

NASPI Work Group Meeting
February 29 - March 1, 2012
Hyatt Regency Orlando Airport



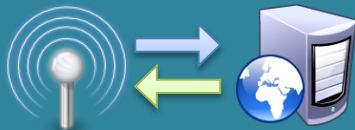
Dalibor Brnobić
**WAMSTER AD-HOC
SYNCHROPHASOR NETWORK:
PRACTICAL EXPERIENCES GAINED IN 2011**

WAMSTER overview

- **industrial grade device for synchrophasor research**
- easy to configure and use, portable, no need for additional communication infrastructure
- data concentrator as a **service**, with a web-based interface



STER PMU devices: lightweight, handheld PMUs with battery backup and SD card memory¹



GRPS: optimized WAMSTER protocol
Ethernet: optimized protocol or IEEE 37.118²

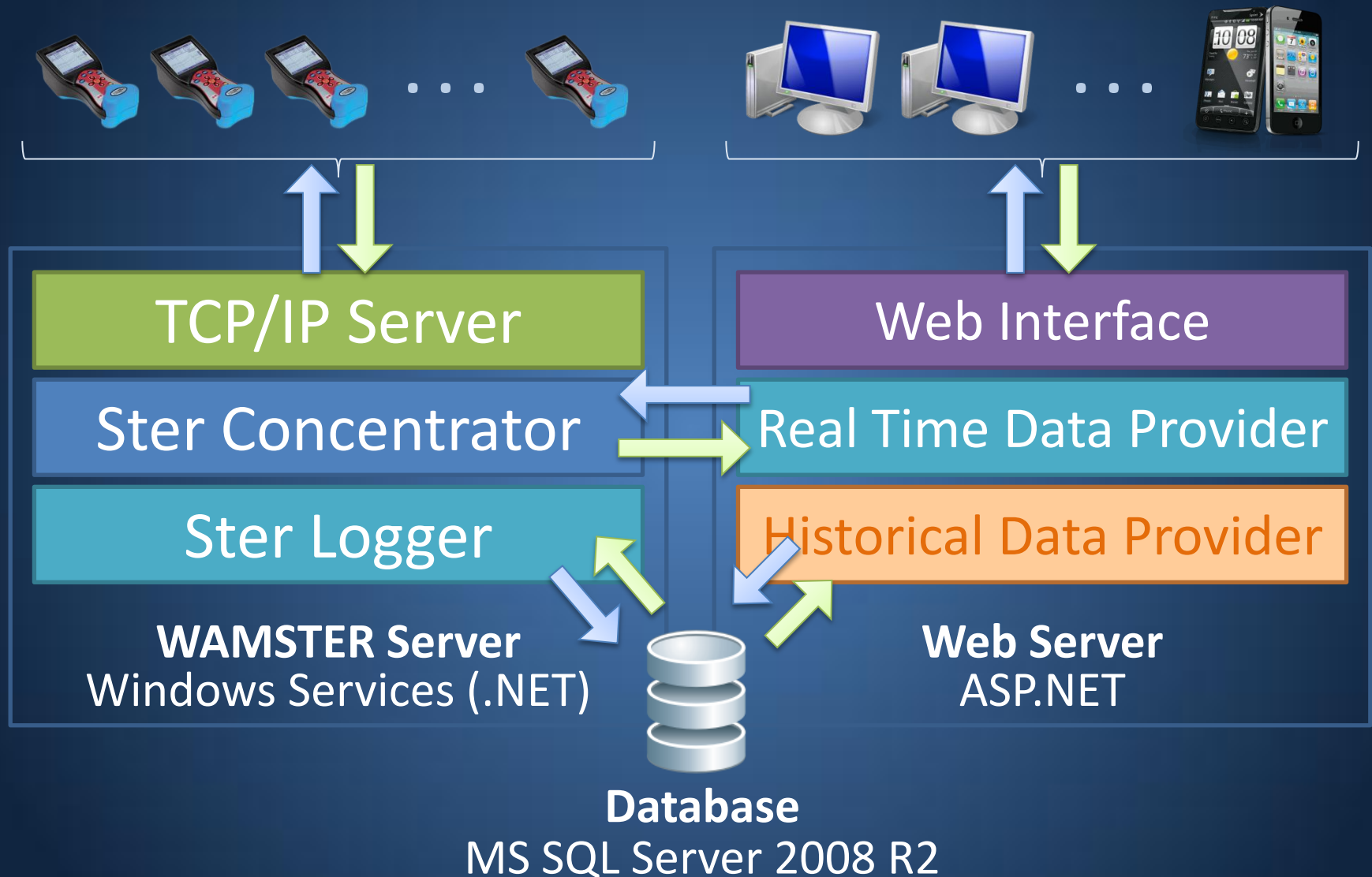


WAMSTER web application: cloud data storage, accessible from anywhere, event-based triggering, analysis, interoperability

¹ 32GB card can store more than **4 months** of synchrophasor data at the device side

