A HOME ENERGY MANAGEMENT NETWORK

By Bill Melendez

The most significant change in the electricity industry has been the move towards an intelligent, or smart, grid. The smart grid is so designed that it can provide solutions to load management and peak demand, as well as handle potential blackouts such as have been seen in the California energy environment.

What the smart grid does not do is solicit support from the energy users whose demand for energy precipitates the crisis in the first place. Eliciting the co-operation of those who consume energy may eventually be the only choice left in reducing energy consumption. The less energy used, the less energy generated, and the less air pollutants released into our atmosphere. This is clearly illustrated in Table 1, which shows what a typical home could save in terms of CO_2 emissions and costs and demonstrates the advantage of including consumers in the conservation equation.

Getting consumers to reduce electricity use is a difficult and daunting goal. In many places electricity is extremely cheap due to the low cost of fossil fuels used to generate that electricity. As long as fossil fuels such as coal are readily available, the issue of air quality and global warming will continue to be a major problem in the United States, among other countries. However, numerous studies have shown that consumers are eager to do their part in conserving electricity and saving costs. They only lack the tools to do so.

There are many incentive programmes being used to help consumers minimise energy use and thus help reduce demand, particularly during peak periods. These programmes are simple and do provide a measure of success in achieving a reduction in energy use. However, the methods employed and costs associated with such programmes limit them to trials and small deployments when compared with the number of energy consumers. What is needed is an economical and simple way of inducing energy users to curtail and manage how energy is consumed at home or at work.

In America that requires a change in attitude and lifestyle concerning energy. Changing the American viewpoint on energy use can be done only through legislation and through programmes that foster long term lifestyle changes. Programmes that combine political, social/psychological, and economic incentives that benefit all stakeholders provide an acceptable solution to the issue of energy consumption and its direct affect on the global environment.

While there are many options and solutions in today's market, not many address energy conservation from the perspective of both the energy provider and the energy consumer. The bridge that links this divide seems to be regulated to a distant future. While technology is available to accomplish this linkage, the industry as a whole has been slow in adapting or implementing innovations that extend the smart grid further into the home or business.

Part of the reason is the focus of the industry on defining and conceptualising the 'smart grid' and advanced metering infrastructure (AMI) initiatives. These act as major distracters to any technological implementation. The need to resolve the conflicting interests of the key players dominates and prioritises how home automation is deployed in its role towards energy conservation. Finding a commonality in a world where technology is constantly changing and the availability of myriad options exists creates delays in implementation.

Fortunately for the energy industry, manufacturers in the home control industries, the media industries, the telecom industries and other home connected markets are not waiting for AMI or smart grid solutions to appear. Instead these industries, by their sheer numbers and momentum, are setting the pace for home integration.

Home integration of home appliances, particularly entertainment devices and computers, is at the forefront of driving the energy industry towards a smart home solution. The problem with the smart home approach is that it is limited financially to high end appliances and homes that can easily absorb the cost of integration. Home automation for the masses is not viable economically until manufacturers position and market solutions within the affordability of the everyday consumer. Providing low cost home automation, then, is an imperative to global acceptance of energy conservation strategies that use automation as their foundation. Without the

The following scenario shows what a typical home may possibly save in CO2 emissions using a home energy conservation network and what the utility may avoid in air pollutants on an annual basis

National Averages per Residential Dwelling

NATIONAL AVERAGE RESIDENTIAL (electricity only)		ANNUAL SAVINGS
Electricity Savings	20%	
Cost of Electricity per kWh*	11.04	
Annual Average Use in kWh**	11,040	2,208
CO2 per Home per lbs/kWh***	1.34	
Total Average CO2 lbs per home	14,794	2,959

CUSTOMERS	CUSTOMERS REDUCED kWh by 20%	CUSTOMERS REDUCED CO2 by 20%	COST SAVINGS TO CUSTOMERS
1	2,208	2,959	$243.76
500	1,104,000	1,479,360	$121,881.60
1,200	2,208,000	2,958,720	$243,763.20
1,500	3,312,000	4,438,080	$365,644.80
2,000	4,416,000	5,917,440	$487,526.40
2,500	5,520,000	7,396,800	$609,408.00
5,000	11,040,000	14,793,600	$1,218,816.00
5,500	12,144,000	16,272,960	$1,340,697.60
7,500	16,560,000	22,190,400	$1,828,224.00
100,000	220,800,000	295,872,000	$24,376,320.00
500,000	1,104,000,000	1,479,360,000	$121,881,600.00
1,000,000	2,208,000,000	2,958,720,000	$243,763,200.00
2,000,000	4,416,000,000	5,917,440,000	$487,526,400.00

*EIA DOE Statistics
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***http://local-warming.blogspot.com/2007/06/overview-carbon-save-money.html

Table 1 – Potential savings from a typical home using a home energy management network

