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Smart TSO-DSO interaction schemes, market architectures and ICT Solutions for the integration of ancillary services from demand side management and distributed generation

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Lessons learnt from the SmartNet project

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Agenda

- The SmartNet project
- Lessons learnt on barriers to deploying flexibility
- Further (preliminary) regulatory remarks

Motivations

- Increased reserve needs due to explosion of variable RES
- Opportunities from new DER in distribution?
- Five key questions:

Which ancillary services could be provided from entities located in distribution networks	How the architectures of dispatching services markets should be consequently revised
Which optimized modalities for managing the network at the TSO-DSO interface	What ICT on distribution-trans-mission border to guarantee observability and control
Which implications on the on-going market coupling process	

"Some actions can have a negative cross-network effect. For instance, TSO use of distributed resources for balancing purposes has the potential to exacerbate DSO constraints. Equally, whilst DSO use of innovative solutions, such as active network management, can deliver benefits to customers, if not managed properly they may in some cases counteract actions taken by the TSO" (CEER Position Paper on the Future DSO and TSO Relationship – Ref. C16-DS-26-04 – 21.09.2016)

Article 32

Tasks of distribution system operators in the use of flexibility

1. Member States shall provide the necessary regulatory framework to allow and incentivise distribution system operators to procure services in order to improve efficiencies in the operation and development of the distribution system, including local congestion management. In particular, regulatory frameworks shall enable distribution system operators to procure services from resources such as distributed generation, demand response or storage and consider energy efficiency measures, which may supplant the need to upgrade or replace electricity capacity and which support the efficient and secure operation of the distribution system. Distribution system operators shall procure these services according to transparent, non-discriminatory and market based procedures.

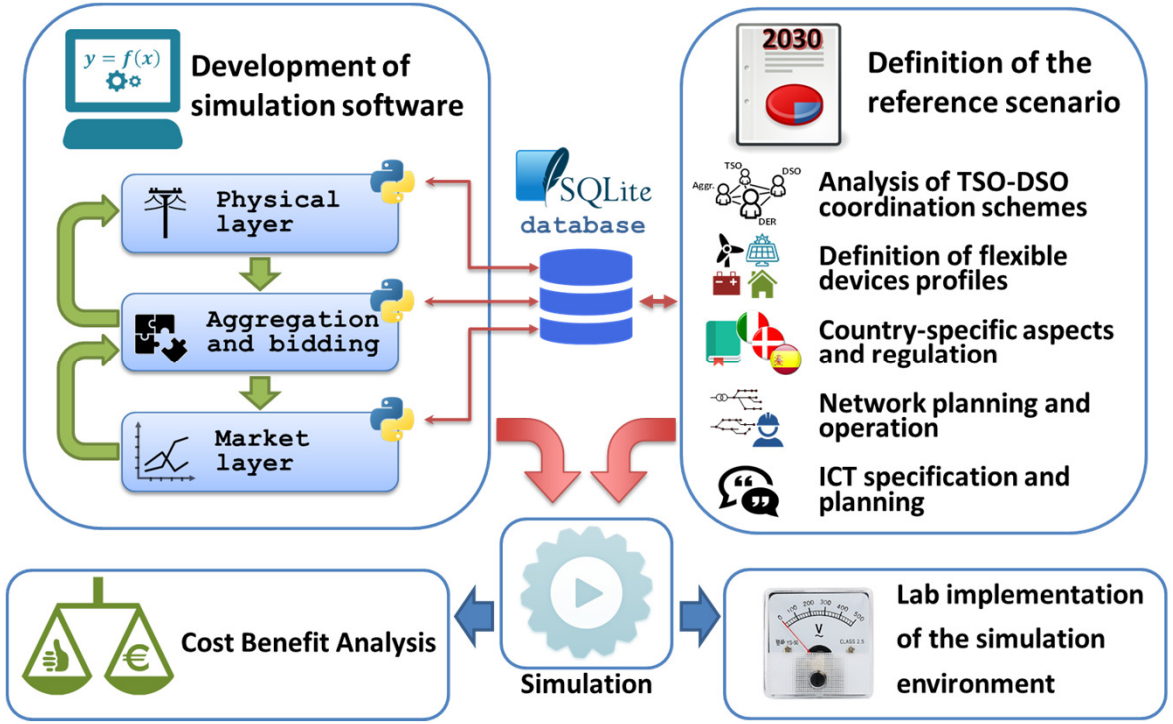
Distribution system operators shall define standardised market products for the services procured ensuring effective participation of all market participants including renewable energy sources, de
operators shall exchange all n
system operators in order to e
secure and efficient operatio