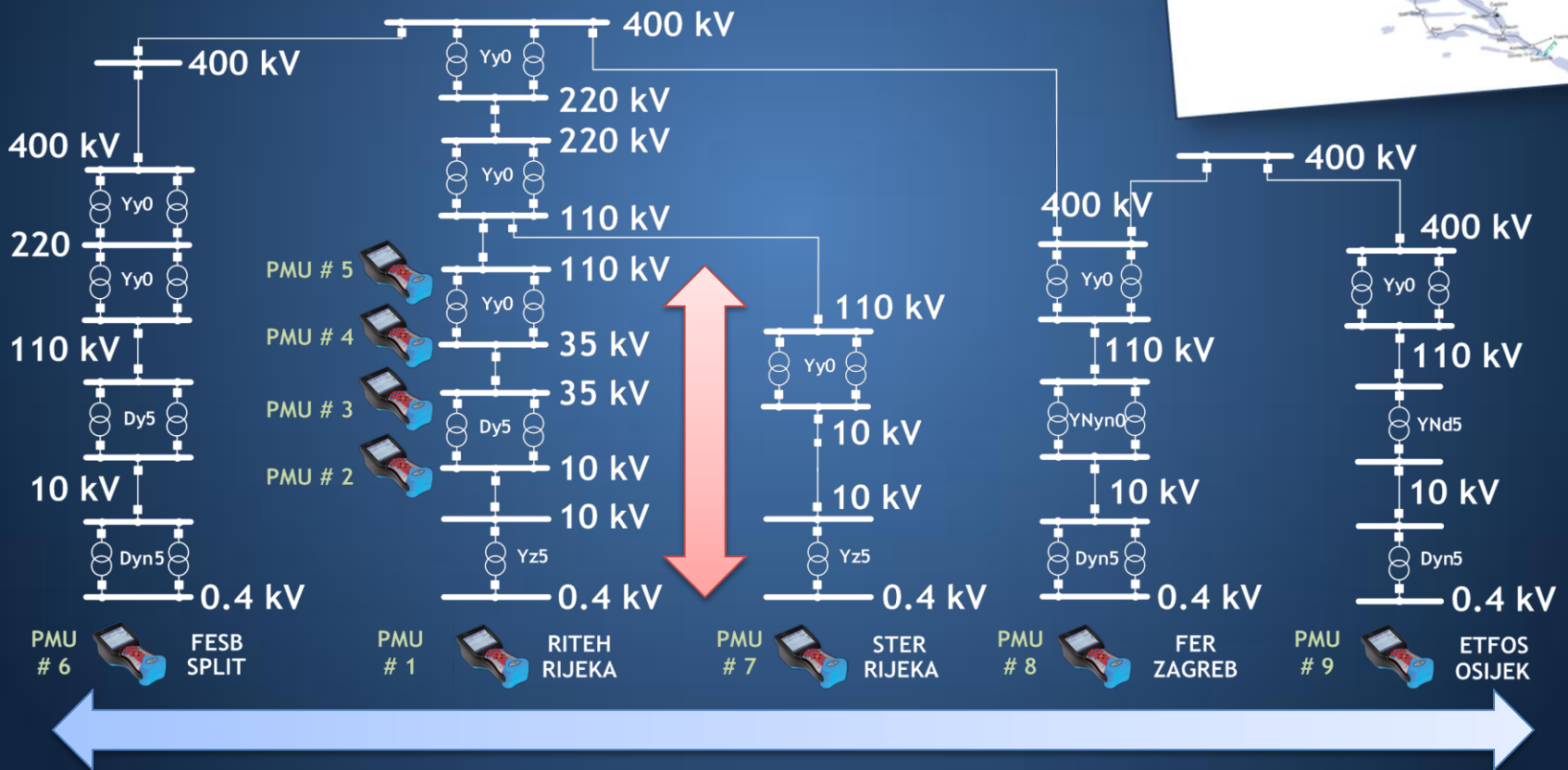
² For mobile networks, custom STER protocol is recommended due to its additional features (adaptive reporting speed, historical requests, remote firmware upgrade, basic events). Note that device stores synchrophasors at 50/60 FPS locally.

WAMSTER components



Case 1: CARWAMS

- Implemented for University of Rijeka
- Active from Sep 2010 until Sep 2011
- Hor.: 0.4kV, Vert.: 0.4kV - 110kV
- Data streaming towards TSO PDC



