CINELDI

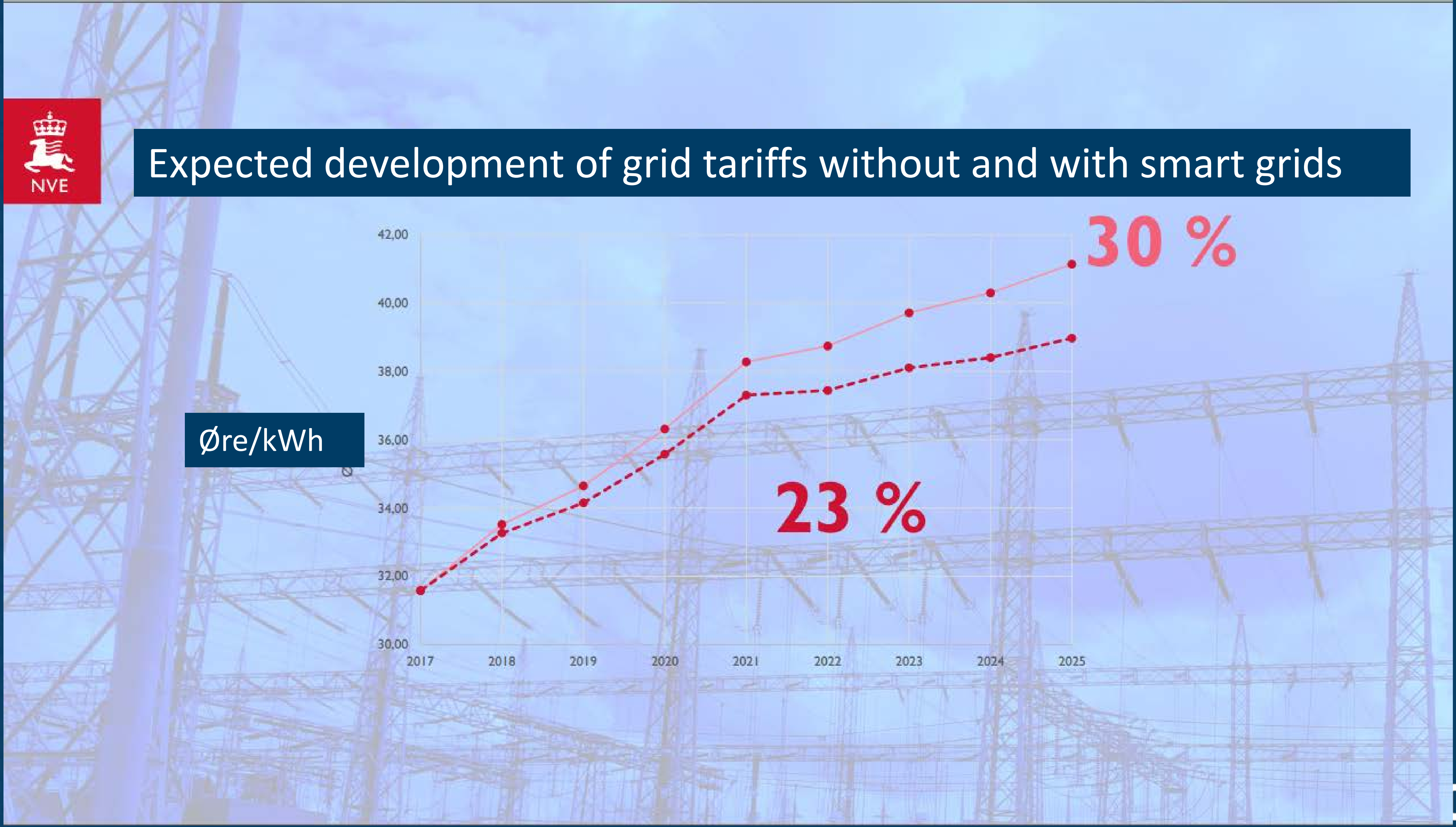
Centre for intelligent electricity distribution
- to empower the future Smart Grid