EC (2016) Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on common rules for the internal market in electricity

Winter package assigns a role to DSOs for local congestion management, but not for balancing

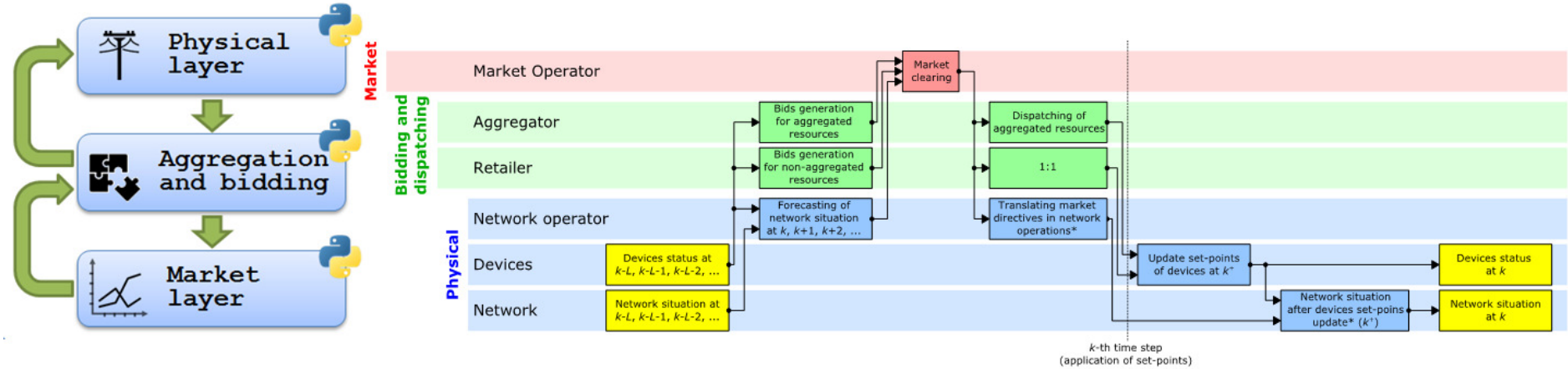
The SmartNet project http://SmartNet-Project.eu

- **architectures for optimized interaction between TSOs and DSOs** in managing the purchase of ancillary services from subjects located in distribution.
- **three national cases** (Italy, Denmark, Spain);
- *ad hoc* **simulation platform** (physical network, market and ICT)
- **CBA** to assess which TSO-DSO coordination scheme is optimal for the three countries.
- Use of **full replica lab** to test performance of real controller devices.
- **Three physical pilots** are also developed to demonstrate capability to monitoring and control distribution by the TSO and flexibility services that can be offered by distribution (thermal inertia of indoor swimming pools, distributed storage of radio-base stations).



1. Need for scarcity prices:
    a. Do you test locational scarcity pricing in your project to solve congestion management?
    b. Please explain how this is tested?

- Aim of the simulation platform is to allow comparing the performance of 5 different TSO-DSO coordination schemes over three countries (Denmark, Italy, Spain)
- The simulated ancillary services market procures balancing services and solves congestion on a nodal basis (including or not nodal detail for distribution depending on coordination scheme) while avoiding voltage problems.
- It implements a rolling horizon concept: clearing performed every 5 minutes for several time steps ahead 8e.g. 1hr). Results for the next time steps have an advisory role: they will assist aggregators and TSO to anticipate the availability of flexibility in the upcoming time steps.
- Arbitrage opportunities with previous energy markets sessions are dealt with too: depending on price opportunities operators can opt to modify their position in intraday, thus modifying their basis for participating in RT market.



