Fortum SGEM Program
Presentation of ongoing research activities

MV and LV Network Automation Solutions in EU

Benchmarking Research

sgem Smart Grids and Energy Markets

CLEEN Cluster for Energy and Environment

Fortum

Existing Distribution Grid

- Little change in the past few decades
  - Mostly radial
  - Mostly overhead lines
  - Mostly unidirectional power flows
  - Passive
  - Poor reliability
- Primary role?
  - Energy delivery to customers

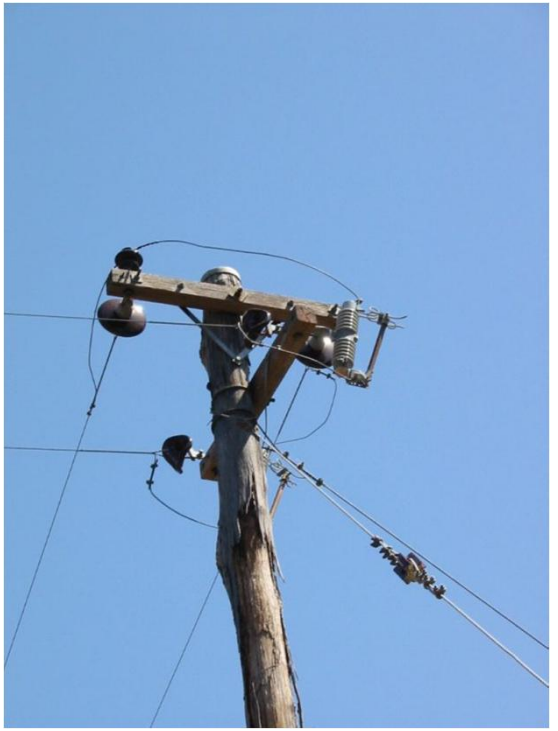


