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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

FPM workshop – Mannheim| 11.07.2017

SmartNet: A European research project to study TSO-DSO coordination for ancillary services provision from distribution networks

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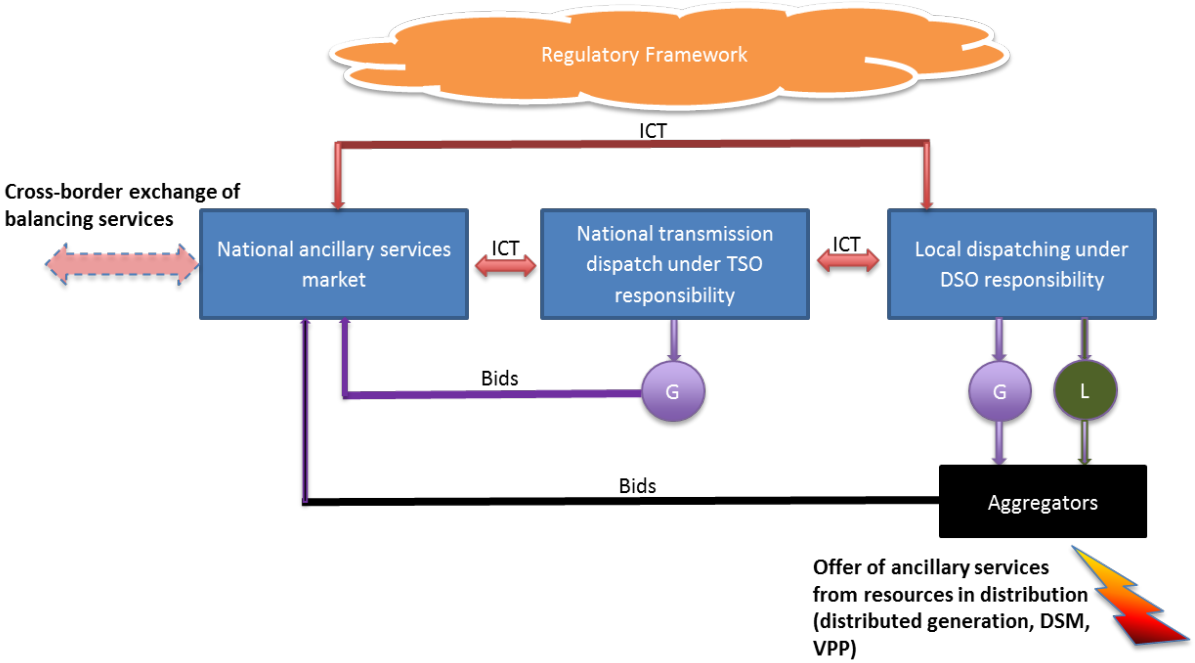
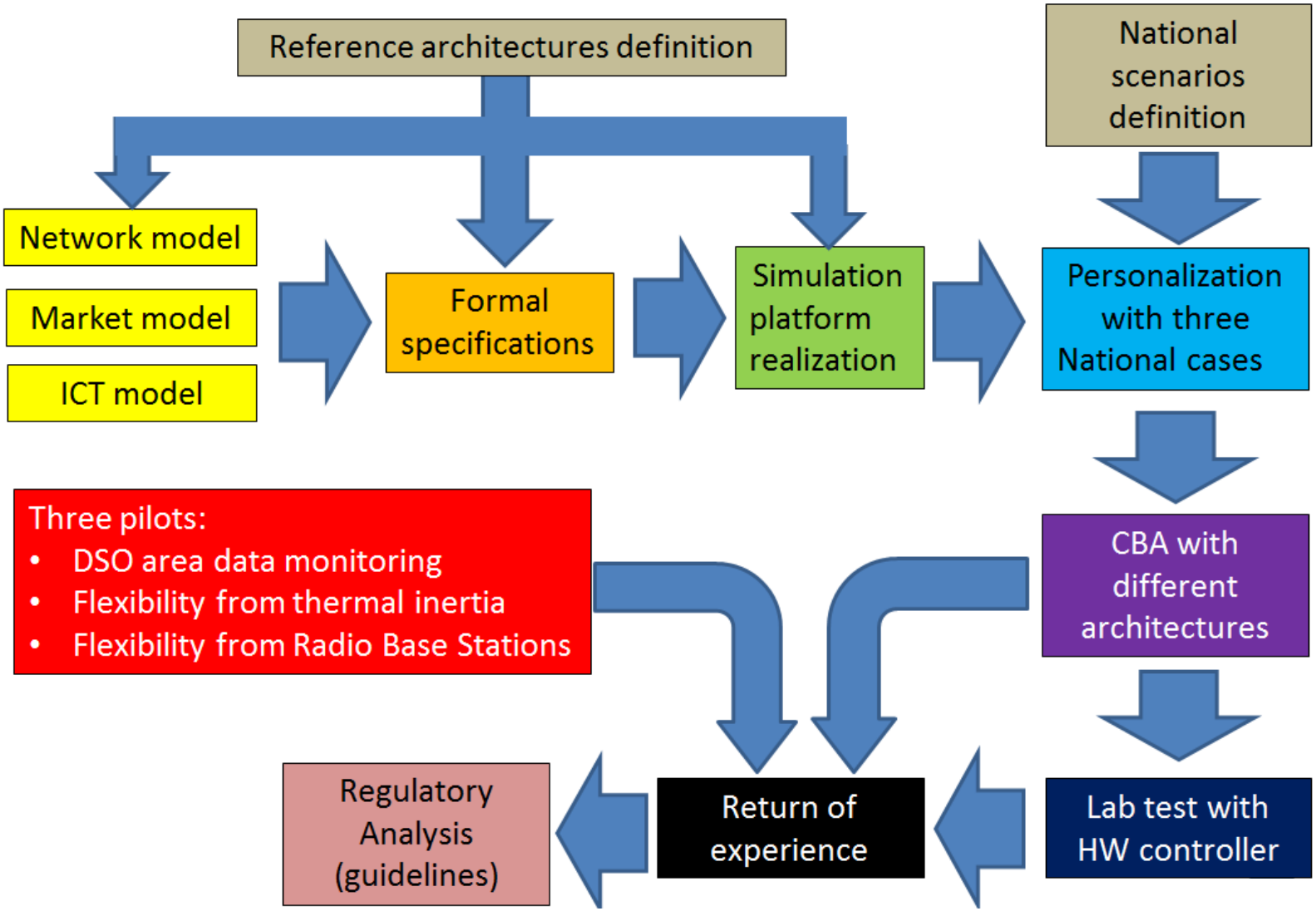
The SmartNet project

