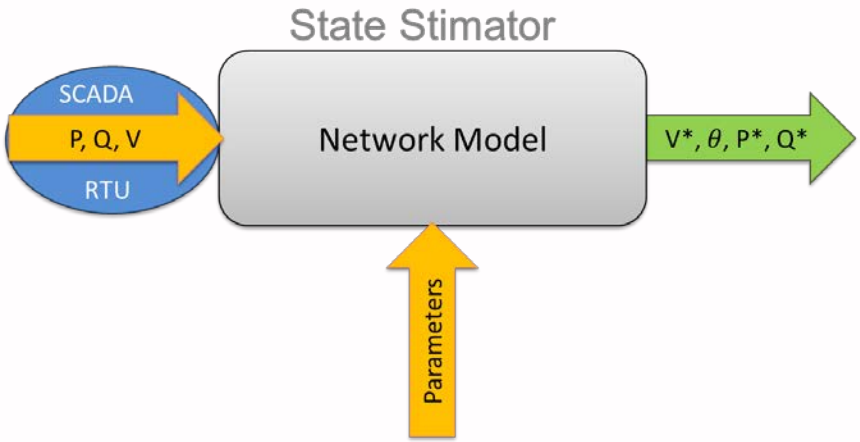
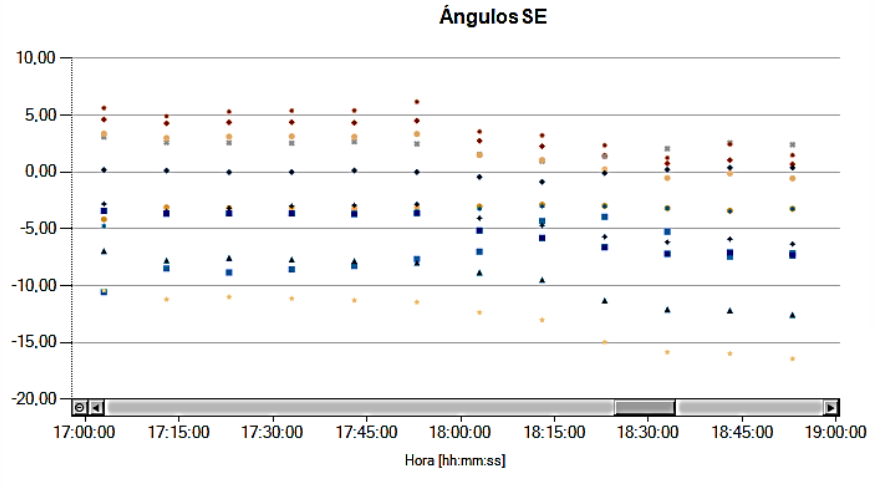
How? - Methodology developed



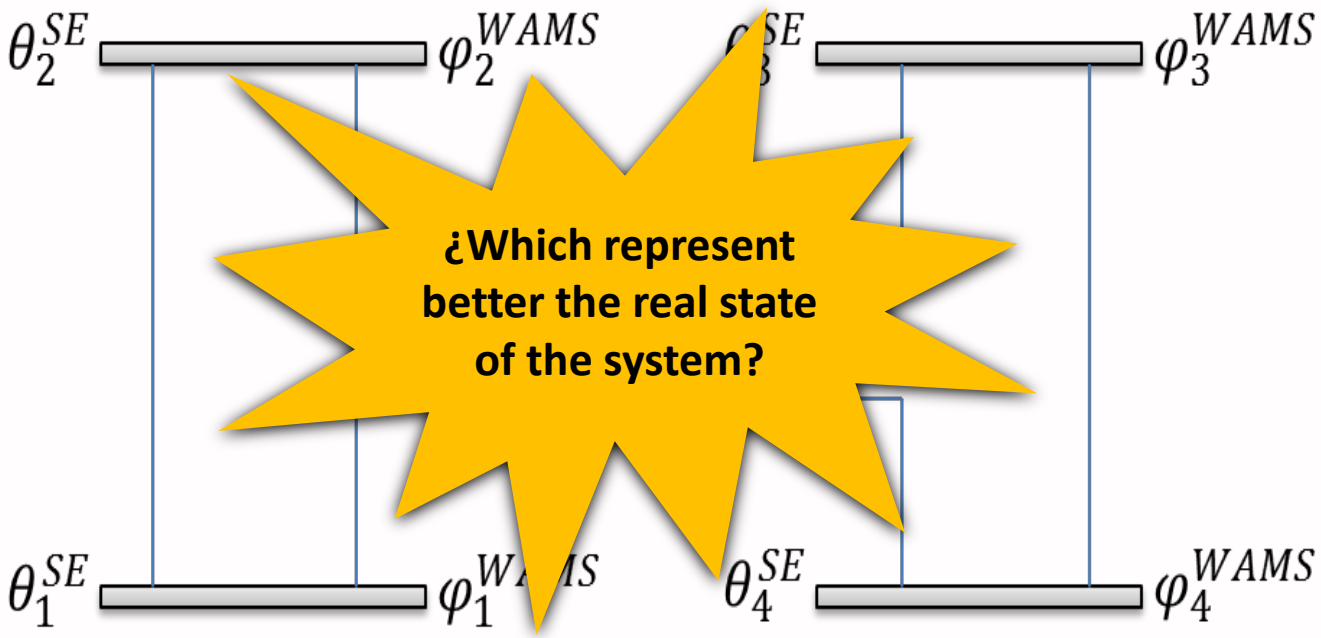






How? - Methodology developed

State Estimator Angles (θ) & WAMS Angles (φ) [1]



