HOW TO BUILD A MICROGRID PLATFORM WITH FUTURE INTERNET TECHNOLOGIES

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on behalf of the FINSENY project

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“Smart Energy enabled by Future Internet”
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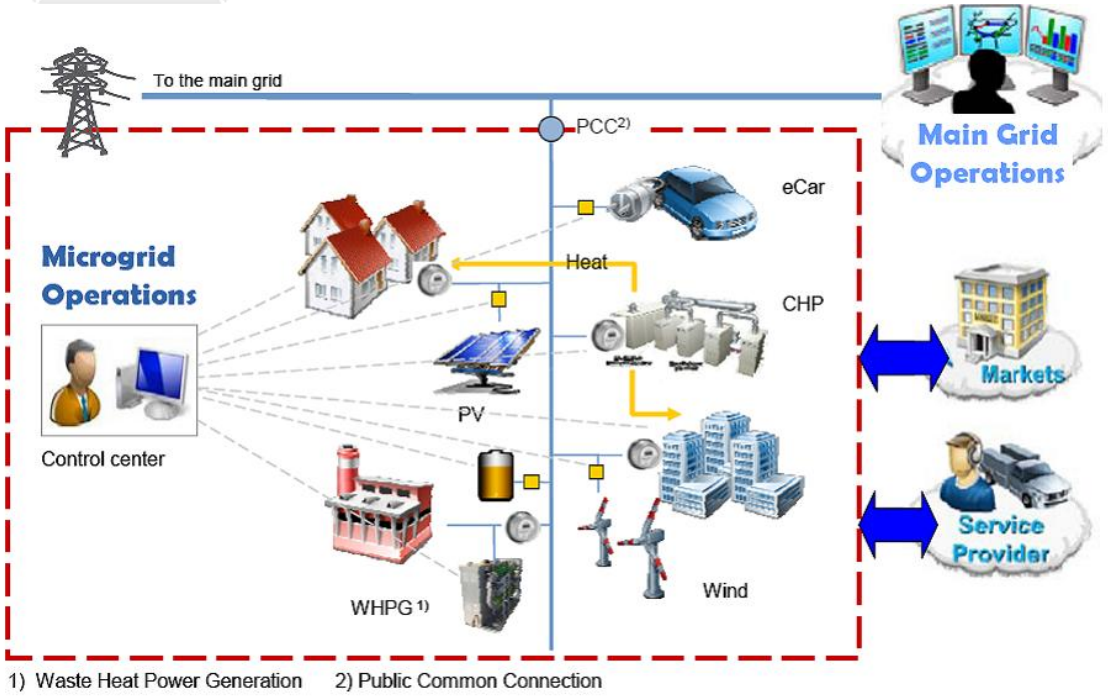
Overview

- What is a Microgrid?
- What are its benefits?
- Typical Microgrid use case
- Use Case Analysis & ICT Requirements
- Functional Architecture
- Conclusion

What is a Microgrid?