Flexibility and smart grid communication from the CINELDI perspective

The CINELDI Conference 2019

Kjell Sand, NTNU

Regulators perspective – cost reduction



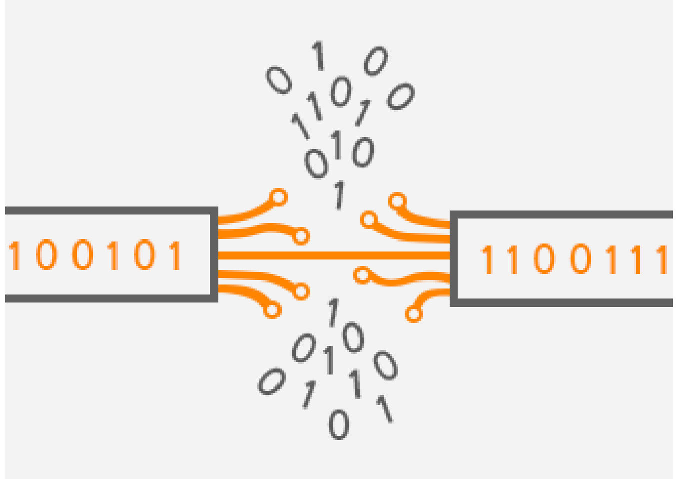
Flexibility (controllable)

- Modification of injection and/or extraction of electrical power, on an individual or aggregated level, in reaction to an external signal in order to provide a service within the energy system (IEC 62913 -2-1 Draft)

- Capacity to change electricity consumption, generation or storage for improved power system performance and network user benefits (KS)

Smart grid communication and cyber security

- Communication- information transfer according to agreed conventions (IEC)
- Data communication - a form of telecommunication intended for the transfer of information between data processing equipment (IEC)
- ISO/IEC 27032 defines Cybersecurity as the "preservation of **confidentiality, integrity** and **availability** of information in the Cyberspace"
- Cyberspace: the complex environment resulting from the interaction of people, software and services on the Internet



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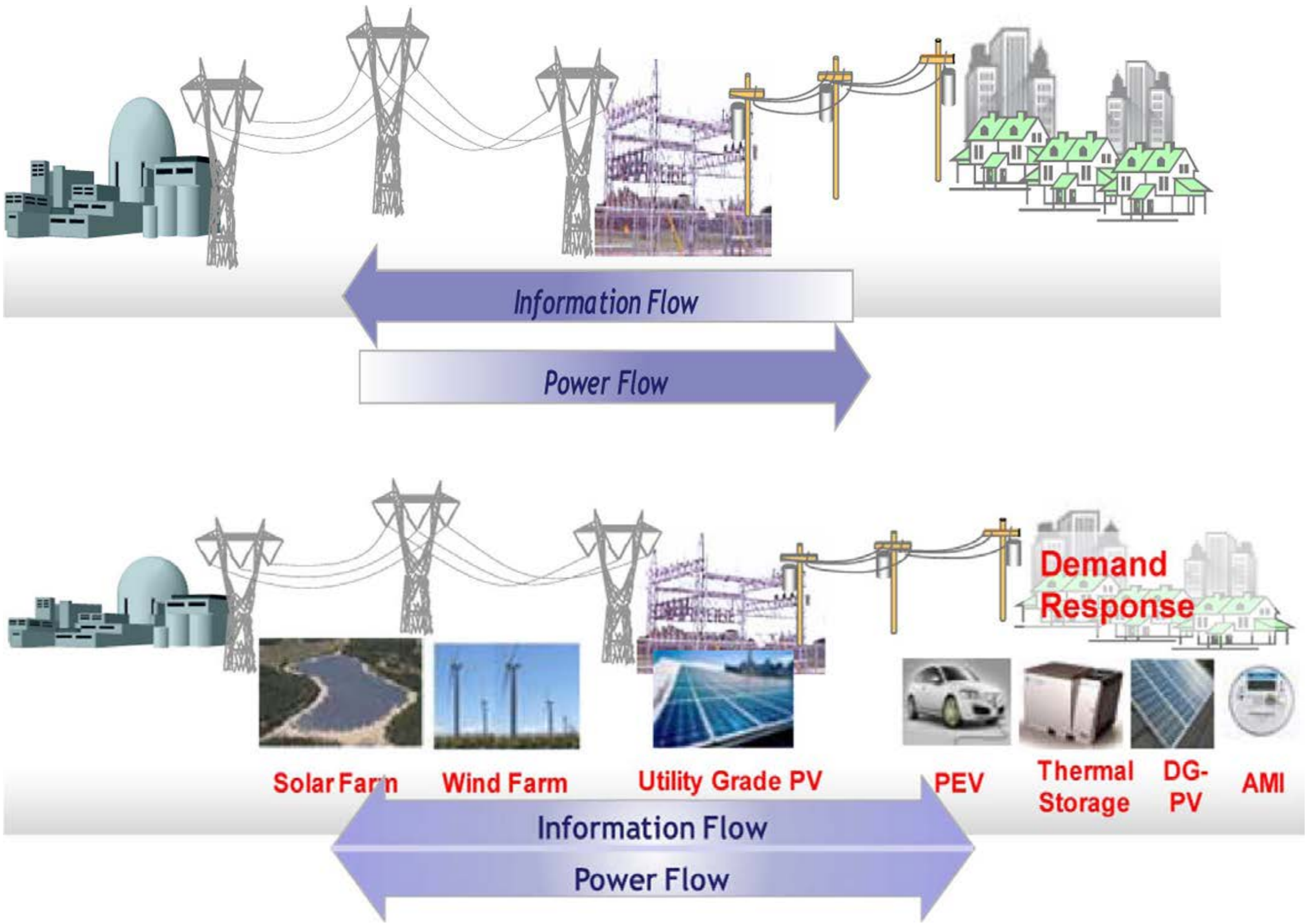
NIST