[1] Q. Zhang, X. Luo, D. Bertagnolli, S. Maslennikov y B. Nubile, «PMU data validation at ISO New England,» *Power and Energy Society General Meeting (PES), IEEE* , 2013

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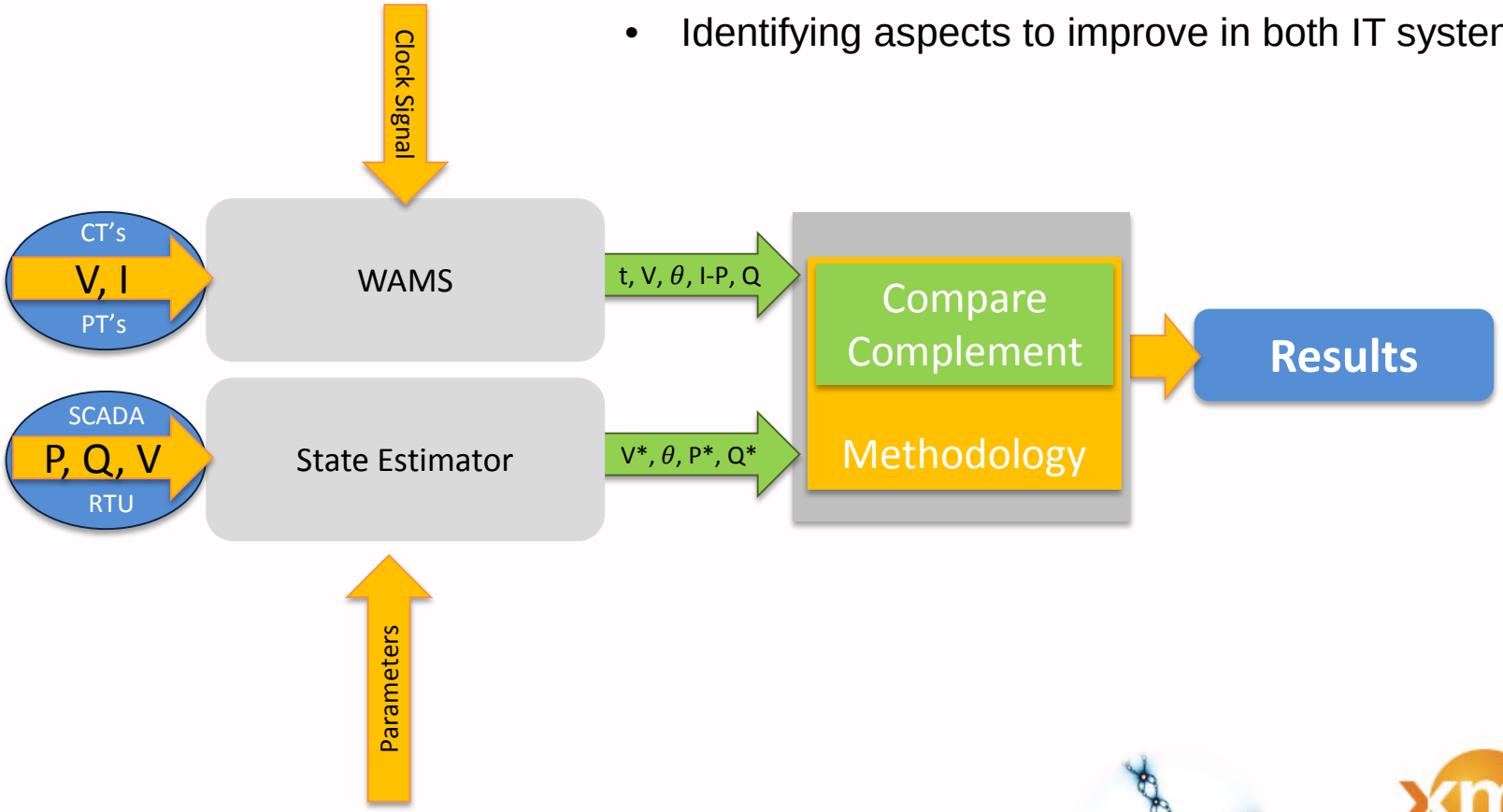
How? - Methodology developed

- Complementing the capabilities of both IT systems
- Identifying aspects to improve in both IT systems