1) Waste Heat Power Generation 2) Public Common Connection

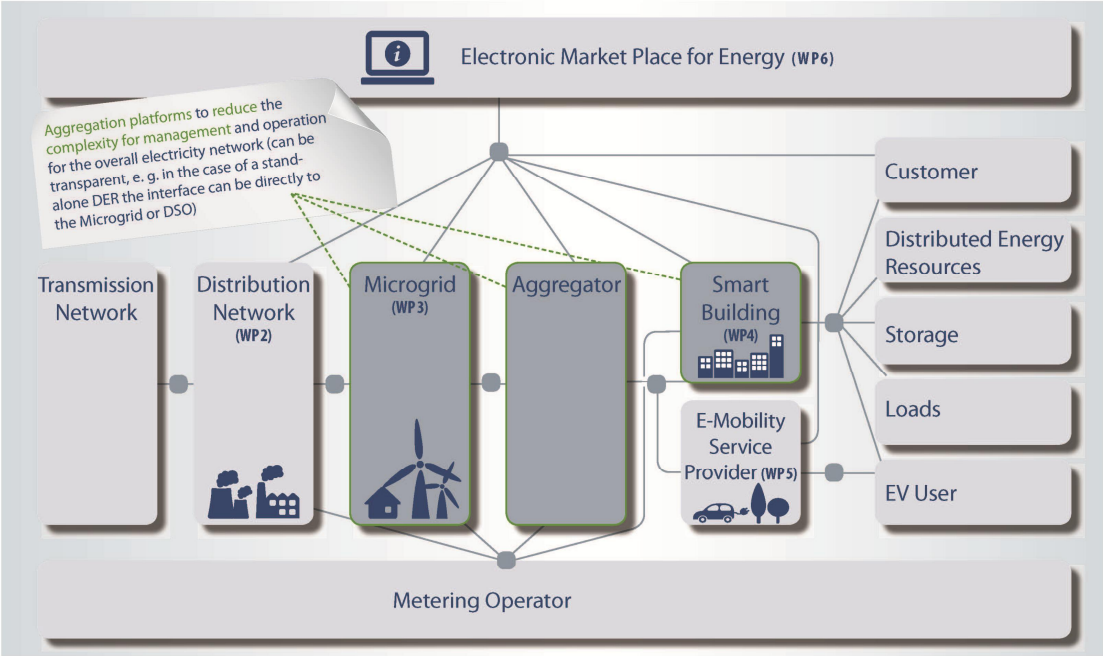
Source: Siemens AG

Microgrids

- comprise **local LV or even MV distribution systems** with **distributed energy resources** (micro turbines, fuel cells, PV, etc.) together with storage devices (flywheels, energy capacitors and batteries) in order to **satisfy the demands of energy consumers**

- can be operated in a **semi-autonomous way**, if interconnected to the grid, or in an autonomous way (**islanding mode**), if disconnected from the main grid
- sizes could range **from residential to campus or community** wide systems

Microgrid Benefits

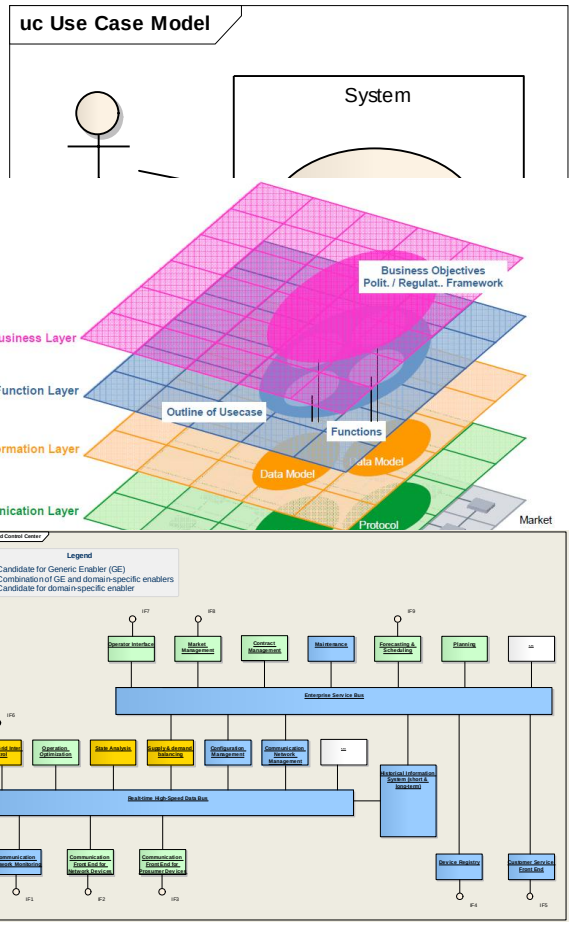


- Microgrids provide an **aggregation platform** to handle the complexity for operation of the whole energy system
- **Reduction of line losses** due to generation closer to the loads
- **Mitigation of voltage variation** through coordinated reactive power control and constrained active power dispatch

- **Reduction of peak loading** of constrained network devices through optimized scheduling of all sources
- **Autarkic/islanding mode** in case of connection loss to main grid
- Includes essential features of **Virtual Power Plants (VPPs) & Aggregators**

FINSENY's Methodology aligned with Smart Grid-Coordination Group

1. Scenario description
   - Identify use cases and actors (market roles as well as systems & devices) according to IntelliGrid method
2. ICT requirements
   - Define requirements for communication & information flows as well as services and middleware
3. Functional Architecture
   - Identify key functional building blocks and interfaces, specify data models and communication protocols
   - Develop ICT architecture based on generic and domain-specific enablers