Figure 1: Typical Distribution Network Pole

Distribution Grid Today and Tomorrow

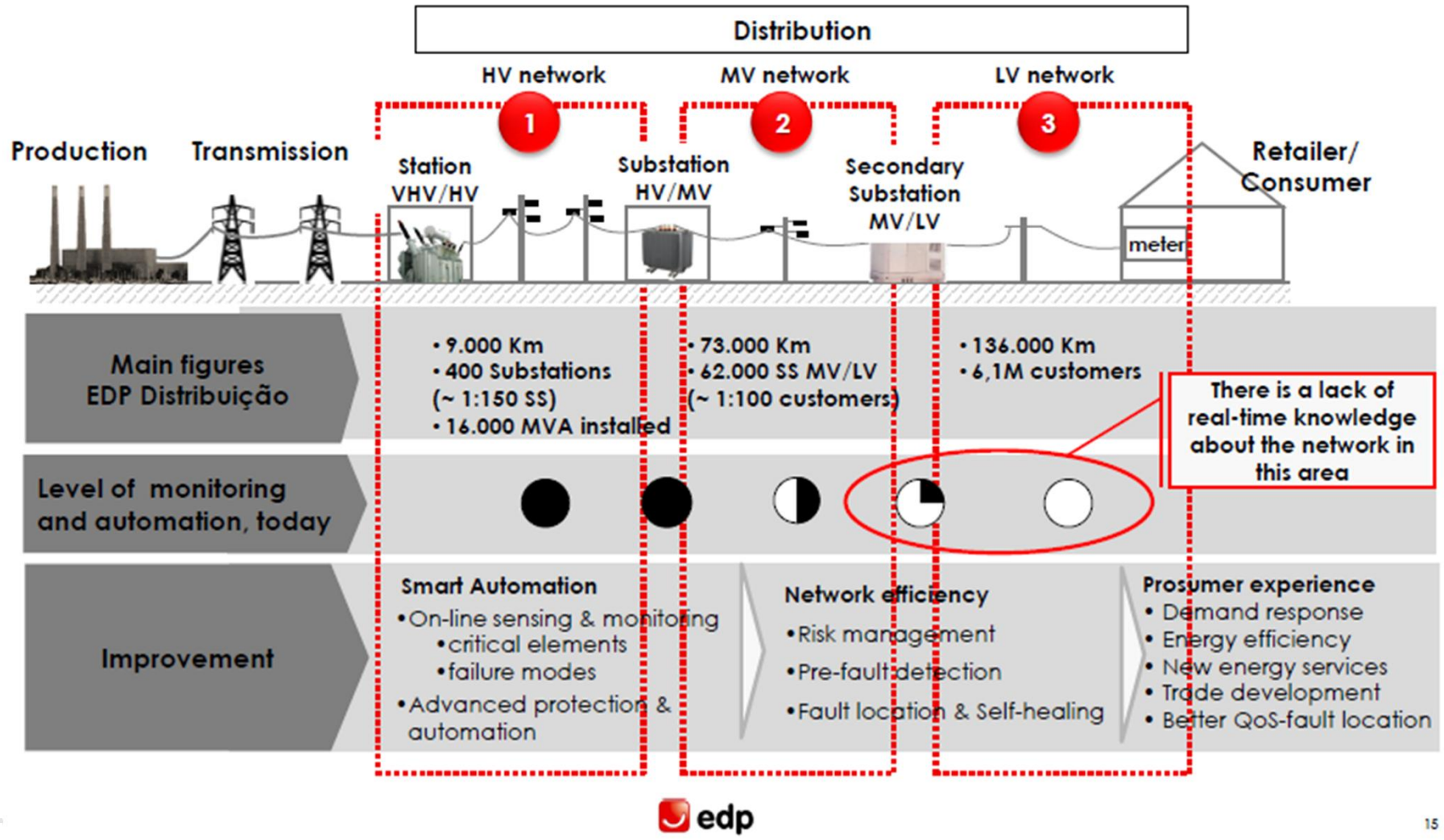
Present Grid

- Responds to disturbances to prevent further damage.
- Focuses on protection of assets following system faults.

Future Grid

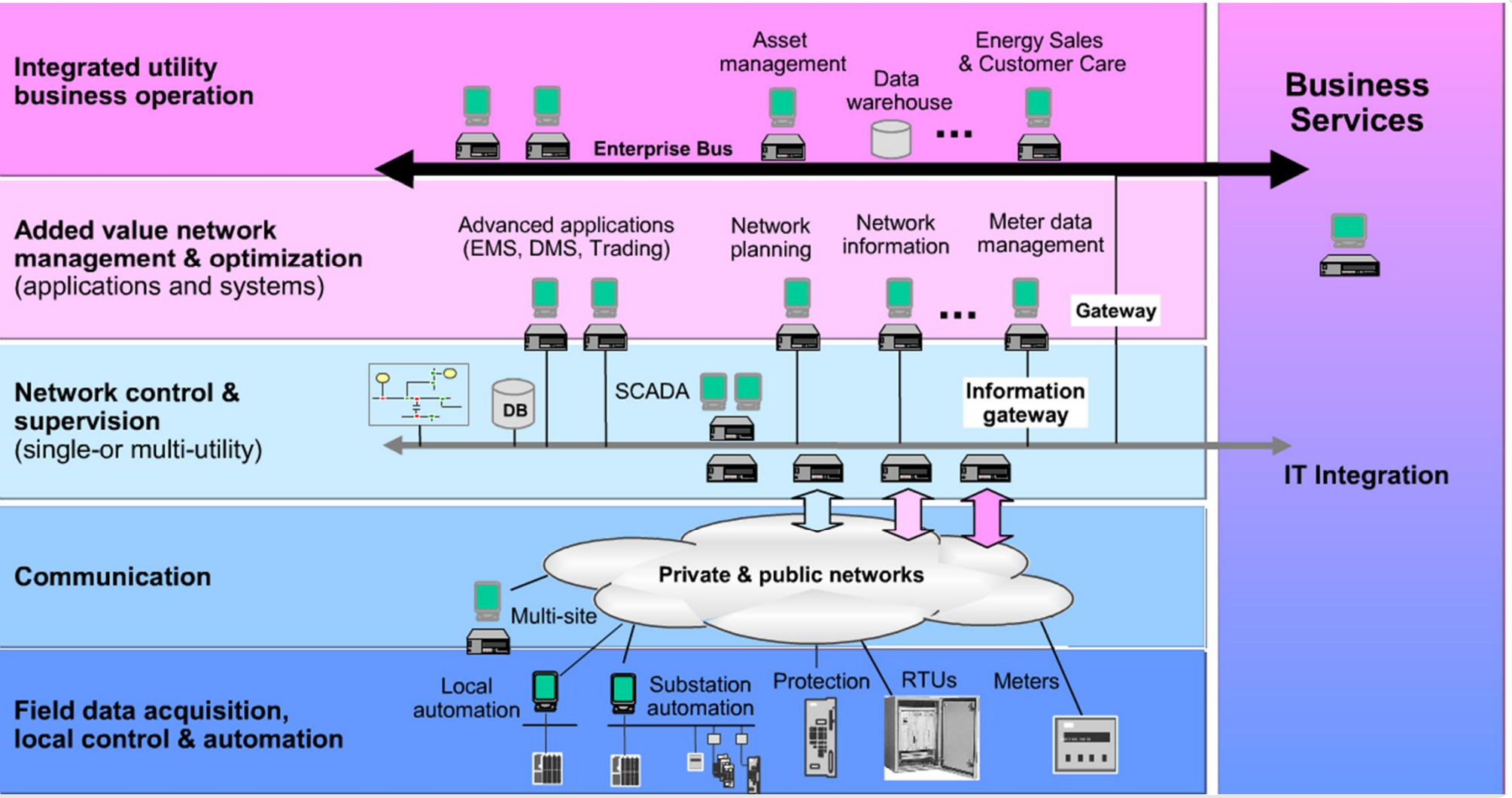
- Automatically detects and responds to emerging distribution problems in the real-time.
- Focuses on prevention of disturbance. Minimizes the amount of customers affected (consumer impact).

