

## Decentralized multi-agent systems for distribution network control

### Dezentrale Multiagentensysteme für die Verteilnetzsteuerung

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*Increasing deployment of decentralized energy generators (DEG), especially in rural areas with low load density, will soon push the stability and operation of distribution networks to their limits. Beside conventional grid extension there is an intelligent agent-based solution which could manage the reverted power flows and improves the utilization of existing assets. Adequate multi-agent systems are developed as part of the project Grid4EU. This project will create a network reconfiguration algorithm which uses the network automation, provides a homogenous loading distribution and maintains the stability of the grid.*

*Der zunehmende Einsatz von dezentralen Erzeugungsanlagen (DEA), insbesondere in ländlichen Gebieten mit niedriger Lastdichte, wird schon in naher Zukunft einen Betrieb des Verteilnetzes an den Zuverlässigkeitsgrenzen erfordern. Neben dem traditionell eingesetzten Netzausbau verspricht eine intelligente agentenbasierte Lösung die Rückspeisung in übergeordnete Netzebenen zu fördern und vorhandene Betriebsmittel besser auszunutzen. Entwicklung geeigneter Multiagentensysteme ist Teil des Projektes Grid4EU. Unter dem Einsatz der Sekundärtechnik in Verteilnetzen werden Algorithmen zur Topologierekonfiguration konzipiert, so dass die Belastung im Netz gleichmäßiger verteilt werden kann und die Stabilität des Netzes gewahrt wird.*

The project Grid4EU consists of six demonstration projects. The part of ie<sup>3</sup> is being executed in cooperation with RWE Deutschland AG and ABB.

In the near future, the increasing by DEG could cause overload and voltage stability problems. According to some forecasts for the DEG development, in less than twenty years the amount of generation could rise to the triple of the current load. For some regions such a scenario would lead to bottlenecks and line overloads.

A modern technical solution is the combination of the conventional automation approaches, such as monitoring and control, and the so called agent-based technology which combines intelligence and communication. An agent is an autonomous unit which is capable of observing his environment and making decisions. Neighboring agents share their information and cooperate with each other in order to act secure and reasonable.

The main issue of the project is to provide a well-balanced distribution of generation among the substations by active network topology reconfiguration. On the one hand an optimal exploitation of assets can be achieved and on the other hand the reliability can be improved through switching. The proposed system consists of identical agents which are placed at some strategically important middle voltage/low voltage stations

(‘ONS’ in figure 1). All of the agents are able to measure their local state variables and to switch. They also communicate with each other in order to share information. At some particular points of time switching has to be done. The switching decision is the result of a cooperative negotiation process.

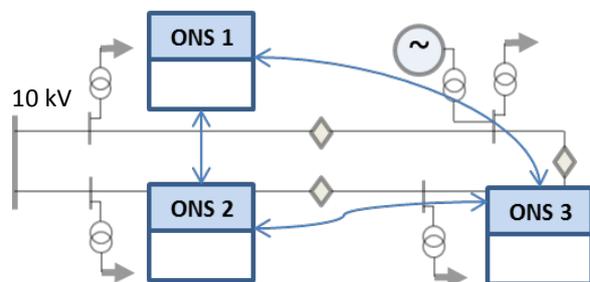


Figure 1: Principle system of Agent Based Communication in a distribution grid

A central supervisory instance called control center is responsible for the integration of the multi-agent system in the SCADA system. The control center is continuously registering all activities in the system. It is able to deactivate parts or the whole system in cases of field works or other human interventions. The proposed automation system is a modern approach for a more efficient and reliable network operation.