- The Smart Grid can be defined as an electric system that uses information, **two-way, cyber-secure communication technologies**, and **computational intelligence** in an integrated fashion across the entire spectrum of the energy system from the generation to the end points of consumption.

- The availability of new technologies such as distributed sensors, **two-way secure communications**, advanced software for data management, and intelligent and autonomous controllers have opened up new opportunities for changing the energy system.

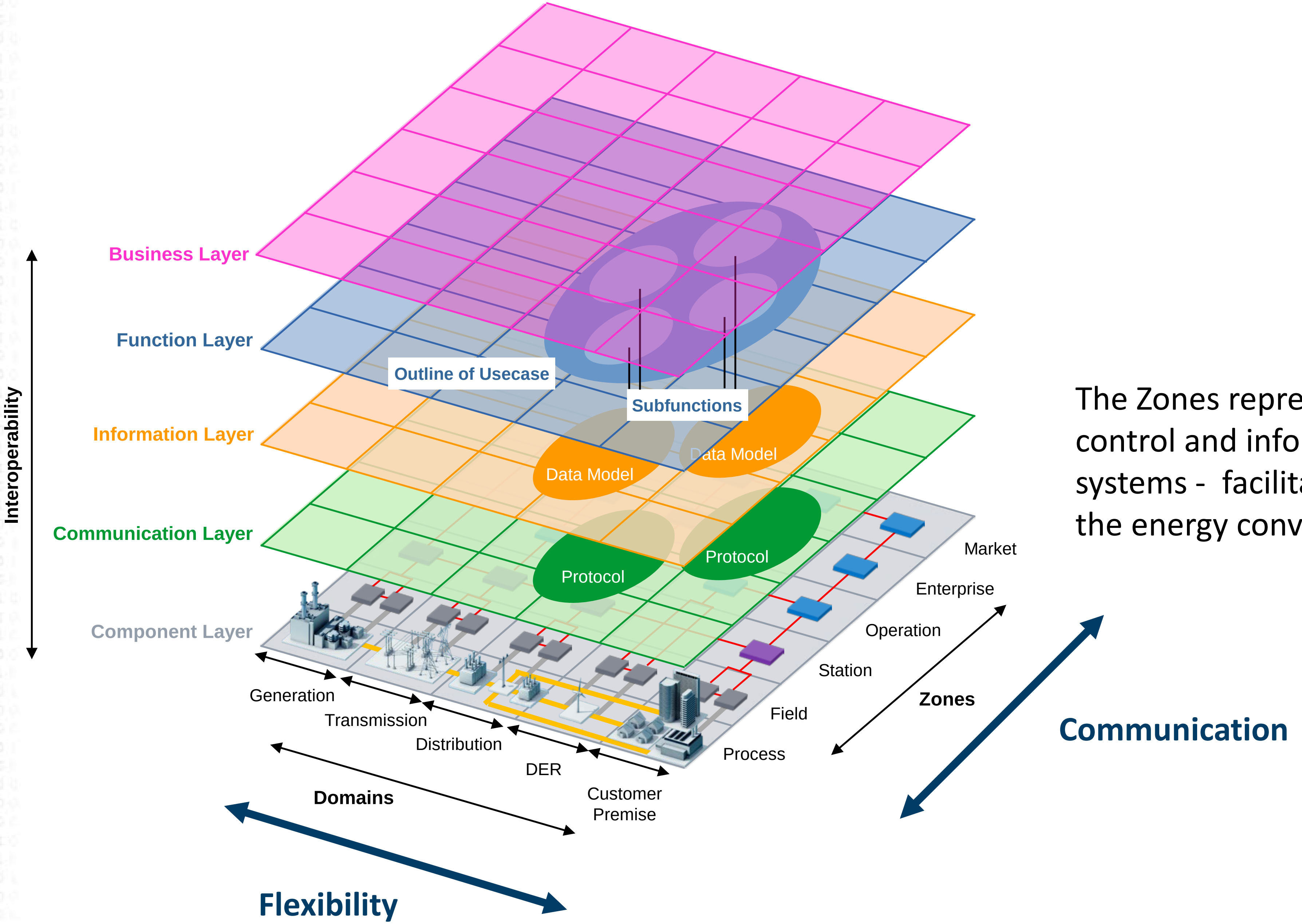
A smart grid where everybody interacts with everybody, will offer new opportunities and challenges. It will be a complex system of systems



Before

After

SGAM -Smart Grid Architecture Model



The Zones represent the ICT based control and information exchange systems - facilitating and controlling the energy conversion chain.

