Energy Saving Information Platform (ENERsip)

ICT infrustucture for energy-positive buildings and neighbourhoods

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Abstract— **The main impact of ENERsip project will be the energy consumption reduction achieved by coordinating the actual users' needs with the in-buildings and neighborhoods positive-energy generation.**

Keywords (Energy, SmartGrid, ICT, Infrustructure)

I. INTRODUCTION

Over the last few decades, worldwide energy demand has increased due to industrial development and global economic growth, resulting in a simultaneous increase in global energy costs and poor environmental behavior. The Electricity Consumption breakdown in the EU was recently characterized by the European Project REMODECE (Residential Monitoring to Decrease Energy Use and Carbon Emissions in Europe). The final report published in November 2008 states that electronic loads (mostly entertainment and ICT) consume more than 22% of the electricity, a significant percentage (can be over 50%) of which is standby and other non-active modes (e.g. a router left on 24 hrs. per day). Lighting left on in unoccupied rooms is another source of waste. Other miscellaneous equipment (bread-makers, coffee-makers, microwaves, etc.) also have wasteful low power modes. Real-time consumption information allows the typical household to reduce electricity usage by 10 - 20%. Seeing the actual usage that results from existing household habits will influence most consumers to change their attitudes toward conservation and reduce overall consumption.

The main goal of the ENERsip project, recently funded by the FP7 ICT and Energy theme, is to create an adaptive, customizable, and service-oriented ENERgy monitoring and control system for energy grids and decision makers to allow reduction of energy consumption by coordinating the actual users' needs with the in-buildings and neighborhoods positive-energy generation facilities.

II. BACKGROUND

A. The ENERsip idea

The European Society is directly affected by consequences of industrial development and global economic growth, having a large impact on environmental conditions and the cost of energy. Improving energy efficiency in European buildings and businesses has become a very important goal in the European Commission. One of the main concerns of the EC in respect to energy is the increasing consumption and dependency of energy in every day's aspect. This leads to a constant increase in the dependency on energy imports, the increase of contamination and global climate change.

On this line, the EC has committed the States to convince the society, and provide them with the means to reduce energy consumption, create a culture of energy efficiency, and promote the construction of green buildings with energy co-generation. So, the energy positive terminology appears as an answer to what EC directive is looking for.

ENERsip was conceived on the idea that mixing energy, communications, control, computing and implementation of the consumption and generation elements, must be active and proactively coordinated. To bring the idea into reality, ENERsip will develop and test in real-world conditions, an open Information and Communication Technologies platform that will provide a set of tools for near real-time optimization of generation and consumption matching in buildings and neighborhoods.

ENERsip is targeted to allow the emergence of an open electricity market by using components from different suppliers, unifying their protocols and providing reliable data exchange services, thus helping reinforce European industrial and technological position in ICT-enabled energy efficiency technologies.

B. Energy generation networks are evolving…

Nowadays, energy generation, transmission and distribution networks evolve towards an increasing presence of electricity generation sources in buildings, either for proprietary consumption or for being sold to an electricity operator. As of today, most of these buildings have their own infrastructure for the generation of electricity. Sometimes, the motivation of building householders for installing these networks is achieving economic profitability via the sale of the energy; in other occasions, they may aim to implement their central hot water or central heating systems. This infrastructure is usually installed by professional companies and it is compliant with energy distributors' guidelines, but it tends to lack adequate maintenance from an energy efficient point of view.

C. ... allowing end user interaction with the network...

On the other hand, the ENERsip project will help consumers manage the used energy in order to be able to save energy while maintaining desired comfort levels. For doing so, the project will provide an open service-oriented platform accessible through an intuitive interface that will enable remote control of electrical appliances be informed about near-real time consumption of energy, and even know individual consumption of each electrical appliance.

From a global perspective, the ENERsip platform will expand AMR (Automatic Meter Reading) systems beyond the meter via in-house networks to obtain information and allow smart consumption in energy-smart buildings, and beyond the sub-station into the building generation to improve energy efficiency and network integration. Thus, it will no longer just collect consumption information from the AMR system, but rather act upon that information to improve the efficiency of the energy consumption. The user will not only be informed about consumptions, but the system will also automatically help to reduce those consumptions.

D. ... and helping create nation-wide smartgrids of Energy Generation Networks

Having the domestic generation network controlled, and having a detailed consumption pattern of each user, ENERsip will allow the integration of the different domestic networks within the distributor's network. This will take grid operators from a generate-sell model, to a generate-predict-sell model. The Automated Demand Response (ADR) protocol will enable the energy network to seamlessly communicate with each home network, under open standards, so that the complete energy infrastructure will work in complete harmony. A great deal of attention will be given to emerging standards for network communication, such as the OpenADR protocol.

With an open integration platform, new actors come to play within the scenario, creating small consumption generation and consumption grids, and also the emergence of new local business models. The support of these new business models is currently outside of the ENERsip project scope.