2. Prosumers/consumers to react to prices through implicit Demand Side Response:
   a. How does locational scarcity pricing interact with wholesale or balancing markets?
   b. How is the interaction between the TSO and DSO organised, in particular in relation to the interaction between the wholesale market, balancing and congestion management?

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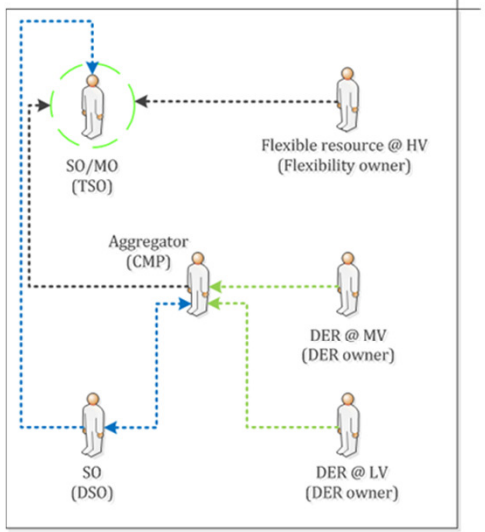
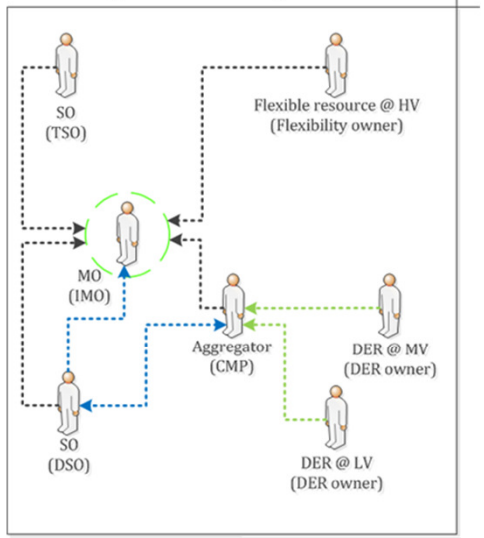
5 possible coordination schemes TSOs & DSOs for AS by distributed flexibility resources

A. Centralized AS market model
B. Local AS market model
C. Shared balancing responsibility model
D. Common TSO-DSO AS market model
E. Integrated flexibility market model

