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SS4: “Enabling Technologies and Methodologies for Wide Area Monitoring Protection and Control Systems”

“WAMPAC Seduces SCADA in a Control Room”

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Agenda



- **Wide Area Monitoring, Protection and Control**
 - Problems and challenges
- **WAMPAC Adoption in a Control Room**
 - Challenges and barriers vs SCADA
- **WAMPAC and SCADA Integration**
 - Data exchange
- **System Integrity Protection Scheme - SIPS**
 - Solution and operation
- **Conclusion/Future Work**

Wide Area Monitoring, Protection and Control (1)

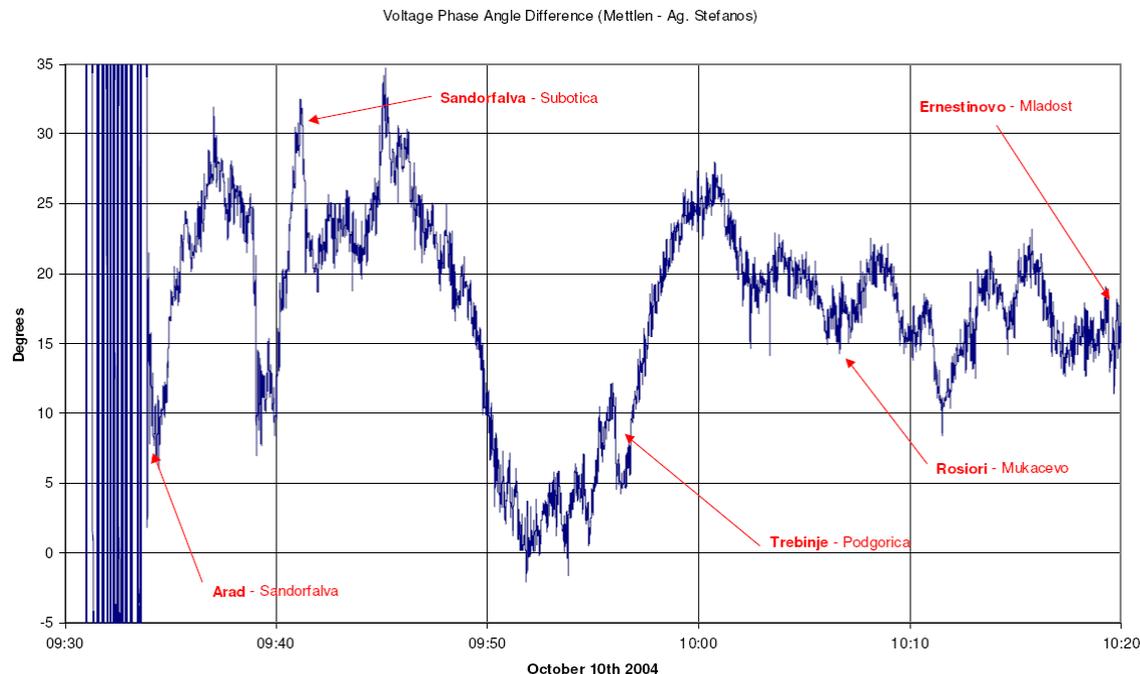
- There is general agreement that:
 - deregulation,
 - renewable energy sources,
 - a changing mix of generation resources
 - lack of infrastructure investment,
 - low inertia
 - low carbon
- Dynamic characteristics of the power system, and the task of supervising dynamic characteristics of the power system is increasingly important

PROBLEM and CHALLENGE



Wide Area Monitoring, Protection and Control (2)

- Synchrophasor measurements and Wide Area Monitoring (WAM) widely deployed in power systems worldwide
- WAM - proven to be a very valuable resource to observe and understand the dynamics of power systems



WAMPAC Adoption in a Control Room

Challenges vs SCADA (1)

- Specific installation of WAMPAC in control room exists - observation of the stability of oscillations
- But mainly WAMPAC waiting in the lobby of a Control Room
 - Post mortem analysis
 - Power system dynamic modelling
 - Power system planning
 - Dynamic studies and offline analysis
 - Etc.

