WP3: ICT requirements

ICT role

The energy markets and energy systems are evolving. The question is how can ICT improve the future energy systems to become smarter and more flexible? The specified five TSO-DSO coordination schemes in WP1 [1] revealed new challenges and opportunities for ICT with respect to communication cost, quality, resiliency, response time, and security. In the future, communications can be one of the key enablers or a hindrance in the transition towards flexible energy systems. In order to fully exploit potentials offered by ICT, we analyzed the TSO-DSO coordination schemes carefully and took advantage of existing and future ICT technologies to design a flexible ICT architecture to fulfil the identified communications and security requirements.

Analysis procedure

To understand the role of ICT in various TSO-DSO interaction operations, we analyzed the use case definitions prepared in WP1 covering the five TSO-DSO coordination scenarios [1]. We created an analysis procedure to identify and classify ICT requirements for today's and tomorrow's systems by utilizing partners' competence in both energy and communications domains. We broke the relationships among interacting stakeholders (business actors) down to system components and interfaces. Core operations were divided into four functional stages: prequalification, procurement, activation, and settlement. The stages were presented with sequence diagrams including exchanged data object with requirements for networking, security, latency, and data protocols.

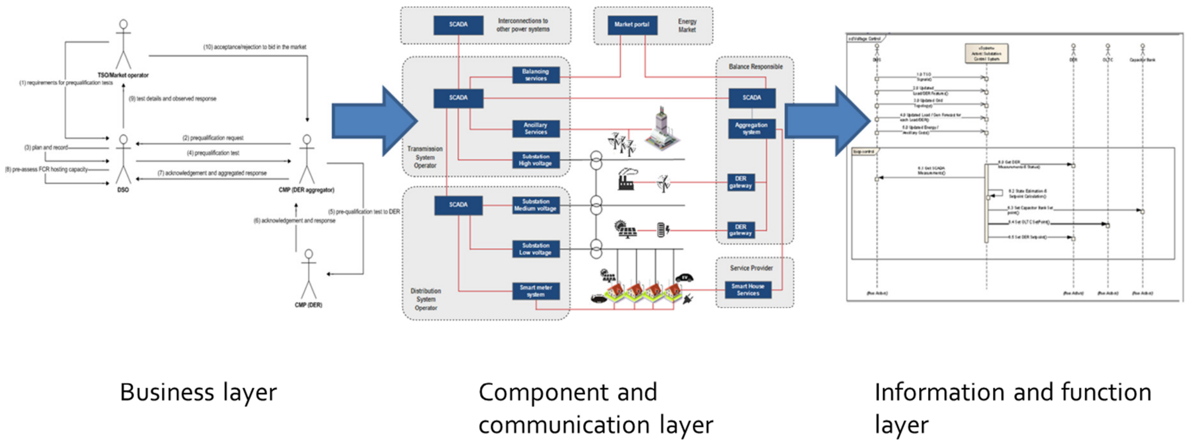

Figure 1. Transition from business actors into system components and interfaces, as presenting exchanged information objects with sequence diagrams.

The architecture design was done both top-down and bottom-up, so that we can differentiate common architectural components suited for all TSO-DSO coordination schemes and those that are highly TSO-DSO coordination scheme specific. From the energy system side, the increased interoperability between energy and communication domains forced us to seek solutions that service both complex and global networks. We studied definitions and terms specified in the Electra project [2], and the results of European approach promoted by the Smart Grid Coordination Group in response to Smart Grid Mandate M/490. The mandate requests CEN, CENELEC and ETSI to develop a framework aiming at smart grid interoperable solutions within the European Union. This framework also defines high level requirements for ICT development within SmartNet [3]. The analysis also involved the study of new technologies including the next generation wireless networks (5G), Internet-of-Things (IoT), DataHub, and Blockchain. These are potential tools to improve reliability, cost-effectiveness, and security between all stakeholders in the SmartNet ecosystem extending from TSOs to small DER owner.

We used an iterative and incremental analysis process to translate the use case descriptions into system components, interfaces, and exchanged data objects with ICT requirements. The analysis involved several refinement and harmonization cycles to reduce and harmonize the large number of data exchange objects and associated requirements to a size that was manageable and comprehensive for architecture design.

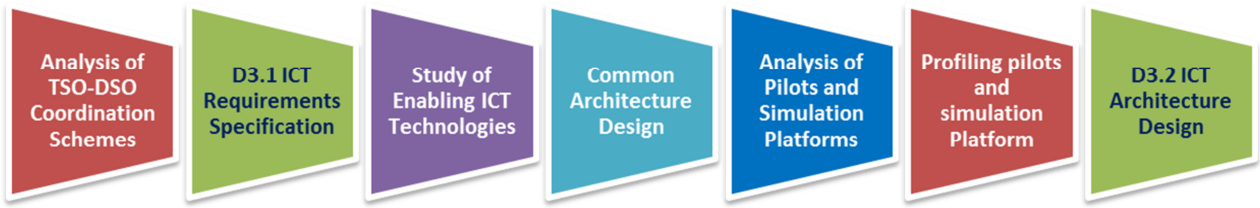

Figure 2. Analysis procured used for capturing ICT requirements and specifying the architecture design.