http://SmartNet-Project.eu

- **architectures for optimized interaction between TSOs and DSOs** in managing the purchase of ancillary services from DER.
- **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** 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).



Overall project layout



TSO-DSO coordination schemes: scope and definitions

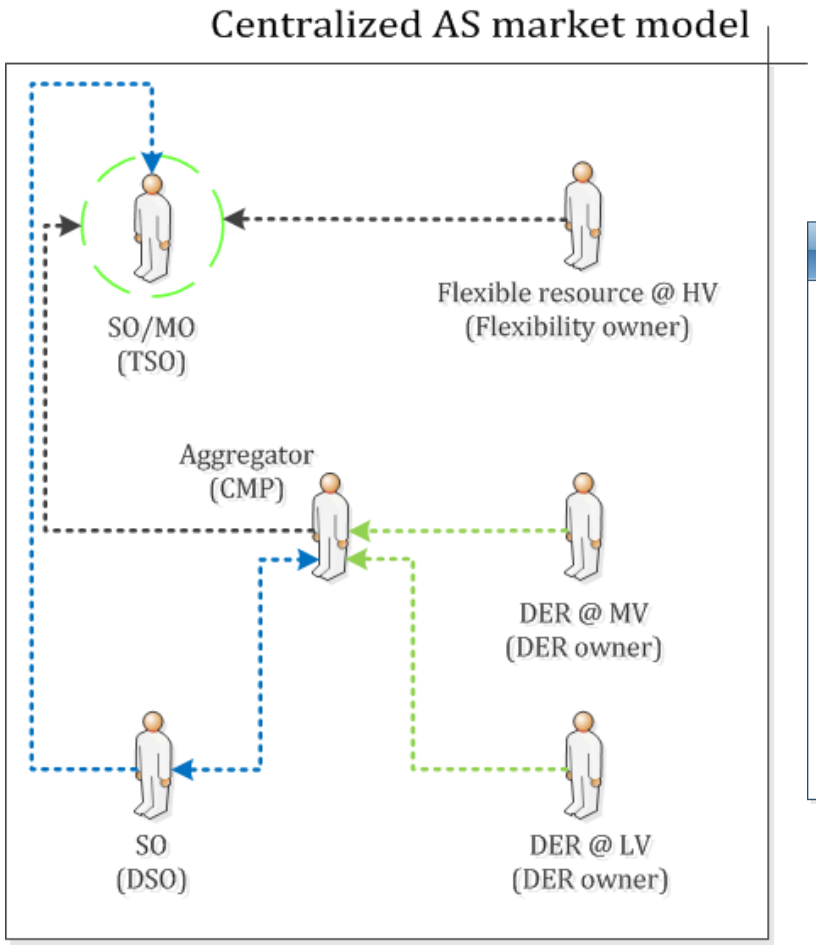
- Objective: analyze TSO-DSO coordination schemes (CSs) for the provision of flexibility-based system services by distributed resources (DG, DSM, …)