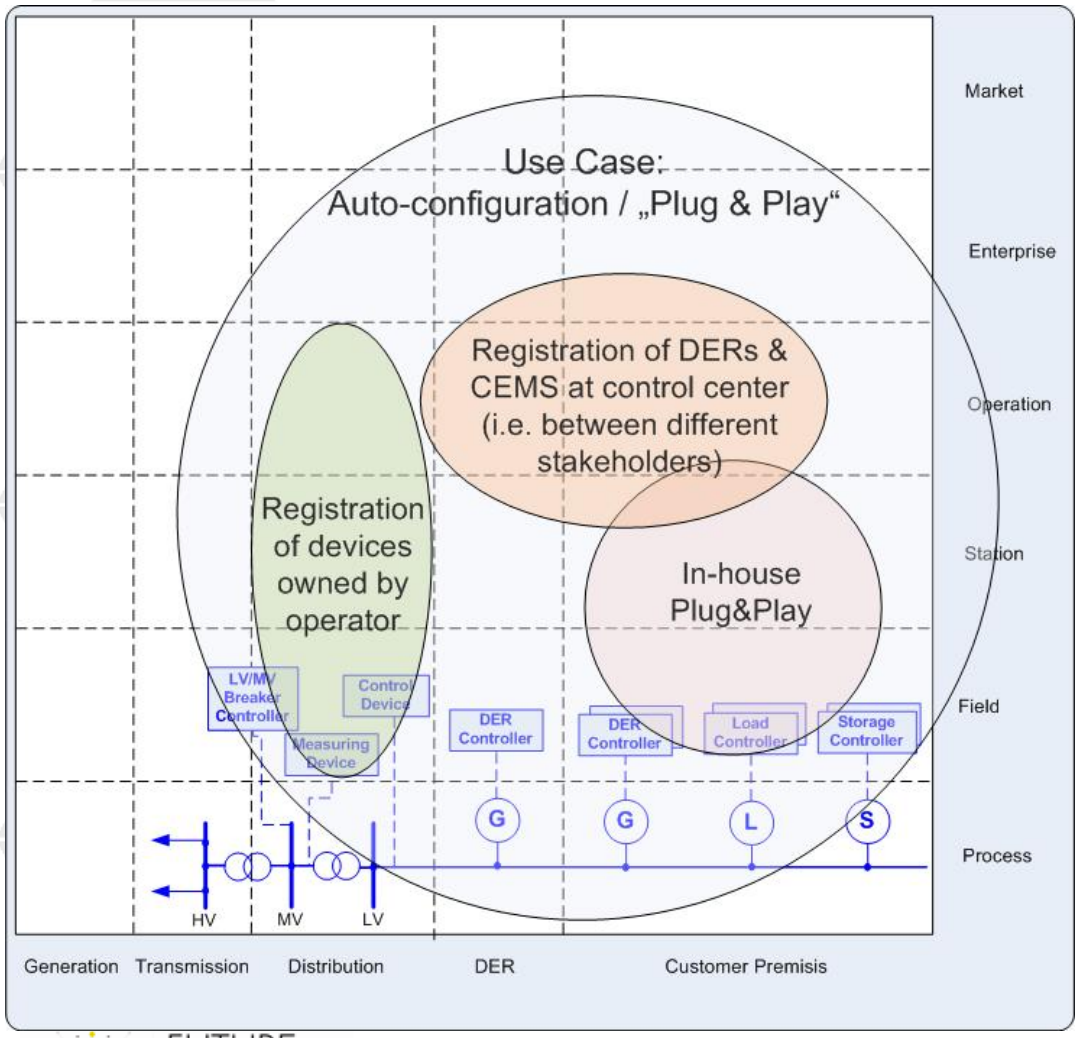


Microgrid High-level Use Cases

- Business Use Cases
  - „Interactions with other market roles to negotiate and to contract energy or ancillary services”
    - Microgrid Operator sells and buys energy on external markets
    - Microgrid Operator sells Balancing and Ancillary Services
    - Microgrid provides Islanding Mode
- Control & Management Use Cases
  - “Describes the action taken to run a function of the system”
    - Balancing supply and demand on different time-scales
    - Demand-side management / Demand Response
    - Supply-side management
    - Black start in Islanding mode
    - Auto-configuration
    - Long-term planning of Microgrid infrastructure design and upgrading

