On Multi-Energy Networks and Challenges of Integration of Massive Quantity of Data

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Presentation Outline

Data Analytics Research Area

- General Observations

- Specific Questions

- Methodology

- Specific "urgent" research questions

- Examples

- **PANEL**

Data Analytics Research Area
General Observations

- The volume of data received from different types of sensors is increasing

- A need for understanding the entire measuring chain , sources of uncertainties, risks, opportunities

- Data traffic management and supercomputing resources

- Secure data acquisition, handling and knowledge extraction

- How to improve e.g. system planning and operation, ancillary services, integration of smart transmission and distribution applications, asset management etc.?

- How to optimize the system operation?

- Who should be involved to ensure success?

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Data Analytics Research Area

Specific Questions

- To identify sources of data needed for the Whole Systems assessment

- To understand performance of sensors, communication infrastructure, data acquisition platforms, as well as the quality of data received

- To identify optimal sampling frequencies for data acquisition and to understand stochastic properties of data

- To explore optimal approaches for data integration into future platform(s) for data acquisition and concentration (future data concentrators, which can also be designed as clouds);

- Assessment of a need for the "supercomputer power" capable of processing massive data streams in tera, peta, or even exa size

Data Analytics Research Area

Specific Questions

- What is the optimal architecture for future data acquisition systems, respecting cyber security and a need for redundancy? Costs and risks?

- What are approaches for knowledge extraction from big data, appropriate for the Whole Systems assessment

- What are requirements from the next generation of super-computers needed for efficient real-time data processing? Data-flow machines?

- What are limitation and capabilities of future high speed Internet communication links (e.g. "Internet 2")

- How to cope with a large number of different communication protocols and media?

- 5G?

Data Analytics Research Area
Specific Questions

- To explore which applications relevant for an optimal utilization of future energy systems will be developed. Some examples:

  - Forecasting

  - Planning and Operation

  - Condition monitoring

  - Asset management

  - Dynamic rating

  - Data driven modelling?

- Data sources from an Integrated Energy Systems. Examples:

  - Smart meters, Phasor measurement units,

  - Meteorological data,

  - data from Gas and Heat Networks

Data Analytics Research Area
Specific Questions

- Development of Smart-Grid Applications based on Big Data through integration of EMS and DMS, supporting forecasting, monitoring, visualisation, decision supporting, control, protection…

- Design of test platforms for demonstration of "Data Analytics" related solutions. Examples:

  – Hardware in the Loop (HiL) testing

  – Support using time synchronisation sources (e.g. GPS, Galileo, or Glonas) and time-servers

  – Testing of communication links (latency and bandwidth)

  – Platforms for real-time data processing and different types of applications

- How to utilize The Internet of Things paradigm? What are the opportunities and applications today?

Data Analytics Research Area
Methodology

- Co-ordination of "Data Analytics" related research with the multi-energy networks related research, targeting opportunities for collaboration and synergy

- Co-ordination of the "Data Analytics" related research within the multi-energy networks topic with the research in other fields

- Strong involvement of industry

- Identification of other stakeholders which could contribute to future outcomes (e.g. those who have been involved in Data Analytics related research, but in other businesses, e.g. banking, trade etc.)
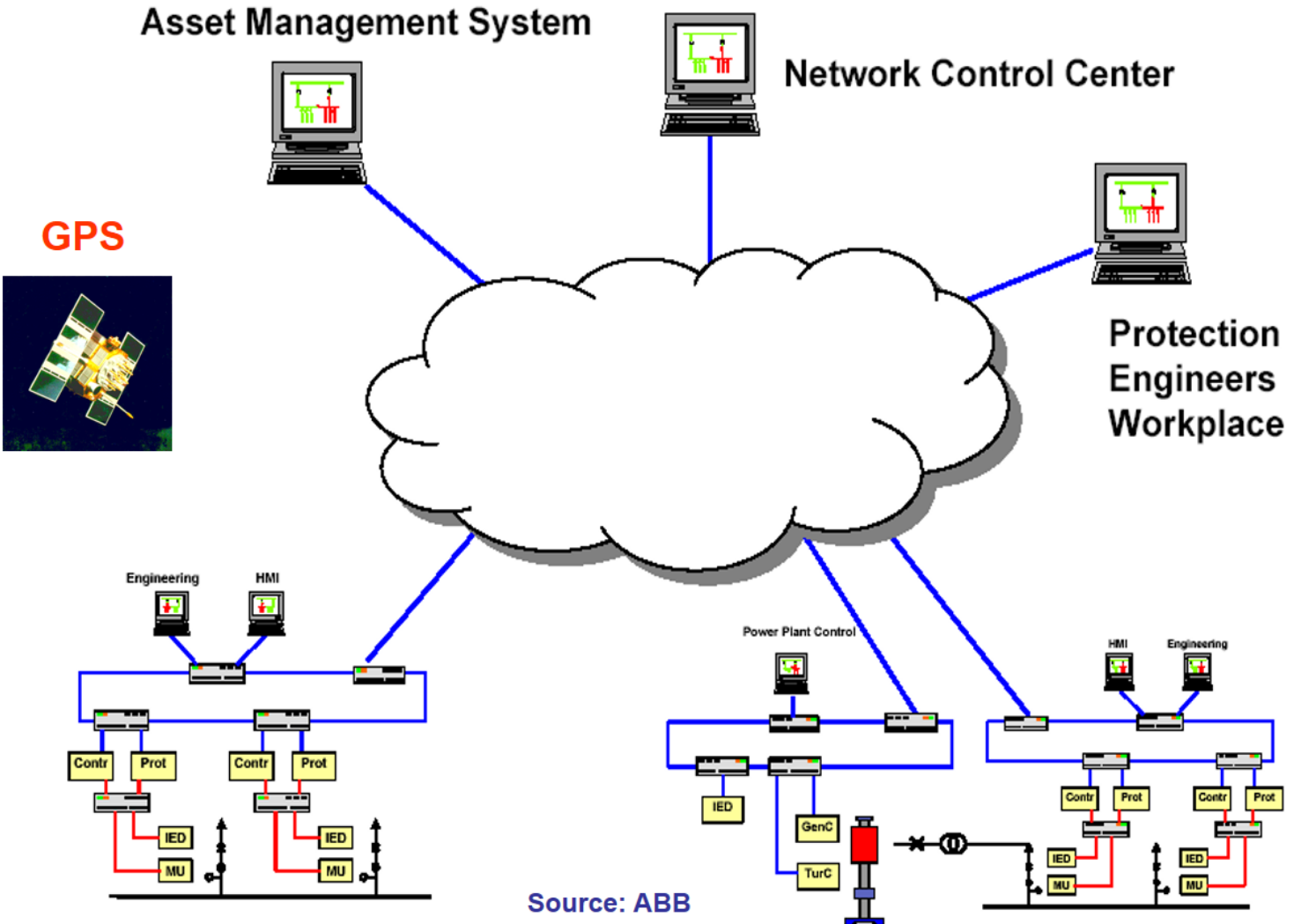
Data Analytics Research Area