Case 1a: CARWAMS LV analysis

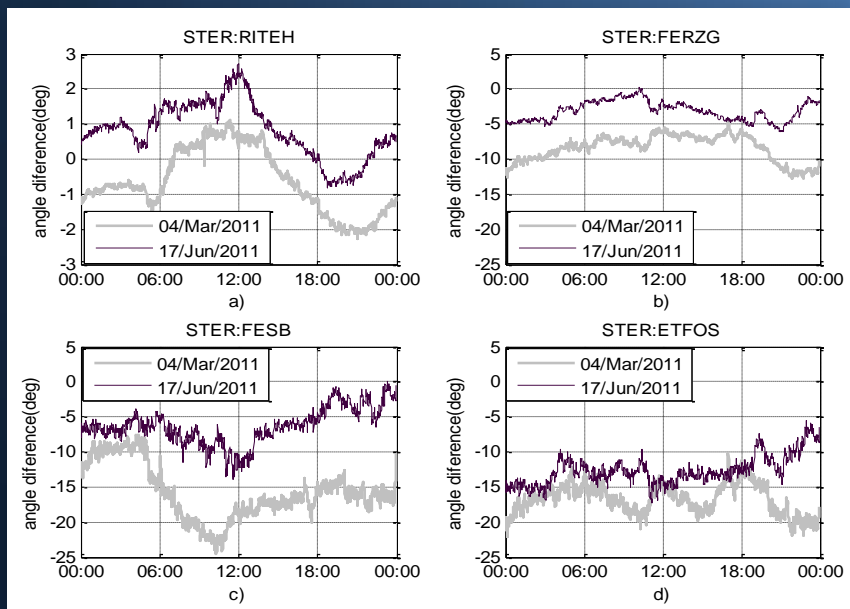
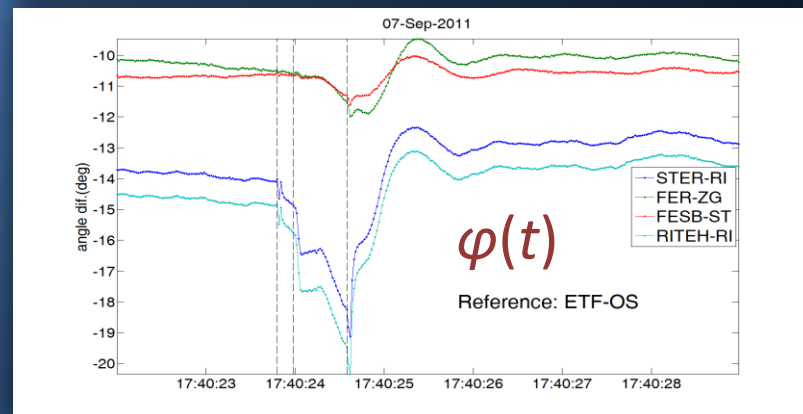
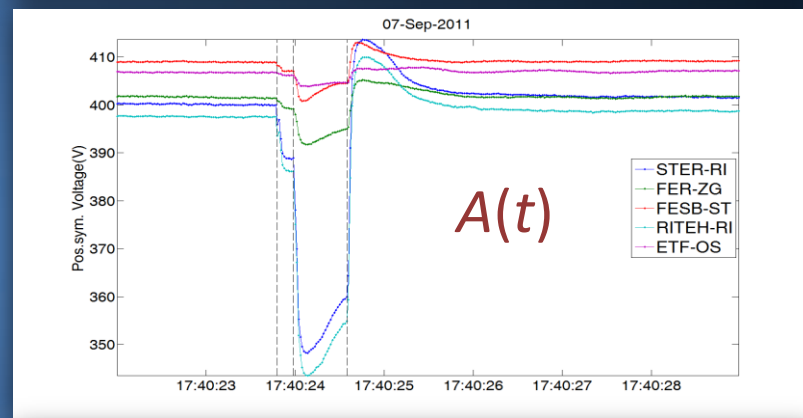
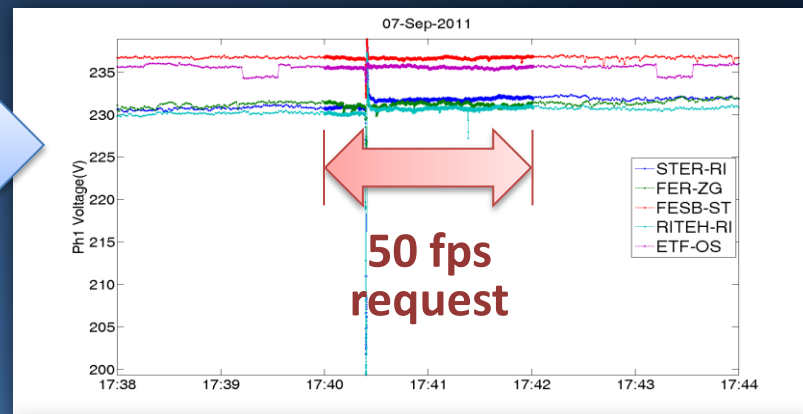
Transients:

- 50 fps on demand

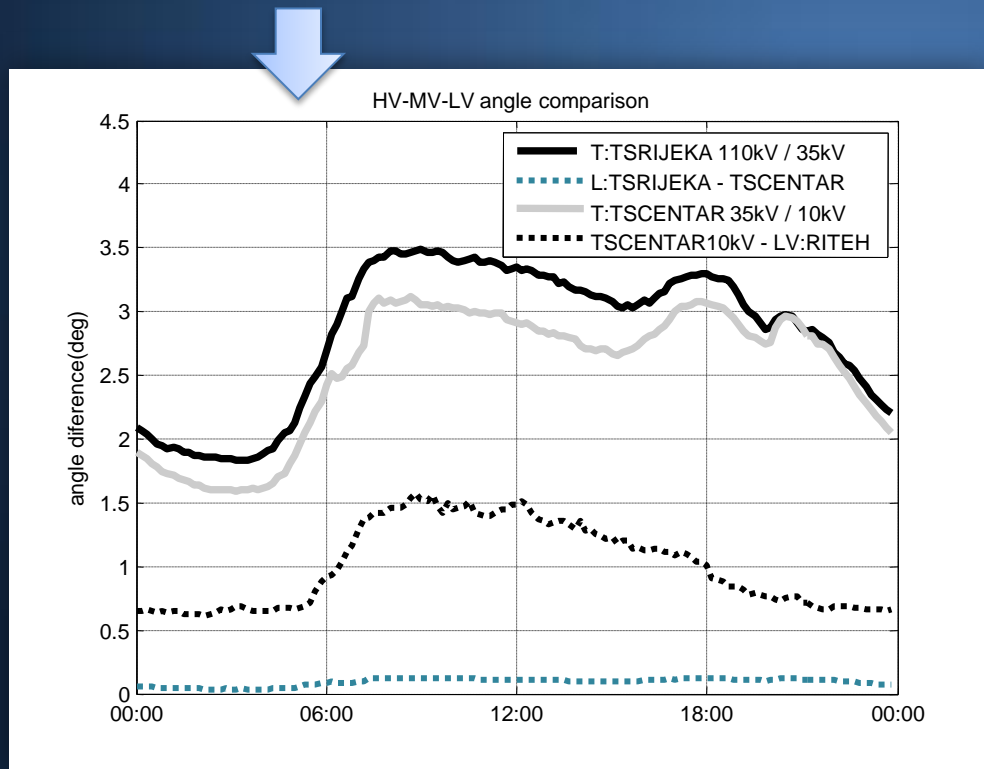
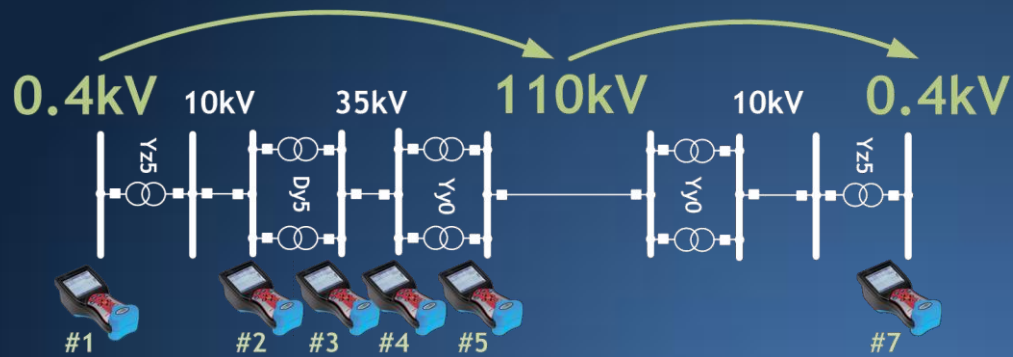


Long term baselining:

- Reporting at 1 fps
- Daily fluctuations
- Seasonal changes



Case 1b: CARWAMS HV-MV-LV coverage



Shortcomings found:

- 1 fps insufficient for transients and oscillations
- 8 MB of flash memory was sufficient for only **77 minutes** of data

HW upgrade:

- Removable SD flash memory card – 32 GB more than **4 months** of data autonomy
- Ethernet connectivity for continuous 50/60 fps reporting rate