WAMPAC Adoption in a Control Room

Challenges vs SCADA (2)

- Challenges:
 - WAMPAC has to provide a clear and simple synthesis of sophisticated **processes that do not require additional interpretation.**
 - All the operational procedures must be prepared for the operators as **precise actions** on the system,.
 - The **control room staff needs in-depth training.**

- Actually WAMPAC seduces operators – both to end, not in a bedroom but in a Control Room

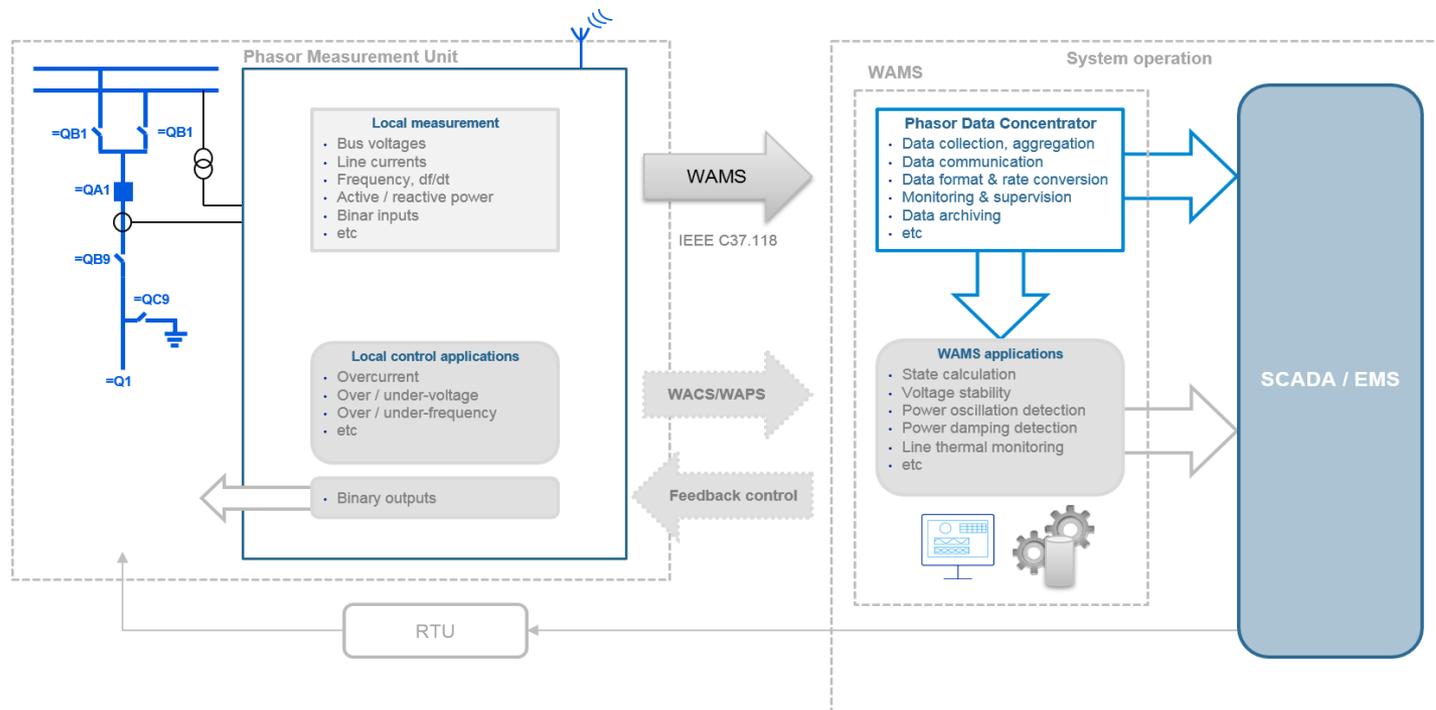
WAMPAC Adoption in a Control Room

Challenges vs SCADA (3)

- Operator adoption and acceptance of WAMPAC barrier that could be improved by:
 - Better understanding of existing system stress including system dynamics and the benefits that WAMPAC system could bring to manage the associated risk.
 - Increased operator training (Only 50% of respondents reported operators were trained on WAM system.)
 - More suitable visualisation with precise presentations of information, if possible customizable interface for different users.
 - Integration with EMS applications?