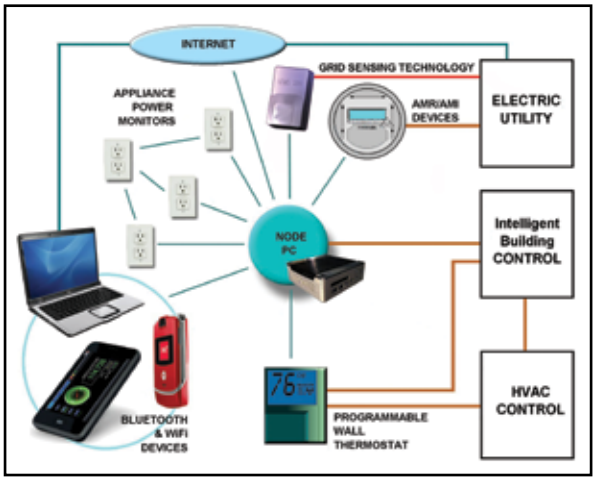

Figure 1 – Schematic of a low cost home energy management network

mechanism for automation in place, the smart grid becomes an external and unknown entity to energy consumers. Bringing smart grid automation inside homes and business means changing the consumer paradigm of being oblivious to energy consumption towards one of being actively responsible and engaged with this precious commodity.

Extending the smart grid means defining an intelligent grid that sees the endpoints beyond the meter and harmonises energy activity within the home with that within a community of energy consumers. No longer is energy consumption an individual, isolated event based on house-by-house use. Instead, home energy use is co-ordinated as an activity that is part of a larger network. Intelligent appliances communicate and respond to grid conditions as living organisms respond to external stimuli.

While this concept is futuristic in scope, it is doable in today's technology. A low cost and easy to implement system that can be expanded to include all energy use within a home or business can be designed and manufactured, incorporating open source and open architecture. An energy management system's communication architecture can be either wireless or wired. Current and future implementations of this type of energy network would most likely use a wireless approach with a communications pipe of ZigBee™, Z-Wave™, or OpenRF™ mesh technology. These wireless technologies can easily be implemented while also maintaining a low cost solution.

A home energy management network focuses on appliance energy use and load management by providing scheduled ON/OFF and tracking of appliance power. In this way, each appliance is monitored and the costs associated with electricity use are recorded to a centralised node. This information is available to the homeowner through the use of a handheld monitor, cell phone (or iPhone clones) or home PC as part of a demand side management function. The network monitors appliance efficiency and provides status reports on all appliances linked within the network. It would also make this available to outside agencies that are part of the network, such as an energy management service provider.

On the demand response side of the equation, the network receives input from the energy management service provider, the utilities, or the grid sensing unit assigned to the network. The grid sensor gives the network a preemptive command should the grid experience a rolling blackout or if there is an imbalance in the grid. The sensor notifies the node, based on prearranged settings, that takes whatever action is needed to turn off appliances for whatever predetermined time. In a scheduled blackout, the node will receive that notification from the utility or energy management service provider.

The concept of an energy management service provider as a mediator between the energy provider and energy consumers highlights the need for a completely dedicated entity that can interact with the production, transmission and distribution of energy (electricity or gas) and the end users. If completely independent, i.e. not part of the utility, it can also offer pricing services to consumers.

With the ageing population comes the need for more telehealth and telemedicine home automation. These systems create another complex layer of home networking, which also may include a home security service. A home energy management network must be flexible enough to possibly acquire these additional functions as part of its growing and expanding requirements. Integrating all the various functions and features of a modern home while maintaining good energy conservation practices, is a balancing act that energy management systems manufacturers have to consider. While the home network must have the capacity to co-exist or even manage different systems, the challenge facing home automation is integrating these systems to maximise resources and minimise the redundancy or duplication that exist in today's home networks.

Today, low cost home energy management networks are practically nonexistent. Having said that, the future looks good for such products as more utilities and systems integrators seek to meet the need for more networked capabilities in both residential and business energy conservation programmes. MI

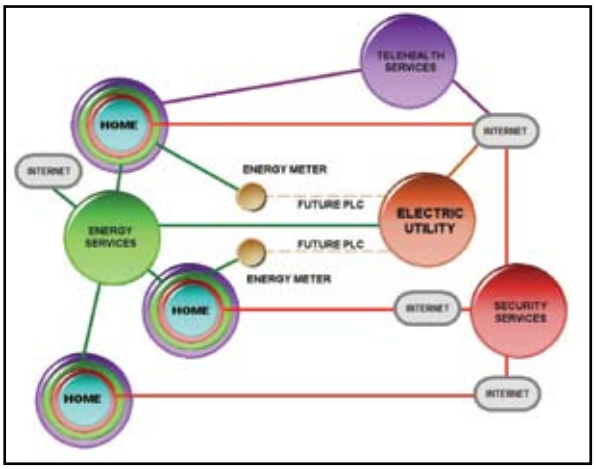

Figure 2 – The home energy management network as part of the smart grid

ABOUT THE AUTHOR: Bill Melendez has a background in RF systems, both management and product R&D. He received officer training in tactical mobile communications systems and has a combined experience of over 23 years in the utility AMR/AMI market. He holds an MBA from the University of Maryland.

ABOUT THE COMPANY: HEMS Technology provides a demand side management/ demand response (DSM/DR) solution designed as open architecture. The company's solution enables a utility to get past the meter for monitoring and controlling home demand at a reasonable price point while providing a potential means of managing rolling blackouts and peak demand.

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