A Distributed Registry for Service-based Energy Management Systems

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Agenda

- Problem Statement
  - Aggregation of DER
  - The Aggregators Need

- Distributed Registry
  - Supporting DER Search for Aggregation
  - Technical Requirements
  - Architectural Concepts

- Conclusions
  - Business Cases
  - Further Research
Problem Statement: Aggregation of DER

+ More and more Distributed Energy Resources (DER) become part of the grid
+ DERs are highly heterogeneous
  + Different conditions (wind, sunshine, etc.)
  + Scale (from solar cells on a rooftop up to MW-wind turbines)
+ Most DERs cannot participate on exchange markets directly

Generation or Load

EEX → VPP → DER → DER → DER
Problem Statement: The Aggregators Need

- Aggregation of DERs as Virtual Power Plants (VPP)
  - Enables organized market participation of small- and medium-scale producers.

- To organize DERs as VPPs System Operators will need Energy Management Systems (EMS) as middleware
  - In this scope we call the VPP managing and aggregation platform in the Market Domain [NIST-Framework] EMS

- DERs may register at a registry where a system operator can search for an appropriate amount of generation capability and control-capabilities to compensate demand-side fluctuations
Distributed Registry: Supporting DER Search for Aggregation

- DERs register their service at the Registry
- The Operator plans the needed VPP structure
- Searches the Registry for appropriate DERs
Distributed Registry:
Technical Requirements

- Highly automated and fast process
- Role- and security-system for access-rights
- Should support and interact with diverse EMS through a generic interface
- System resilience against failures and losses as well as storing many datasets

These requirements can only be achieved through a loosely coupled distributed registry!
Distributed Registry: Architectural Concept I

- Regional Layer
- District Layer
- Local Layer
Distributed Registry: Architectural Concept II

Legend
- Region
- Grid Connection (High or medium voltage)
- DHT-Database-Part
- DHT-Database-Link
Conclusions: Business Cases

- The distributed registry serves as a yellow pages service for DERs
  - Allows dynamic publishing and searching DERs
- Location-based coordinated Demand Response
  - Optimizing the utilization of the grid by reducing transport losses
  - Obeying DSO operation conditions
- Primary sector
  - Grid operators can use the DERs as additional control capabilities for voltage regulation
Conclusions: Further research

- Evaluation of the proposed Registry Distribution Concepts
  - Technical Analysis of the Operation Requirements
- Interfaces between EMS and registry
  - Complete Support of Business Models
- Semantics and Standardization of the Protocols
Thank you for your attention!

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