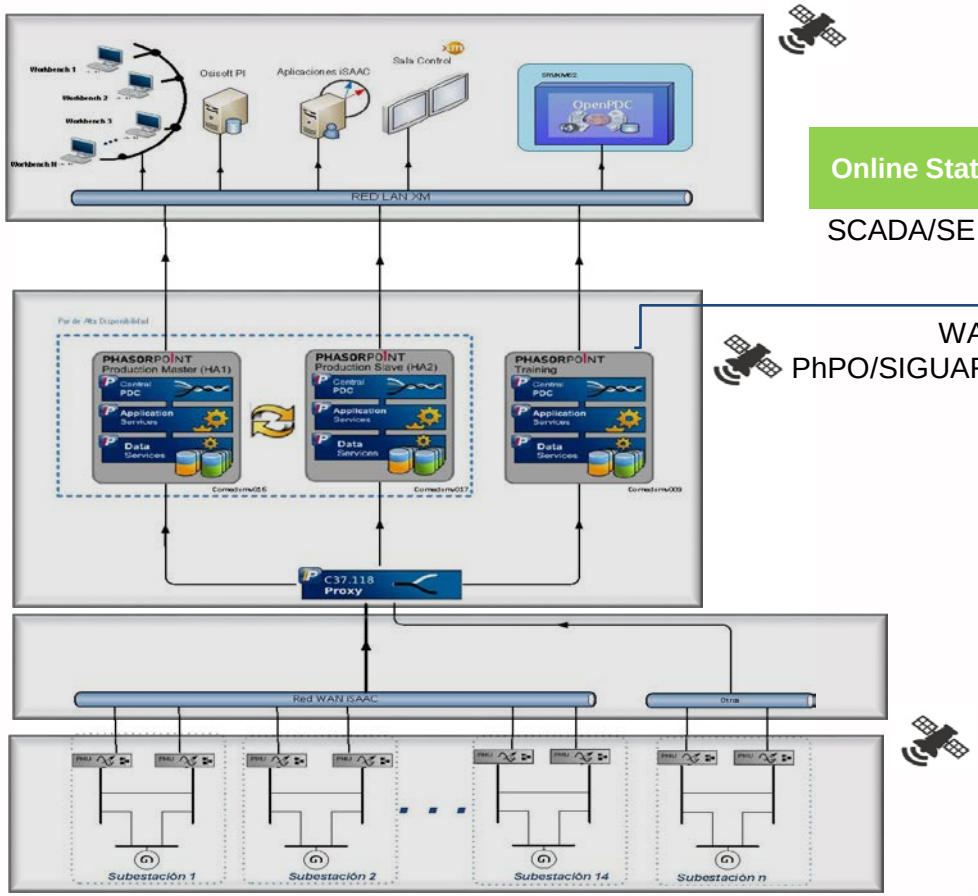
What? - WAMS architecture

Visualization

Data Process

Telecommunications

Measurements



Online State Estimator

SCADA/SE

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User

WAMS

PhPO/SIGUARDG/OpenPCD

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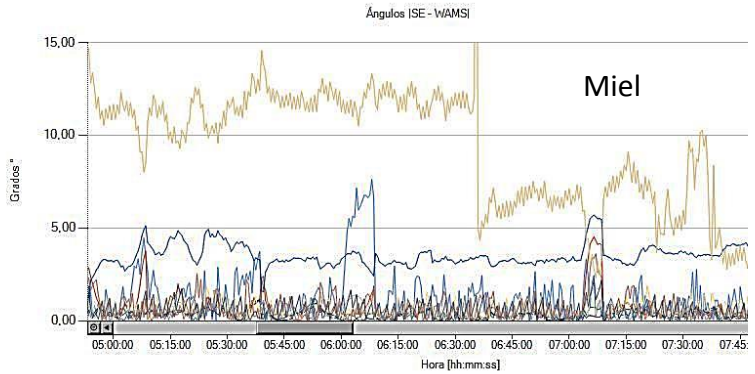
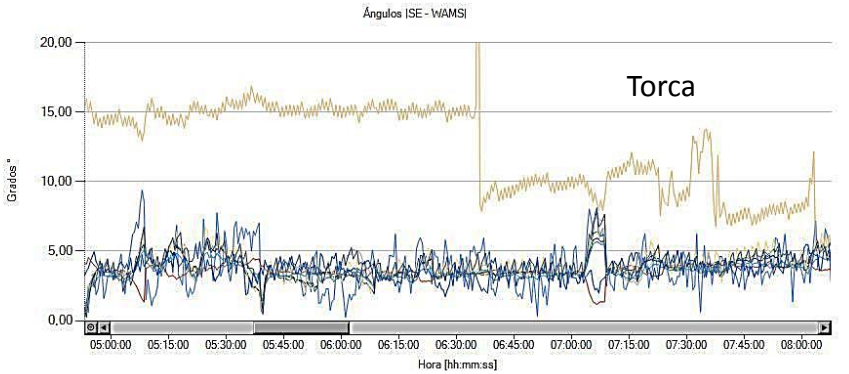
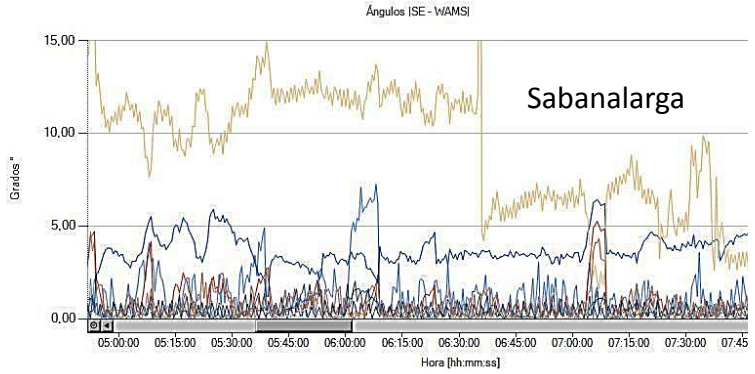
Off-line tool developed in stage 1: First results obtained

