SmartNet

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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ICT requirements

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Outline

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2. Scope of ICT requirements specification
3. Ancillary service requirements
4. Data exchange and service architecture requirements
5. Security and communications requirements
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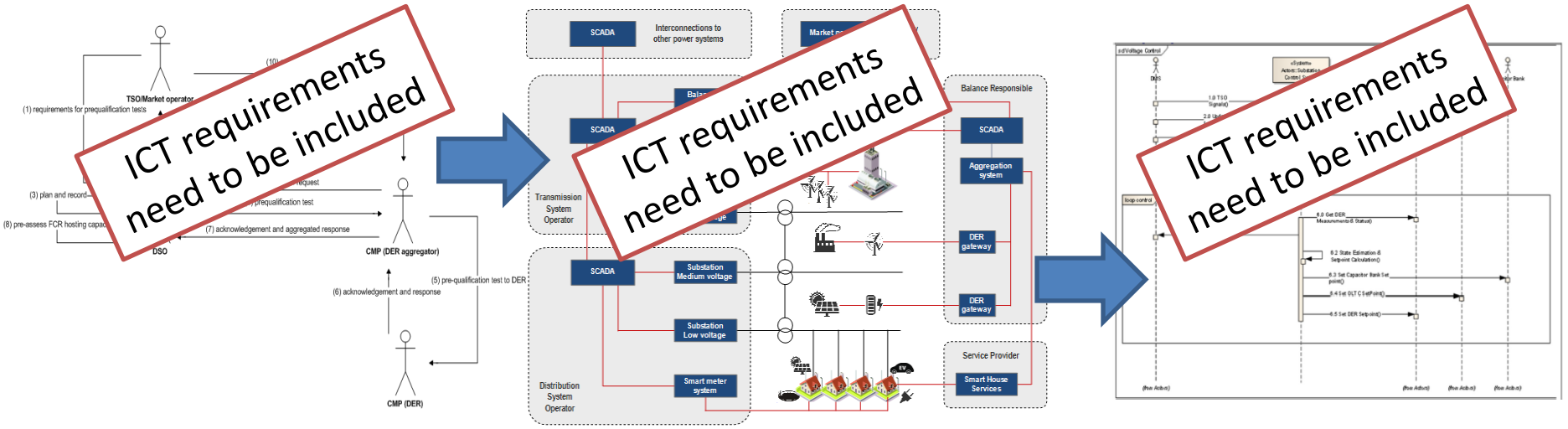
State-of-the-Art

- Energy systems are moving towards **more flexible** and **distributed** structures.
- Energy and data flows will be **bidirectional** and demands for communications **more versatile**.
- This poses a challenge for today's communication systems, because they do not always meet the expectations.
- It will take time before the new TSO-DSO coordination schemes and market models are realized.
- Meanwhile, ICT solutions will evolve fast making it **difficult to choose solutions that meet the requirements and have a long life expectancy**.

Transition from business requirements to ICT requirements



Business layer

Component and communication layer

Information layer

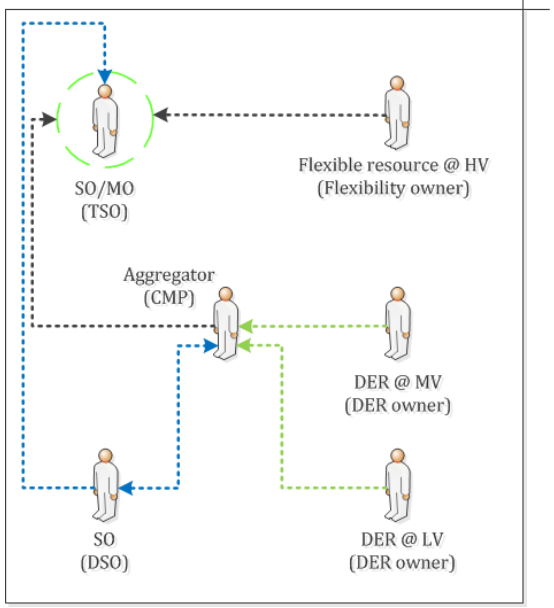
Scope of ICT requirements identification

- General information sources:
  1. **General Smart Grid approach** at European Level representing the high level framework.
- SmartNet project specific:
  1. **Coordination Schemes (CS)** definition, which represents the market models, involved actors/roles, and their relationships.
  2. **Use Cases (UC)**, which describe the main characteristics of the ancillary services used in the SmartNet ecosystem.
  3. **Market characteristics**, which impose certain requirements related to market operations.