Deriving Sub Use Cases

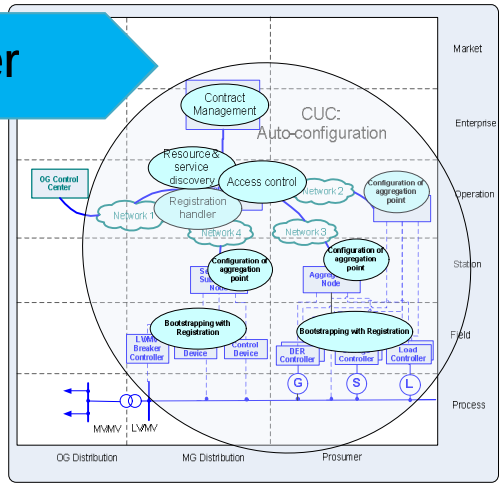
Example: Auto-configuration



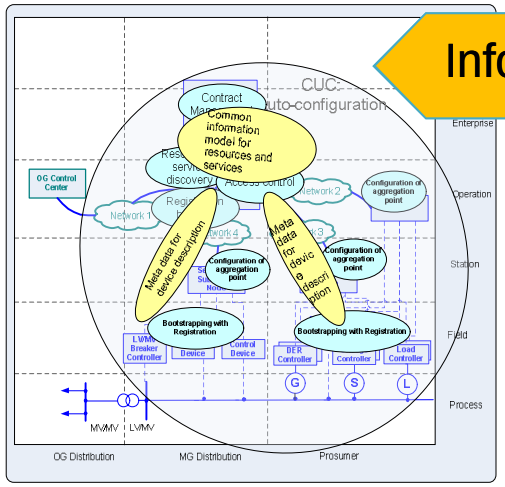
- Auto-Configuration:
  - New sub-systems or devices installed in the Microgrid automatically configure itself.
- Sub use cases:
  - Registration of devices owned by the Microgrid Operator
  - Registration of DERs & CEMS at control center (i.e. between stakeholders)
  - In-house Plug&Play (out of scope for Microgrid)