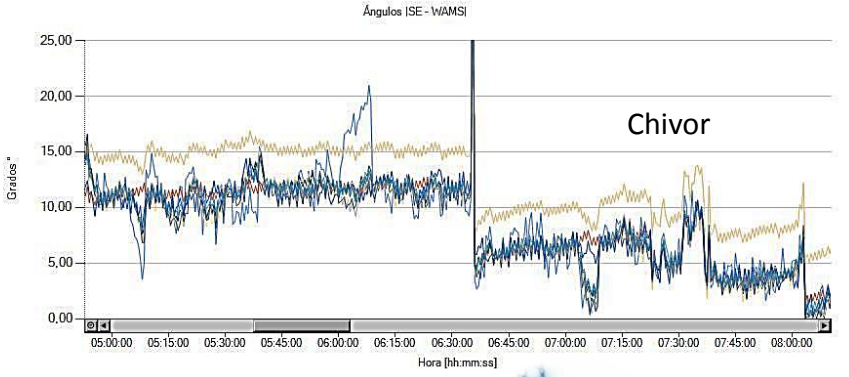
You have to use a reference node to compare both systems.

This shows the importance to select a “good” reference node.









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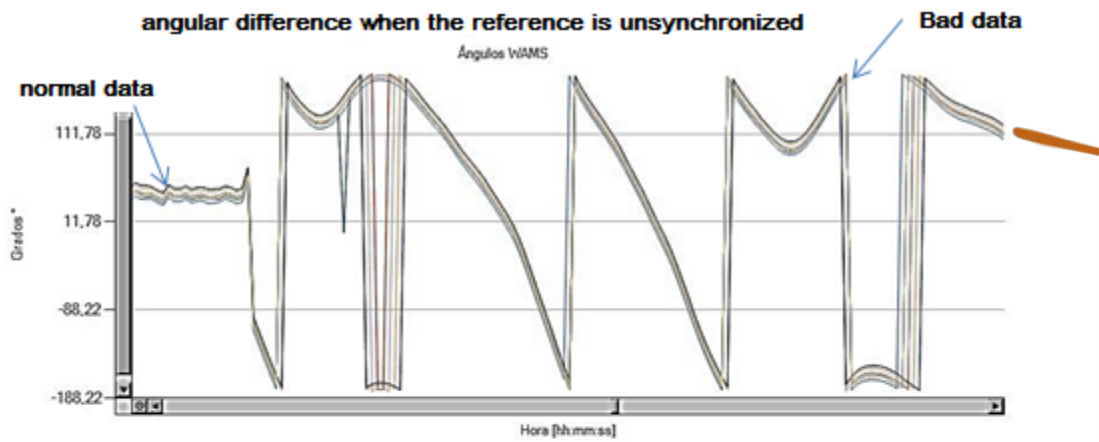
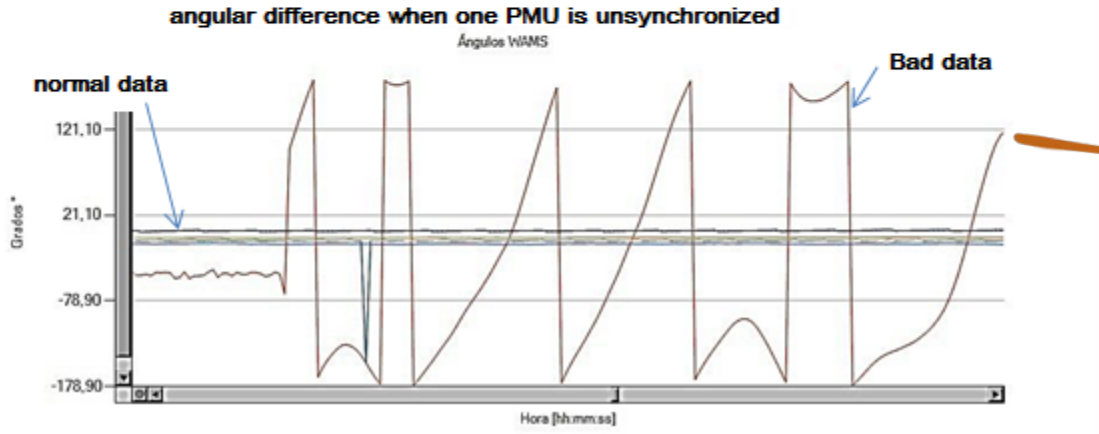
Off-line tool developed in stage 1: First results obtained

Identifying un-synchronized PMUs.