Specific "Urgent" Research Questions

- Integration of different types of big data sources into a single platform

- Extraction of knowledge from tera, peta, even exa data streams in real-time, using high performance data-flow and supercomputer based platforms

- Creation of applications which will ensure optimal utilisation of future energy systems, contributing to planning, operation, forecasting and economical energy production, transmission and consumption

- Demonstration of new solutions using Hardware in the Loop (e.g. Real-Time Digital Simulator - RTDS) laboratory testing facilities

- Targeting higher TRL solutions, having robust character and power to be quickly implemented.

Example 1

WAMPAC System

Asset Management System

Network Control Center

GPS

Protection Engineers Workplace

Engineering HMI

Contr Prot   Contr Prot

IED   IED

MU   MU

Power Plant Control

IED

GenC

TurC

HMI Engineering

Contr Prot   Contr Prot
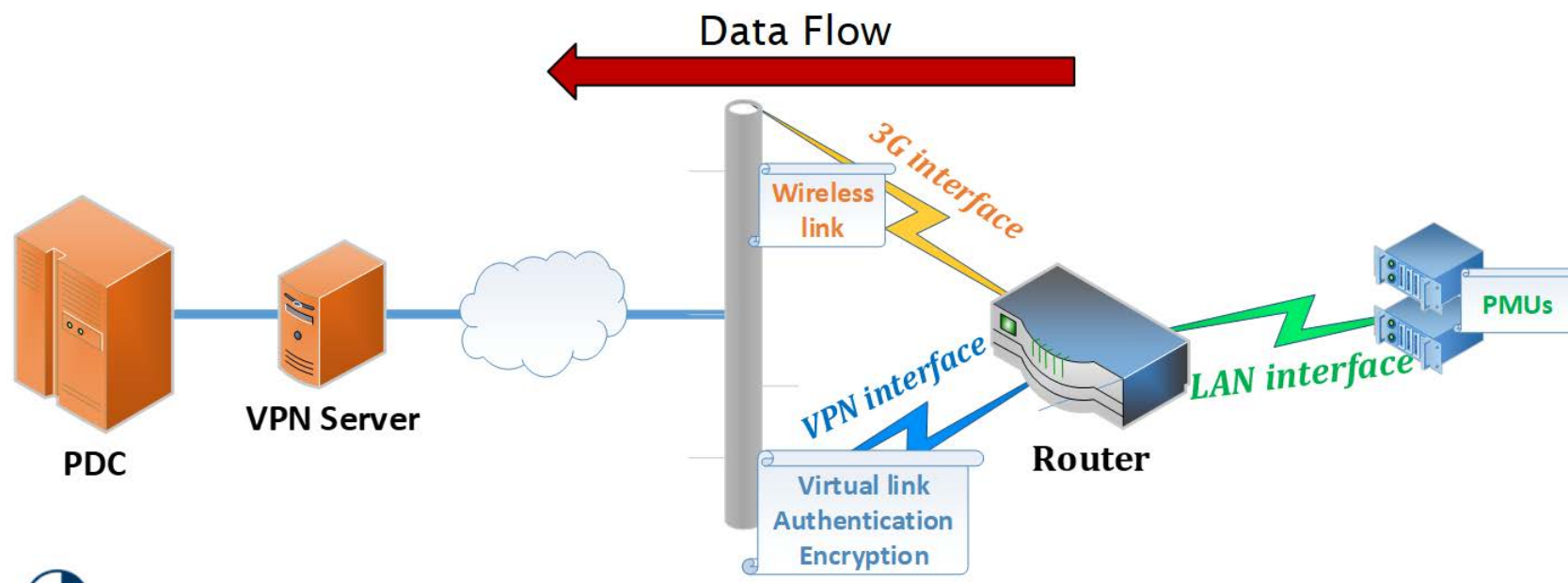
IED   IED

MU   MU

Source: ABB

Example 2

Cyber security aspects

The whole infrastructure has to be designed for enhanced security:

- Authentication
- Encryption
- Strict firewall rules

Multi-Energy Networks; ICT, Big Data - PANEL

- Do we understand the sources of data?

- Do we understand communication protocols?

- Do we understand the ICT limitations?

- Which data analytics approaches?

- Other open questions?

The 3rd International Symposium on Smart Grid – Mehtods, Tools, and Technologies

Jinan, Shandong, CHINA

Sep. 16-19, 2019

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