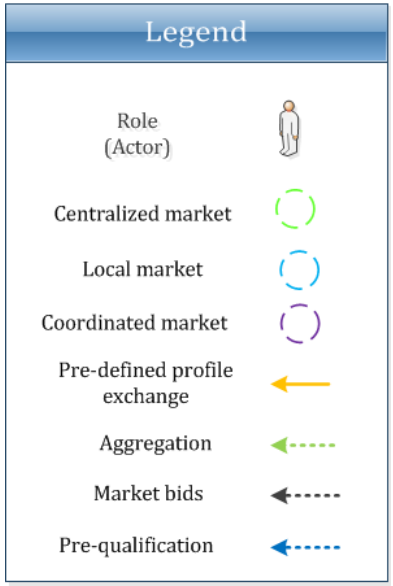
- Analyse each CS, focusing on:
  - envisioned set of roles and responsibilities,
  - potential market architectures, and
  - relevant information exchanges

- Impact on TSO grid operation, DSO grid operation, the role of other market participants and the related market design ⇔ national regulatory frameworks and EU context

Five possible TSO-DSO coordination schemes: 1) Centralized AS market model

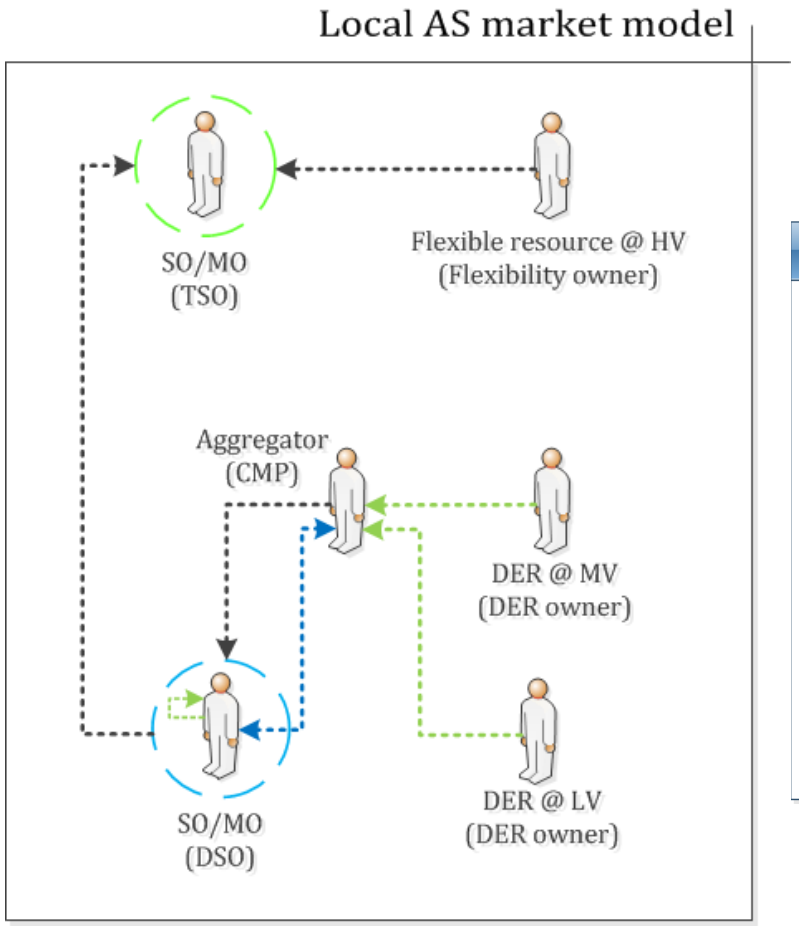
- 1 common ancillary services market managed by TSO
- Separate DSO process for checking distribution constraints (e.g. prequalification)

