

CLEEN

Cluster for Energy and Environment



sgem

Smart Grids and Energy Markets

Distribution Automation as an enabler for Smart Grids

Jani Valtari

CLEEN Annual Seminar, 12.6.2013

Background

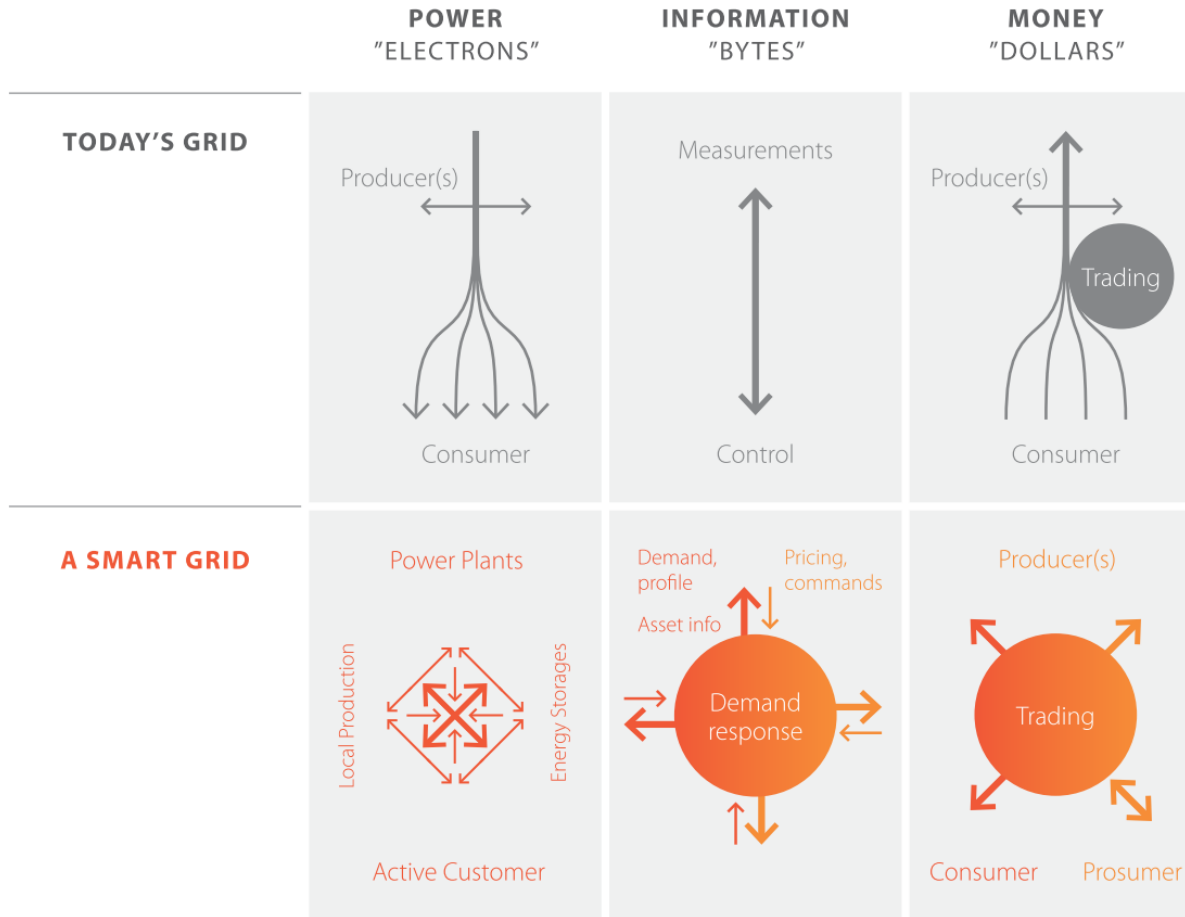
- Smart Grid is changing the way we do business
- “Fit and forget” or Smart Grids?
- Different levels in automation

