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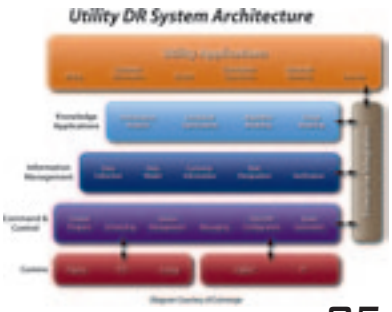

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Electric Energy Magazine is published 6 times a year by: Jaguar Media Inc.
1160 Levis, Suite 100,
Terrebonne, QC Canada J6W 5S6
Tel.: 888.332.3749 • Fax: 888.243.4562
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Michael A. Marullo, Editor in Chief

Toward A Smart(er) Grid

There is so much being said and written about Smart Grid lately that I just have to get a couple of things off my chest. Both of the items I want to focus on today have to do with misguided ideas about the Smart Grid concept, its definition and especially – the reality. That brings me to my first point…

You might have noticed that there has been a rising backlash against the use of the term "Smart Grid" lately. While at least some of the whining is probably well placed – after all, quite a bit of "smarts" is already in place out there in the form of computers, intelligent electronic devices and so called killer apps – it's also true that the installed base paints a fairly disjointed picture of what COULD have been done.

I could go on and on about all the things we DON'T have when it comes to the deployment of automation tools and information technology, but that doesn't implicitly make the grid dumb. So let's be fair… there IS a whole lot of intelligent equipment out there – and there's more being designed, built and installed daily. Moreover, it's certainly no secret that utilities have only rarely been properly incentivized to accelerate automation deployments on a regular basis. But the reality is that there's smart – and then there's smarter.

According to a recent Entergy (my home utility, incidentaly) publication, "smart grid" generally describes a communications network designed to more efficiently deliver electricity to customers and to enable them to consume it more efficiently, resulting in emissions reductions and financial savings. Rusty Burroughs – vice president of Entergy's Integrated Energy Management team – is quick to point out that today's electrical grid is anything but dumb.

"It amazes me that anyone can refer to a complex machine with the track record and reliability of today's electricity grid as dumb," Burroughs said. "On the contrary, today's electric grid already hosts multiple 'smart technology' applications."

Burroughs goes on to explain that smart grid technology would improve the grid by improving communications between system devices and customers. And new technology will provide a platform for delivering renewable power, energy storage, advanced outage management and other capabilities.

From the first electrical distribution system, utilities have sought and implemented new technologies to meet the increasing demand on electrical infrastructure. So the 'new' idea of a smart grid ignores the fact that today's electric system is far more intelligent than many self-proclaimed experts know.

But even though Entergy has always worked to develop a smarter grid, Burroughs cautions that Entergy's approach will involve a measured, disciplined approach to ensure a sustainable result. Looking further ahead, a smarter grid could employ self-healing technology and an array of generation and storage options, including technology designed to enable new services for plug-in hybrid electric vehicles, renewables, energy storage and smart appliances.

Burroughs says Entergy must continue to monitor and evaluate these opportunities as they develop. But he cautions that new technologies often require years to mature and operate at reliable levels. Further, implementing a technology before it has fully matured can be wasteful and costly to both the company and customer. Burroughs and his team are keeping these factors in mind as they envision tomorrow's smarter grid.

I personally think that Mr. Burroughs and his team have the right idea. As an Entergy customer and ratepayer, I want them to keep working on improving the grid's IQ, but I also want them to be cautious and proceed along a well thought out path rather than jumping at the first attractive-looking technology that comes down the pike.

As regular readers know, I'm a strong proponent of aggressively adding, upgrading and expanding automation for the grid – and that I've been quite vocal about it in this publication's pages as well as in several other forums. But that doesn't mean I don't want my utility to be smart (and get even smarter) about how they do it, which brings me to my second point…

Does anyone else think that there's way too much hype and distrortion about the Smart Grid, or am I just being too sensitive? To hear some people tell it, there's this huge design issue that will require trashing everything we've ever done before and starting over with a clean sheet of paper that has only the words "Smart Grid" written at the top. In my opinion, nothing could be further from the truth!

