Smart energy metering in houses

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There is no control without connection and no control without metering!

Beside the comfort and security, we expect from Smart House also savings in operation and energy saving behaviour. So, except of famous outsider and inside temperature metering, each Smart House should have metering of all kinds of consumed energy.

Metering and consumption

Metering of overall energy consumption in each home, flat and administrative building is has been arranged at least once per year by suppliers and distributors since a long time. The reason is to make the invoice of delivered electric energy, gas, heat and water. The consumer may anytime read the values of these meters and wrote them into a diary. He will get the paper overview of consumption in the past, usually without context with other events and quantities influencing the consumption, for example outsider temperature or cooling down by wind. And only a small part of them use the values for thinking of where to save by changing of behaviour, exchanging of appliances by economical ones, thermal insulating of buildings or watering the garden by rain water instead of water from pipeline.

Current consumption has to be visible Present Smart Houses are regularly equipped by possibility of consumption metering. Usually by secondary meters, because the meters for invoicing are a property of suppliers, sealed and not many of them are equipped by outputs ready for automated reading. The most developed are electricity meters, which provide optical pulses via LED indicator. Only few water and gas meters are ready to provide such pulses too, but the number of them is increasing.

On the contrary temperature meters are usually equipped by electronic communication for automated data reading. Continuous pulse reading of each meters and displaying the status on some display, smart phone or TV screen is the simplest we may require from Smart House at this field.

Energy consumption and money consumption

Available secondary pulse electricity meters of size one circuit-breaker module enables monitoring of each circuit consumption, so from the whole consumption we may separate consumption of floor rating, air-conditioning, pump for watering from water well, pool operation, permanently switched on TV or heat pump. Metering of heat (flowing multiplied by temperature difference) at rating pump output and comparing with its electricity consumption we may get real present efficiency. And like that by metering of heat on output of solar panel we may see the gained energy we had to buy in other case.

This secondary consumption metering is not the most rousing information. It is consumption of all energies converted to money consumption. Just this value, displayed for example at TV screen may stand the consumer up from his chair to switch off the uselessly lighting light or decrease the temperature in some rooms. That´s right that in Smart House he cannot even stand up. The only thing he need is to catch the mobile phone or tablet and execute the change. Most smart houses may execute this by themselves. If they are programmed or set well, they evaluate when and where they light and heat uselessly.

Smart Metering and Smart Grid

From the other side, EU is taking care about global energy consumption decreasing by declaring many directives, time limits and percentage targets. One of them defined target to equipped 80% of consumers by smart metering till 2020. This will be valid in case that till 3rd September 2012 (after deadline of this issue) EU member states analyze, that declaration of these systems will bring positive results. Smart metering becomes an integral part of Smart Grid – smart distribution network, what is speed developing by mass application of renewable energy sources like wind and photovoltaic power.

Operator and the network stay in front of new technical fact – necessity of energy delivery stability when the ratio of unstable sources depending on weather and daily time is higher and higher. A logic idea is that to hold and control distribution network stability have to run inside the network detailed information about consumption of each consumption place, about possibility to postpone consumption or accumulate energy at consumer, controlled and motivated by various tariffs, about current capacity of local energy sources, about weather development in the area (wind, sunshine, clouds).

Implementation of smart electricity meters communicating via distribution network or mobile operator network enables operator to automate remote metering of each consumption place the consumption within 15 minutes interval. This information may be used for more exact and more often invoicing but also for flexible network control and on-line informing of consumer about his consumption development at web pages protected by name and password.

Advanced Metering Management

In the Czech Republic each one from three electricity suppliers analyzes its pilot projects, when it has been installed thousands of AMM electricity meters (Advanced Metering Management). Some of them prepared possibility to inform consumer about current consumption right at his TV green and even more often than 15 minutes. Information from AMM electricity meter to be read each 30 sec. and updated at TV screen in kW and in money according to valid tariff. The consumer may see ether result of his intervention (switching on/off some appliances or moving their operation) within one minute.

Smart electricity meters measure even other parameters of the network like voltage and current in each phase. Of course, it measure also reversed energy flow, because today there is a reality that, in case of strong wind or sunshine, the consumer becomes a energy supplier.

We may see beginnings of electricity meters, which read automatically water and gas meters equipped by transmitters according to standard Wireless M-bus.

Such measured and stored values may electricity meters provide to consumers TV screen or transferred via network together with values of electricity consumption to gas or water supplier. Again for invoicing, for more exact monitoring of consumption time course, for monitoring of leakage and other failures in water and gas distribution networks.

In this case we have different requirements on Smart House and its control system than functions of systems for controlling lights, jalousies, interior temperatures, security systems or systems focused on multimedia comfort. House intelligence gets new technical dimension. For choosing and directing manufactured energy at the moment and for specific individual system of sources, accumulating devices and appliances we need to choose free programmable system.

Image: 1: Use of metering device Tecometer:
a) Intelligent electric energy meter with transmitter, b) Receiver connected to common TV

Implementation of AMM electricity meters communication bidirectional with central module will replace HDO (Czech short name for Mass Remote Control) and enables implementation of more energy tariffs. The supplier will be able to offer more advantageous tariffs in different periods, graduated according to for example accumulation capacity (hot water tank, electric car,…) which the consumer is able to offer supplier for storing of energy surplus as compensation of tariff decreasing.

Smart House as a part of Smart Grid

In connection with progressive increasing of local electric energy sources, it is advantageous for the whole transmission system to consume the energy at place of its origin and burden the transmission system minimally. Consumers in the Czech Republic are motivated to this by Green Bonus. In such case the consumer is in the same position as producers and distributors. What to do with electricity when is not needed, where and for what price to get it during the night or windless conditions, when he usually need it.

Such system, which measure and display (for example at mobile phone) consumption and transfer of energy in technological nodes, but the results use for control – open and close the valves, charges accumulators or warm accumulating tanks. Systems, which may be only parameterized, usually doesn´t have functions for such tasks.

Each Smart House is becoming, from energy supplier point of view, a new type of appliance with high rate of independency, with individual behaviour and individual requirements for energy delivery from oxide and from own sources. Control system of such house and its communication interface will become beside smart electricity meter next regular participant of network Smart Grid. It will become a node, which provides to electric energy supplier operative information about current energy consumption including short time forecast. On the other side, such node will be ready to get information from supplier about expected current development of electric energy surplus for a discounted price (tariff) and according to this it may optimize using of such cheaper energy by switching on selected appliances, whose functions allow this.

More metering, more savings

Beside of primary energy consumption metering from supplier, we begin to measure in Smart Houses other values, whose may look like additional, but they definitely belong to complex of total consumption control. Into this group we may involve water level metering in water-well or water level in rain water tank for catering the garden. Energy savings for watering and water savings have connection with ground humidity metering and rain sensors. Concentration of CO2 and related room controlled ventilation with recuperation also help to decrease energy consumption for rating or cooling. Room sun shining and following closing jalousies minimize the warm in the room during the summer, so we save energy for air-conditioning.

From energy metering we may get many useful information for house security. When the house is reporting a high consumption of energy after the last resident left, it may be warning, that we forgot to switch of something – oven, gas burner, filling bath by water etc. If the empty house reports not null electric energy consumption, it may signify, that someone is inside the house. Is it a member of our family or an intruder?