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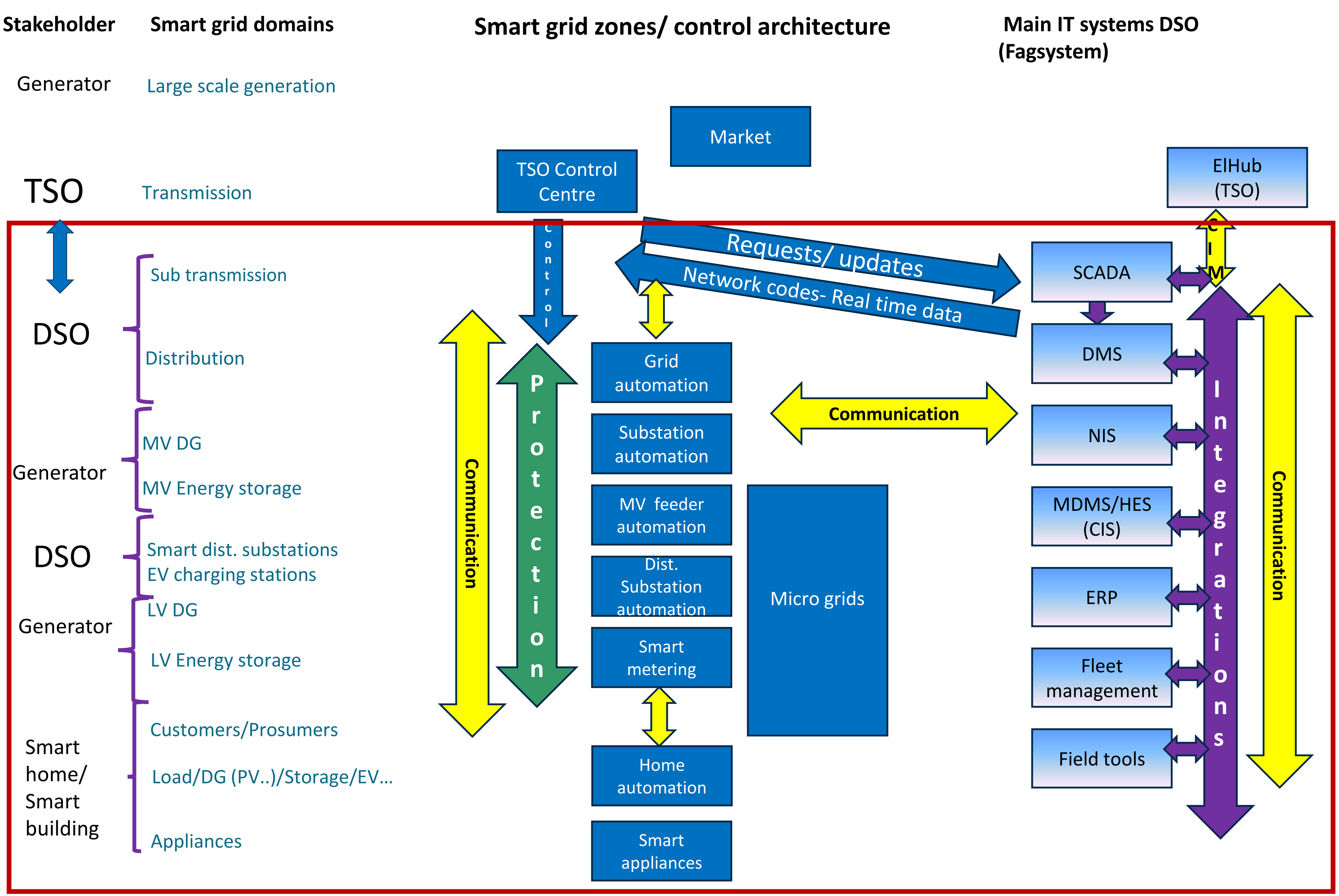
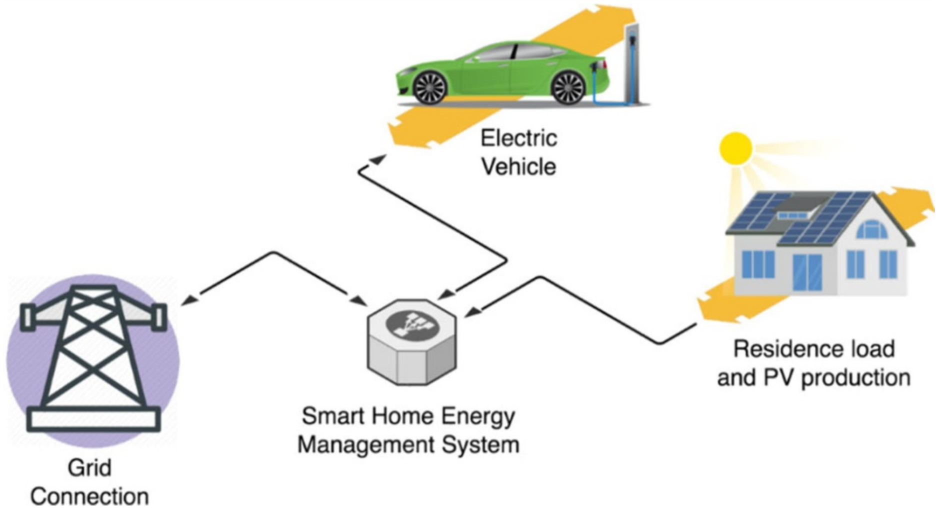