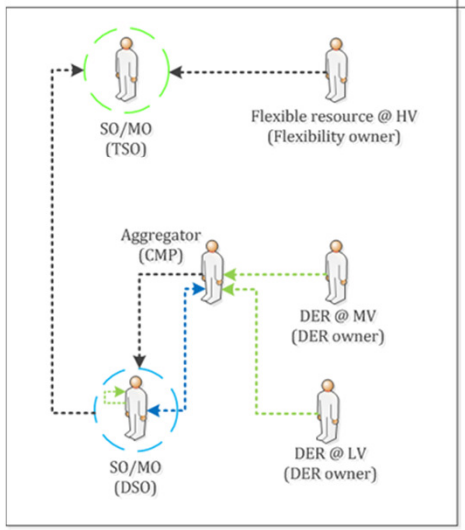
Centralized AS market model



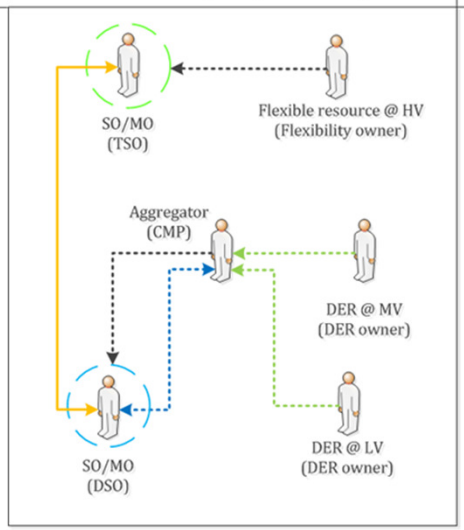
Integrated flexibility market model



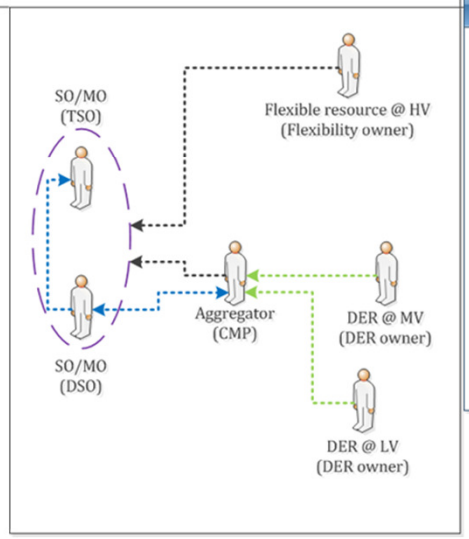
Local AS market model



Shared balancing responsibility model

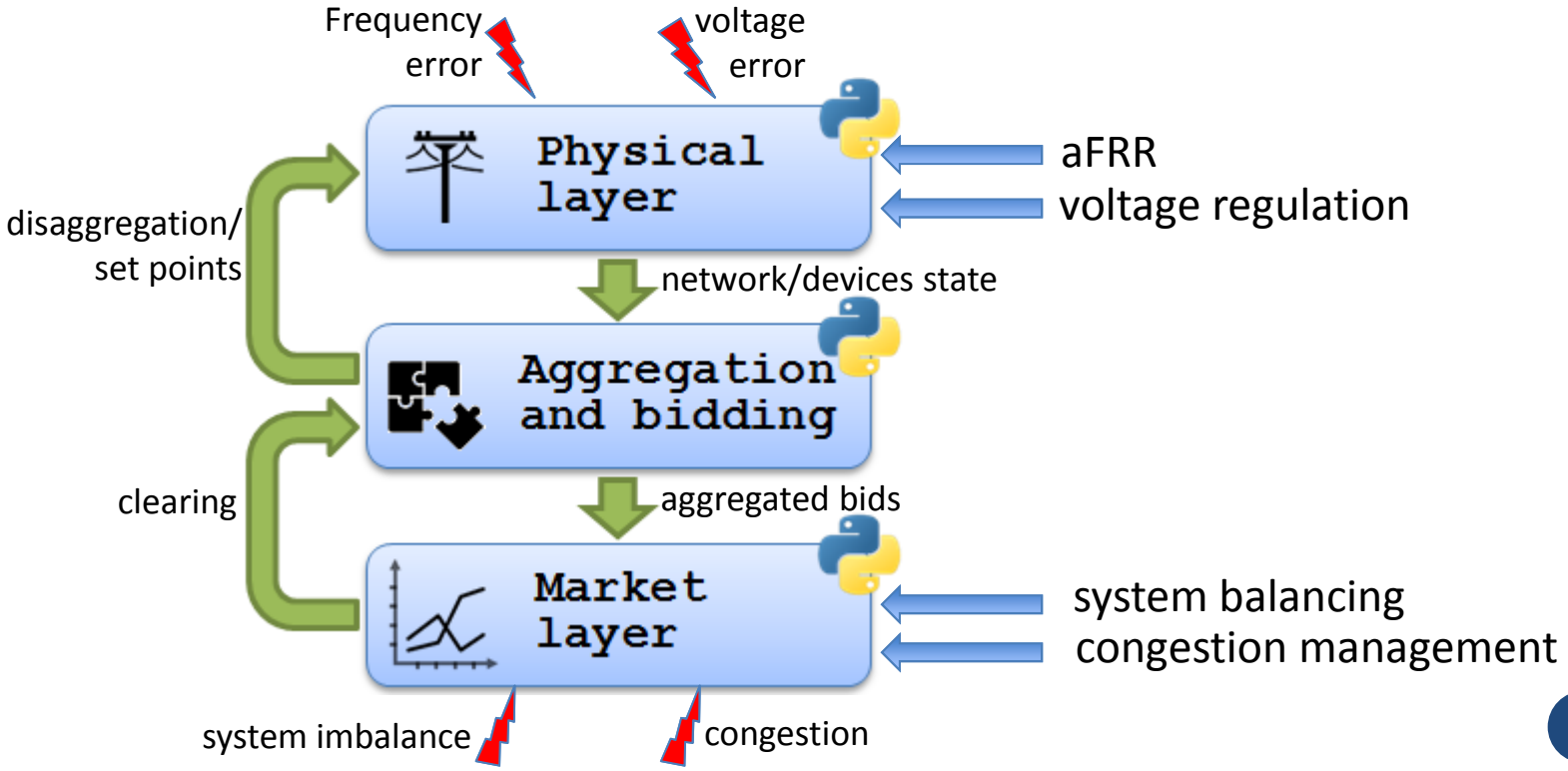


Common TSO-DSO AS market model



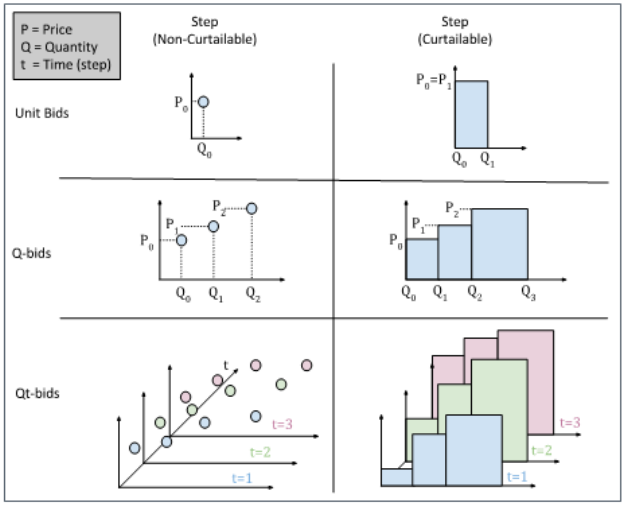
3. Market framework for explicit DSR:
   a. What kind of flexibility is tested in your project (to what grid management needs does it correspond, e.g. frequency control, congestion management)?
   b. How is the flexibility product/service procured and activated?
   c. How is the 'delivery' of flexibility measured?
   d. How is the settlement and payment for the delivery of the flexibility organised?

- SmartNet only takes care of the activation phase (reserve capacity procurement, flexibility measurement and settlement of imbalance payments are out of scope for the project).
- Beyond balancing and congestion management (both procured through AS market), the physical layer of the SmartNet simulation platform also “traps” frequency and voltage problems, which are solved by dispatching aFRR and voltage regulation resources.



4. Non-discriminatory access to all markets
    a. How is the flexibility product/service defined?
    b. How have you aimed to ensure that this is done in a non-discriminatory way (e.g. no preference for specific technology or actor)?
    c. How have you aimed to ensure non-discriminatory access to markets and platforms?

- Bids are defined by quantity/price pairs in their simplest form, can be curtailable or non-curtailable; multi-period bids are also possible.