SGEM Highlights from different automation levels

- Process: Low-cost fault indicator
- Substation: Self-healing rural networks
- Substation: Centralized protection & control
- Network: Self-Healing city networks
- Network: Network management utilizing Smart Metering
- Enterprise: DA Strategy for urban networks

Summary

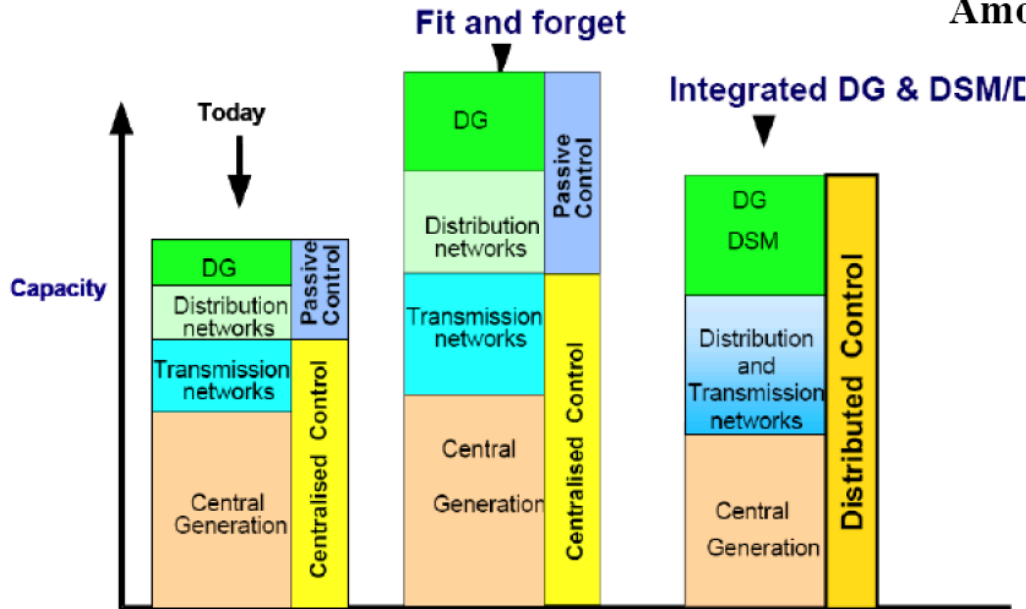
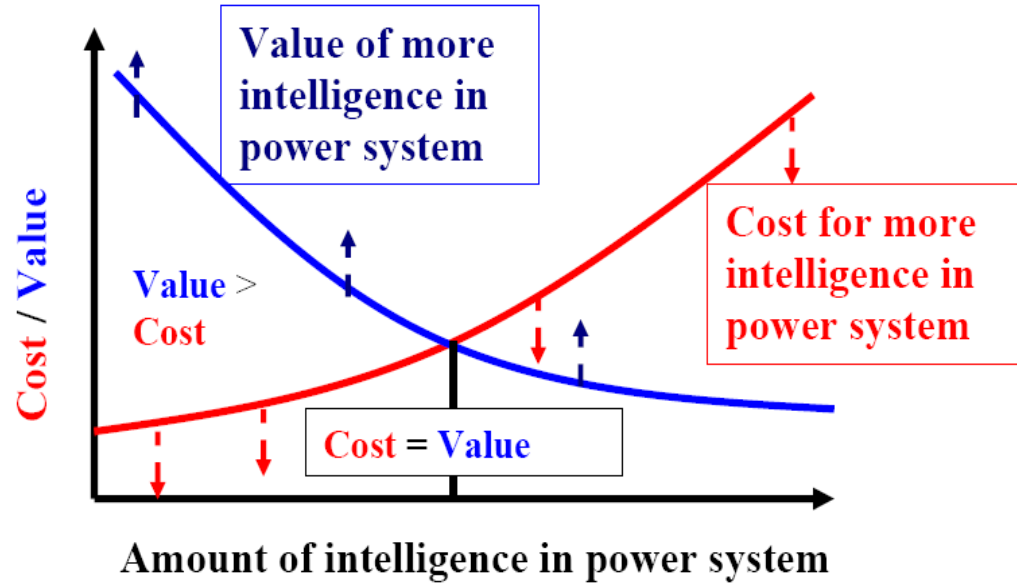
Smart Grids are **changing** the way we do business