Look, we've had 30-plus years of advanced computer, communications, control and information technology to build on, yet there are apparently those who think we've simply been writing papers and giving presentations about this stuff. Helloooo – it's real, it's available and it's working. There just isn't enough of it in the field yet, and now is the time to fill that void.

And on the grid side, things like distributed resources, flexible AC transmission systems, variable frequency transformers and the like have been around for decades. These technologies – like their automation and information technology counterparts – are simply, and in many cases grossly, underutilized.

At this juncture, we're about to embark on the largest infrastructure re-investment period in modern times. Sure, there will be a lot of money squandered on frivolous projects and there will undoubtedly be some inefficiencies in the planning and disbursement of those funds, all of which will no doubt be both rampant and at times, enormously frustrating. But I also believe in the notion that the good things that will be done with those funds and resources are every bit as inevitable as the downside involved in making those good things happen – if we can manage to be smart(er) about it as we go along, that is. – **Ed**.

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Lockheed martin and black & veatch team to help utilities upgrade energy grid

Companies Working Together to Help Utilities Secure Smart Grid Project Funding

ROCKVILLE, Md. and OVERLAND PARK, KS — Lockheed Martin [NYSE: LMT] and Black & Veatch today announced they have teamed to help utility clients improve the reliability, efficiency and interoperability of the electric power grid and protect it against cyber attacks. Together, the companies offer a comprehensive suite of integrated technology and communication solutions to help utilities shape projects and request grants being offered by the U.S. Department of Energy (DOE) Smart Grid Investment Grant Program.

The Smart Grid Investment Grant Program is part of the DOE's Electricity Delivery and Energy Reliability Recovery Plan, which has been allocated $4.5 billion to support the modernization of the electric grid.

The companies have supported several first-round applications, and are well-positioned to continue assisting other DOE funding applications, such as the DOE's loan guarantees for employing innovative energy efficiency, renewable energy and advanced transmission and distribution.

"Our nation's power grid is at a crossroads – to support a clean energy future, the grid must smartly and securely manage and distribute a new mix of traditional and alternative energies to users," said Tom Grumbly, vice president, Lockheed Martin Energy & Environmental Services. "With federal grants making Smart Grid a reality, and the opportunity to create new jobs in the process, utilities should not delay in shaping projects to modernize the grid."

Together, the companies are ideally positioned to help utility clients address this opportunity, and deploy advanced Smart Grid technologies in support of energy efficiency, distributed resources and reliability initiatives. Lockheed Martin, a top energy efficiency provider for utility customers, brings its information management, business process reengineering, and cyber security expertise to the team's offering, as well as modeling and simulation and demand response tools. Black & Veatch is continuously ranked as one of the top U.S. contractors for the design and construction of telecommunications and transmission and distribution infrastructure, providing complete planning, design and implementation services to utilities.

"Implementing Smart Grid solutions requires extensive expertise with leading-edge communications and automation technologies," said Martin Travers, president of Black & Veatch's Telecommunications Division. "Black & Veatch provides a deep understanding of the interdependencies of power delivery and telecommunications infrastructure to optimize the value of the Smart Grid."

Black & Veatch and Lockheed Martin will focus on supporting DOE applicants' Smart Grid initiatives for Advanced Metering Infrastructure, Substation and Distribution Automation, SCADA (Supervisory Control and Data Acquisition), Distribution Management Systems and Demand Response projects, especially in the areas of interoperability and cyber security. Collectively, the two companies have the unique understanding of the necessary advanced communications infrastructure, electrical technology, cyber security measures and IT solutions to design and implement an efficient, reliable and sustainable utility operation.

For additional information, visit our Web sites: *http://www.lockheedmartin.com* and *http://www.bv.com*

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NV Energy Selects OSI Technology for its Energy Management and Distribution Management Systems in Las Vegas and Reno, Nevada

Open Systems International, Inc. (OSI) has been awarded a comprehensive new contract by NV Energy Inc. (NVE) to supply next generation SCADA and Energy Management platforms for its two Nevada subsidiaries, Sierra Pacific Power Company (SPPC) in Reno; and Nevada Power Company (NPC) in Las Vegas.