CINELDI architecture

Flexibility - from milliseconds to years

- **Flexibility for CAPEX savings**
- **Flexibility for OPEX savings**
- **Flexibility for Power system stability:**
  - Flexibility for operational margins (N-1 etc.)
  - Flexibility for frequency
  - Flexibility for reserves
  - **Flexibility for DSO-TSO interaction**
  - **Flexibility for balancing services/markets**
  - **Flexibility for black out avoidance**
- **Flexibility for Transfer Capacity**
- Flexibility for Energy
- **Flexibility for Voltage**
- **Flexibility for market operators**
- **Flexibility for customer benefits/savings**



Electric vehicles can provide flexibility for the grid and the end-user (From the MSc thesis by S. Bjarghov, 2017, Dept. of Electric Power Engineering, NTNU)

Challenge: Multiple flexibility products and services utilizing same flexibility assets

- Coordination and prioritization becomes complex.
- Flexibility monitoring and state estimation - an important element for thrust (and depending on secure communications)
- Market arrangements and regulatory rules are essential

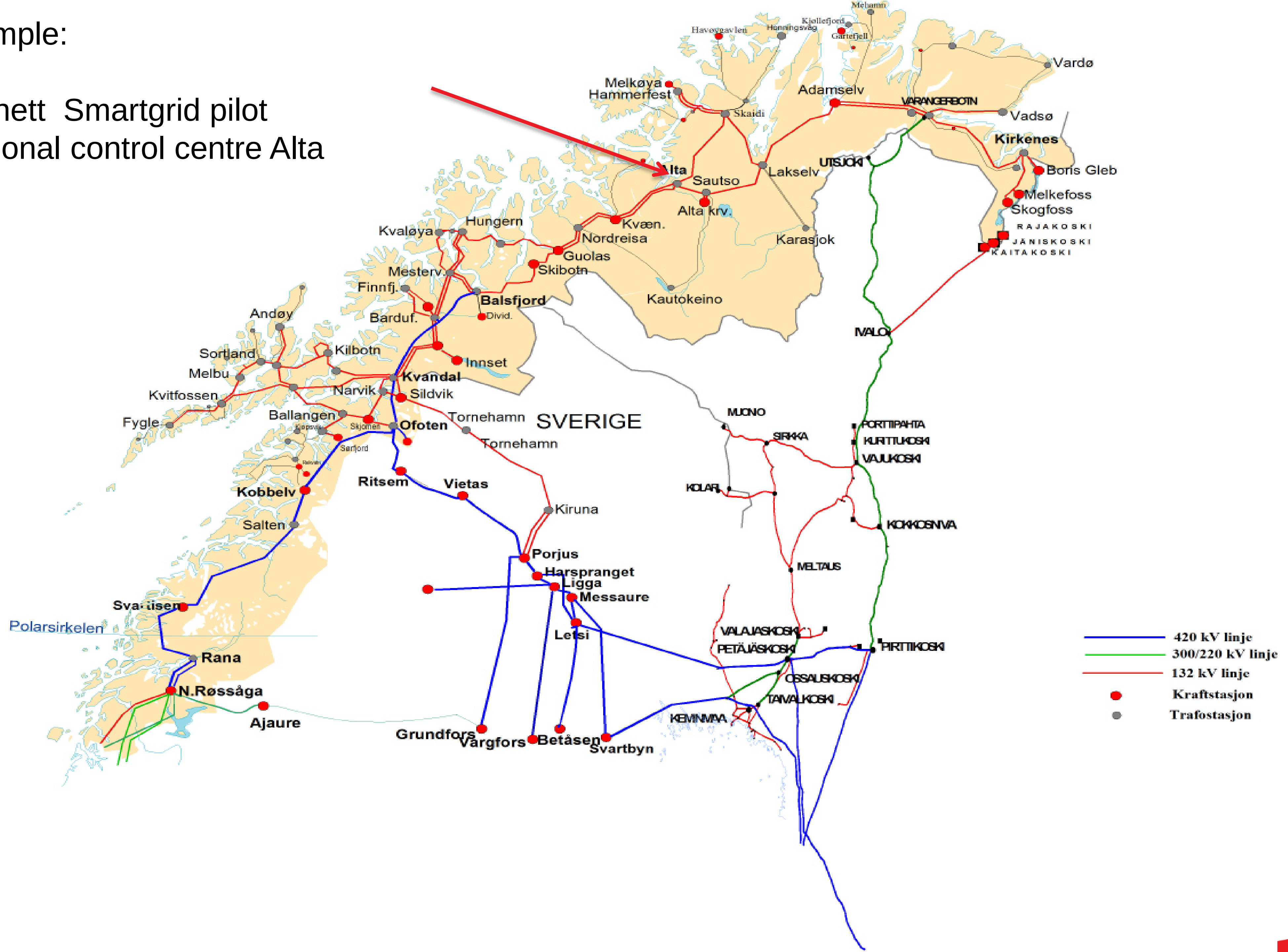
Det krever god moral å selge strikk i metervis