- Distribution Automation has an important role in both main functions:
- **Enabler of energy-efficient and environmentally friendly energy market**
 - **Critical infrastructure of society**

"Fit and Forget" or Smart Grids?

- What is the economical optimum in a changing situation?



- Original visions from 2009 are still valid today
- Regulation has an important guiding role

Different levels of automation

Location

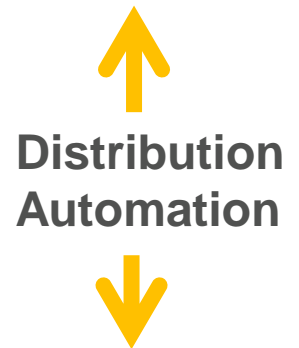
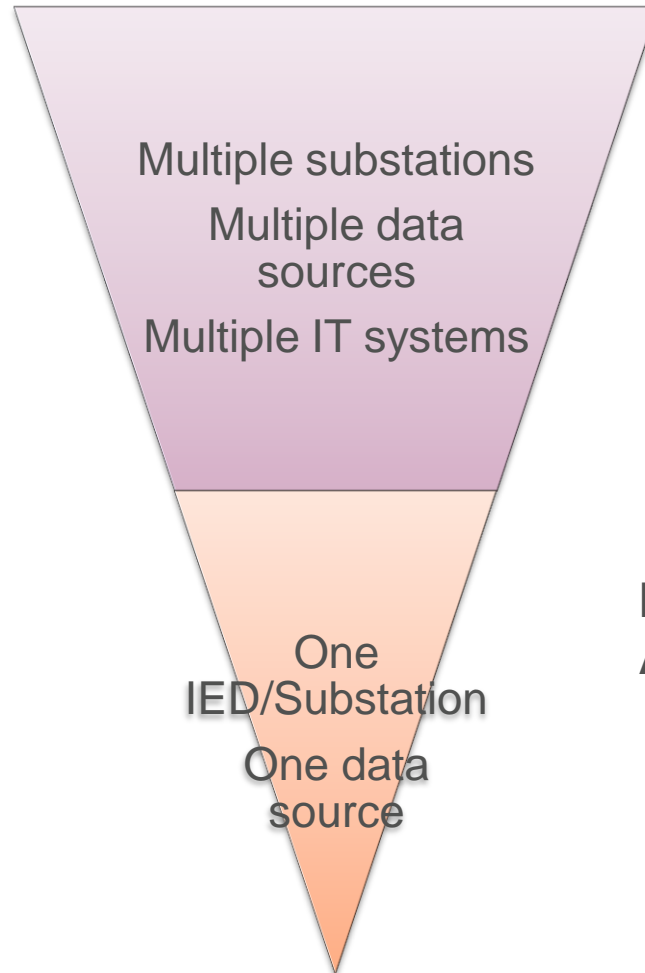
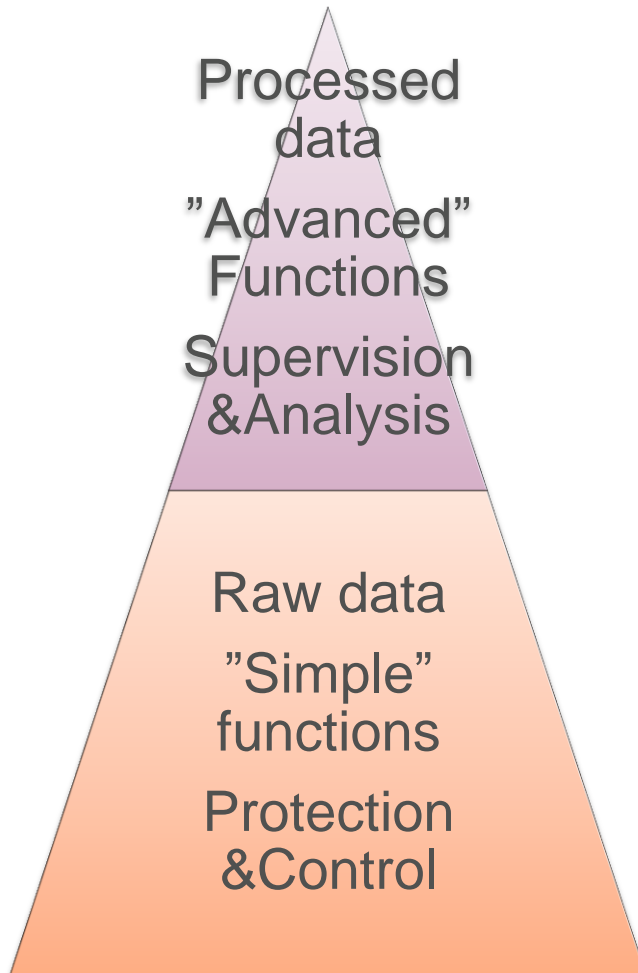
Enterprise