Use Case Analysis with Smart Grid Architecture Model

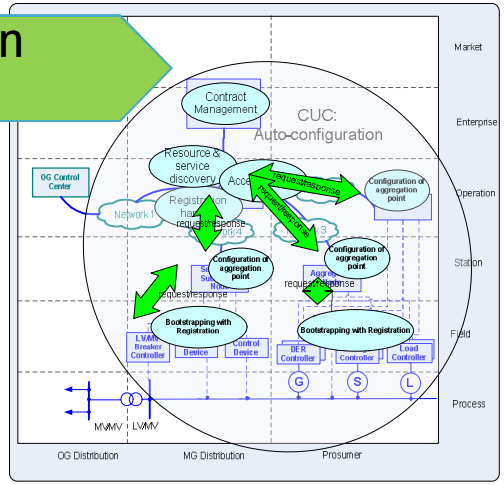
Functional Layer



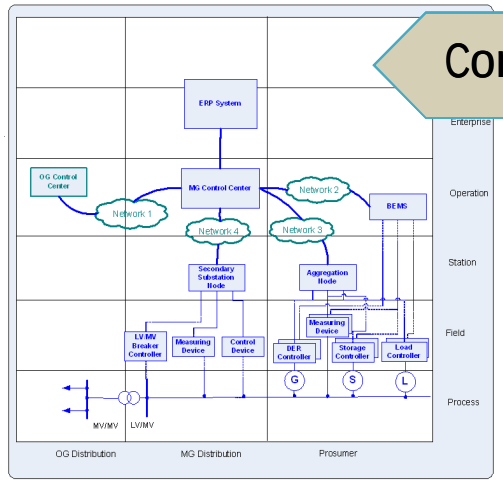
Information Layer



Communication Layer

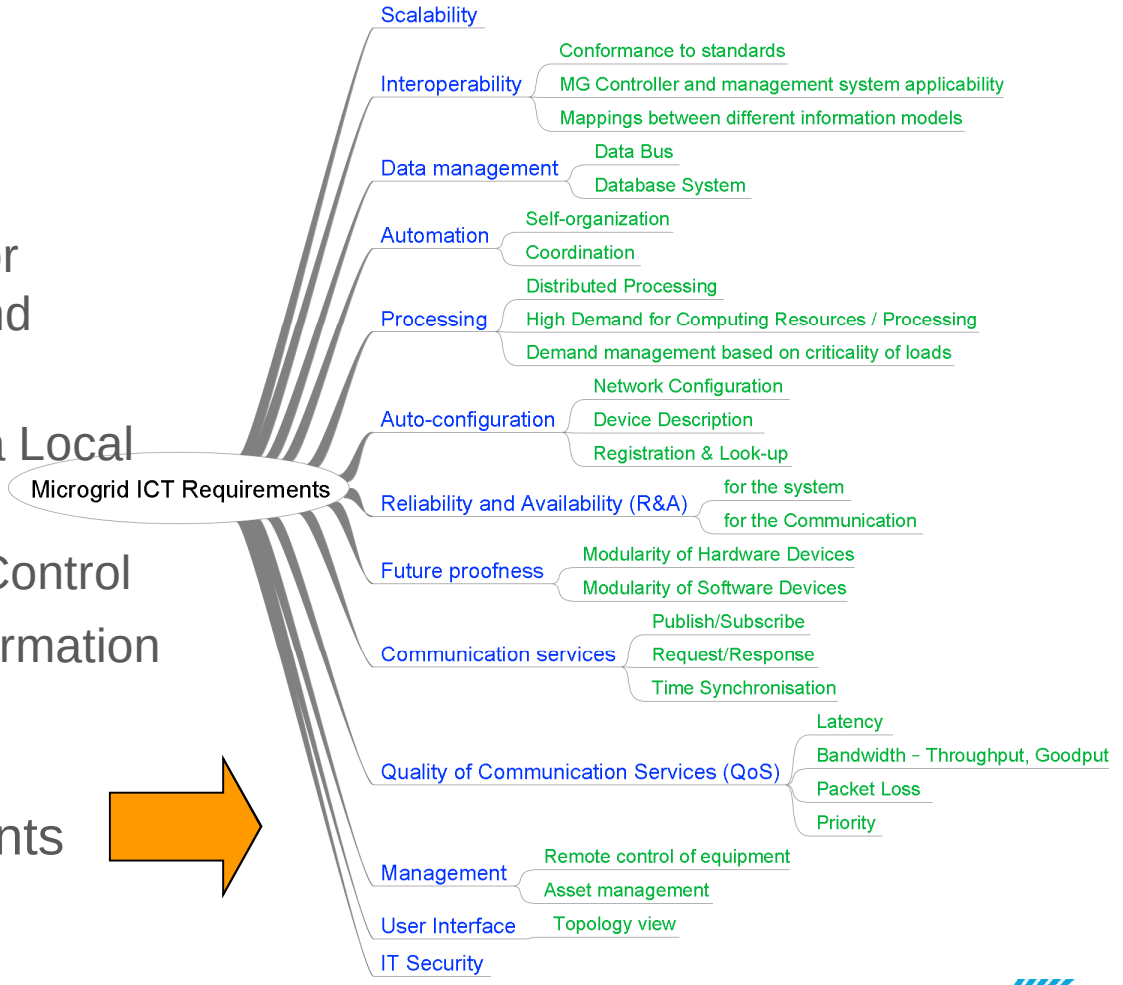


Component Layer



ICT Requirements for Microgrids

- Auto-configuration
  - Addressing
  - Device description
  - Device registration for remote monitoring and control
  - Device discovery in a Local Area Network
  - Role-based Access Control
  - Mapping Tool for Information Models
- Further ICT requirements