There is a considerable degree of visibility and control over the High and Medium Voltage networks but less over the Low Voltage network



What Can Be Done to Existing Distribution Grid?

Network Automation Vision



Stage 1: First Steps

Evaluation and Recognition of MV/LV Network Automation Solutions:

- Relay Protection and IEDs;
- Feeder Automation;
- Switchgear;
- ICT;
- SCADA Systems;
- Low Voltage Automation;
- Self-Healing Networks.

MV AND LV NETWORK AUTOMATION SOLUTIONS OVERVIEW

- Relay Protection and IEDs
- Feeder Automation
- Remote-Controlled Disconnectors
- Automatic Reclosers
- Sectionalizers
- Circuit Breakers
- Fault Indicators
- Sensors
- Automatic Source Transfer
- Fault Localization, Isolation and Restoration
- AMM
- ICT
- DMS and SCADA Systems
- Low Voltage Automation Solutions
- Self-Healing Networks

Figure 2: Clip-on Sensor [source: Cooper Power Systems]

Stage 2: Network Automation Solutions in EU

The following countries are planned to be evaluated and benchmarked:

1. Finland
2. Sweden
3. UK
4. Italy
5. Germany
6. Spain*

* Spain did not make it to the final report.

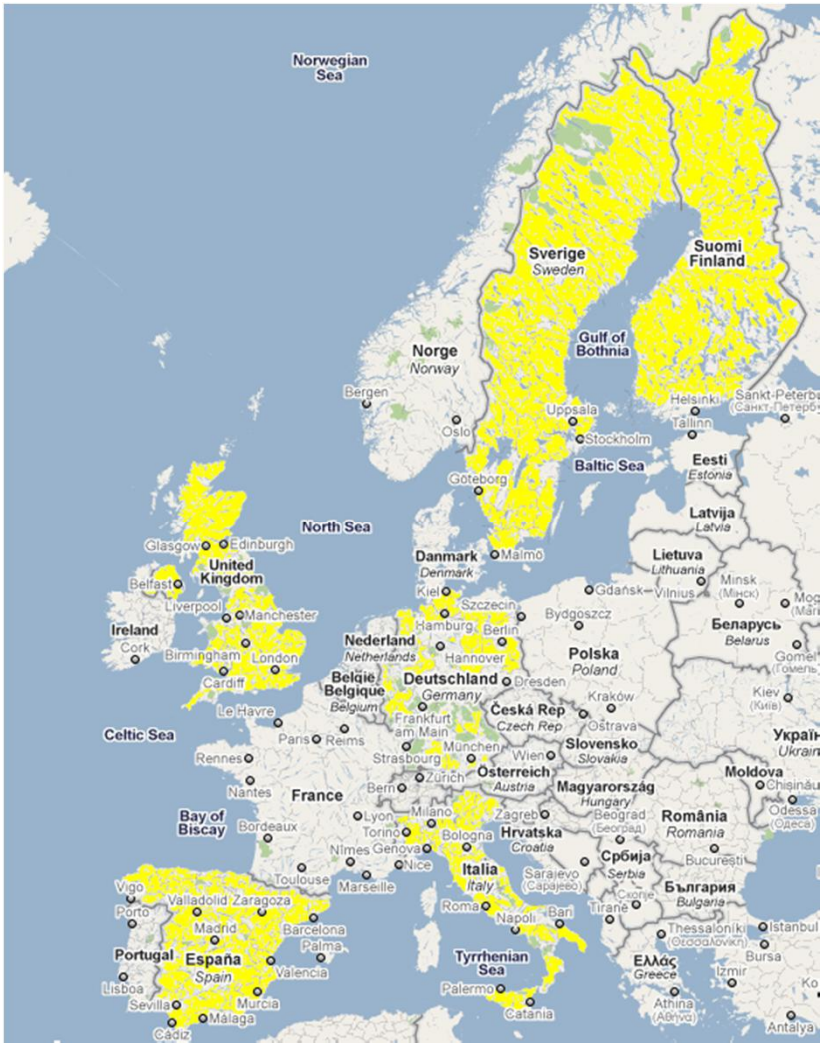


Figure 3: Countries proposed for the benchmark [Google Maps]

Stage 3: Future Concepts of Self-Healing Networks

Identification of the following aspects of Self-Healing Networks:

- Key technologies
- Strengths and weaknesses
- Opportunities
- Security threats
- Economic factors