Network
Control
Center

Substation

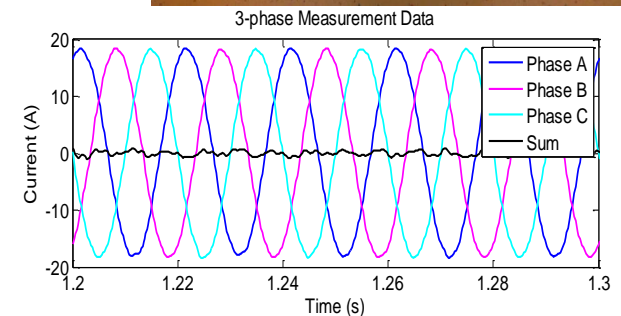
IED

Process



Developed and field tested in collaboration with VTT, MIKES and ABB

- Harvests power from line with a current clamp
- Coherent detector reveals direction of current
- 3-phase unbalance measurement possible
- Nonlinearity <3%, 0-85A
- Accuracy $\approx \pm 2\%$
- First field tests April 2012, new tests in compensated networks on 2013



Self-Healing rural networks

Proof of Concept demo in Kirkkonummi

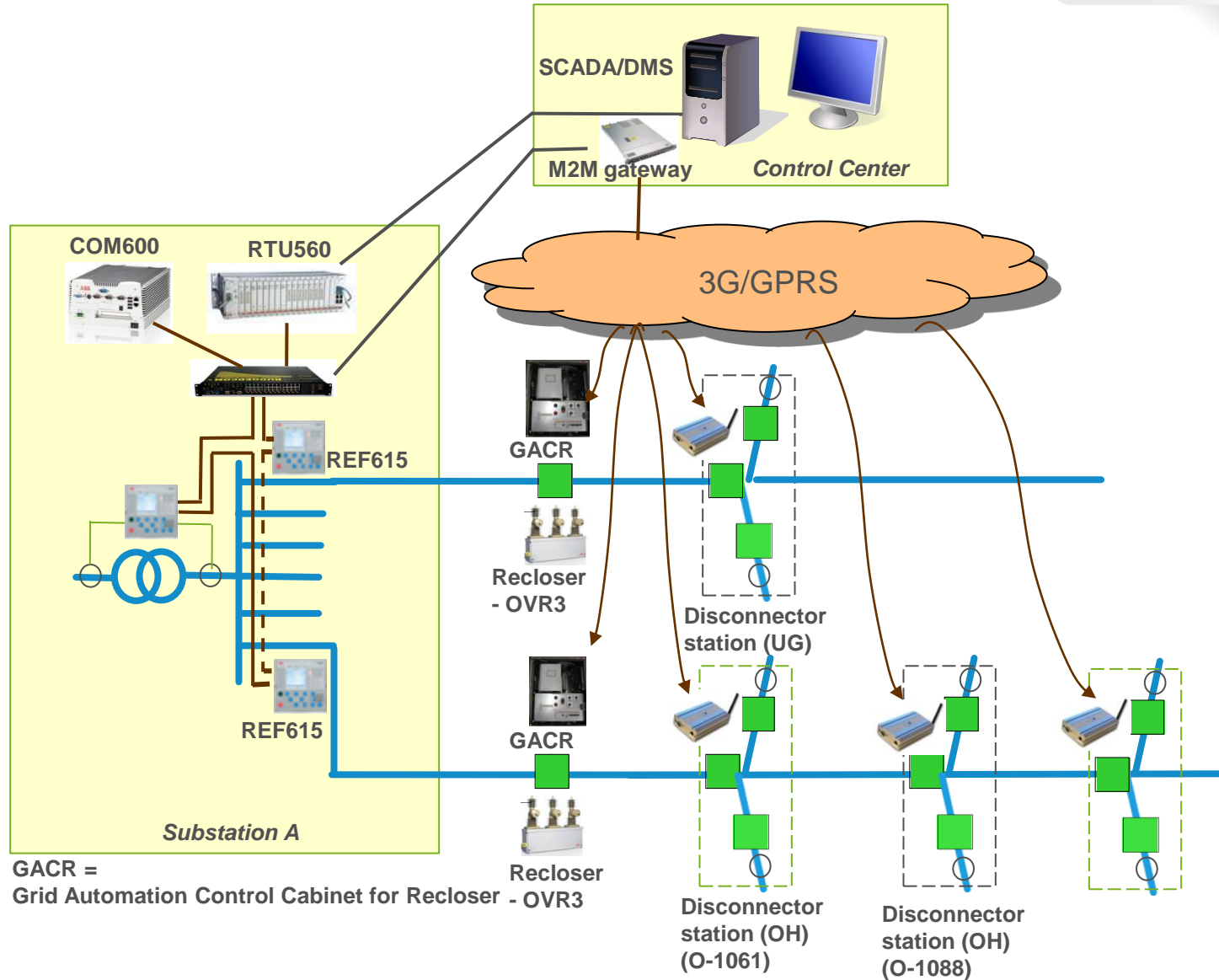
Field tests conducted week 16/2012

- Earth fault location with 1-2km accuracy (in some cases even few 10m accuracy)
- Located nearly 100% of faults
- Located also temporary faults