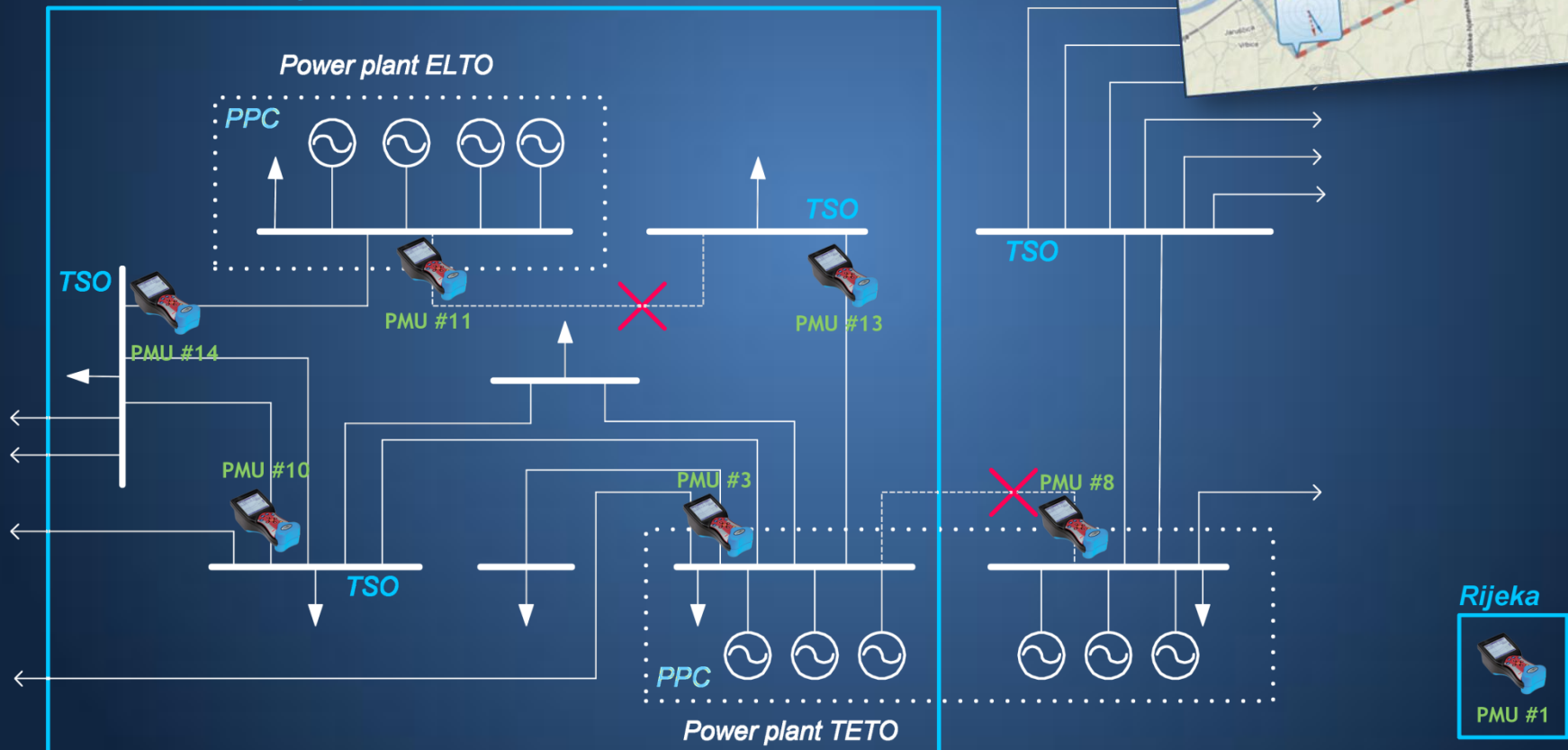
SW upgrade:

- Event detection/triggering
- Web access improvements

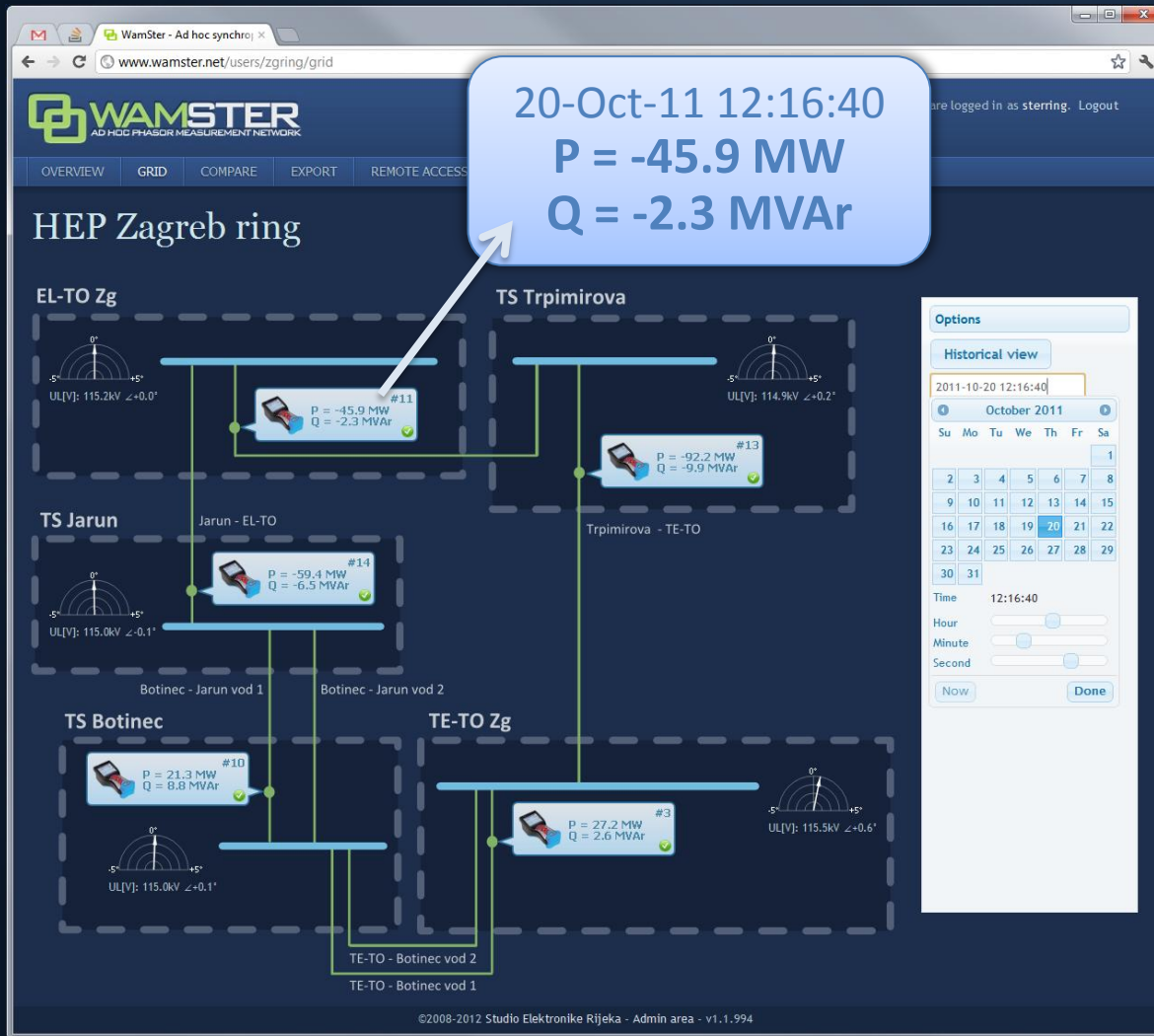
Case 2: Zagreb 110kV loop

- Installed in Sep 2011 (ongoing)
- Part of SIPS Project for TSO conducted by Faculty of Engineering Rijeka

Automated control system area



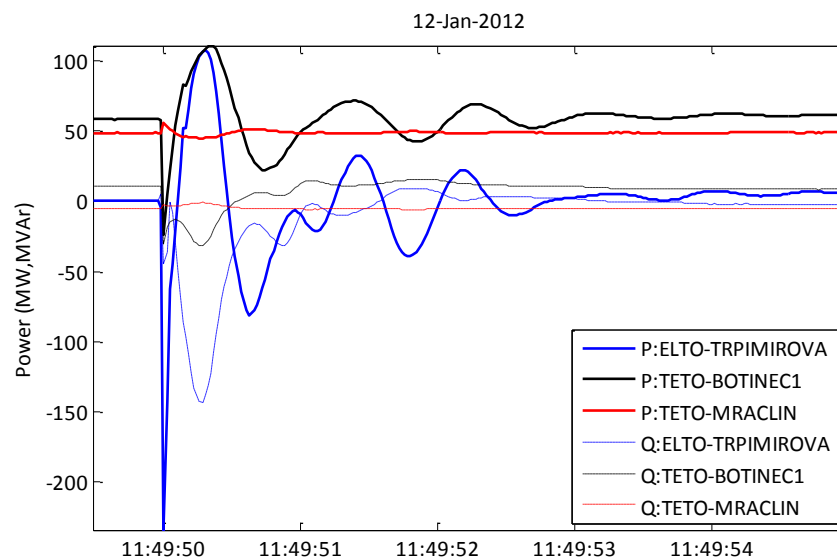
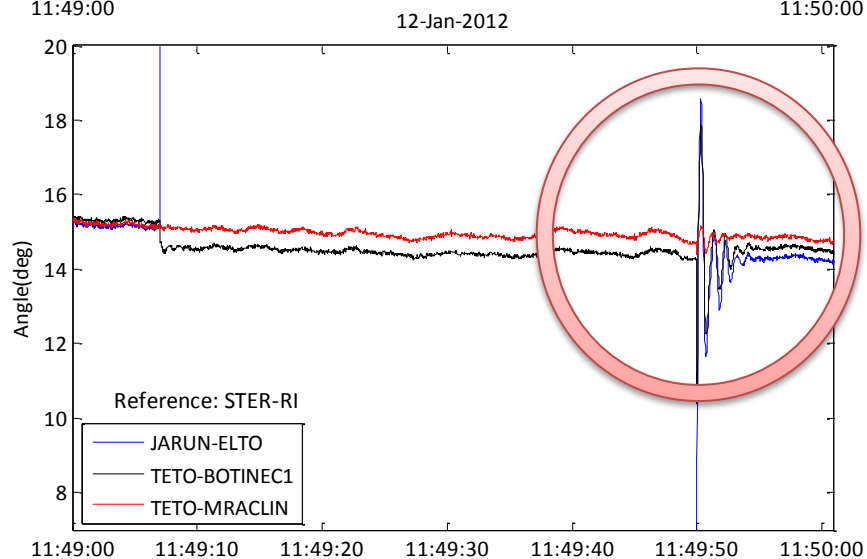
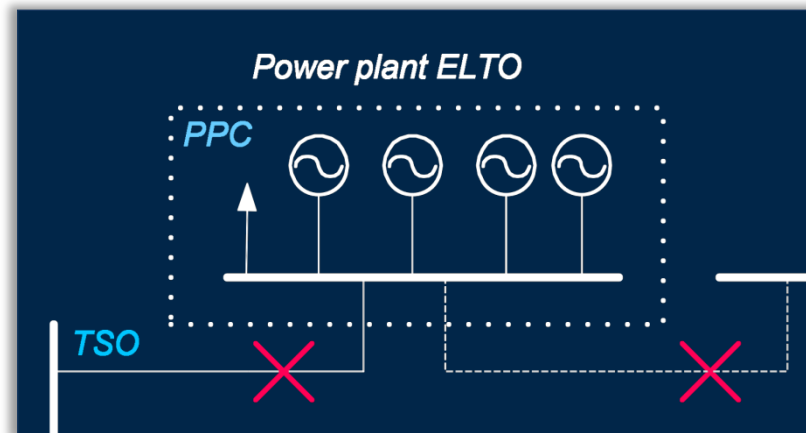
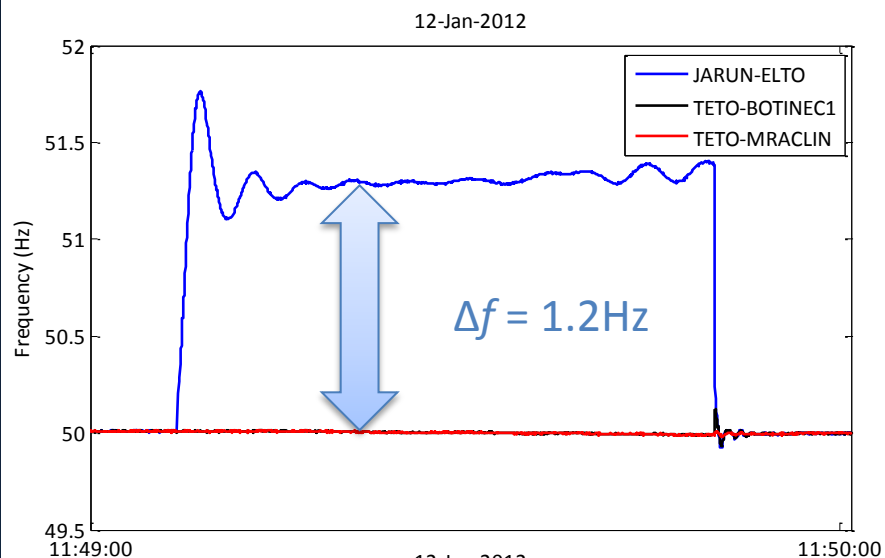
Case 2a: Zagreb 110kV Loop: closed loop transition