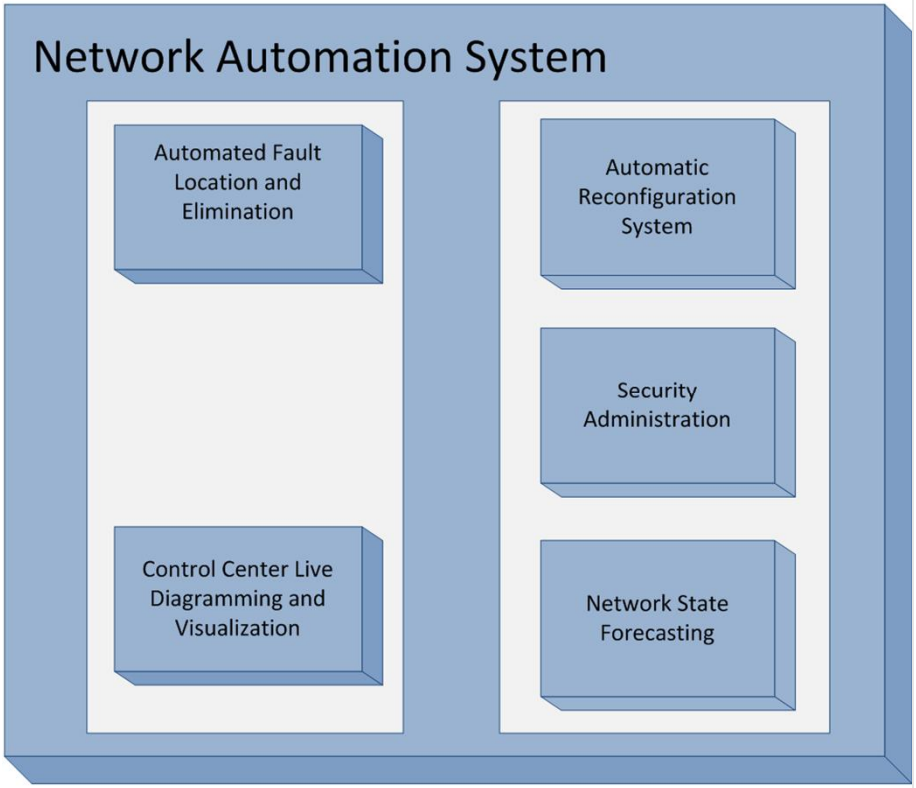


Figure 4: Future Components of Network Automation

Stage 4: Conclusions

- Conclusions about network automation state in Europe in general
- Conclusions of feasibility of self-healing networks
- Comparison of automation levels in reviewed countries

So What is a Self-Healing Network?

Self-Healing Network Definition

- A system that utilizes real-time information gathered from multiple sensors and IEDs along with control and communication technologies to deal with unforeseen disturbances and minimize the affected area.

- Intelligent Smart Grid comprising an autonomous digital system capable of identifying surges, downed lines, and outages; resilient, providing instantaneous damage control; flexible, capable of accommodating new off-grid alternative energy sources; reliable, providing dynamic load balancing; and secure, minimizing vulnerability to any types of attacks.

Capabilities of Self-Healing Smart Grid

- Anticipation of disruptive events
- Look-ahead simulation capability
- Fast isolation and sectionalization
- Adaptive islanding
- Restoration

Resilience

– the capability of a network to recover itself and re-shape itself after interruptions and disturbances;

Robustness

– A system is 'robust' if it is capable of coping well with predictable and unpredictable internal and external variations in its operating environment with minimal damage, alteration or loss of functionality.