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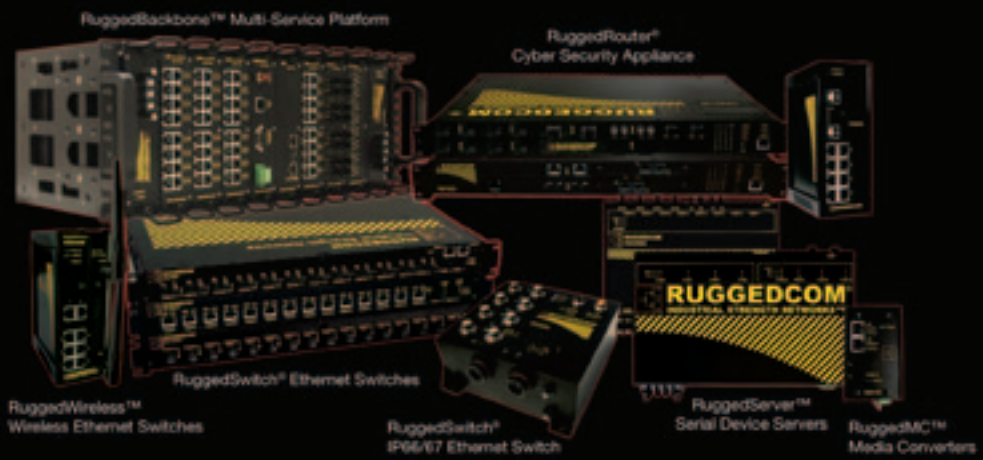

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NVE is an investor-owned energy utility based in Las Vegas, Nevada that provides energy services to a 54,500-square-mile territory in the state of Nevada, including more than 2.4 million residents as well as an annual state tourist population that exceeds 40 million people.

In anticipation of the pending 'One Nevada Transmission Line' (ON Line) project; a 230-mile, 500 kV north-south AC transmission line set to interconnect the transmission systems of NV Energy's subsidiaries in northern and southern Nevada, NVE has embarked on a system modernization project, choosing OSI to upgrade and enhance its energy management and control infrastructure, replacing and consolidating two existing legacy energy management systems. OSI's exceptional delivery performance, modern and open technology, unmatched customer service and extremely efficient support and system upgrade plans have been the main decision factors behind NVE's choice of OSI for this project.

These new systems are based on OSI's monarch distributed open architecture; featuring an advanced Microsoft .NET based Graphical User Interface and including Supervisory Control and Data Acquisition (SCADA), Automatic Generation Control and Dispatch (AGC), Historical Information Systems (HIS), Transmission Network Analysis, Web-based Graphical User Interfaces, Operator Training Simulator, Secure ICCP communications, as well as functionality for hot standby backup/disaster recovery control systems. With these new and networked systems, NVE is planning to retain Transmission and Distribution operation for both utilities in their respective locations, Las Vegas and Reno, while providing balancing authority EMS functions for the consolidated transmission network in its Reno location.

"*OSI is very excited to have NVE join our growing family of users. NVE is a prestigious company with a historic past that we are extremely proud to be working with. In the face of ever-expanding regulatory challenges, OSI's forward looking business model and technology have been consistently proven to respond perfectly and to fit extremely well with the specific needs of progressive utilities like NVE. Welcoming NVE into our family of users; OSI pledges to do everything in our power to meet and exceed their expectations, as we do for all OSI customers,*" said Bahman Hoveida, President and CEO of OSI.

Headquartered in Las Vegas, Nevada, NV Energy, Inc. (NYSE: NVE) is a holding company whose principal subsidiaries are Nevada Power Company (Las Vegas) and Sierra Pacific Power Company (Reno). Servicing a 54,500-square-mile territory that stretches north and south from Elko to Laughlin Nevada, NV Energy provides energy services and products to more than 2.4 million residents, as well as an annual state tourist population that exceeds 40 million people.

For additional information regarding this news release please contact *news@osii.com*.

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SEL-487E Transformer Protection Relay Now Offers Real-Time Control

TPULLMAN, WA — Schweitzer Engineering Laboratories, Inc. (SEL) today announced wide-area-measurement-based control in a transformer relay for the first time. This enhancement to the SEL-487E Transformer Protection Relay allows it to receive IEEE C37.118 synchrophasor messages from up to two phasor measurement units, time-correlate the information, and take control actions based on local and remote messages. Remote angles, currents, and voltages received in the serial synchrophasor message can be combined with local measurements for basic or advanced applications.