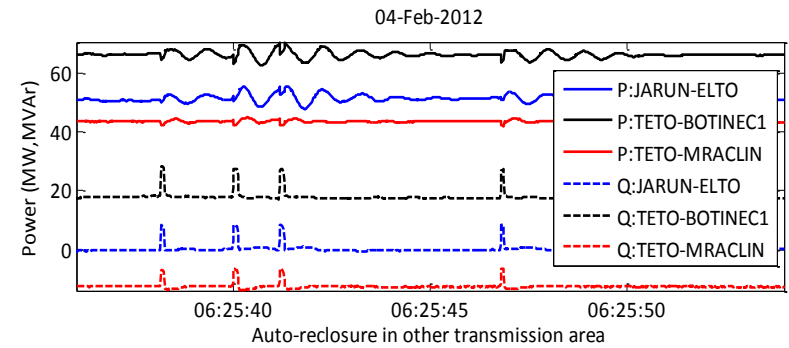
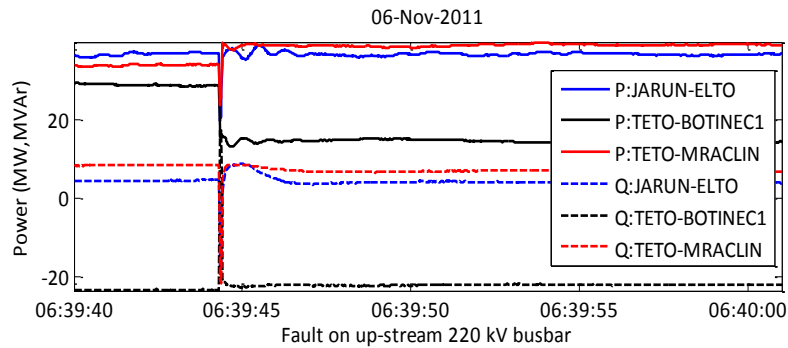
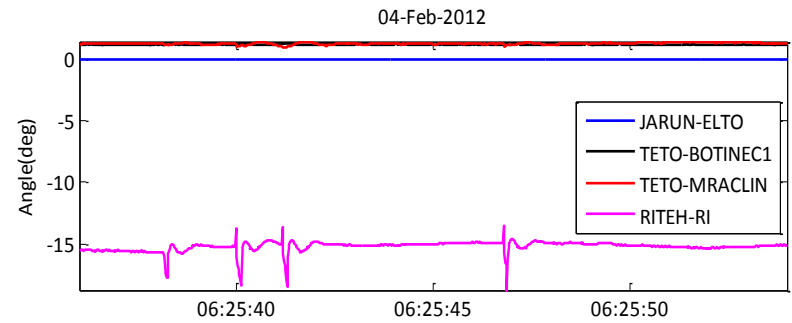
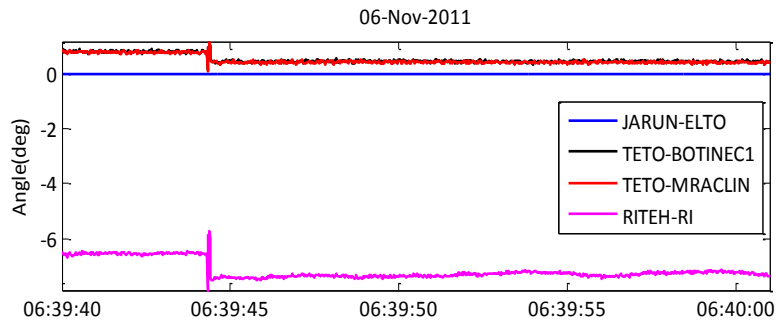
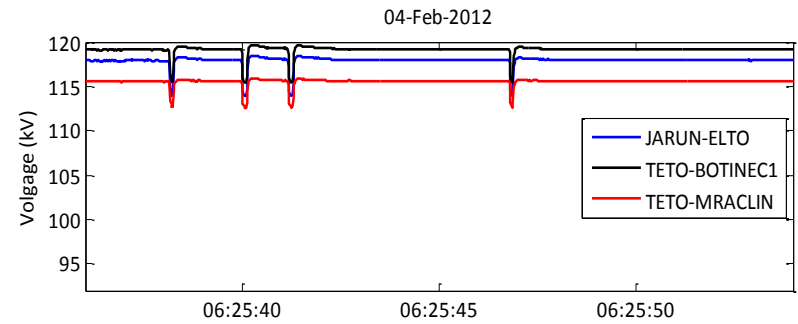
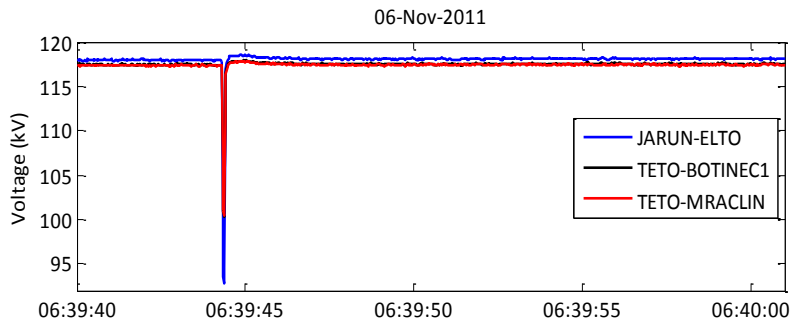
Continuous monitoring:

- Near real-time system dynamics monitoring
- Load modeling based on SCADA
- Evaluation of model dynamics
- Parameter tuning
- Reporting at 10 fps, with 50 fps for triggered requests

Case 2b: Zagreb AVPS Loop: islanding caused by an operator mistake



Case 2c: Zagreb 110kV Loop: typical disturbances



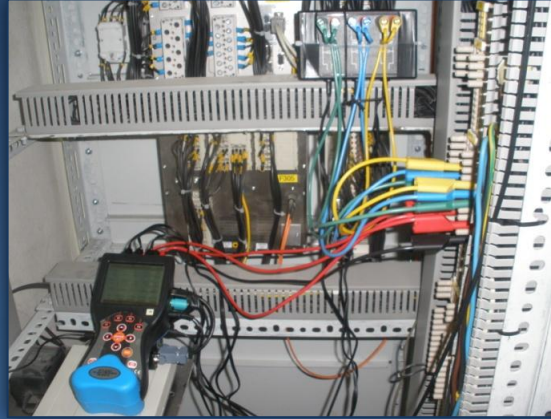
6 PMU devices for the Zagreb AVPS Project including all the additional equipment (extension cables, tools,...)



STER PMU is small enough to fit into any place inside an electrical cabinet.



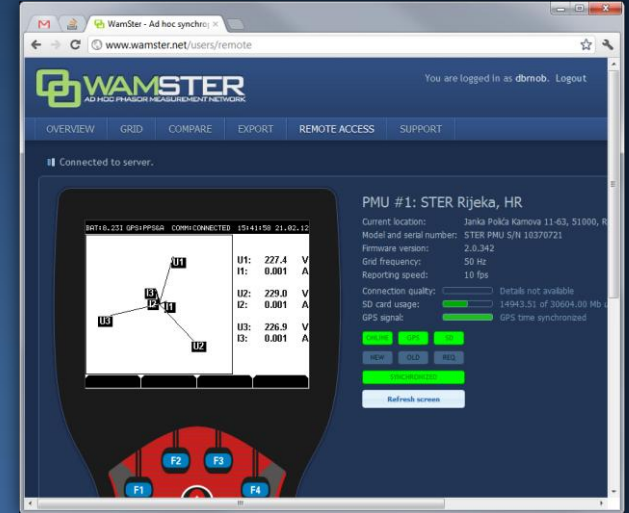
STER PMU device connected to the terminals inside a cabinet.



Web interface can be accessed on site, using any web-enabled device.



WAMSTER protocol supports remote access to the device using the web interface



GPS device with magnetic support placed on a window or slipped under the door.



Try a live demo now

- Do you have a web-enabled device with you?
- Laptop / tablet / smartphone?
- www.wamster.net is available to you right now.

Contact

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Questions?

Thank you.