i-PCGRID 2017
Panel session IEC 61850 solutions

DER Grid Integration and IEC 61850

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Integrating DER

- IEC 61850-90-15: IEC 61850 based DER Grid Integration
  - Basic concepts
  - Functional requirements
  - IEC 61850 data models
Possible use cases for DERs

... from European research project OS4ES

<table>
<thead>
<tr>
<th>Category</th>
<th>Use Cases</th>
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| Integration into Energy Trading  | • Certified Energy Market  
                                 | • Energy Management using Virtual Power Plant                           |
| Imbalance Management             | • Marketization of Balancing Group Management                              |
| Grid Services                    | • Frequency Control  
                                 | • Volt / Var optimization and control                                     |
| Grid Congestion Management       | • Aggregation and settlement of flexibility  
                                 | • Demand Response management of EVs                                      |
What wants the aggregator know?

**... IoT for DER systems**
- Which functions (or service) does a DER system support?
- What are the rated values?
- Can it be controlled?
- Is it predictable?
- If not - what is the forecast?
- Is it available?
- Can I book it?
- Can I book it only partially?
- What does it cost?
- Where is it connected?
Integration of DER system

Electrical connection (ECP)  Utility EPS  PCC (Point of common coupling)

DER System

Facility EPS

DER System

DER Unit

DER Unit
Modeling DERs

**Electrical and functional characteristics**

- Ratings of DER system at PCC
- Electrical connection characteristics of the PCC
- Generic functional characteristics
- Generic time constraints of DER system
- Functional capabilities
  - Understanding schedules
  - Providing forecasts
  - Planning capabilities
Modeling DERs

**Electrical energy function at PCC**

- **Active power**
  - Load
  - Generation

- **Flexibility**
  - Storage (energy corridor)
  - Time shiftable profile

- **Autonomous frequency control (frequency/watt)**

- **Reactive power (Volt/Var)**

- **Constant voltage**
Modeling a Electrical energy function

- Rated parameters
- Actual values that are available at the PCC
- Setpoints and controls

Additionally, as part of supporting function

- Planning forecast
  - Based on the own usage – what is the planned availability of the function
- Forecast for intermittent (non-deterministic) DERs
Integration approach

**OS4ES – Open System for Energy Services**

Diagram showing the integration approach with components:
- Aggregator
- Registry
- OS4ES Core
  - Protocol conversion
  - Message routing
- DER System
UML Model – Example Active power
Example – Active power

... actual and rated values

- Energy Services: Active Power Generation
- Energy Services - Actual::Gen Actual
  + MaxWInst :float
  + MinWInst :float

- Rated parameters of energy services
  Energy Services - Rated Parameters::Gen Rated Parameters
  + MaxWRtg :float
  + MinWRtg :float
  + PowerStepSize :float
LN DSPG

 Actual values

 Rated values
Adding new DER

sd Add DER

Flexibility Aggregator

Registry

New DERs available?()

List of new DERs(Aspects)

Select(DER ID)

Establish Relationship()
Implementing information exchange

sd Add DER

Smart Grid Application (from Actors)

Registry (from Actors)

DER System (from Actors)

MESS4: Registering of DER system

Register DER System()

loop Service registration

Register DER Service()

MESS5: Update DER info

Update forecast()
Registration - details

sd MESS4: Register DER

seq Registration of DER system

RegisterDERSystem()
«conceptual»

GetLogicalDeviceDirectory()

[until LNClass DDER is found]

GetLogicalNodeDirectory()

rsp(List of LNs)

GetAllDataValues(Obj Ref to DDER)

rsp(list of DO and values)

RegisterDERSystem(Generic DER System Information)
«conceptual»

loop Search LNs for Generic DER System Information

Contact.req()
«conceptual»

Associate.req()

Associate.rsp()

CheckDERStatus()
Conclusion

- IEC 61850 provides in various parts of the standard the framework for Smart Grid applications
- The concepts explained in this presentation have been developed and verified in various demonstration projects like OS4ES, a project sponsored by the European Commission