"A multirestraint transformer differential relay, such as the SEL-487E, is an ideal platform for synchrophasor-based control," says Roy Moxley, SEL marketing manager for synchrophasors. "Large generators and transmission stations that frequently use this type of relay can now easily apply remote measurements to control tap changers, regulate generator voltage, and notify operators of system conditions."

This advanced SEL-487E Relay communications technology allows customers to:

- Trip or start generators based on system load angles.
- Control tap position based on combined values.
- Send alarms based on changing angles.
- Apply SELOGIC® control equations to time-correlated remote measurements.
- Detect system separation to initiate islanding control.

For more information on features, benefits, and applications, visit *www.selinc.com/p99*.

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Confident in your Smart Grid Strategy?

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Sensus Welcomes GE Energy Meters to the FlexNet™ Smart Grid Solution of Interoperable Smart Metering

A Key Alliance of Market Leaders for the Energy Utility Industry

Raleigh, NC — Sensus, a provider of solutions for secure Smart Grid and Advanced Metering Infrastructure systems, and General Electric Energy, a leading supplier of power generation and energy delivery technologies, announce the integration of the Sensus **FlexNet**™ smart grid communications technology with GE smart meters.

"We are delighted to add General Electric smart meters to the list of electric revenue meters already integrated with FlexNet," said Doug McCall, Director of Marketing at Sensus. "With today's announcement, our electric utility customers will have another technology leader they may depend on to deliver intelligent FlexNet integrated products to the industry," he added.

Under this agreement, Sensus and GE will work together to meet smart meter and network requirements driving existing and future Smart Grid implementation programs. With expected availability later in 2009, the GE meters with FlexNet integrated communications will provide a superior option for Sensus **FlexNet**™ customers familiar with the time-tested GE meters.

For more information, visit *www.sensus.com*.

FlexNet™ is a trademark of Sensus.

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Trilliant Teams with IBM on Enterprise Software for Smart Grid Solutions

Trilliant Delivers Smart Grid Technology on IBM WebSphere and Tivoli Software

Redwood City — Trilliant Incorporated, a leader in delivering Smart Grid solutions that enhance energy efficiency, utility operations, and renewable resource integration, announced it is integrating its technology with IBM WebSphere and Tivoli products to help utility companies more easily and securely expand their Smart Grid initiatives.

Under a new agreement, Trilliant will incorporate IBM's WebSphere® and Tivoli® products into Trilliant's UnitySuite™. Trilliant and IBM will also pursue joint solution architecture development and integrated solution offerings to the global utility market, as well as cooperate on industry standards development.

"IBM is delighted to add Trilliant to its extensive portfolio of Smart Grid solutions. By taking this step forward in our relationship and integrating their products and services, we can offer improved performance, security, and scalability to our utility customers worldwide," said Guido Bartels, General Manager of IBM's Global Energy & Utilities industry. "This combined offering sets a high standard for enterprise integration and management of advanced Smart Grid networks."

Trilliant will incorporate IBM's WebSphere Application Server capabilities to enhance the scalability, security, fault tolerance, and performance of Trilliant's core Smart Grid management software. Using WebSphere Enterprise Services Bus capabilities both simplifies and enhances the integration of Smart Grid network capabilities into utility enterprise grid networks, including pre-built adapters to over 100 different integration products and enterprise software systems, such as SAP. Utilizing true enterprise-grade tools brings drag-and-drop system integration to the Smart Grid, greatly simplifying the complex process of leveraging Smart Grid capabilities in the utility enterprise.

Additionally, the incorporation of Tivoli components into Trilliant's existing network management platform brings a whole new level of enterprise event management, real-time system visibility, enterprise dashboards, automatic diagnostics and notification to Trilliant's already strong operations platform. Running on industry-standard protocols and services, the system allows the creation of extensive enterprise management capabilities without advanced programming or customization.