To exploit the architecture design in practice, we created an ICT architecture model with the Enterprise Architect tool as a part of analysis work. The architecture was created according to the Smart Grid Architecture Model (SGAM), which describes the structure of the architecture and interactions between entities from the business layer down to the component layer. The full ICT architecture model with sequence diagrams, interaction charts, and requirement tables included in the Enterprise Architect model is very detailed and thus not suitable for a paper report. Therefore, a simple reference model depicted in Figure 3 was created to assist the end-user to map their systems and interactions to the design. In this model, large gray boxes present core system actors, blue boxes interacting system components, and green ones core services. The more detailed model is presented in ICT Architecture design report [4] that will be available in the end of February.

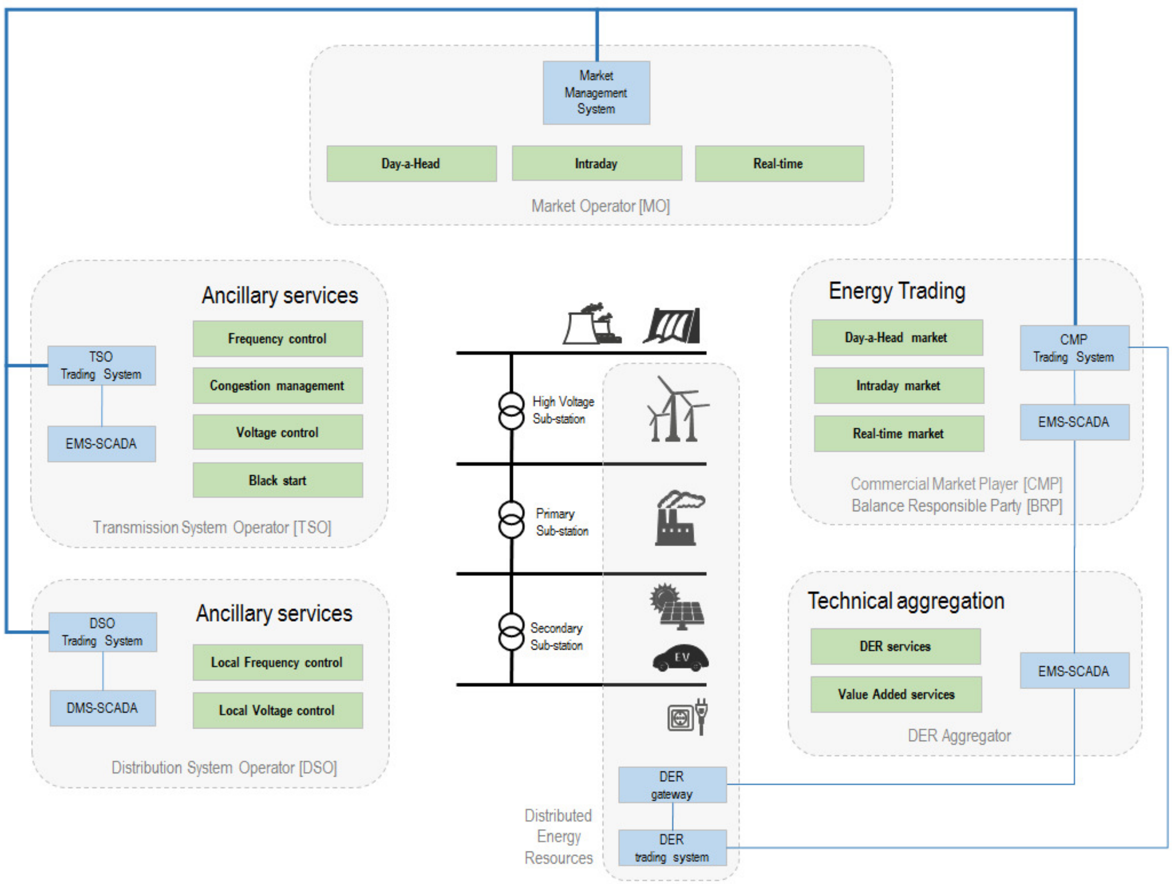

Figure 3. SmartNet ICT reference model.

In addition to the common architecture design with generalized interconnections, we also created more detailed SGAM models for pilots and simulation platform. These derived models focus on real ICT system implementations which mainly cover one TSO-DSO coordination scheme. These realization models are called profiles, and they are used to map the common ICT architecture and communication requirements of specific coordination schemes to the pilot realizations. The interactions between system components are more detailed, because the components are taken from the pilots' design plans. The figure below presents an example of the profile created for the Danish pilot.