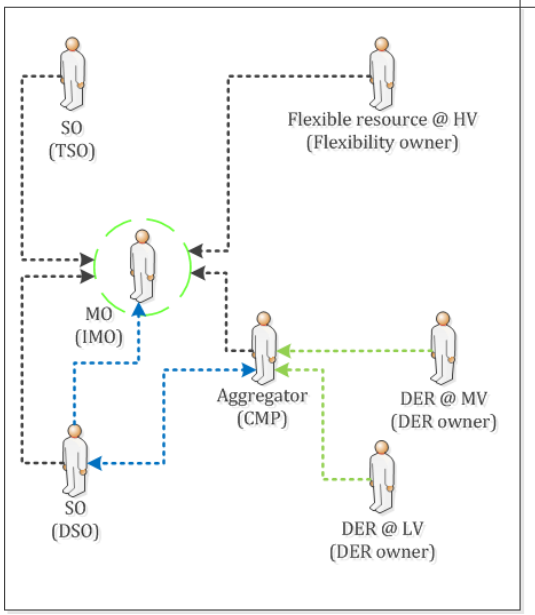
TSO-DSO coordination schemes

Five possible TSO-DSO coordination schemes for AS by distributed flexibility resources

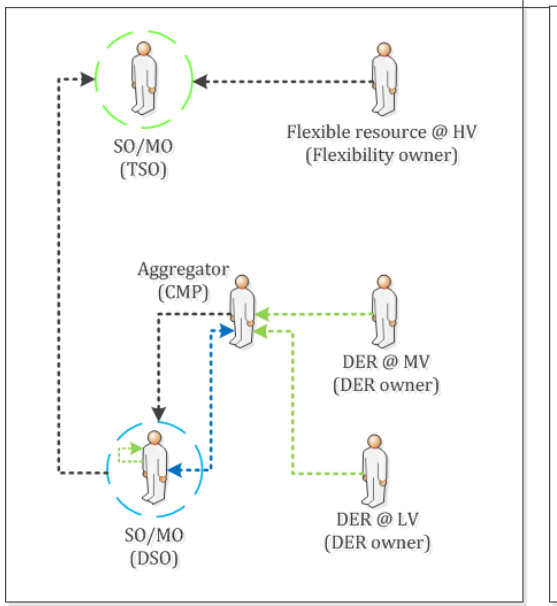
Centralized AS market model



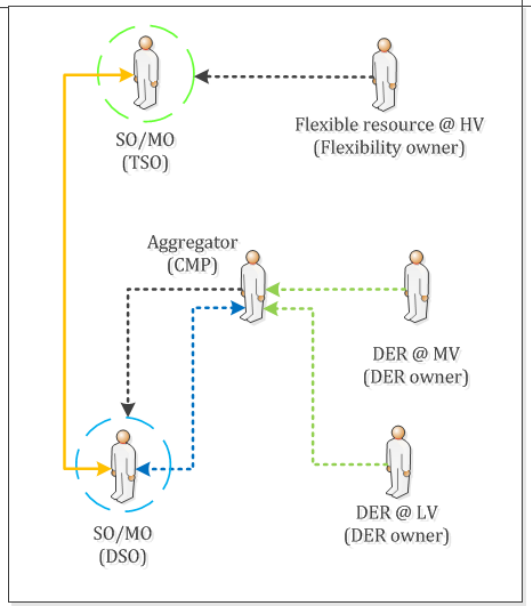
Integrated flexibility market model



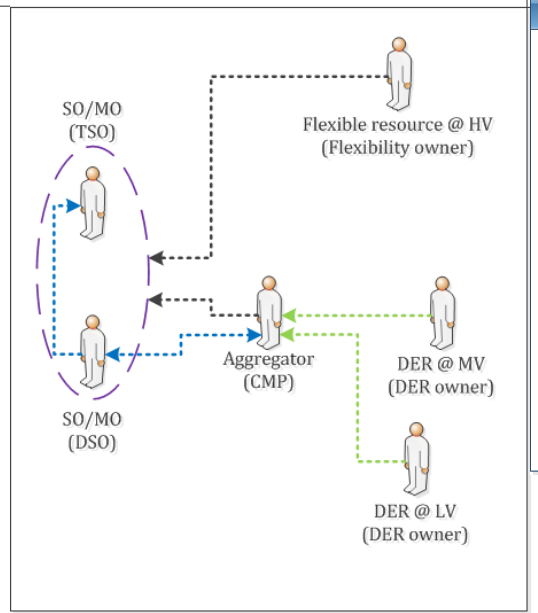
Local AS market model

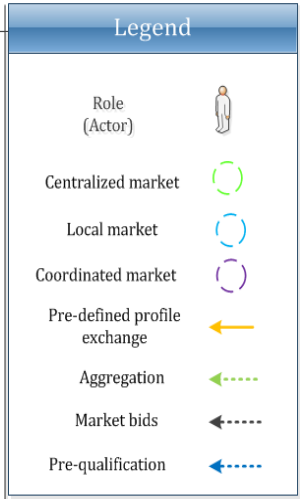


Shared balancing responsibility model



Common TSO-DSO AS market model





Ancillary service requirements

- The most relevant ancillary service procedures are:
  - Market: prequalification and procurement

Increased coordination affects **interoperability** and **security** requirements.