"With the largest Smart Grid field deployment in the industry (more than 1 million devices), Trilliant appreciates the need to use the best solutions available to solve the challenge of enterprise system deployment and integration," said Andy White, President and CEO of Trilliant. "IBM's technology and enterprise system experience are unmatched in this area and we can think of no better partner with whom to work."

For More Information Contact Trilliant Incorporated
www.trilliantinc.com

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Demand Response 2.0

Dispatchable, Reliable and Cost-Effective

Brad Davids, Vice President of Utility Solutions, EnerNOC, Inc.

Demand Response (DR) is the deliberate reduction in electric consumption by energy users in response to system needs, such as periods of peak demand, high wholesale market prices, or system emergencies. DR resources can act as capacity, energy, and ancillary services products and can defer or eliminate the need for new supply-side infrastructure like peaking power plants, transmission, and distribution assets. Utilities and grid operators can also rely on DR as an economic resource that reduces the overall cost of power.

EnerNOC's Boston Network Operations Center is staffed by highly trained personnel who monitor energy usage for thousands of customer sites, track emergency triggers such as extreme weather conditions and coordinate energy reduction strategies on a 24x7x365 basis. (Photo Courtesy of EnerNOC)

Demand Response 2.0

There are two general categories of DR: Price-based programs and Capacity-based programs. Under dynamic pricing regimes – such as critical peak pricing and real-time pricing – users make a voluntary decision to change behavior in response to varying retail electricity rates. Capacity-based DR resources, by contrast, are generally structured as firm resources. While system operators can't be assured that users will respond to changes in retail pricing, capacity-based DR programs can be structured as a dispatchable, reliable resource.

Participating electricity users are usually paid incentives, typically cash payments or rate reductions, for their agreement to reduce consumption temporarily when dispatched for DR events.

In many ways, dynamic pricing and capacity-based DR models are complementary; in fact, the California Public Utility Commission recently issued a proposed decision that users can participate in both types of programs concurrently.[1]

Capacity-based Demand Response in the 21st Century

Dynamic pricing and capacity-based DR programs are directly responsible for reducing a substantial and increasing percentage of peak demand in the United States. A recent study by the Federal Energy Regulatory Commission estimates the total potential for DR to be as high as 20 percent of peak demand in 2020,[2] with approximately 41 gigawatts built out today.[3]

[1] California Public Utility Commission, DRAFT "Decision adopting demand response activities and budgets for 2009 through 2011," Application of Southern California Edison Company (U338E) for Approval of Demand Response Programs, Goals and Budgets for 2009-2011, June 20, 2009.
[2] Federal Energy Regulatory Commission, "A National Assessment of Demand Response Potential," June 2009, p. xii.
[3] Federal Energy Regulatory Commission, "Assessment of Demand Response and Advanced Metering," December 2008, p. 23.

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BACKGROUND IMAGES

While a variety of studies have shown that dynamic pricing has system benefits, there is a large market for dispatchable, capacity-based DR resources that utility operators can deploy to address a variety of individual system needs. In many cases, utilities chose to outsource the development and deployment of this resource to a third party DR expert (sometimes referred to as "DR aggregator" or "curtailment service provider [CSP]"). In fact, CSPs reportedly already manage over 10,000 megawatts (MW) of DR capacity across the U.S.[4]

Capacity-based DR is not a new concept – interruptible tariffs for large customers and residential direct load control (DLC) programs for residential customers have existed since the 1970s. But today's DR is different. In the era of the smart grid, utilities are evaluating and implementing a broad spectrum of technologies for improving system efficiency and driving down costs, integrating renewable resources and demand-side technologies, and generally increasing the level of customer responsiveness to price and other system signals.

What to Expect from Today's Demand Response

- **It's real, and you can see it.** Many DR programs leverage the capabilities of advanced meters or other monitoring devices with two-way communications, which can provide real value to utility operators as they are able to reliably measure DR reductions in real time. Previously, system operators had very little visibility into DR reductions. Consequently, system operators were often skeptical about the reliability of these resources.

- **It's dispatchable – and gives utility operators complete control.** Dispatchable DR resources give utility operators the control they need to keep supply and demand in balance continually. Many demand-side management initiatives – e.g., energy efficiency and load shifting programs – permanently reduce kilowatt (kW) and/or kilowatt-hour consumption, but don't provide direct benefit to system operators that are actively running systems in real time.