Flexibility payment

- Flexibility reserve compensation
- Activated flexibility compensation
- Reserved kW and kWh versus activated
  - flexibility reserves volumes > activated volumes ➡ more money in reserves (?)

Example:

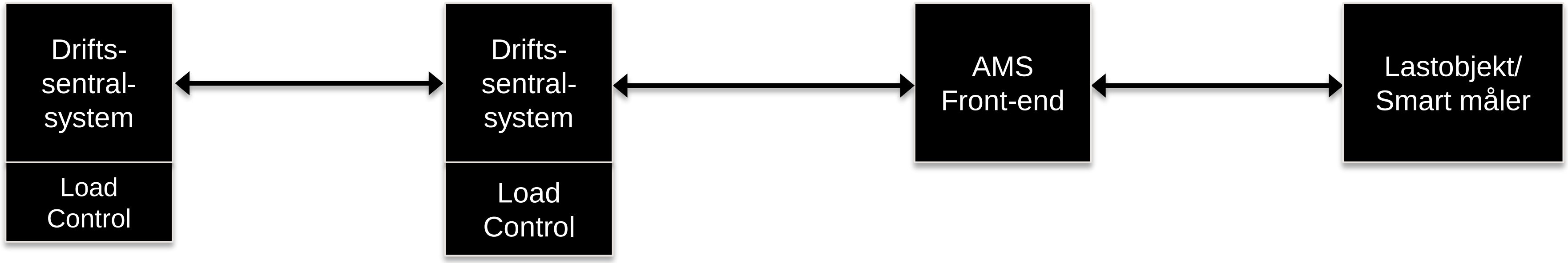
Statnett Smartgrid pilot
Regional control centre Alta



Statnetts demand response pilot

Statnett

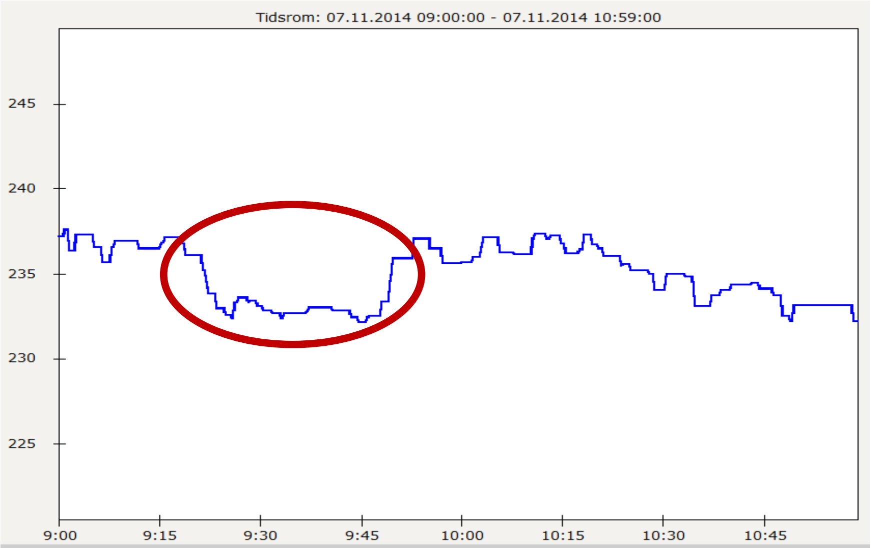
TSO	DSO	Network user
SYSTEMOPERATØR	**NETTSELSKAP**	**SLUTTBRUKER**
Klasse 3	Klasse 2	