- At the operational level, tighter coordination between TSO-DSO, as well as between many other different actors and systems, is needed in case of distributed models.

Data exchange requirements

- Suitable data exchange protocols and standards already exist.
  - Smart Energy Grid Coordination Group (S(E)G-CG) has recommendations for

The existing data exchange protocols and standards suit well to the proposed coordination schemes. The main question is more related to **privacy** and **data ownership** issues.

and settlements.

- **IEC 62351** is the reference standard for security in smart grid environments (aimed at improving security in automation systems in the power system domain).

Service architecture requirements

- The selected service architecture has a significant impact on energy systems' **interoperability**, **flexibility**, and **security**.

Proposed solutions:

- **TSO-DSO level**: Conventional Enterprise Service Bus (ESB) solutions are applicable in core parts of the systems.
- **Aggregator level**: Service-Oriented Architecture (SOA) Gateways are offering additional security by splitting the secure and insecure parts of the networks.
- **DER level**: Microservices (single-function modules) are a cost-effective and flexible way of building local services. In addition, global players e.g. Amazon and Google can also be service providers in future.

Security requirements

- Market and grid operations are separate.
- Recommendations:

The security challenges are more likely from the interactions with **small actors** and components stationed **at the edges** of the grid.

  - Economic information: market bids and financial settlement.
- **Authentication:** is high in all cases. The origin of the information must be ensured.
- **Non-repudiation:** is "low" level requirement for pre-qualification and settlement processes, and "high" for procurement and activation.

Communications requirements (1 / 2)

- Main requirements
  - OPEX and CAPEX costs
  - Security
  - Reliability
  - Latency (response time)
- Choosing the optimal communication solutions depends on several factors e.g. **regulation**, **business and market models**, **existing infrastructure**, **stakeholders' requirements**, and **investment and operation costs**.

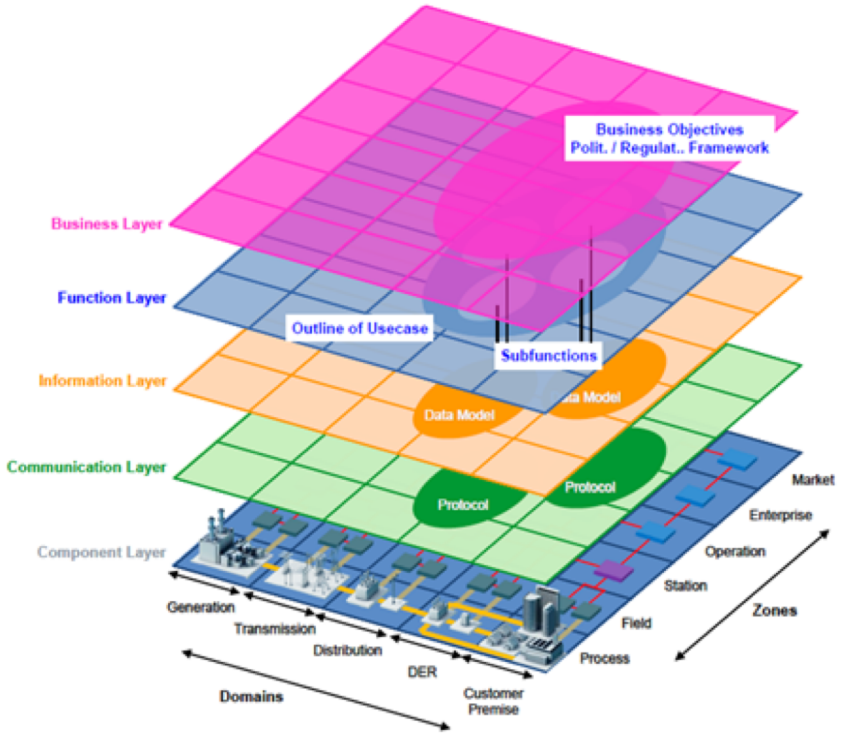


Figure 3 – Smart Grid Architecture Model (SGAM) [Source: SG-CG/M490/C]

Communications requirements (2 / 2)