- **It's reliable and can be automated.** Technology is available that automates DR reductions (often termed "AutoDR"), which can make the resources more reliable. In many cases, CSPs provide financial guarantees that the demand reductions will be delivered.

- **It's customized to meet precise system needs.** CSPs can customize DR programs to meet individual utility needs – and utilities can dictate features like notification period (e.g., 10 minutes, 2 hours), when the resources are available (e.g., year round, during business hours), and how often the program can be dispatched per year (e.g., 20 hours, 80 hours).

- **It's scalable, can be built quickly, and can be expanded over time.** Unlike a peaking power plant, which can take years to permit and construct, DR is quick to market and can scale easily.

- **It is a complement to increasing levels of intermittent renewable resources.** As states are adopting aggressive renewable portfolio standards, DR can help operators accommodate the incremental variability and uncertainty added by wind and solar energy in a more efficient and cost-effective manner than traditional fossil-fueled resources.

Case Study #1: Tampa Electric Finds DR a Reliable, Cost-Effective Resource

Tampa Electric has supplied the Tampa Bay area with electricity since 1899 and currently serves more than 670,000 customers within a service area that covers 2,000-square-miles across west-central Florida. Like many utilities, Tampa Electric is facing increasing system demand, higher costs, and a strong need for an environmentally responsible solution for managing peak demand. The company, which was already active in numerous demand-side management programs including interruptible rates, residential direct load control, and more, began looking at DR as a cost-effective option in 2007.

"We were intrigued by DR and open to the possibilities," recalls Howard Bryant, manager of rates and regulatory affairs.

[4] EnerNOC estimate; based on publicly available data.
[5] See Darren Brady and Rob Gramlich, "Getting Smart about Wind and Demand Response," Wind Systems, July/Aug 2009, available at http://www.windsystemsmag.com/articles/Enernoc_JulyAug09.html.

2009

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Tampa Electric recognized that DR was an effective way to balance the utility's needs for reliable capacity and financial performance, with an opportunity to improve customer satisfaction.

"As an electric company employee, I recognize that we're here to serve our customers and deliver a return to our shareholders," says Jackie Perrone, manager of energy management service at Tampa Electric. "Programs like DR show that we can accomplish both of these goals in an environmentally-friendly way."

After carefully evaluating its options, in 2007, the company partnered with EnerNOC to deliver up to 35 MW of DR capacity. The Tampa Electric program, which runs year-round, from 7:00 am to 7:00 pm on weekdays, gives participants 30 minutes advanced notice of events, which can last from 1-8 hours.

With the program rules established, Tampa Electric needed to get the approval of the Florida Public Service Commission. "The Commission clearly understood the value and potential of DR," says Bryant. "But they were concerned about turning it over to at third party. Could we count on getting the capacity when we asked for it? Would they be able to perform?" Following regulatory scrutiny, the Tampa Electric DR program received approval in late 2007 and the implementation process began.

In October 2008, the first major test of the Tampa Electric program was conducted, and the system over-performed by approximately 12 percent of the nominated capacity. Success was driven by a number of factors: the close working relationship between EnerNOC and Tampa Electric to recruit commercial, institutional and industrial customers into the program, and a technology-enabled approach to DR.

First, a list of target customers – primarily middle-tier assigned accounts with the potential to participate in DR without any discernible impact on business operations – was identified. "For us, getting accounts signed up for DR was secondary to a more important goal – the customer had to be happy throughout the process," says Al Grinnell, commercial and industrial account manager at Tampa Electric.

Once each site was evaluated to identify energy reduction strategies that would work within each company's specific business parameters, the team installed, programmed, and tested communications and relay equipment, so that real-time energy consumption data could be collected and used to verify the impact of the site's demand reductions. The entire process was done in close collaboration with the candidate companies, each having different needs, concerns, and levels of knowledge about energy. Moreover, this was all done at no cost to the end user.