Continuation project for 2013

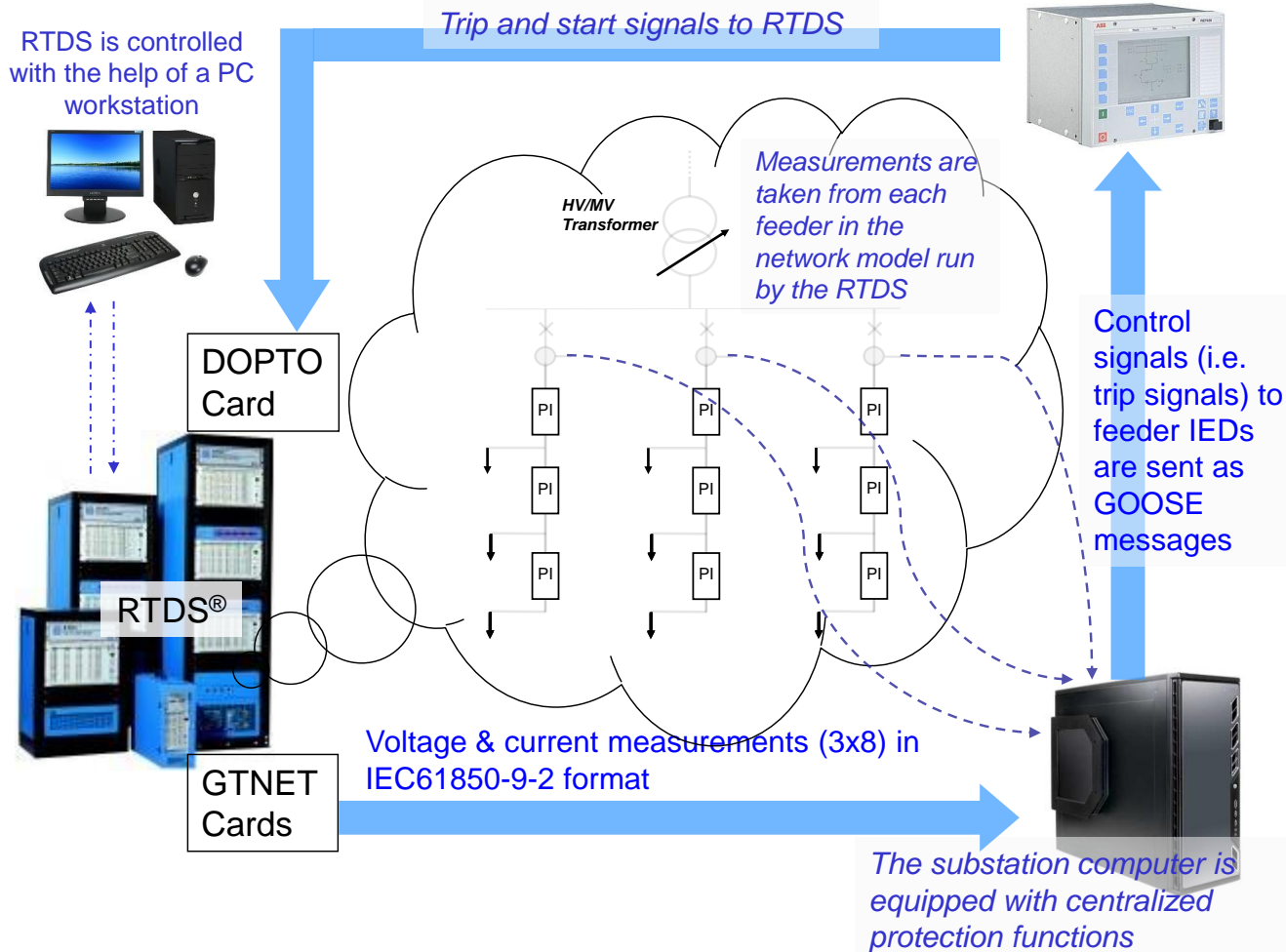
- New substation in compensated networks → new algorithms researched

(ABB, Fortum, VTT)

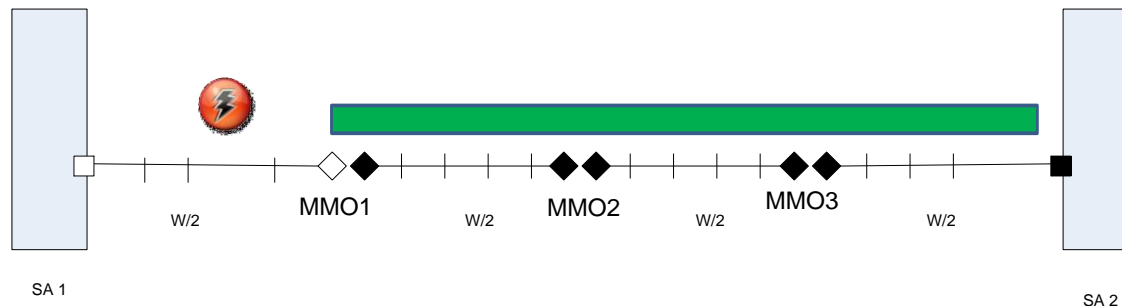


Centralized Protection & Control

Centralizing substation protection & control functionality from multiple bay level IEDs to one PC, tested in RTDS laboratory environment of TUT in collaboration with ABB

