OpenMUC – SOFTWARE FRAMEWORK FOR ENERGY MANAGEMENT GATEWAYS

Power generation structures are developing rapidly. Volatile distributed generation requires new flexibilities and the coordination of supply and demand. New business models and markets are evolving. Energy management gateways are used to link and control different devices, such as sensors, meters, generation systems, controllable loads, feedback interfaces and grid infrastructure.

Fraunhofer ISE offers an open source software framework for the growing market of energy management gateways. It simplifies the development of customized energy management solutions for the smart grid and smart home domain, in which devices use different communication protocols.

The design principle of OpenMUC follows a modular approach based on Java and OSGI, resulting in a platform-independent, lightweight framework perfectly suitable for low-power embedded systems.

Monitoring, Metering and Communication

The scope of the application can be anything from a simple data acquisition system to a complex energy management system or a virtual power plant. Some examples are:

- data logging
- building automation
- PV plant monitoring and control
- smart metering (electricity, heat, gas)
- controlled charging of electric vehicles
- self-consumption optimization
- market integration of Distributed Energy Resources (DER)
- Remote Access and Control (RAC)

OpenMUC provides several components, such as a web interface for configuration and visual feedback, data servers, data loggers and drivers. Remote applications – such as smart phone apps and cloud applications – can access OpenMUC through data servers, e.g. the “RESTful” Web Service.
Innovative Control and Energy Management

Our simulation tools and our algorithms for prognoses and optimization allow innovative system designs, new business models and control concepts to be developed and evaluated. OpenMUC is seamlessly integrated in our SmartEnergyLab environment, allowing for realistic and profound validation procedures.

OpenMUC supports a growing set of communication protocol drivers:
- IEC 61850
- IEC 62056-21
- DLMS / COSEM
- eHz / SML
- M-Bus
- Modbus TCP / RTU
- KNX
- Siemens S7 PLC
- CANopen

Further drivers are currently under development to connect to PV inverters, heat pumps, battery systems and home automation components. OpenMUC uses a uniform data representation independent of underlying protocols and drivers so developers can entirely focus on the application's logic rather than the details of communication protocols.

References

OpenMUC has been extensively used in several research projects, since its first application in 2007 as a smart meter gateway in the DEMAX project. Further developments focused on the remote control of CHP units via IEC 61850 and CIM (in the E-Energy project eTelligence), as a SCADA system for a concentrated photovoltaic plant and the core of our charging infrastructure for electric vehicles at Fraunhofer ISE with a complex GUI and RFID authentication.

Currently, the focus of development is on the integration of complex optimization algorithms. In “Fellbach ZeroPlus”, OpenMUC builds the core of a home energy management system for self-consumption optimization, including the controlled charging of electric vehicles. In the “HeiPhoss” project, predictive algorithms for generation and loads are used to optimize the economic operation of a PV battery system, considering grid aspects like the buffering of the solar peak around noon.

Service and Support

OpenMUC is published under the open source General Public License (GPL). Exclusive developments and licenses are possible. Fraunhofer ISE offers various research and development services around energy management systems and general monitoring, logging and controlling tasks. Our expertise and many years of experience enable fast development of customer-specific applications and solutions. In addition to driver, component and application development, we develop customized demonstrators and pre-production samples and turn prototypes into a marketable commodity. Our innovative SmartEnergyLab at Fraunhofer ISE enables us to verify our developments. Commercial product development and long-term support is the scope of the Fraunhofer spin-off company “Enit Solutions GmbH”.

1 Interior view of our SmartEnergyLab at Fraunhofer ISE.
2 Low power OpenMUC platform.
3 Interactive EMS user interface.