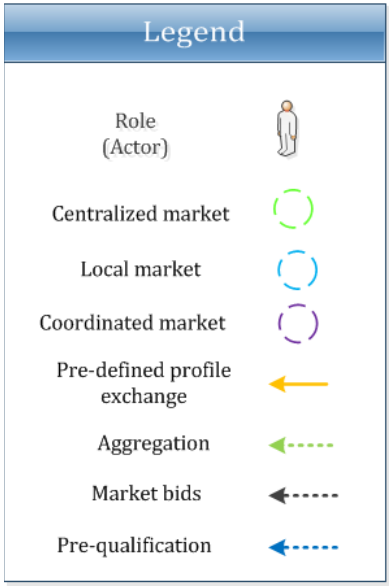




Five possible TSO-DSO coordination schemes: 2) Local AS market model

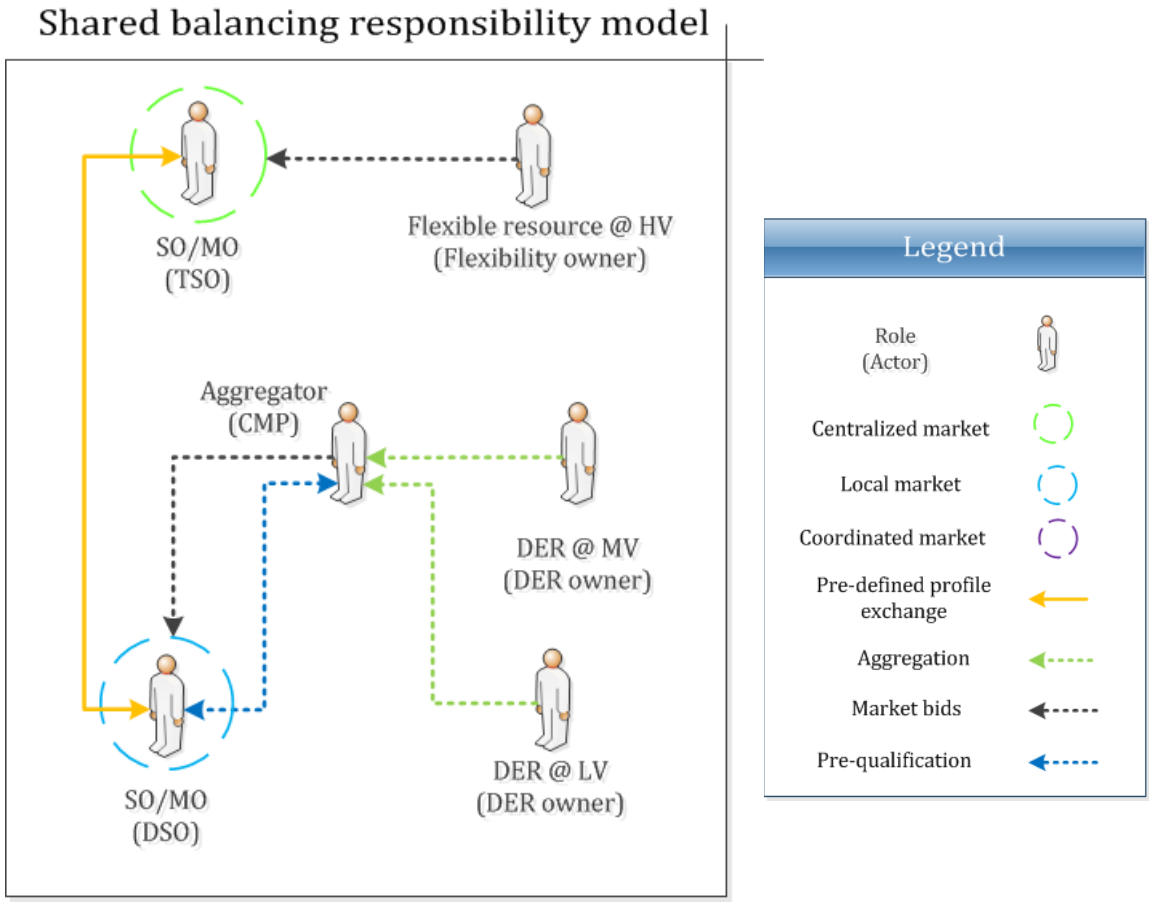
- Separate local market managed by DSO for local issues
- Transfer remaining flexibility to TSO ancillary services market level