- A comprehensive set of complex constraints (temporal constraints and logical constraints) fits the needs of the different kinds of loads and generators (atomic loads, CHP, thermostatic controlled, storage, curtailable generation and sheddable loads)



Temporal constraints (Intra-bid)

- **Accept-All-Time-Steps-or-None**: → Profile tracking
- **Ramping**: → Turbines
- **Max. number of activations**: → Avoiding wear & tear
- **Max. duration of activation**: → Air conditioning
- **Min. duration of activation**: → Plant efficiency
- **Min. delay between activations**: → Avoiding wear & tear; cool-down and warm-up
- **Integral**: → Electric storage

Logical constraints (Inter-bid)

- **Implication**: → Series factory lines
- **Exclusive Choice**: → Parallel factory lines
- **Deferability**: → Wet appliances

Further regulatory (preliminary) remarks

- TSOs could need to share with DSOs part of responsibility for the provision of ancillary services if the contribution from entities in distribution will grow.
- a balance has to be sought for between local optimality and the implementation of a harmonized pan-European design.
- smaller DSOs have to integrate their efforts in order to be fit for the new responsibilities.
- real-time market architecture must to take into account the characteristics of the potential flexibility providers connected to distribution grids
- aggregators must be able to provide a simplified interface towards the market, hiding details of flexibility providers, and deliver efficient price signals to incentivize participation from distribution.
- viable business models must be available for all market participants, including DERs, aggregators and other customers.
- network planning will also have to facilitate better utilization of RES exploiting flexibility.

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Thank You

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