It is obtained when the reference is unsynchronized.



It is obtained when one PMU is unsynchronized.

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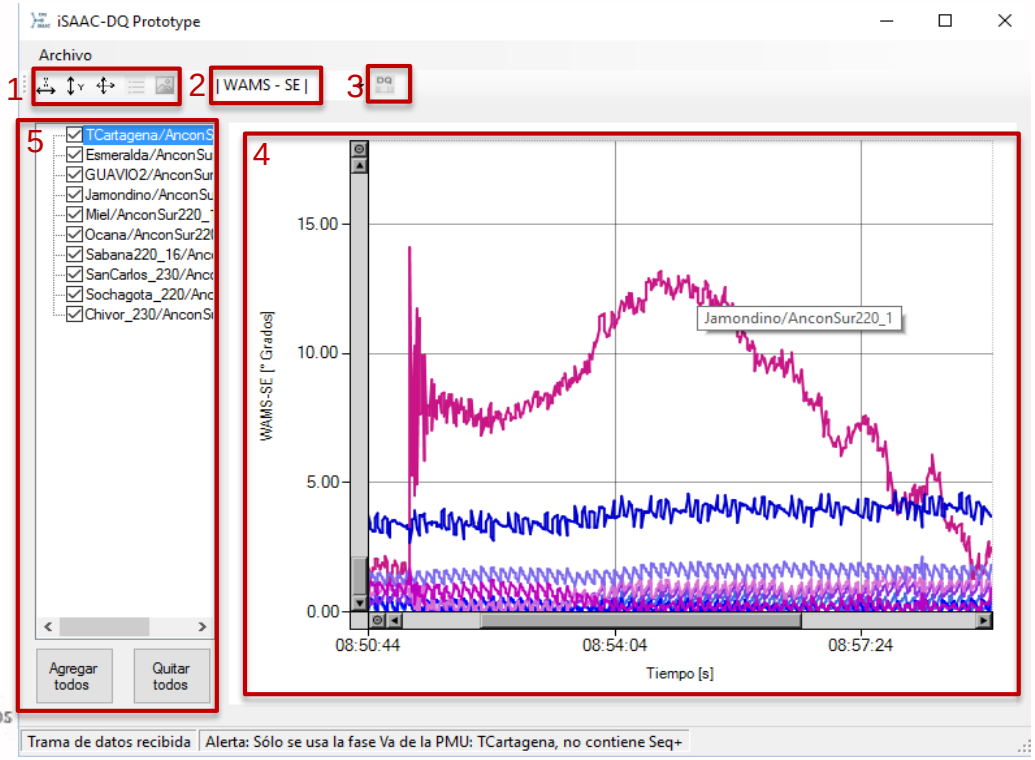
How does it work? – Coherence EMS/WAMS Prototype

WAMS Data

Select last SE result → Data Conditioning → Carry both systems to same reference → Identify the same point in both systems → Compare coherently data (time and location)