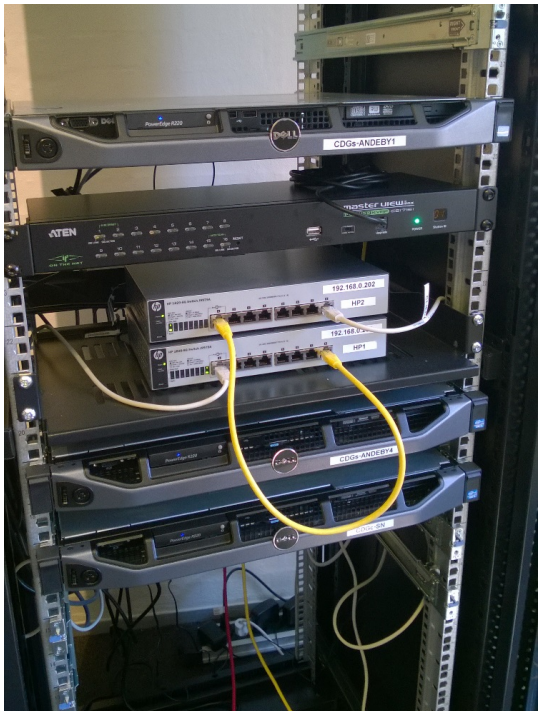
- Wireless technologies for **flexibility and cost-efficiency** at the edge of the grid

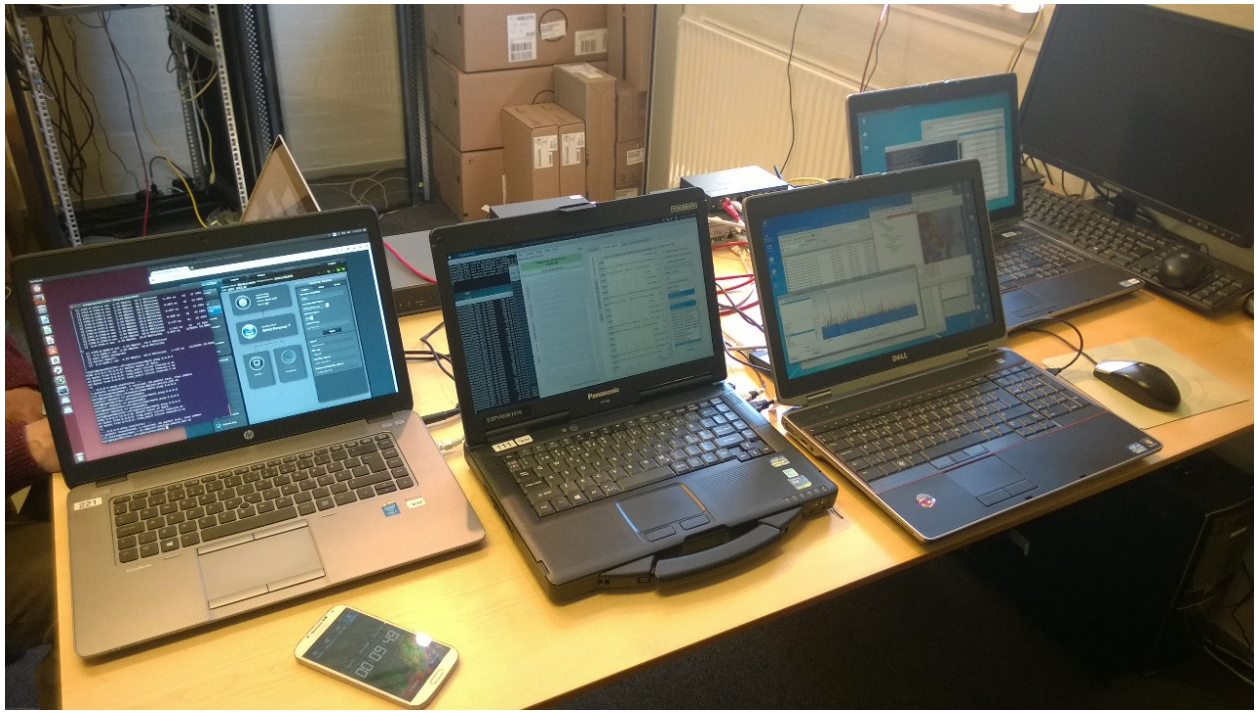
Regulatory support may be needed, since small stakeholders may not have sufficient competence or capital to make their **communication links** and **data secure**.

lowest investments for communication quality and security.

- Requirements and responsibilities need to be well defined (device manufacturer, service provider, and end-user).

Example of validation of delay requirements





QoS profiles from trial measurements are used to mimic wireless communication at the lab and assess its impacts.

Conclusion

- ICT requirement identification is needed in all steps from business use cases to the system operations.
- From ICT's viewpoint, the coordination schemes are not so different.
- The existing data exchange protocols and standards are suitable for new coordination schemes. The main question may be privacy and data ownership issues.
- Security and communication quality are critical in case of small actors and when inexpensive components are used at the edges of the grid → regulatory support is needed to make the communication links and data secure.
- Note, additional ICT requirements can also be proposed to ICT industry:
  - 4G and earlier mobile technology generations were technology-driven, but 5G is more service oriented focusing on industrial use cases.

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Thank You

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