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SmartNet: a new Horizon2020 project dealing with TSO-DSO coordination

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Agenda

- The context
- TSO-DSO interaction in the view of the European stakeholders
- Goals of SmartNet and added value for the system
- Three main reference architectures
- Overall project layout
- Work-packages and chronogram
- The consortium
The context: some key “driving forces”

Need to balance G and L in real time (bulk storage is still insufficient)

An adequate level of reserve must stay available

Need for new patterns of TSO-DSO coordination

Possibility to provide advanced services for the system if dispatchability is guaranteed

Increased needs for system flexibility and reserve

Explosion of RES deployment in T&D system: network under stress

Drive to extend market coupling towards real time markets

Need to provide economic “signals” to allocate reserve in an efficient way

System unbundling: creation of electricity markets:

Evolution of distribution systems:
- Smart Grids
- VPP (storage + generation)
- DSM
**European Commission:** “The Commission will prepare an ambitious legislative proposal to redesign the electricity market and linking wholesale and retail. This will increase security of supply and ensure that the electricity market will be better adapted to the energy transition which will bring in a multitude of new producers, in particular of renewable energy sources, as well as enable full participation of consumers in the market notably through demand response ... enabling the roll-out of new technologies smart grids and demand response for an efficient energy transition”.
(From: “A framework strategy for a resilient Energy Union with a forward-looking climate change policy”, part of the Energy Union Package)

**ACER:** “The remit of DSOs is perhaps changing faster than any other single actor in the energy sector. Some networks are beginning to require more active management as significant volumes of small-scale generation connect to distribution grids. The TSO-DSO interface therefore requires careful management, as does the need for efficient information exchange, coordinated congestion management and integrated planning (coordination requirements between TSOs and DSOs introduced, for example, by the Demand Connection Code provide a valuable starting point). NRAs and ACER will work with DSOs and TSOs to assist them in more clearly defining their respective roles and responsibilities so that DSOs may manage their evolving networks in a transparent and reliable way, whilst at the same time supplying system services to TSOs”
(From: “European energy regulation. A bridge to 2025”)

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**TSO-DSO interaction in Stakeholders’ view**
ENTSO-E: indicates, among other, the following three policy actions:

- TSOs and DSOs need to provide consumers access to participate in all markets.
- TSOs should work with DSOs and regulators in determining requirements around observability and active power management of distributed generation (DG) and demand-side response (DSR).
- Many aspects of TSO-DSO interaction will be addressed by the Network Codes.

The implementation, maintenance and amendment of Network Codes are a priority for TSO-DSO collaboration in the coming years.

(From: Towards smarter grids: Developing TSO and DSO roles and interactions for the benefit of Consumers)

CEDEC, EDSO4SmartGrids, ENTSO-E, Eurelectric, Geode: To solve their respective challenges in a cost- and resource efficient way, both TSOs and DSOs will rely upon access to a common set of supply and demand side resources. Ensuring coordinated access between TSOs and DSOs to this limited pool of assets is essential for enabling TSOs and DSOs to fulfil their missions in a manner that minimises societal cost and maximises sustainability and security of supply of our power system.

(From: General Guidelines For Reinforcing The Cooperation Between TSOs and DSOs)
SmartNet: goals

SmartNet analyses architectures for optimized interaction between TSOs and DSOs in managing the exchange of information for the acquisition of ancillary services (reserve and balancing, voltage regulation, congestion management) from subjects located in the distribution segment.
Different architectures are compared on three simulated national cases (Italy, Denmark, Spain).
The simulation platform is then implemented in a full replica lab, where the performance of real controller devices will be tested.

Three physical pilots developed to show:
• modalities to exchange monitoring signals between transmission and distribution networks
• study cases on services that can be offered by entities connected to distribution
  o thermal inertia of indoor swimming pools,
  o storage of radio-base stations for telecommunication.

| Physical network layer | Market layer | ICT layer |
SmartNet: added value for the system

The ambition of SmartNet is to tackle such questions as:

• **which ancillary services** could efficiently be provided from distribution to the whole system (via transmission)

• **which optimized modalities (“architectures”)** could be adopted for managing the network at the TSO-DSO interface and what monitoring and control signals could be exchanged to carry out a coordinated action

  • **what information has to be exchanged** and how (ICT) for the coordination on the distribution-transmission border, starting from monitoring aspects, to guarantee observability and control of distributed generation, flexible demand and storage systems

  • **which regulatory implications** could the above issues have on the European system and on the ongoing market coupling process.
Relationship between main system actors

- National ancillary services market
- National transmission dispatch under TSO responsibility
- Local dispatching under DSO responsibility

Cross-border exchange of balancing services

ICT

Bids

Offer of ancillary services from resources in distribution (distributed generation, DSM, VPP)

Aggregators
Three main reference architectures

Extended central dispatching

Local DSO dispatching

Programmed exchange at primary substations
Architecture 1: use case diagram

- Aggregator
- RT distribution status
- DSO
- Local Services request
- Power availability
- Market clearing
- Bid
- Distributed generation
- Flexible load
- TSO & Balancing market operator
- RT transmission and imbalances
- <nMW
Architecture 1: sequence diagram

- **DSO**: Request of local services
- **DG**: Power availability
- **DSM**: Request of RT distribution status
- **Aggregator**: Bids
  - Check of transmission & imbalances
  - RT distribution status
- **TSO**: Market clearing
Architecture 2: use case diagram

- Bid
- Aggregator
- Local market clearing
- Bid
- Local Services request
- Distributed generation
- Flexible load
- TSO & Balancing market operator
- RT transmission and imbalances
- Market clearing
- Power availability
- <nMW
- DSO
- RT distribution status
Architecture 2: sequence diagram

- **DSO**
  - Request of local services
  - Bids
  - Check of RT distribution status & local market clearing

- **DG**
  - Power availability

- **DSM**
  - Aggregator

- **TSO**
  - Bid
  - Check of transmission & imbalances
  - Market clearing
Architecture 3: use case diagram

- Aggregator
- Market clearing
- Exchange limits with TSO
- DSO
- Bid
- Local Services request
- Power availability
- Distributed generation
- Flexible load
- <nMW
- RT distribution status
Architecture 3: sequence diagram

- **DSO**
  - Request of local services
  - Bids
  - check of RT distribution status & exchange limits with TSO
  - Market clearing

- **DG**
  - Power availability

- **DSM**

- **Aggregator**

- **TSO**
Overall project layout

Reference architectures definition

Network model
Market model
ICT model

Formal specifications
Simulation platform realization

National scenarios definition

Personalization with three National cases

CBA with different architectures

Lab test with HW controller

Three pilots:
- DSO area data monitoring
- Flexibility from thermal inertia
- Flexibility from Radio Base Stations

Regulatory Analysis (guidelines)

Return of experience
Work packages and activities chronogram
The SmartNet consortium

• **R&D partners**
  • Research Organizations: RSE, AIT, SINTEF, Tecnalia, VITO, VTT
  • Universities: DTU, Uni-Strathclyde, KU Leuven
  • Other: EUI/FSR

• **Industrial partners**
  • TSO: Energinet.dk, TERNA
  • DSO: ENDESA, NYFORS, SELNET
  • Manufacturers: SELTA, SIEMENS Italia
  • Software developers: Eurisco, N-SIDE
  • Telecom: VODAFONE
  • Trader: Danske Commodities
  • Vacation rental: NOVASOL
Thank you for your attention...

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