Five possible TSO-DSO coordination schemes: 3) Shared balancing responsibility model

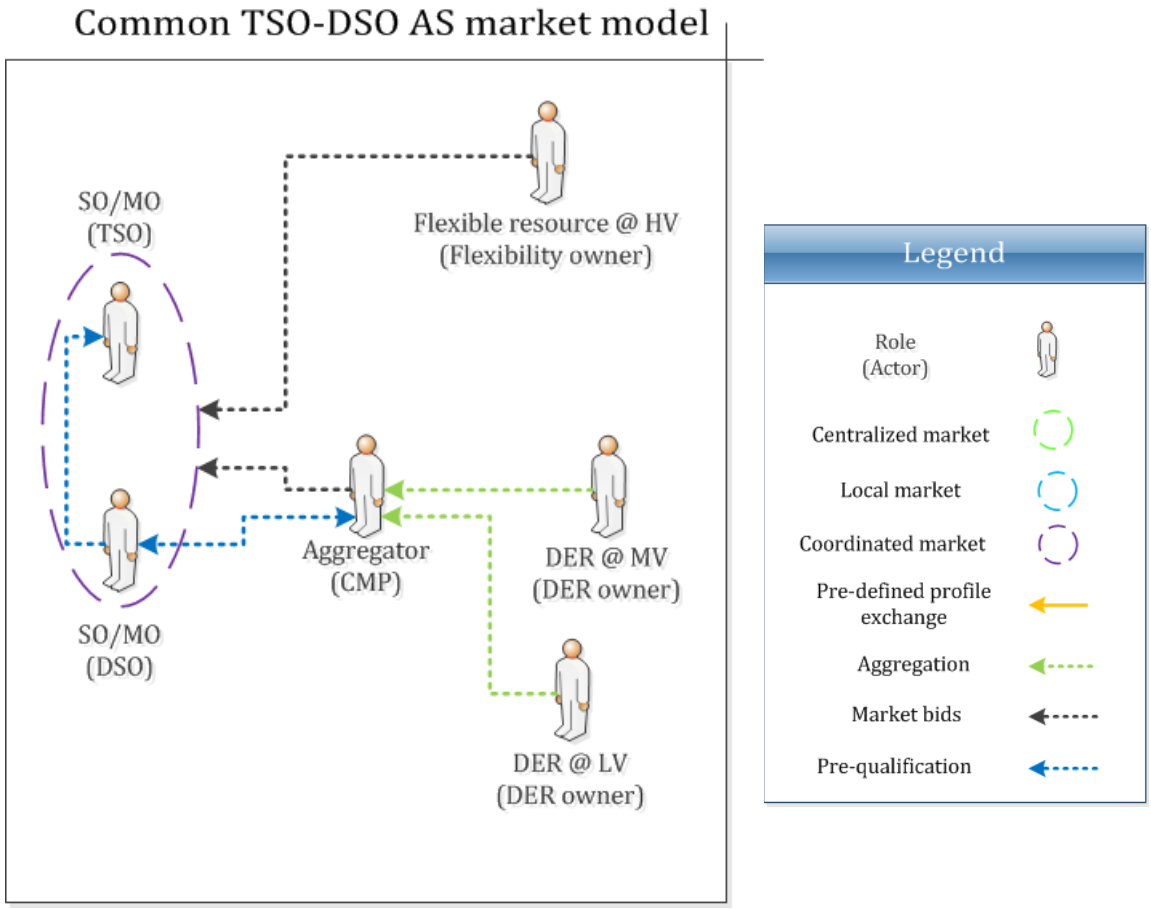
- Ancillary services market for transmission grid-connected resources managed by TSO
- Local market for distribution grid-connected resources
- Agreed pre-defined TSO-DSO scheduled profile