With the right mix of customers enrolled in the program, responsibility then shifted to the network operations staff to ensure that events were executed seamlessly. With millions of dollars invested in its DR technology and a modern Network Operations Center (NOC), thousands of DR sites are monitored throughout North America, including Tampa Electric customers. The NOC is staffed by a team of analysts that, among other event readiness activities, are on standby 24/7/365 to coach DR participants to success during an event.

In the end, the DR system proved to be a reliable method of addressing and reducing summer and winter system peak demand. Among the chief benefits, Tampa Electric cites the delivery of a complete end-to-end solution – including program design and implementation, customer recruitment and retention, site enablement, event dispatch and management, reconciliation, and verification – while enhancing the Tampa Electric brand amongst its customers. "We wanted Tampa Electric to be front and center throughout the process, and we were able to do just that," says Bryant.

Case Study #2: Albuquerque Tortilla Company Relies on DR to Reduce Energy Costs While Keeping Quality High

Specializing in authentic New Mexican cuisine, Albuquerque Tortilla Company's popular food products serve restaurants and grocery stores throughout the Southwestern U.S. Succeeding in the food business can be difficult, even in a normal economic environment. But in 2007, Albuquerque Tortilla began experiencing major increases in its energy costs, ranging from a 17 percent increase in electricity rates to higher fuel costs for its trucking fleet. These escalating costs of energy created a major challenge for the company, which needed to carefully control its bottom-line.

"Many of our ingredients are commodities," comments Ben Lovato, Albuquerque Tortilla's general manager, who has wide-ranging responsibilities within the company. "We try to lock in prices on items like flour and shortening for a year or more, which lets us anticipate and control costs. But energy is another story," Lovato says.

In late 2007, ATC's managers met with EnerNOC and PNM – their electric utility provider -- to learn about DR. Initially, being paid to temporarily reduce electrical use during grid emergencies sounded too good to be true, but a thorough discussion of the PNM Peak Saver program finally convinced Albuquerque Tortilla that there wasn't a catch.

"When we heard about other savings programs, we weren't given the whole story," says Pete Martinez, director of operations for Albuquerque Tortilla. "But all of our questions were answered and we learned precisely how the PNM Peak Saver program could actually generate real revenues, not just save us a dollar here and there."

These discussions led to a thorough evaluation of electrical usage across Albuquerque Tortilla's complex, large-scale operation -- from its food production line to its storage freezers. EnerNOC and PNM worked closely with Albuquerque Tortilla's facility staff to gain a clear picture of what energy-consuming equipment might be a possible candidate for adjustment or shutdown during a DR event.

Encouraged by this evaluation, Albuquerque Tortilla Company enrolled in the Peak Saver program in 2008 at the 450 kW level. The program runs from June to September and provides a 10-minute advance notification of an impending DR event. During an event, the DR system makes remote adjustments to Albuquerque Tortilla's freezers, coolers, and air conditioning units, enabling the company to achieve its full 450 kW reduction. The freezers are capable of maintaining temperature control limits for 4-8 hours and beyond. Notably, Albuquerque Tortilla can override any of these changes if necessary, giving the company full control over its production facility during DR events.

DR events are largely invisible to the company's 300 employees and have no effect on food production, quality, or safety. The company's main food production operation continues to operate on an uninterrupted basis.

During DR events, the customer and provider jointly monitor Albuquerque Tortilla's energy use through a web-based monitoring software, which provides a real-time view of energy consumption. "We have access to the same data and charts as EnerNOC in Boston," says Lovato, "so we can always see exactly what's happening and make any necessary adjustments."

Participating in the PNM Peak Saver program enables Albuquerque Tortilla to continue to meet its main goal – delivering high-quality, consistent food products to its customers – while also conserving energy resources and saving money. Since its main food production line isn't affected by DR events, the company can be confident that its high standards for quality and safety are still being met. And temporary adjustments of coolers and freezers have no impact on the food itself. Participation also allows Albuquerque Tortilla to save more than $18,000 a year to help offset its rising energy costs. "We're extremely happy with our DR system," says Lovato, "because it makes a significant reduction in our overall energy costs and also lets us monitor our energy usage in real time and on a continuing basis."

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The WEEC conference features a large, multi-track agenda, a full line-up of seminars on a variety of current topics, certification programs and a comprehensive exposition of the market's most promising new technologies. WEEC also serves as the annual convention of the Association of Energy Engineers, and is attended by more AEE members each year than any other single event.

