Use Case Summary – Automated Meter Reading (AMR) and Customer Energy Management Systems (CEMS)

This use case describes two basic functionalities for enabling future distribution grids for load balancing and integration of decentralized and distributed (renewable) energy resources. Therefore, Automated Meter Reading (AMR) is an enabling technology, which is capable of generating precise multi-sector metering data and aggregate them on local grid operator side for large-area and in-house analysis of current energy consumptions as well as grid load conditions. Additionally, current efforts in context of the Internet of Things aim to connect more devices in the household to create a more intelligent home area network (HAN), including components of customer energy management systems (CEMS) like distributed energy resources (DER) and storages, demand side management, private electric vehicle charging and user interaction. In context of AMR, this adds an additional way of home building automation by combining the energy consumption of accordant components with the current status of the energy grid to improve its stability by shifting loads balanced with the neighborhood area network.

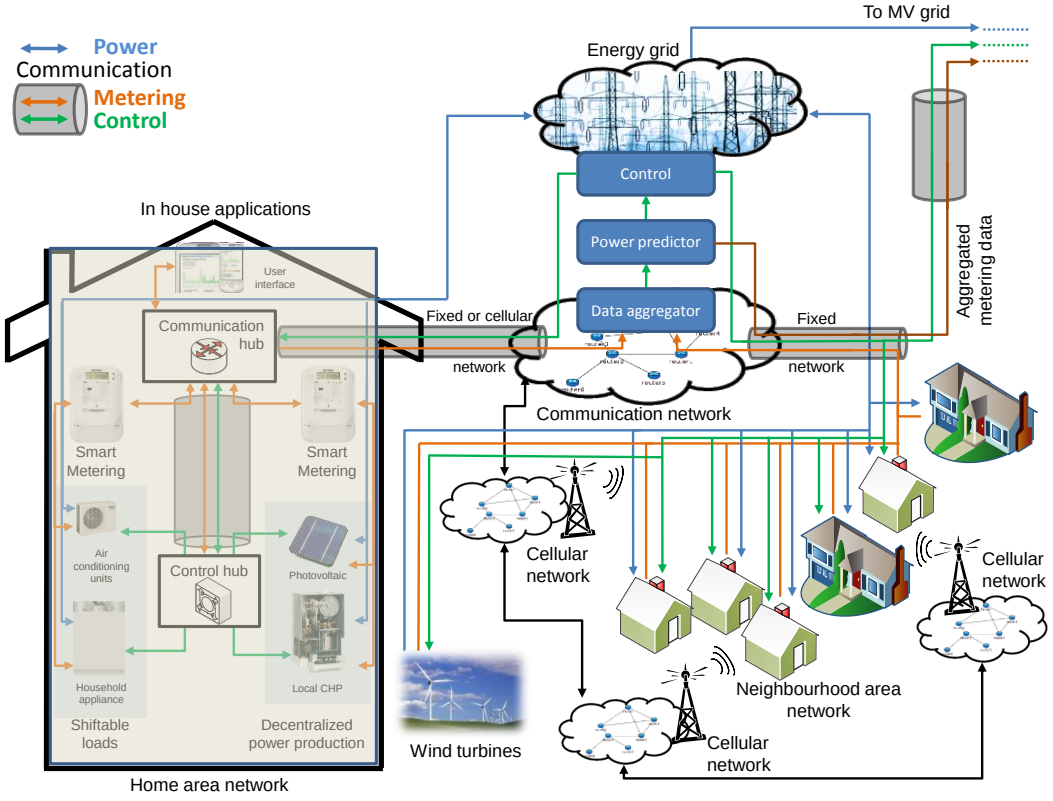

Figure 1: Advanced Smart Meter Reading and Customer Energy Management System Scenario

AMR is often referred as the key application for enabling a Smart Grid. Basically, AMR represent different approaches for automatically collecting energy consumption data from electric, gas, water and heating metering devices and transmitting these data to the meter reading operator for billing and accounting. This information enables the energy utilities for an accurate meter reading and a detailed forecast of the predicted energy consumption. Since several years AMR systems are already deployed mainly for industrial and commercial customers, based upon an integrative approach by combing the actual metering components and a WAN interface for remote meter reading. Due to the European

Mandate M/441, a monthly billing for the customer and a roll-out of Smart Meters in 80% of all European households until 2020 is targeted, which requires cost-efficient, modular concepts for the comprehensive deployment of Smart Metering devices considering a variety of application scenarios. Due to different technology life cycles for energy components and ICT components a modular system is targeted in most of the approaches. Usually a Metering HAN Gateway collects and stores metering data from several metering devices, like electricity, gas, water and heating meters connected by short range radio, e.g. ZigBee or Wireless M-Bus. The collected data is bundled and securely transmitted to the meter reading operator by different access technologies, based on wireless, wired or PLC technologies. Moreover, a local feedback system gives the prosumer transparent insight into his current energy consumption. In conjunction with available tariff information, motivation for reducing overall power consumption can be achieved.

Additionally to the basic functionality of the AMR deployment, a more balanced usage of volatile renewable energy sources (RES) and shift-able and controllable load system (CLS) in the distribution grids is achievable by an active integration of the components on the customer side. In this context, several customer energy management systems (CEMS) are presented, like locally managed and self-sustaining Micro Grids, virtual power plants and centralized load coordination like DSM or DER based on dynamic energy prices. All approaches focus on the bidirectional integration of DER and prosumers (producers and consumers) from both power and communication engineering's point of view. This includes volatile RES such as wind farms and photovoltaic systems, as well as energy-aware households, which are enabled by AMR to get a detailed forecast of the energy demand and additional transparency in energy consumption on the customer side. Moreover, based on CLS and DG through Combined Heat and Power (CHP) generation, micro-turbines and intelligent photovoltaic (PV) panels, the ability to balance load peaks and valleys is given. These approaches require, because of the distributed installations and small shift-able load potential, an aggregation of multiple DER. Through concepts such as VPP, microgrids and energy hubs, different components are combined using various networking concepts into a logical, partly independent group (e.g. isolated networks). At this point, the seamless integration, reliable and near real-time connectivity within the households by an Energy Management Gateway (EMG) and a CEMS, which is required for DER and DSM at the customers side, are key capabilities of reliable power distribution grids.
All in-house components assume to be connected via a CEMS, which can be realized by a dedicated wired or wireless home automation system (e.g. narrowband PLC, broadband PLC, BUS systems, ZigBee, W-MBus, etc.) or a shared medium provided by the customers in-house networks (e.g. wireless LAN, broadband PLC, etc.). At least one access technology (at least cellular networks), but potentially more communication means, depending on the existing possibilities, e.g. power line, 3G or fiber (if already installed in the household) and operators, may differ between households.