Five possible TSO-DSO coordination schemes: 4) Common TSO-DSO AS market model

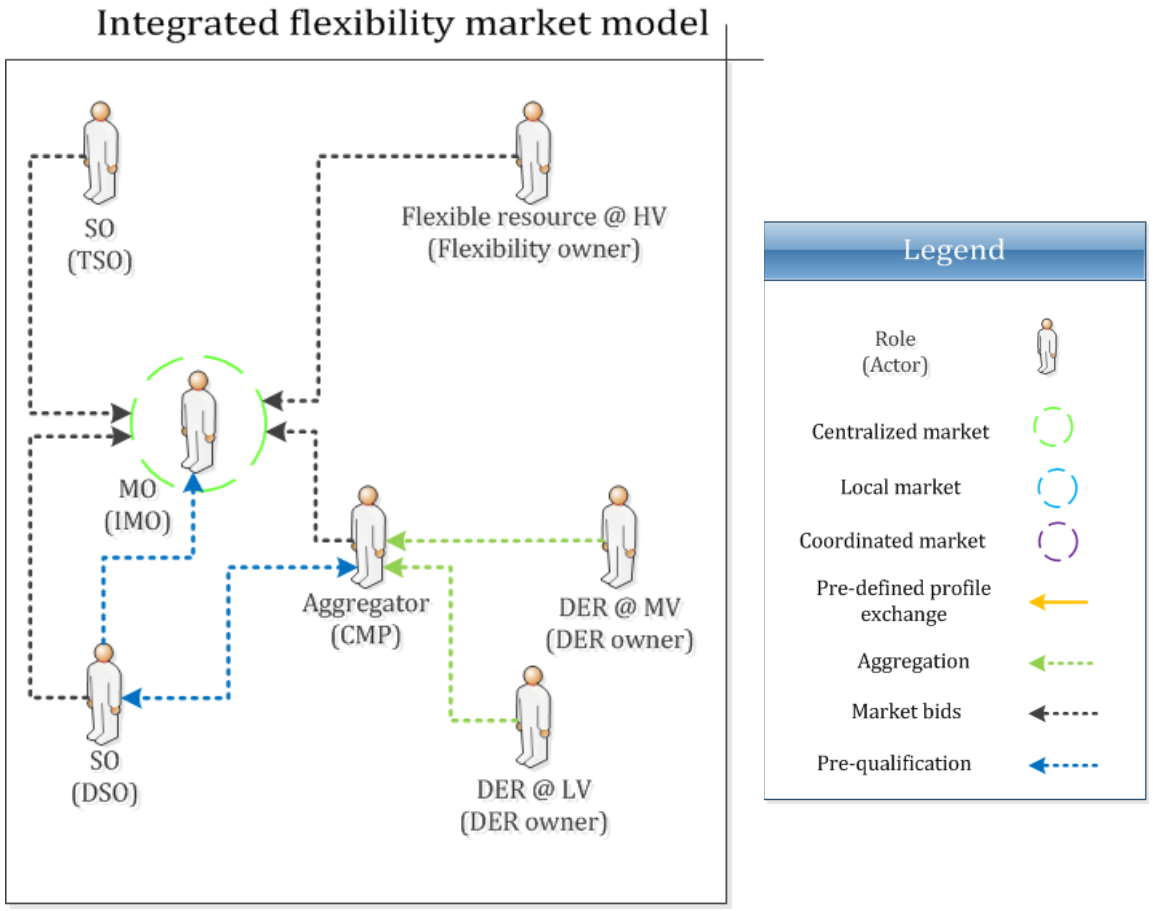
- Common flexibility market managed jointly by TSO & DSO

- Two **Variants**:
  - **Centralized:** One optimization with all grid constraints
  - **Decentralized**: Two optimizations: distribution & transmission constraints



Five possible TSO-DSO coordination schemes: 5) Integrated flexibility market model

- Common flexibility market managed by an independent / neutral market operator
- No priority for TSO, DSO or commercial market player



Five possible TSO-DSO coordination schemes: Benefits and attention points

Coordination Scheme	Benefits	Attention points
Centralized AS market model	▪ Efficient scheme in case only the TSO is a buyer for the service ▪ A single market is low in operational costs and supports standardized processes ▪ Most in line with current regulatory framework	▪ No real involvement of DSO ▪ DSO grid constraints not always respected
Local AS market model	▪ DSO has priority to use local flexibility ▪ DSO supports actively AS procurement ▪ Local markets might create lower entry barriers for small scaled DER	▪ TSO and DSO market cleared sequentially ▪ Local markets might be rather illiquid ▪ Need for extensive communication between the TSO market and the local DSO markets