Quality of Service (QoS) Requirements in Microgrids

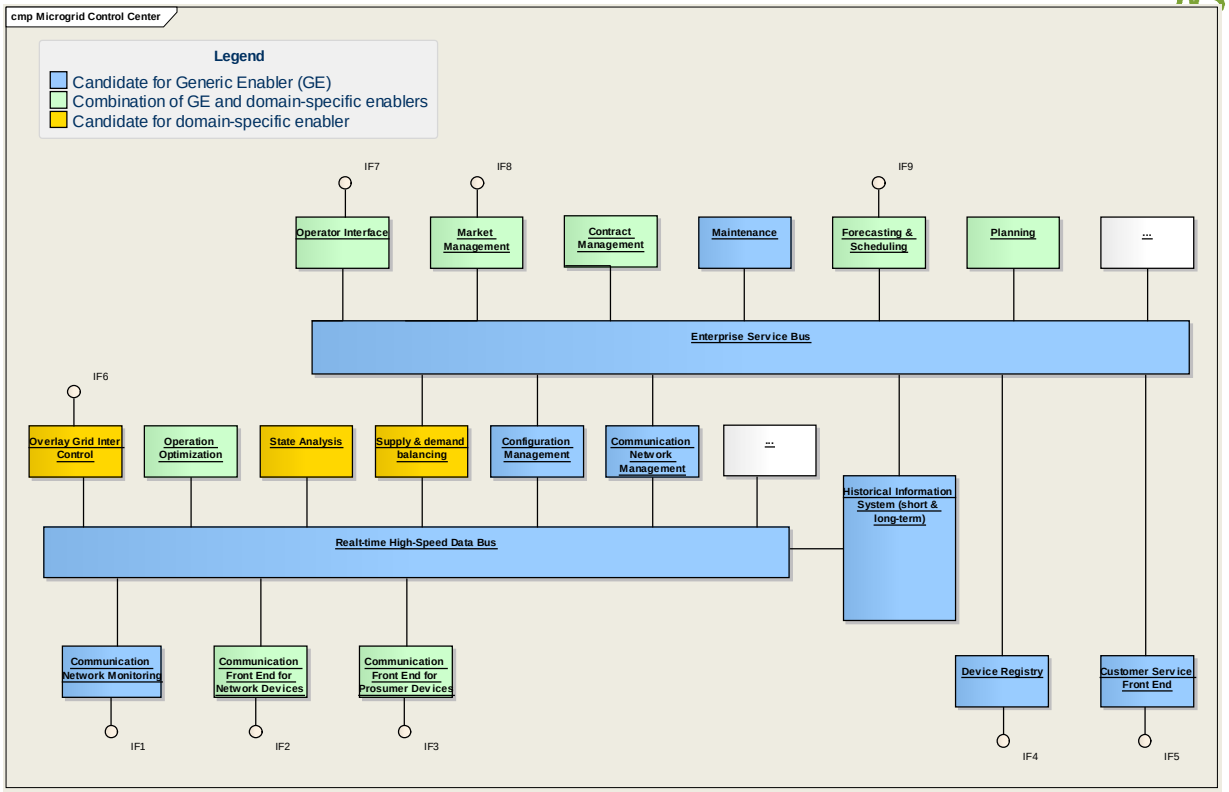
- To ensure the stable operation of the Microgrid different connectivity services are needed with QoS guarantees
  - Four Classes of Service were derived
- Cost-efficient solution has to be designed with the best mix of private, service provider networks and public infrastructure

	Connectivity Service 1: Safety critical	**…**	**Connectivity Service 2B: Operational critical (Monitoring(**	**…**	**CS 4: Background**
Priority	Highest		Medium		Low
Latency	< 10 -100ms		< 1s		Best effort
Data occurrence	Event triggered		Periodically		Event triggered & periodically
Bandwidth / Data volume	< 1500 Bytes		< 100 kbps		Best effort
…	…		..		