WAMPAC and SCADA Integration? (1)

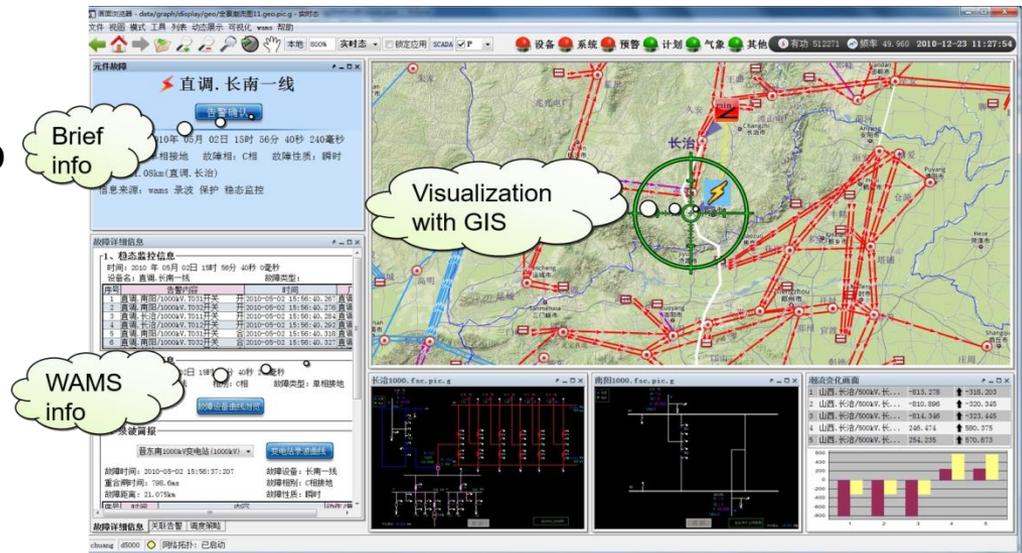
- Integration is not the correct approach:
 - the question of how SCADA and WAM systems can communicate should be reformulated to **what they can share with each other, which they already don't know.**



WAMPAC and SCADA Integration? (2)

Two approaches for stand-alone WAM systems working in parallel with the SCADA/EMS:

- Setup of links in standardized communication formats such as IEC 104, etc. between these two areas for simple exchange of information (**Topology, On line analysis**)
- Realisation of a complete embedded solution by complete integration of WAM system within the SCADA/EMS environment.
- Something in between (China):
 - Integrated Online Analysis and Alarming