III. TECHNOLOGY

A. AMR and M2M in the Energy Companies

M2M technology is by no means a new concept. The trade-off for utility companies is rather to send engineers out to read meters once a period, a very labor intensive process, especially if customers are not at home, or having an electricity meter connected to an M2M module to transmit data regularly, with no need for human involvement. AMR helps make the retention process dramatically more cost-effective. With AMR installed, bills can be based on actual readings rather than estimates without incurring huge personnel costs. With utility companies largely influenced by costs and return on investment, AMR is initially being brought in where the value of customers is highest. M2M technology can definitely help utility companies to meet their three key business drivers: lowering operational costs (by making maintenance cheaper); ensuring sustainability (by monitoring key assets for instant fault reporting); and optimizing the whole process around customer management.

B. Technical limitations of existing products, processes and/or services

The current solutions in the market are based on the overall consumption of each user, on a monthly basis. These solutions are not effective because they are not providing specific information on the way the energy is consumed and the way the energy consumption may be reduced with optimized usage. Most of the technology required to implement the vision of a truly intelligent Smart Energy network has been in place for at least 10 years. Metering and communication resources were available that could support most of the concepts now being explored. The hurdles holding the development of a smarter infrastructure have been two-fold: economical and lack of internationally accepted standards.

The economical factors are quite easy to understand, in that ICT prices have been free-falling for the last 20 years, while energy prices have been steadily climbing, with only minor hiccups. Thus, it is now feasible to setup a complete communication infrastructure, with individually addressable meters, home networks, and massive data mining applied to the huge volumes of data that are generated. On the other hand, the economical feasibility of the concept has been creating pressure for the adoption of open standards that allow the emergence of a new industry around the ICT infrastructure that allows the energy infrastructure to be more efficient.

C. ENERsip Main innovations

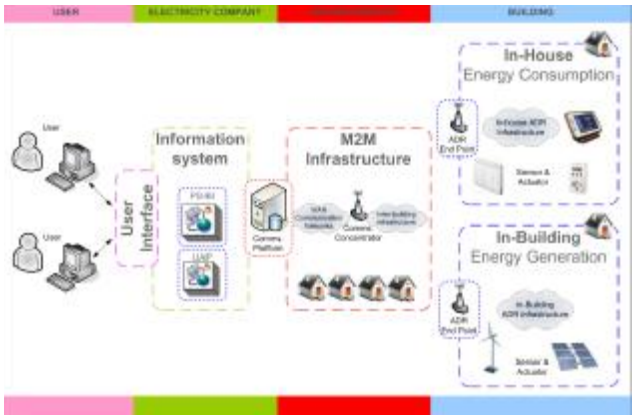

Figure 1. ENERsip Architectural Levels

The main ENERsip result is an open service-oriented platform focuses on data acquisition from the embedded wireless sensors, and integrated management of the elements included in buildings and the neighborhood's energy network. Due to this generic applicability, the ENERsip approach and architecture can be adapted to other distribution environments like water or gas. The entire solution as well as the design of the modules combining the ENERsip platform is novel and could have a high potential to extend its applicability to other

domains requires real time demand-respond balancing operation.

ENERsip relies on a robust and powerful M2M infrastructure, based on intelligent embedded nodes that acquire and adapt the information to the characteristics of the communication segment, and a local execution of operations that allows the performance of remote management operations. These embedded nodes are part of the M2M network that can be remotely managed from the central stations, given that they have autonomous agents independent from the rest of the operations in the system.

The ENERsip architecture presents a Service-Oriented Architecture (SOA), which exposes software functions as usable, customized and advanced services, which can be discovered and invoked throughout the network. The use of SOA allows sharing of data and applications, and provides a flexible and standard mechanism to re-use the services, thus allowing the development of new added value services. Furthermore, SOA facilitates the collaboration between companies, given its focus on B2B environment.

From a technological point of view, ENERsip creates a new environment mixing in single framework different communication technologies, decision making software, information systems for the integration of generation-distribution networks, and interfaces with end users to make them active players in the system. Energy optimization will be brought by the inclusion of information monitoring and the application of a service-oriented approach. In addition, the usage of SOA enables an easy integration and development of new applications since SOA and Web Services are a strong programming paradigm, heavily endorsed by large integrators such as Sun, Microsoft, Oracle, SAP, and IBM.

Due to its openness and vision, ENERsip will facilitate the emergence of new business models, allowing its future integration with billing systems, ERPs, and CRMs as commonly used by utilities and distribution grids, in order to have a complete perspective of the whole lifecycle of energy consumption, user preferences, and the status of the network.

ACKNOWLEDGMENT

Thanks to all the contributors to the ENERsip proposal, whose work allowed the generation and delivery of a clear and innovative idea. The ENERsip project consists of 10 partners from Spain, Portugal, Israel, Czech Republic and Belgium. ENERsip partners according to the alphabetic order are: Amplía Soluciones S.L, AC&A (Aplicaciones de Control y Automatización), ESI (Fundación European Software), Honeywell SPOL, ISA (Intelligent Sensing Anywhere), Israel Electric Corporation, Motorola Israel Ltd. (MIL), UC3M (Universidad Carlos III De Madrid), University of Coimbra, VITO (Vlaamse Instelling voor Technologisch Onderzoek)

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