Five possible TSO-DSO coordination schemes: Benefits and attention points

Coordination Scheme	Benefits	Attention points
Shared balancing responsibility model	▪ The TSO will need to procure a lower amount of AS ▪ Local markets might create lower entry barriers for small scaled DER ▪ Clear boundaries between system operation TSO and DSO	▪ Total amount of AS to be procured by TSO and DSO will be higher in this scheme ▪ BRPs might face higher costs for balancing ▪ Small local markets might be not liquid enough to provide sufficient resources for the DSO ▪ Defining a pre-defined schedule methodology agreed by both TSO/DSO might be challenging

Five possible TSO-DSO coordination schemes: Benefits and attention points

Coordination Scheme	Benefits	Attention points
Common TSO-DSO AS market model	▪ Total system costs of AS for the TSO and local services for the DSO are minimized ▪ TSO and DSO collaborate closely, making optimal use of the available flexible resources	▪ Individual cost of TSO and DSO might be higher compared to other schemes ▪ Allocation of costs between TSO and DSO could be difficult
Integrated flexibility market model	▪ Increased possibilities for BRPs to solve imbalances in their portfolio ▪ High liquidity and competitive prices due to large number of buyers and sellers	▪ Independent market operator needed to operate the market platform ▪ Negative impact on the development and liquidity of intraday markets ▪ TSO and DSO need to share data with IMO

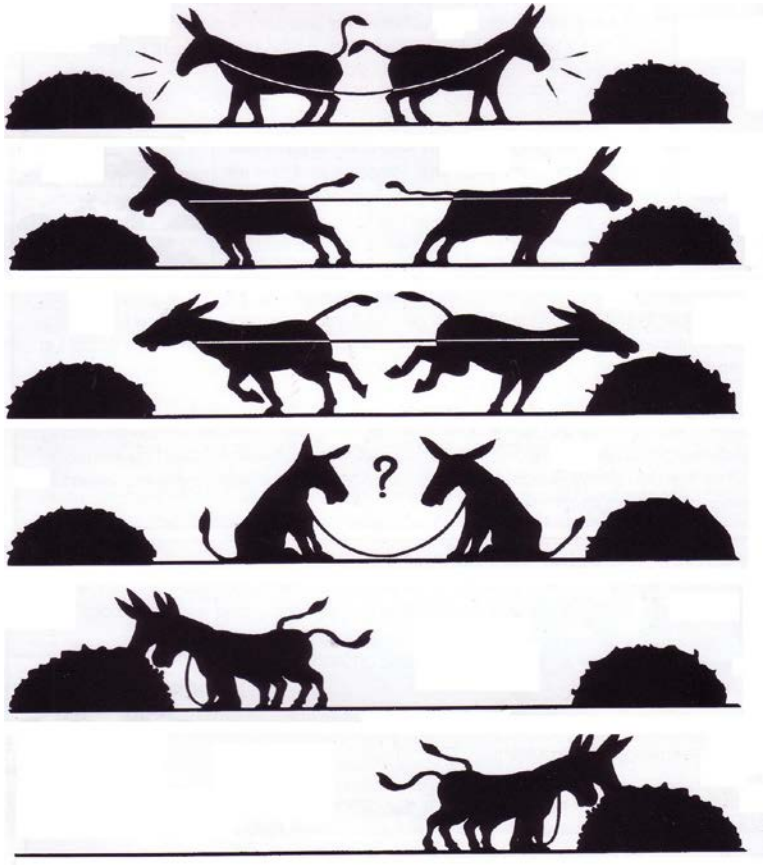
TSO-DSO coordination schemes: conclusions

- Different possible TSO-DSO coordination schemes: each have their own benefits and risks
- Different coordination schemes imply different roles, responsibilities, market design, regulation, grid operation, cost of implementation, …
- Mathematical formulation and implementation ongoing
- Public deliverable available:

http://smartnet-project.eu/wp-content/uploads/2016/12/D1.3_20161202_V1.0.pdf

If they want to go fast, system operators could go alone; if they want to go far, they should go together,

turning challenges into opportunities



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Thank You

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