

Smart phones for the smart(er) grid

Mobile applications for the Smart Grid are developing rapidly, explains Eugene Fodor. And smart devices in the hands of the user will play a key role

Mobile applications on smartphones change the way we interact with the world. We can find out what the local traffic patterns look like before we walk out of our front doors, enabling us to calculate which roads to take to save time. We can shop smarter through camera barcode scanner applications that enable us to compare prices online, and will eventually even allow us to locate items more quickly in the store (e.g., your phone will tell you the dog food is on aisle two on the bottom shelf).

Mobile devices put at our fingertips a host of embedded accessories that we've not had access to before in a sleek, pocket-sized package: GPS, accelerometers, cameras, sensors, lighting and Internet access. They combine these technologies, allowing us to easily connect with colleagues, friends, family and even strangers with a similar background.

Mobile devices also change consumer behaviour. We can sample music before we buy it, shop online, arrange for goods to be shipped directly to our homes, buy and sell stock, check account balances, pay bills, watch our weight, and so on. Mobile applications influence and change the way we behave by increasing awareness.

Awareness is critical in tackling the energy problems that the Smart Grid begins to address. The inherent intelligence we build into the energy backbone of the world needs to require change in human behaviour if we want to make a significant impact and see real savings and curtailment of peak energy use.

Fortunately, mobile applications are now being extended to influence how we use energy, and how we interact with the intelligent devices that engineers design. They enable the con-

sumer to monitor and control air conditioners, dishwashers and other home devices from their mobile phones. Beyond the consumer, mobile applications for the Smart Grid allow a whole new class of applications for diagnosing and monitoring network health, and ultimately easing the burden of connecting devices.

Smart Grid ecosystem

To enable Smart Grid applications, an ecosystem of other embedded devices needs to exist. Fortunately, that backbone is starting to take shape with the Smart Energy Profile defined by the ZigBee Alliance. This application profile sits on top of the ZigBee Network stack and provides the definition for the devices that are now starting to be deployed, such as meters, programmable communicating thermostats, smart appliances, in-home displays and other devices.

Initially, these networks were designed to provide power companies with a magic 'curtail your load now please, Mr Consumer' button to

Smart applications for smart energy

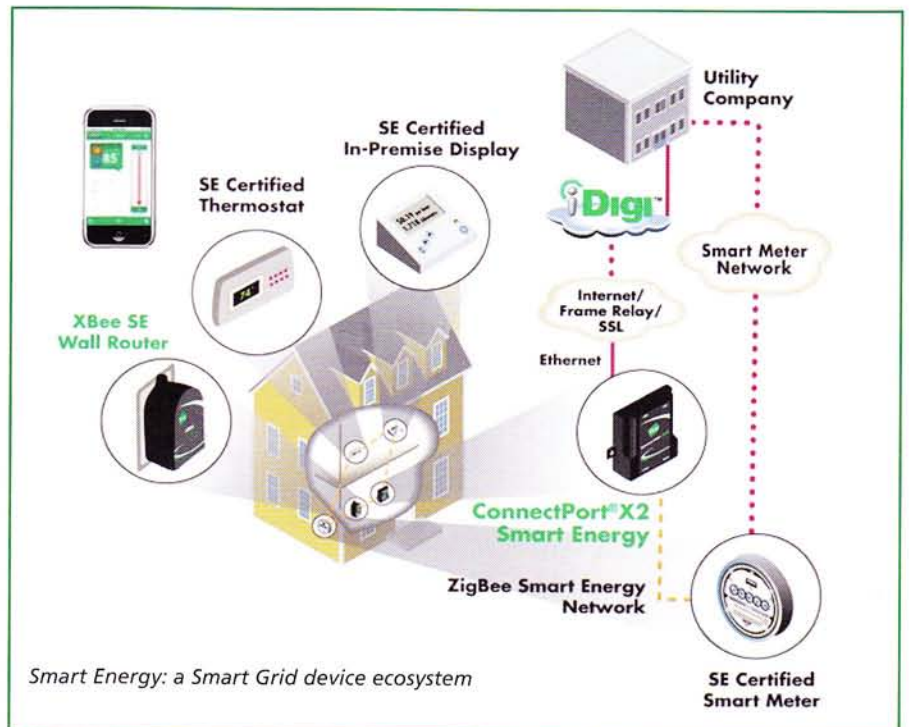
In the future, consumers will be able to compare their energy usage with similar homes by identifying comparable homes using cloud service data and mapping tools built into their mobile applications. Consumers will control, monitor and even sell energy back to the power company during peak periods when the price of energy favours their pocketbooks.