1. Chart tools
2. Types of data to display
3. Data Quality Chart
4. Online Chart
5. Series: Each node

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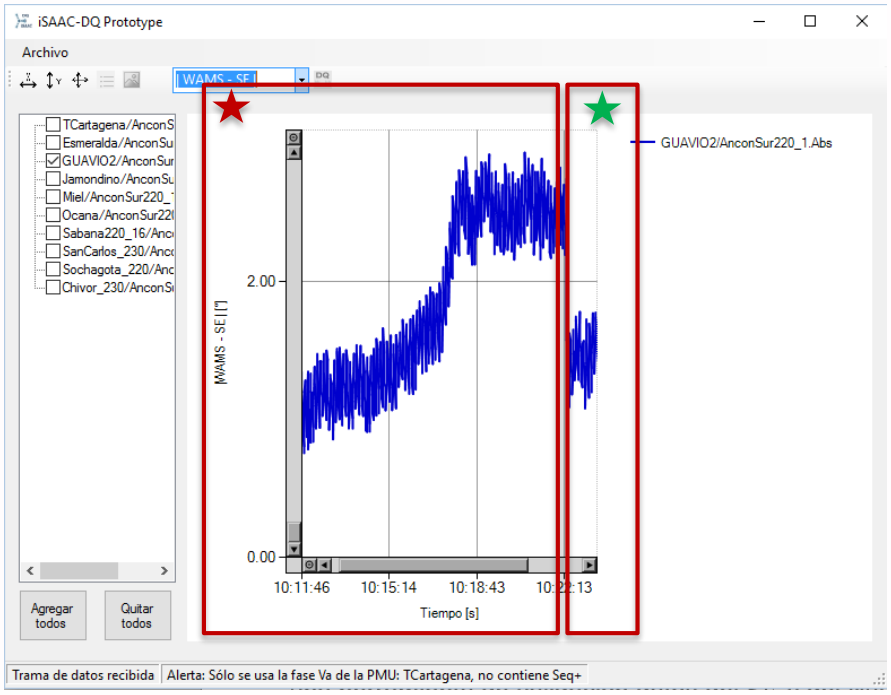
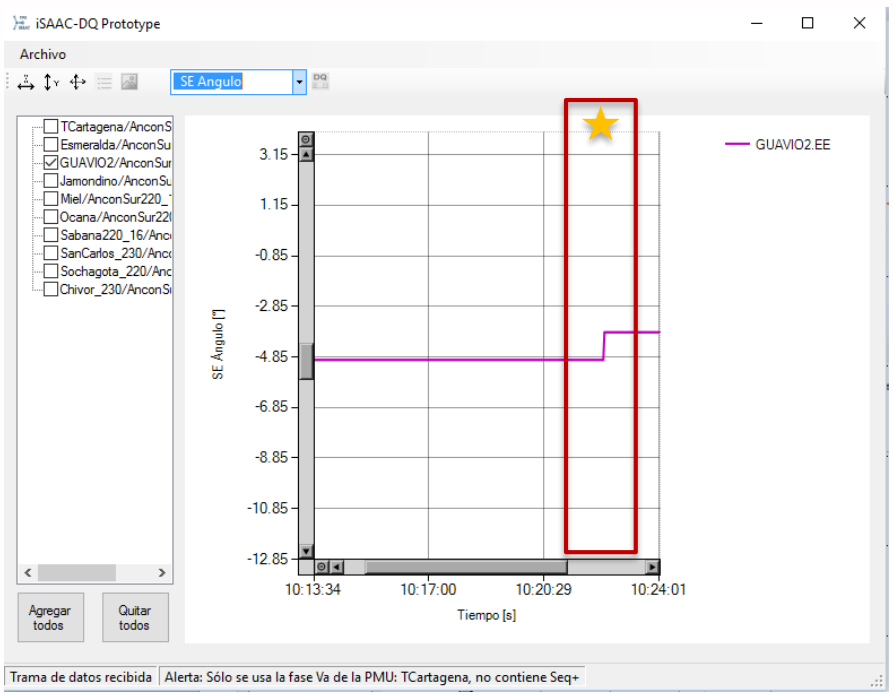
What? - Coherence EMS/WAMS Prototype

★ Show how outdated the SE results are.

★ The difference between SE and WAMS it reduces

★ A new SE result.

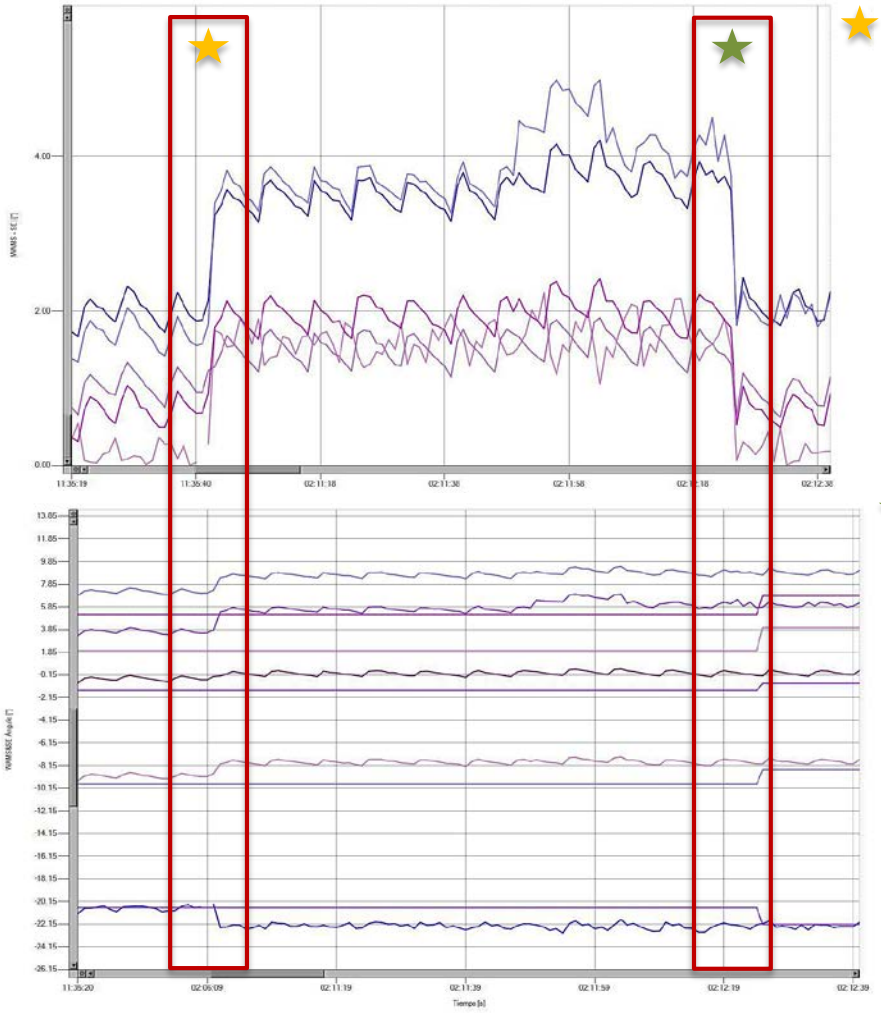




What? - Coherence EMS/WAMS Prototype

Angular difference between SE and WAMS when:

- Power system presents a topological change
- SE update results



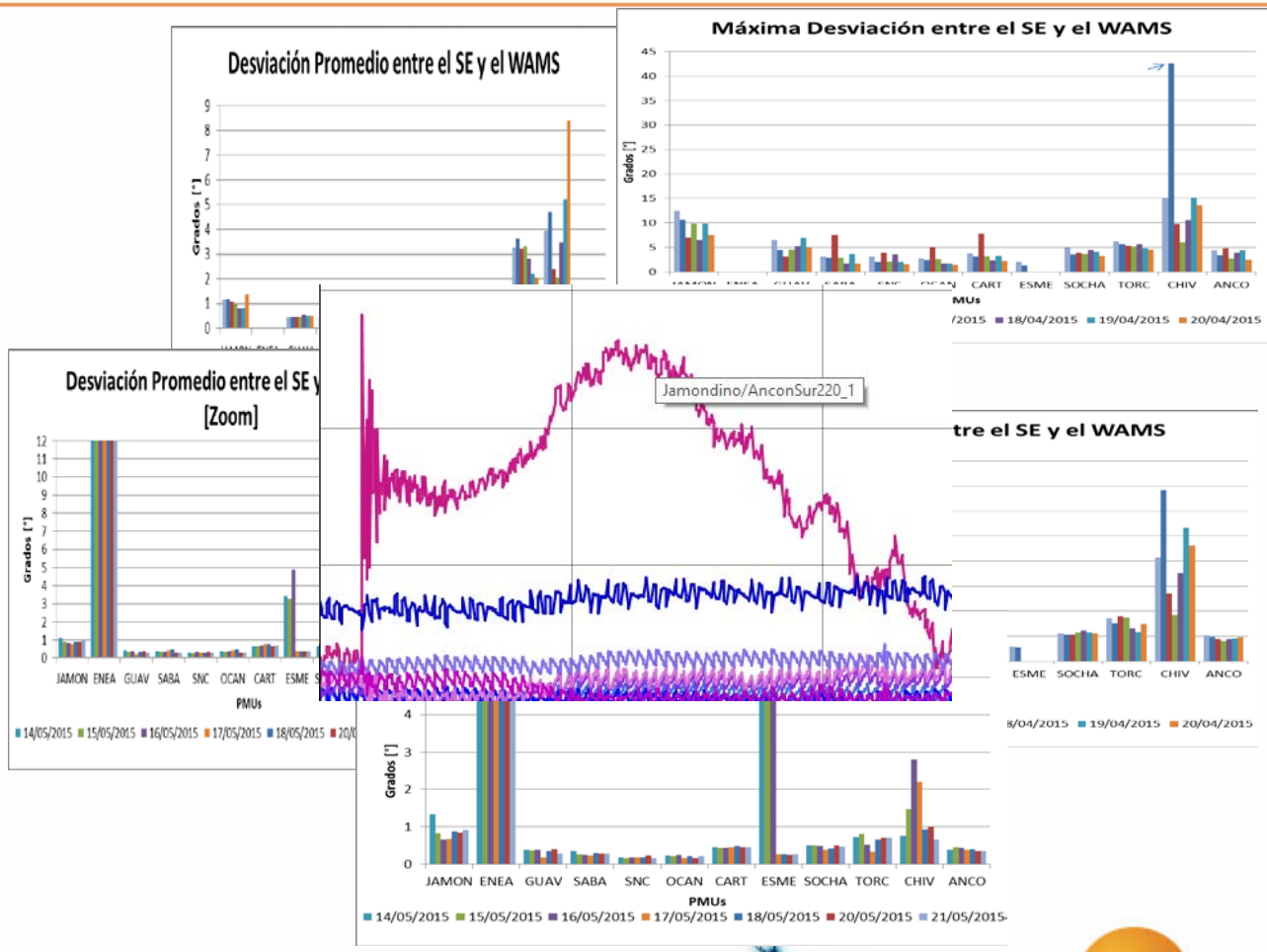
- Indicate operators for:
  - Important changes in power system
  - updated SE results
- Differences between SE and WAMS are reduced

Analyzing the results - Coherence EMS/WAMS Prototype

- The methodology has been developed to monitoring in a quantitative way how coherent the systems are.
- The comparison has shown to be helpful, for example, by finding errors in either of two systems.

