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## ICT requirements for operation of advanced and robust smart grids



### Challenge

Climate change and the scarcity of resources inspired research, in the field of renewable energy and its implications for energy networks, far-reaching ideas from micro-grids, across smart grids, to the super-grid have emerged. Multi-agent systems (MAS) are able to cope with complex tasks in various areas of daily life. An application field is the electric power grid and research approaches towards smart grids. Due to the increased complexity, sole control by the human seems impossible and thus high-performance assistance control systems are required. In order to use multi-agent systems, an efficient and fault-tolerant ICT infrastructure that is feasible for the task of remote control solutions, is needed. ICT4RobustGrid analyses existing structures and compares them with the requirements of a MAS and provides a road map for a possible transition from a centralised to a decentralized control system in the power supply grid.

### Contribution

- Technology development of affordable Smart Grid energy system ICT solutions
- Competitive advantages integrating results in lectures for future scientists
- Securing research excellence in Austria by cooperation of University and industry

### Objectives

- Assessment of pertinent standards and specifications
- Definition of the technical requirements for the integrative operation of ICT and electric grids
- Definition of interfaces and communication handling between the networks
- General communication requirements
- Requirements assessment for integration in current electric grid controls

### Method

- Detailed state of the art analysis, research trends, regulations, and standardization
- Requirements engineering analysis of current conditions in supply and distribution networks
- Concept development and interface definition
- Evaluation review and feasibility analysis

### Results

Agents should not be considered as some exotic AI concept but merely as a design approach that potentially brings significant simplifications in ever step of a software object lifecycle.

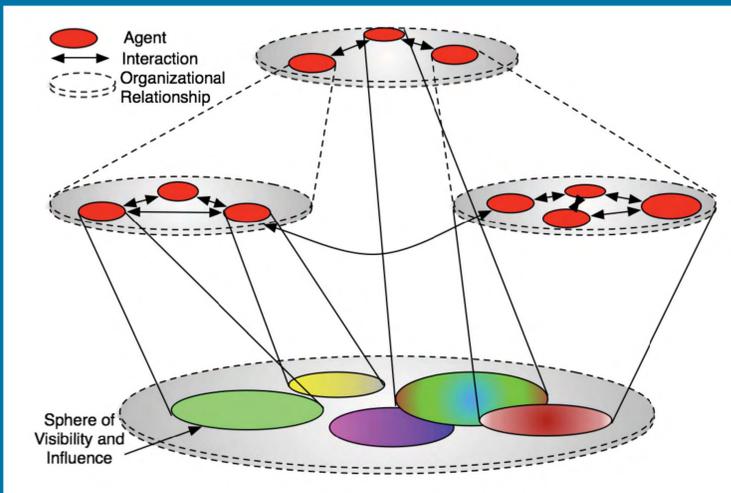


Figure 1: Canonical view of a MAS as in [JB03]

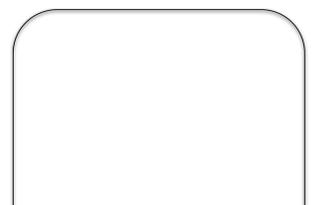
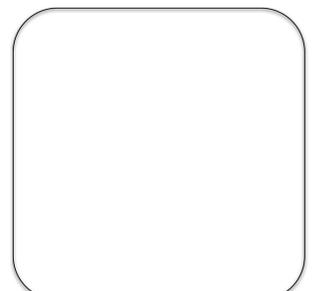
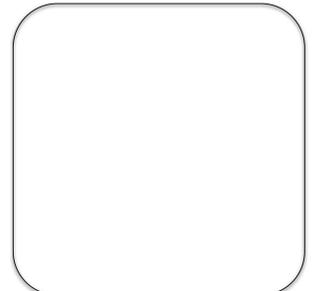
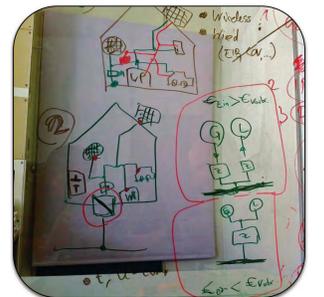
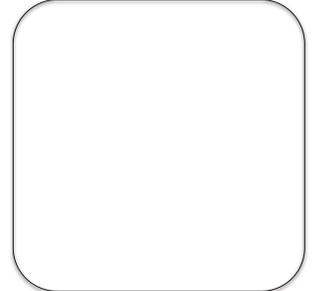
As of now, there does not seem to exist a single control approach using a flat hierarchy. Because of this fact it can be safely assumed that future approaches will also always be a compromise between centralized and distributed architectures. In order to facilitate vendor interoperability it is not sufficient to only support standards, but also a common upper ontology for power engineering has to be defined as stated by Catterson et al. in [CDM05].

### Outlook

- Sound standing recommendations for potential projects including migration plans for embedding into existing systems
- Feasibility analysis for a holistic ICT and electric grid control approach
- Roadmap for a possible transition from current electric power grid controls towards a scalable secure decentralized control concept

### Open Questions

- Evaluation of the economic and financial aspects of the elaborated concepts
- Recommendation of procedures for network operators, political research policies, etc.
- Standardization requirements for MAS and ICT in a Smart Grid Machine2Machine context
- Market issues for commercial MAS solutions



[JB03] N.R. Jennings and S. Bussmann. Agent-based control systems: Why are they suited to engineering complex systems? IEEE Control Systems, 23(3):61–73, June 2003.  
 [CDM05] V.M. Catterson, E.M. Davidson, and S.D.J. McArthur. Issues in integrating existing multi-agent systems for power engineering applications. In Intelligent Systems Application to Power Systems, 2005. Proceedings of the 13th International Conference on, pages 6 pp.–, Nov 2005.

### Project Partners:



# TECHNOLOGY FOR PEOPLE

This exploratory project is funded as industrial research by the Austrian Research Promotion Agency (FFG)

Through our research we „develop scientific excellence“, through our teaching we „enhance comprehensive competence“.