Installers will use GPS to identify which residence they are at and ensure that the right devices get installed in the right home. Mobile applications will diagnose connectivity issues on the fly, ensuring cost-effective and reliable delivery of energy data and management.

In short, mobile applications integrate the technologies that will drive positive change.

About the author

Eugene Fodor is software engineering manager for Digi International, a wireless M2M specialist whose activities include smart grid and energy applications



help drive down demand during peak loads – but this is clearly the beginning of a huge opportunity to allow consumers to take control of their energy usage.

Until the existence of these devices, power usage was a passive activity, since the meter sat on the outside of residences and businesses, and energy consumers viewed their bill only once a month. Today, in-home displays increase energy awareness by informing customers of their power usage via a thermostat-like device on their wall.

Mobile applications

Mobile applications take energy awareness a step further by allowing consumers to access energy usage data on their phones from anywhere a cellular connection is available. This further empowers the tech-savvy, Smart Grid user by allowing him or her to change their home energy usage on demand.

Mobile devices cannot yet talk directly to low-power RF ZigBee devices. Even if they could, much of the business logic would need to sit on an IP network so that the use would not have to be within range of their home area network (HAN). Smart phones work through IP networks and require them to leverage the Smart Energy ecosystem. Mobile applications need to interface with large, scalable, secure, IP cloud-based services to support the business logic to drive behaviour anywhere.

It is also necessary to enable remote device control, and to provide back-end data management, analytics and warehousing. For example, cloud-based solutions exist that provide the basis for creating these mobile applications by connecting Smart Energy devices to cloud services and the end application. This provides for not only consumer-facing applications but also applications for network and device diagnostics and health. These installer-facing applications allow for easy on-boarding of devices on to existing networks.

Key components

So what does a typical mobile application that changes behaviour look like? These are some key functions:

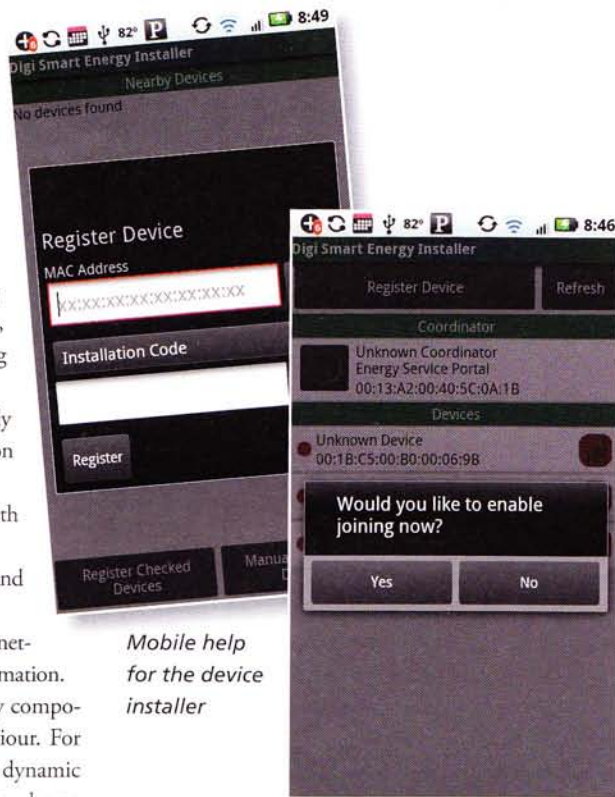
- it connects to the Smart Energy devices on the home area network;
- it receives and sends information from the utility (e.g. pricing alerts, messages, curtailment events, confirmation notice – think paying your bill!)
- it affects your environment remotely (e.g., by changing the set point on your thermostat, turning off lights);
- it reviews your historical usage, both recent and in the long-term;
- it sets goals and receives positive and negative feedback;
- it drives behaviour through social networking to complete and share information.