This proposal allows us to identify:

- Zones that need calibration of parameters and/or measurement data on State Estimator
- Synchrophasor measurement aspects like inverted phases, desynchronization, invalid data, noise data



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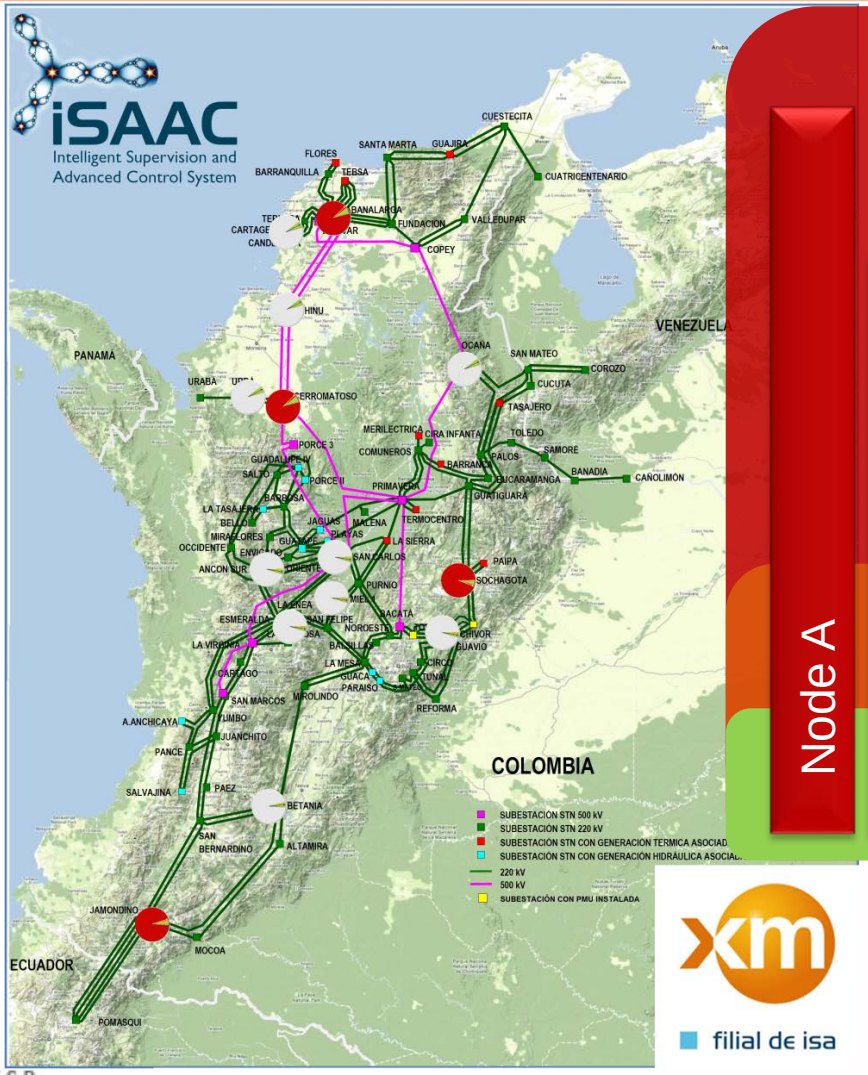
What we imagine in the future? - Coherence EMS/WAMS Prototype

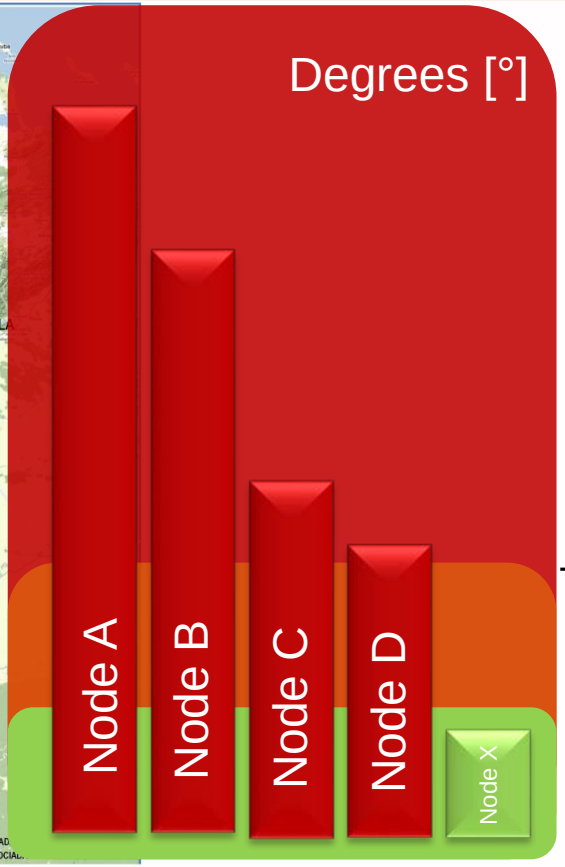
This tool show quickly:

- Where an event occurs and its implication
- A change of condition of the system.
- A bad PMU measurement or synchrophasorial issue.
- Help to tune parameters of system in SE

Important:

- This tool improve if it increase the amount of PMU





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Any question, advice or to work together, please contact us

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