WAMPAC in a Control Room as a Shadow - SIPS

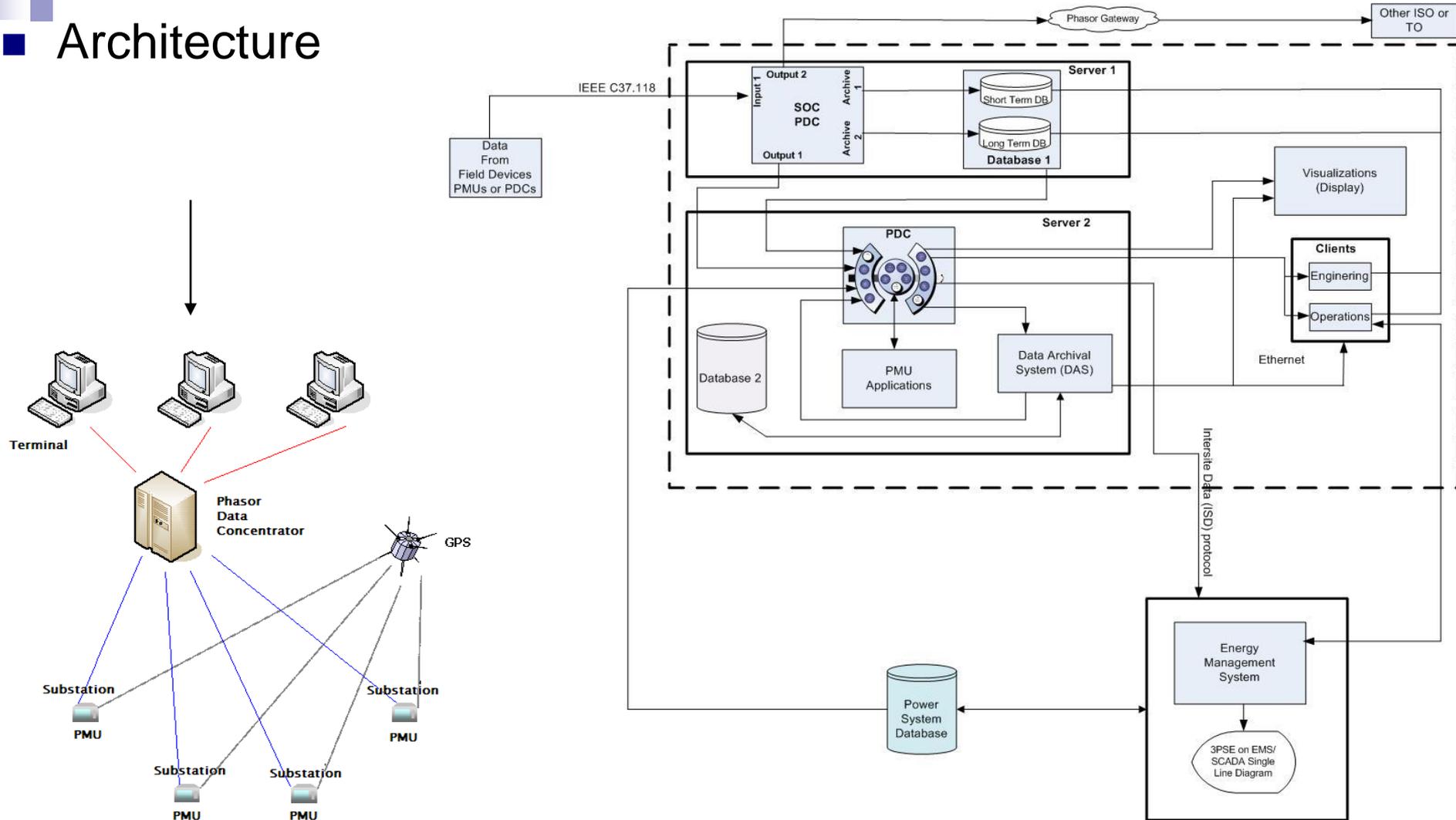
- In interconnections involving multiple (TSOs), share a relatively small number of phasor measurements throughout the interconnection.
- This would allow individual TSOs to apply the TSO's required systems and applications.
- A decentralized structure would enable many of the wide area applications
- Idea is – System Integrity Protection Scheme - SIPS

SIPS

- The SIPS is a specialized protection scheme differs to a great extent from the common protection, especially in its main intention
- It is designed for integrity protection, failure prevention and mitigation of disturbance consequences
- Based synchronized measurements of voltage and current phasors, obtained from the Phasor Measurement Units (PMUs).