Functional Architecture of Microgrid Control Center

Drill-down
of all use cases

identifies all functions
at functional layer

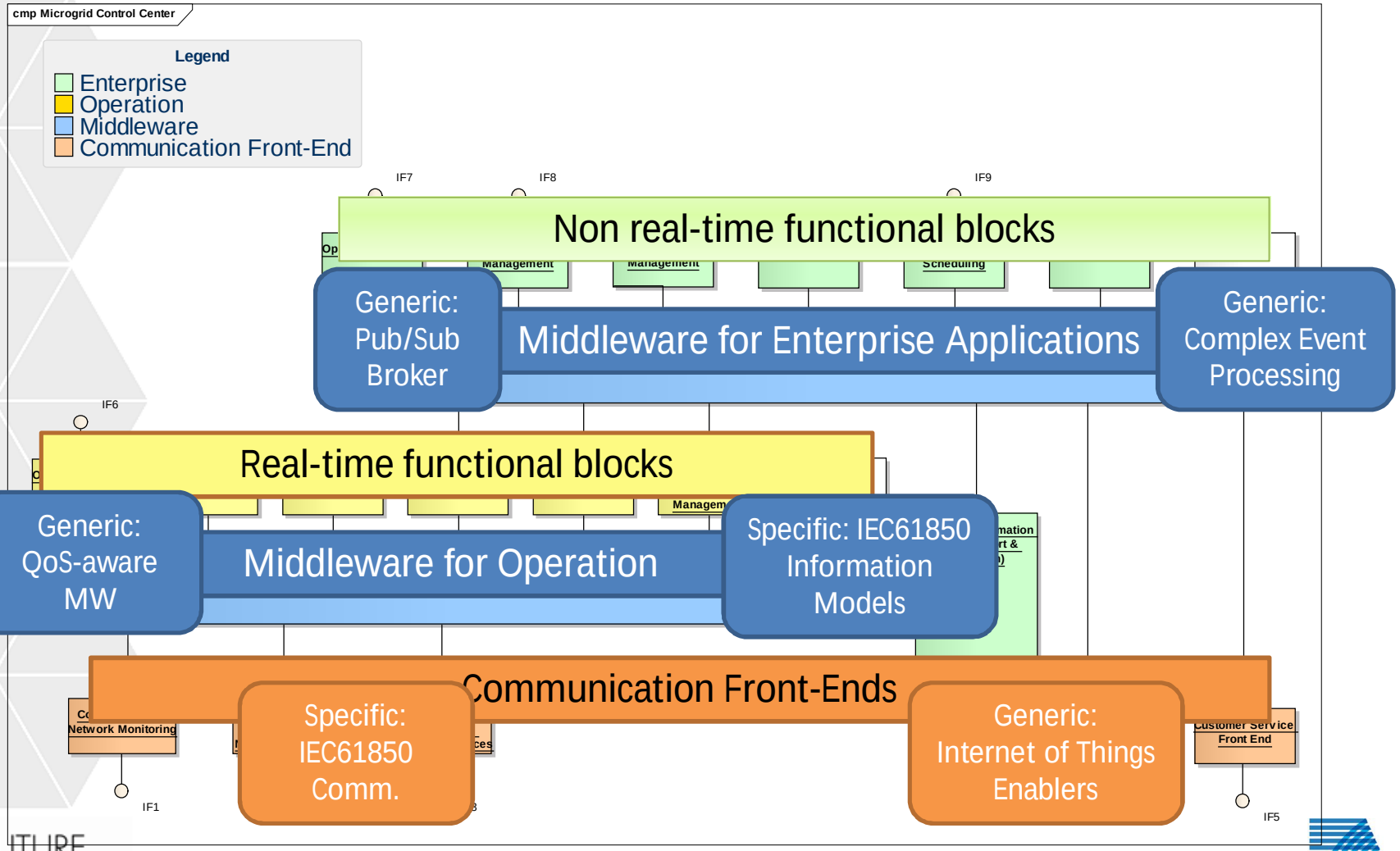


Harmonization of functional layer results in functional building blocks

Architecture and interfaces are derived from building blocks

Building blocks are realised with generic or domain-specific enablers (or combination)

Examples for Generic & Energy-Specific Building Blocks



Conclusions

- FINSENY evaluated the Microgrid scenario and provided detailed results on
  - Identification & description of use cases
  - Consolidation with Smart Grid-Coordination Group
  - Analysis of use cases with Smart Gird Architecture Model (SGAM)
  - Specification of ICT requirements
  - Coordination with the other FI-PPP usage areas on requirements covered by generic or domain-specific enablers
  - Specification of functional architecture considering generic & domain-specific enablers

Internet of the Future for Smart Grids

THANK YOU FOR YOUR ATTENTION!

Siemens is cooperating with partners to find out how Internet-related technologies could be used to control smart grids. As part of this effort, the global Siemens research organization Corporate Technology has become the technical coordinator of the EU's FINSENY (Future INternet for Smart ENergY) project

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Because it is inexpensive and available in many places worldwide, the Internet is an ideal network not only for normal telecommunications but also for many industrial applications.

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