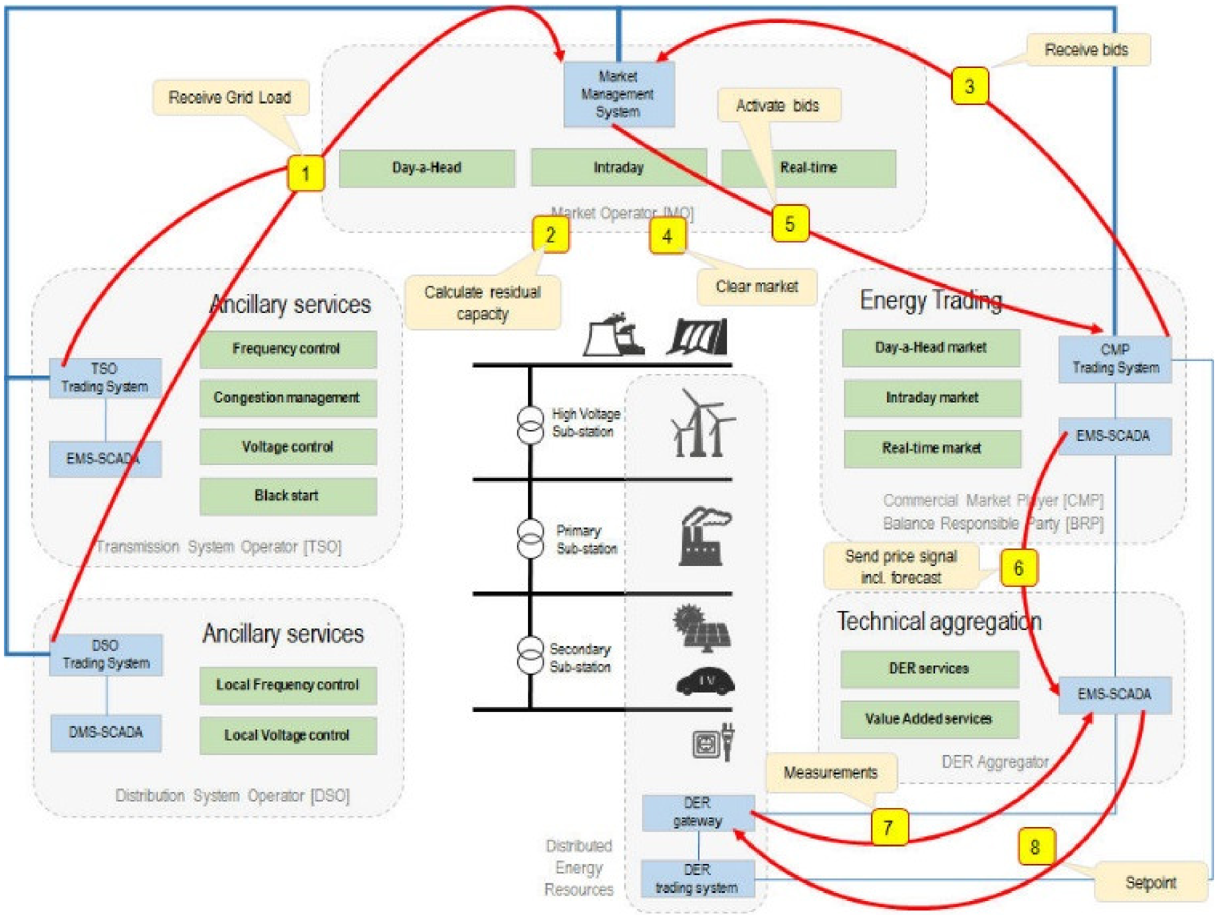

Figure 4. SmartNet ICT reference model applied to the Danish pilot.

The example table shows the summary of the terms and definitions coming from WP1, the ICT requirement classes in WP3, and the operational steps defined in WP5 Pilots.

Table 1. A summary table of ICT requirements for a part of profile created for the Danish pilot.

Step	Latency	Network	Security	Requirement	Protocol	Information
1	Type 5	Two-way communication	High	RC_Prequalification RC_TSOtoMarket	PC_EnergyMarket PC_EnterpriseProcess	IE_ReserveNeeds IE_NetworkConstraints
2						
3	Type 5	Two-way communication	Medium	RC_CMPtoMarket RC_MarketToCMP	PC_EnergyMarket PC_EnterpriseProcess	
4						
5	Type 5	Two-way communication	Medium	RC_Confirmation RC_Activation	PC_EnergyMarket PC_EnterpriseProcess	IE_Activation
6	Type 5	One-way communication	Low	RC_MarketDERtoCMP RC_Participation	PC_NetworkOperation	IE_AssetActivation
7	Type 5	One-way communication		RC_Flexibility Aggregated flexibility	PC_DER	IE_DERParticipationTech
8	Type 5	One-way communication	Medium	Control parameters	PC_DER	

Main results

The work package ends by the end of February and the main results of WP are:

- Requirement specification report (D3.1) including general and SmartNet specific ICT requirements for smart grids.
- Architecture design procedure that uses both top-down and bottom-up analysis approach
- SGAM models created with the Enterprise Architect tool for common ICT architecture and pilots
- Architecture design report (D3.2) with the description of enabling new technologies

References

[1] D1.3, "Basic schemes for TSO-DSO coordination and ancillary services provision", December, 2016

[2] R4.1 "Description of the methodology for the detailed functional specification of the ELECTRA solutions", January 2015

[3] D3.1, "ICT Requirements specification", November 2016.

[4] D3.2, "ICT Architecture design", to be published in February 2017