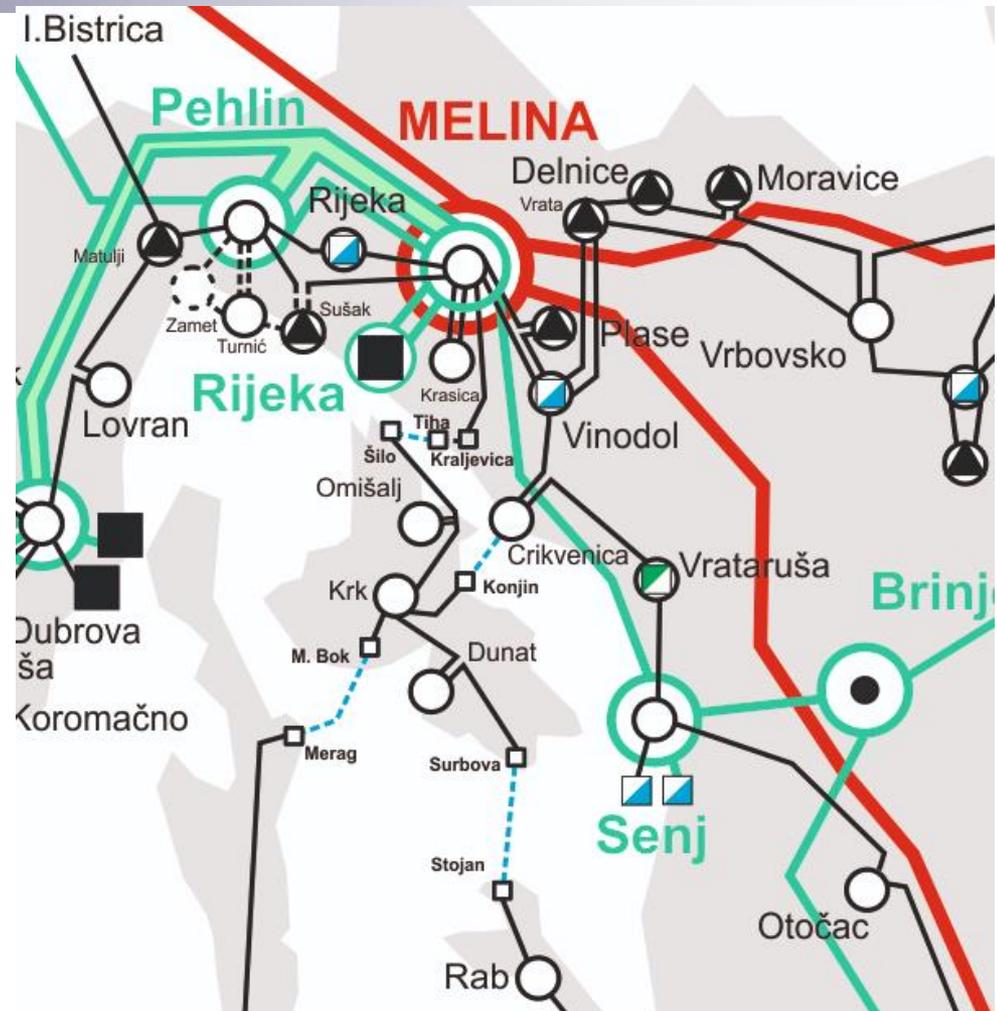
SIPS Architecture

Architecture



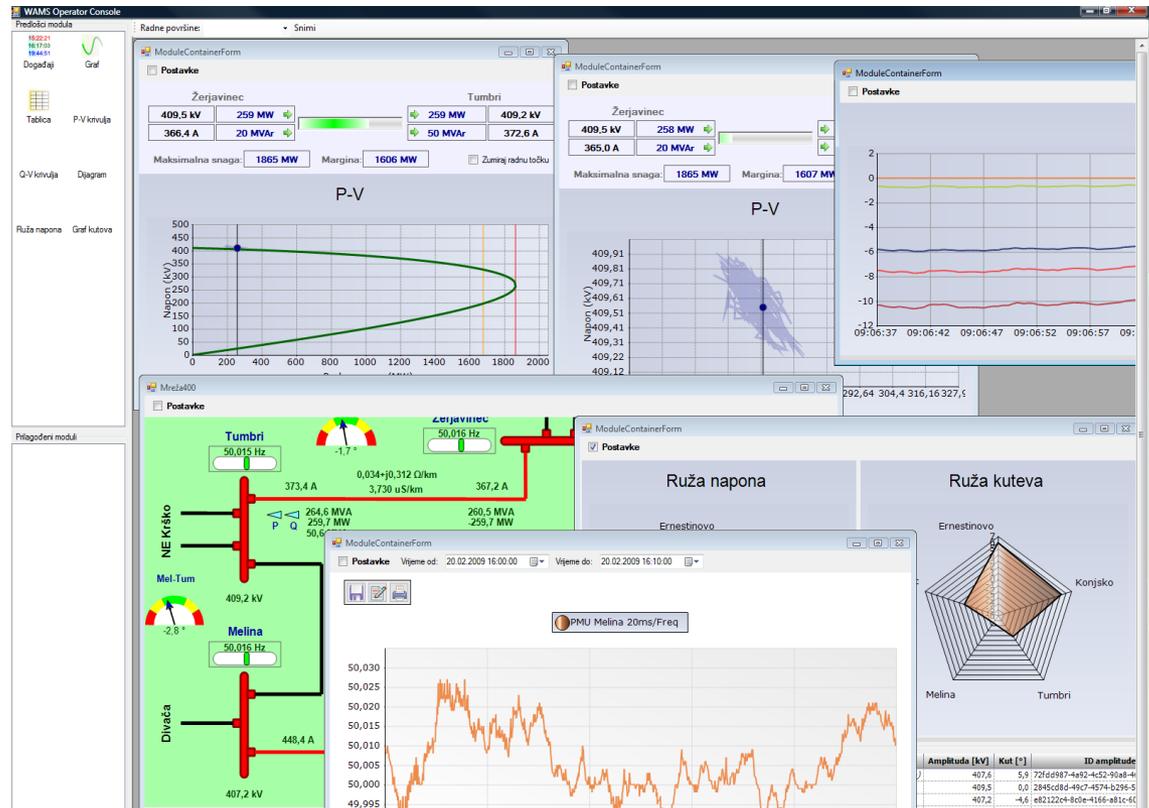
EXAMPLE OF SIPS APPLICATION (1)

- Thus, in one part of the year dominates thermal while in the second, a relatively shorter period, dominates hydro generation
- At the time of good hydrological conditions energy is mainly transporting from south to north of the Croatia.
- A WPP Vratarusa was built in this corridor that under suitable wind conditions can cause some instability in the system (e.g. overload of transmission lines).



EXAMPLE OF SIPS APPLICATION (2)

- Detect and manage possible congestions
- Detect the external emergency for which islanding will be formed
- Load shedding
- Detection and islanding



Conclusion

- SCADA technology arose in the late 1960s, and relies on non-synchronised RTU at rates of one to five seconds.
- SCADA/EMS usually evolves incrementally, building upon existing resources to address additional needs as they arise.
- Major barriers for integration of a WAM system for control rooms.
- Existing SCADA/EMS are often not suited for WAM system integration, as they don't have a high degree of interoperability and are not scalable and flexible enough.
- It should be highlighted that WAM systems **are not intended as a replacement** for SCADA/EMS
- In the long-term, WAM system could eventually become a wholly integrated component of SCADA/EMS.
- Necessary interaction and technology convergence between SCADA/EMS and WAM functionalities must be already considered in the development or tendering-process of future control room systems.

Future challenges

- Interoperability TSO – DSO
 - European Commission 2017/1485 (SO GL)
- Interoperability TSO – Generation Utility

- Synchronized measurements on distribution level
 - Communication
 - Distributed generation
 - Electromobility
 - Demand-response
 - Communication issues – how to connect all active parties
- 5G technology – new applications