ELCOM	**XML / CIM (IEC 61968-9)**	**DLMS / COSEM**
	HTTPS (TLS)	
TCP / IP	**TCP / IP**	**TCP / IP**
Fiber	**Ethernet**	**GPRS**

Communication

Successful pilot



- Large variation in load characteristics and response during disconnection and reconnection
- Communication with and integration of many objects/systems calls for **good specifications and standards**
- Reliability of communication of great importance

Installation Rema1000

Installation at school

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Flexibility Use cases in CINELDI should be prototyped and tested in pilots – and we have a long list with interesting use case identified

- Conformance testing
- Scenario testing
- Safety testing
- Performance testing
- Interoperability testing
- Communication testing
- Cyber security testing
- Scalability testing
- ….

to build knowledge, adjust requirements, choose technologies and standards..

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Illustration: Demand response use case example from a communication and information layer perspective (incl. cyber security perspective)

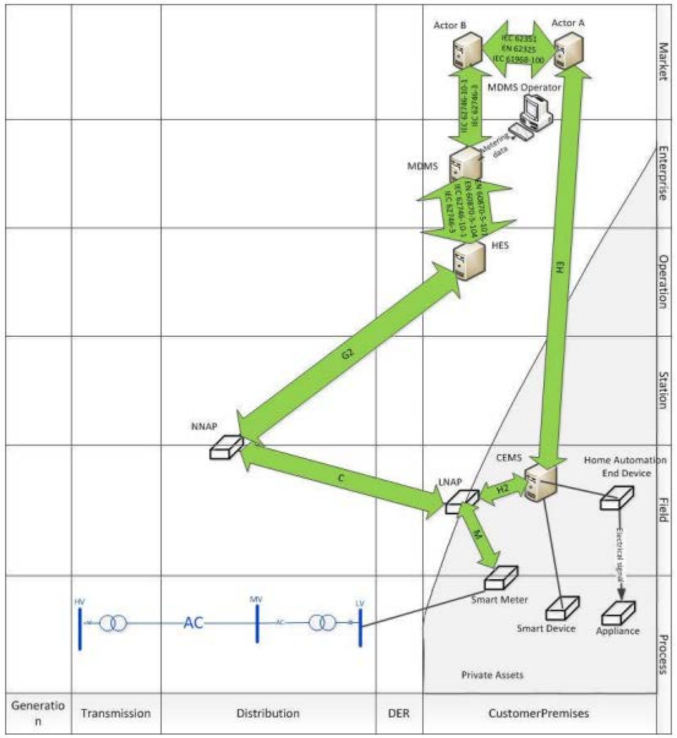

Figure 8. Communication Layer.

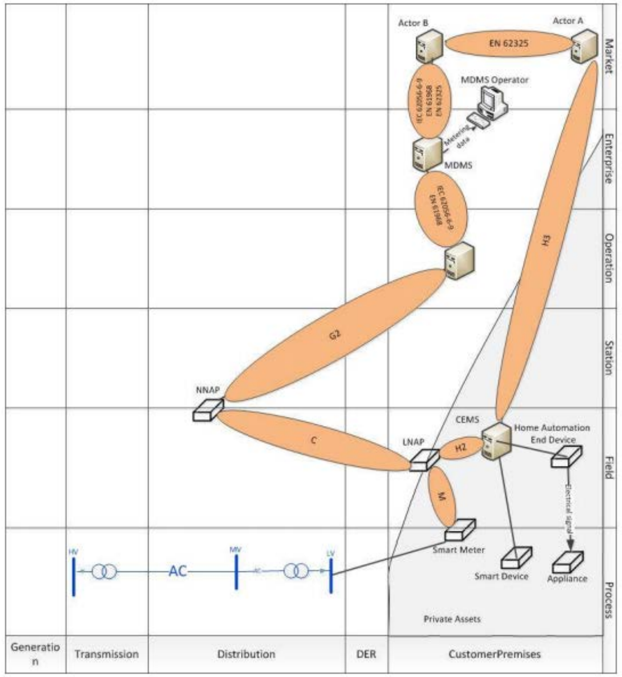

Figure 7. Information Layer.