Solutions exist that utilize these key components to help consumers drive behaviour. For example, an application presents a dynamic view of the Smart Energy devices on a home network, and through the application and the Smart Energy ecosystem, each device can be told to 'identify' itself. Usually, the device then responds by sending a visual or auditory cue to the user.

The application extends the behaviour required by the specification by empowering the user to remotely control the thermostats within an account.

The user can create a monthly budget to track their current usage against each meter and sub-meter in their account and receive instantaneous demand readings to see where and when energy is being consumed. An energy-saving avatar in the form of a piggybank or fruit-bearing tree could be used to represent how the user is tracking against their goal.

Interfaces to social networking tools drive competition by encour-



Mobile help for the device installer

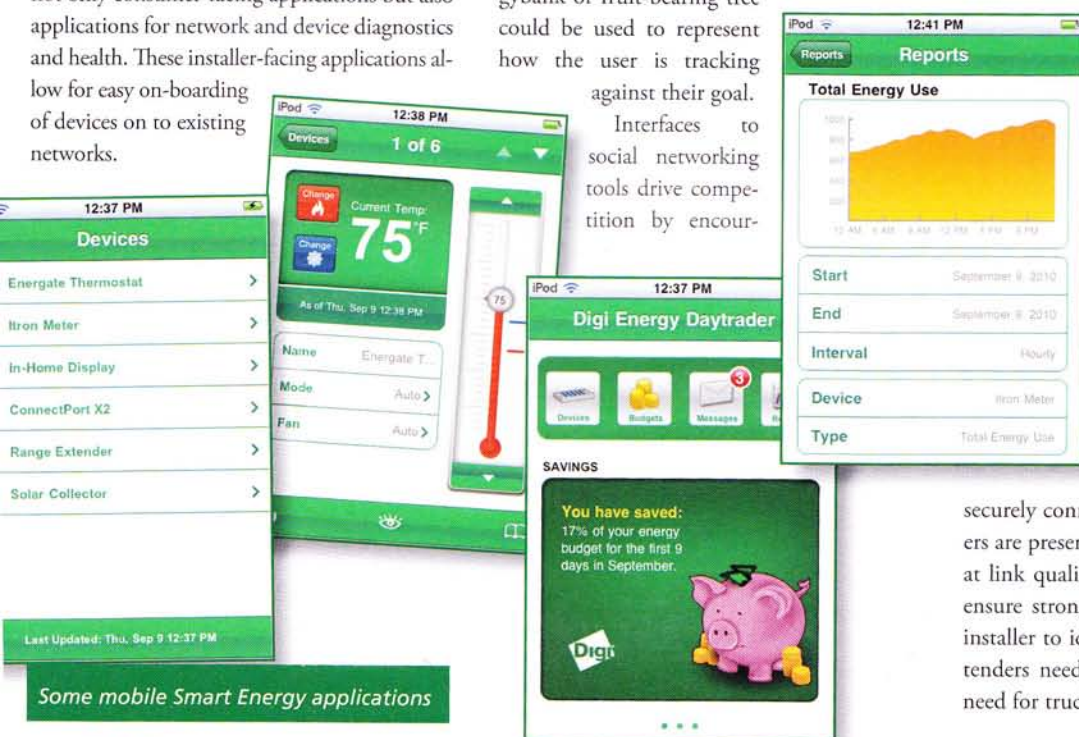
aging the user to compare their energy usage against their friends and homes with similar profiles.

Device installation

Applications that can aid in installing devices exist for both non-technical and technical people. In Smart Energy, all devices are required to join a network with a unique installation code that ensures that the device is authorized to join the HAN. Typically, this code must be hand-entered, and despite a CRC-16 check at the end to ensure correct entry, manually entering and supporting the entry of tens of millions of codes is an expensive endeavour.

Furthermore, RF networks are notoriously difficult to set up, particularly when some devices cannot be physically relocated – washer/dryer hook-ups are located right next to the meter, and no-one has aluminium siding, right?

Installer/diagnostic applications exist that can reduce installation costs and make set-up easy. This is accomplished through back-end key management and barcode scanning through a camera, and network discovery tools that securely connect to back-end systems. Installers are presented with tools to help them look at link quality indicators and RSSI values to ensure strong connectivity. These enable the installer to identify networks where range extenders need to be deployed, decreasing the need for truck rolls.



Some mobile Smart Energy applications