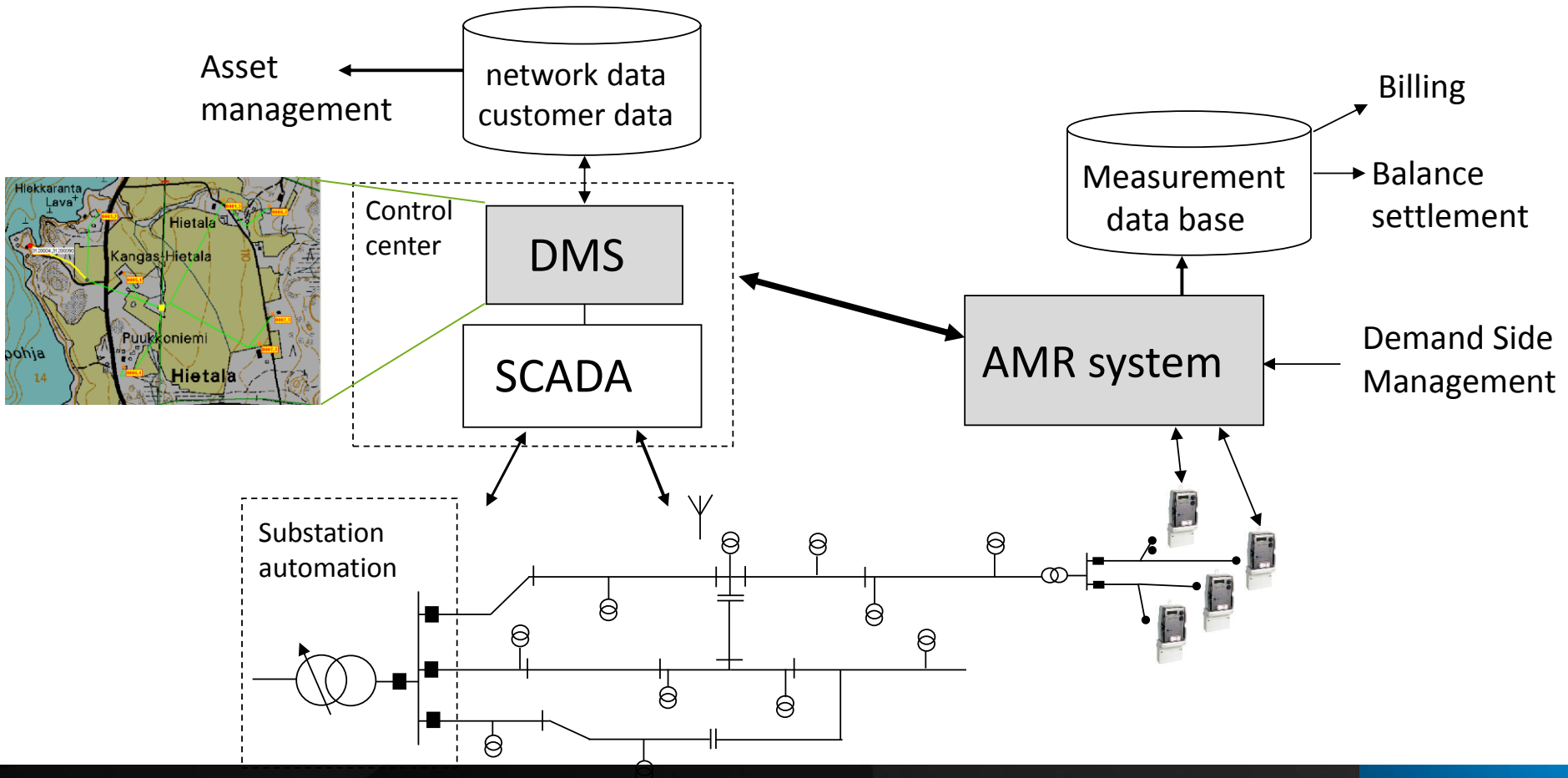


- Full automatic fault location, fault isolation and supply restoration for urban power distribution networks
- Based on reliable fault indicators, real time topology analysis of the network and automatic remote control of switches
- Core technology is the integration of SCADA, Network Information System and IED:s at the secondary substations, combined with a new generation of fault indicators.
- Participants: Helen Sähköverkko Oy, Tekla, ABB, Aalto University



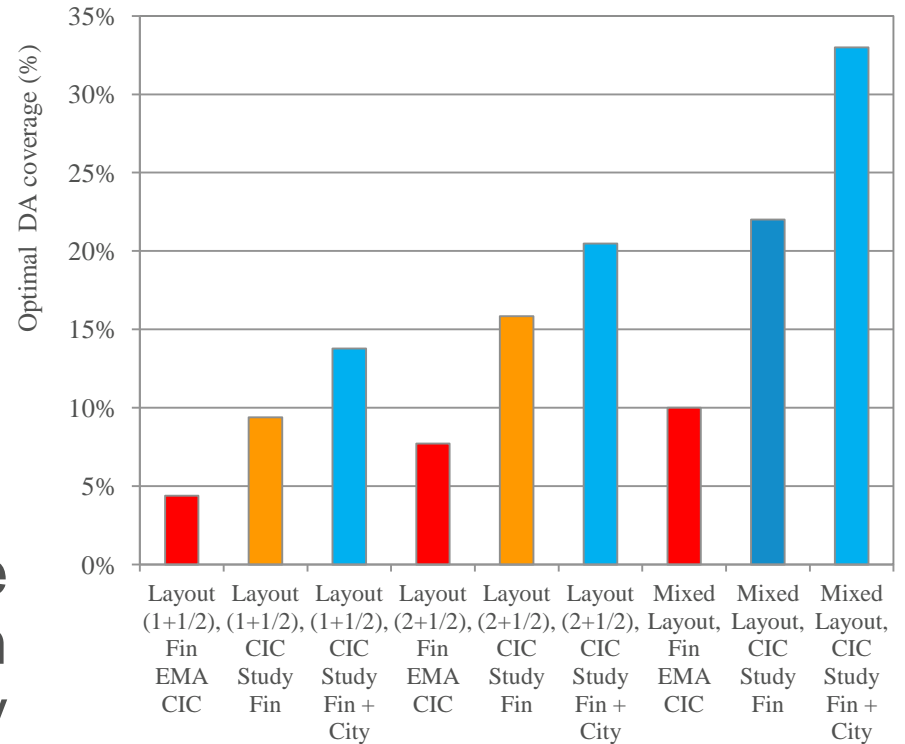
Network management using Smart Metering

AMI/AMR system can be used as an extension of SCADA and DMS for controlling and monitoring also fuse protected low voltage networks, already used by many utilities in Finland



Optimal Distribution Automation Coverage: utilities can target the investments so that the cost/benefit ratio is optimum and the decrease in customer interruption cost is the most significant.

The results demonstrate multiform Distribution Automation layout strategy for urban networks. Also the results in a real urban network are presented.



Partners: Helen and Aalto

Summary

- Distribution automation is an important enabler for Smart Grids
 - Efficient utilization of Smart Grid technologies is the cost-optimal solution
- Solutions require collaboration between many parties
 - ICT providers
 - Energy technology providers
 - Distribution System Operators
 - Energy retailers, service providers
 - Research: Technical, economical and political/regulatory
 - one organization cannot research this alone
- SHOK-programs and SGEM has provided a good ecosystem for researching and piloting the results
 - Common view already during 2009 has led to many results and pilots