Table 3. Interfaces and standards for the information layer.

Interface G2—Standard(s) for Information layer
EN 62056-61: Electricity metering—Data exchange for meter reading, tariff and load control- Part 61: Object Identification system
EN 62056-62: Electricity metering—Data exchange for meter reading, tariff and load control- Part 62: Interface classes
Interfaces C, M—Standard(s) for Information layer
EN 62056: Electricity metering—Data exchange for meter reading, tariff and load control
Interfaces H2, H3—Standard(s) for Information layer
EN 50090-3-3: Home and building electronics systems (HBES)—Part 3.3: Aspects of application—HBES Interworking model and common HBES data types
EN 14908: Open Data Communication in Building Automation, Controls and Building Management

Interoperability Testing Methodology for Smart Grids and Its Application on a DSM Use Case—A Tutorial –
Nikoleta Andreadou , Ioulia Papaioannou, Marcelo Masera

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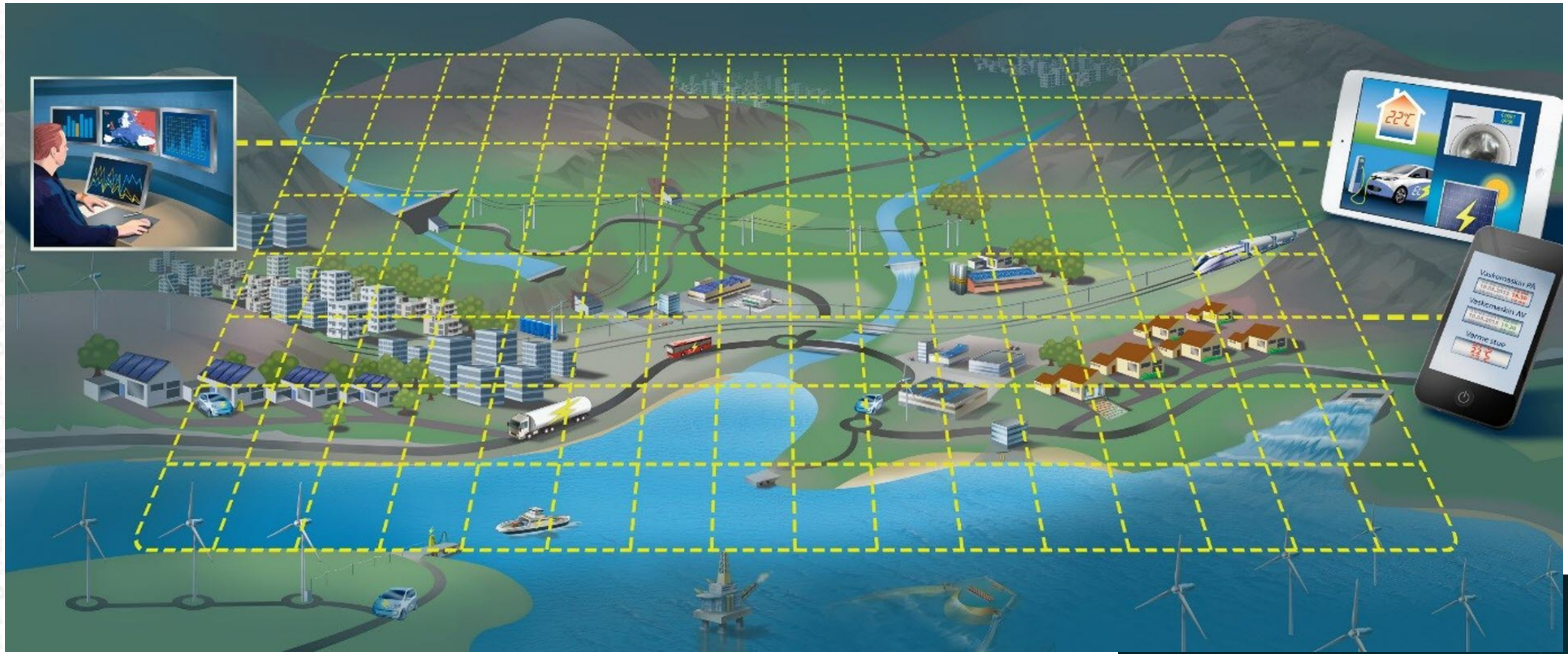

Concluding remark:

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