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- HVAC Systems & Controls
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WEEC's highly acclaimed GreenStreet® expo showcase, co-presented by the U.S. EPA's ENERGY STAR®, will again be a prominent part of the WEEC for 2009 to address the interests and needs of the large number of U.S. government professionals and private sector managers who traditionally attend. Here you can examine firsthand the latest green, sustainable, renewable & environmentally friendly energy – facility technologies now available for both new design and retrofit projects.

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In the past, many cooling units could only be adjusted by sending workers up to the roof, which is an inefficient, time-consuming, and risky approach. Now, centralized control and ongoing monitoring give Lovato and his team new insights into how the company is using electricity, as well as more control over it. These adjustments result in even more energy reductions and savings beyond the company's annual DR event payments.

While there are many benefits to participating in DR, it's not just about the numbers. Albuquerque Tortilla is a family-owned business that is deeply rooted in its community. Participating in DR allows the company to support its community in a new way; that is, protecting local businesses and residents from blackouts, brownouts, and other electrical issues while also conserving precious natural resources and helping to protect the environment. ■

About the Author

Brad Davids, is Vice President of Utility Solutions at EnerNOC, where he manages the company's activities to expand demand response and energy efficiency program implementation with utilities across North America. Previously, Mr. Davids was Vice President of IDC Energy Insights, a provider of research-based advisory and consulting services focused on technology and business developments impacting the energy industry. He also served as President and CEO of Primen Inc., Vice President and Division Manager at a for-profit subsidiary of the Electric Power Research Institute (EPRI), and Senior Vice President and co-founder of E Source, Inc., among other senior management roles at the intersection of technology and the energy industry. Mr. Davids holds a Bachelor of Science with Distinction degree in mechanical engineering, and Master of Science degree in mechanical engineering, both from Stanford University.

CAPTIONS FOR PICTURES
- *Al Grinnell, Manager, Commercial and Industrial Account Management and David Sweat, Manager of Grid Operations, inside the control room at Tampa Electric.*
- *Located in downtown Boston, EnerNOC's Network Operations Center is staffed 24x7/365 to monitor electricity usage for thousands of customer sites, track energy emergency triggers such as extreme weather conditions, and coordinate energy reduction strategies.*

Stephen Johnston
Chief Executive Officer

Dr. Henry Jones
Chief Technology Officer

The 2009 Automation/IT Leadership Series

SmartSynch, Inc.

> "... the smart grid infrastructure that we're talking about is much more lasting in its impact. It is the development of a new infrastructure that will permit new forms of commerce to take place. It is akin to the transcontinental railroad, the phone system, the interstate highway system and the Internet in the way that it will help enhance new fortunes and spawn new Googles and Microsofts." – Jesse Berst, Executive Editor, Smart Grid News

EET&D: We hear the term "Smart Grid" bandied about quite a bit these days, to say the least. Although it's a relatively new term – not more than a few years old – it has quickly invaded our industry debates, our political dialog, and for many of us, our daily conversations on a regular basis. Although I'm quite sure that those of us in the power industry hear it more than the average person on the street, it's fair to say that it is among the most widely used terms in both the consumer and industry press whenever the grid is a central theme. But the foregoing quote strongly suggests that when we use the term "Smart Grid" we're actually inferring a whole lot more than just some newfangled stuff the power industry is doing, aren't we?

Johnston: Yes, that's certainly true. Indeed, the availability of power has been the underpinning of societal advances as far back as the earliest industrialized civilizations. Those with access to low cost, reliable power were able to advance their cultures in construction, technology and quality of life much faster than those without such access. Today we see a stark contrast in the standard of living between those with access to continuous electricity compared to those without. In the United States, we have had the luxury of available power whenever we want it; however, population growth, explosive industrial expansion and the proliferation of devices requiring electricity has pushed our nation's electricity system to the brink.

Jones: To add to this escalating crisis, new generation resources are more difficult than ever to get provisioned – particularly coal-fired generation, which is of course, our most abundant fossil fuel – renewable portfolio standards are becoming more aggressive and we face a strong likelihood of a carbon cap within the next couple of years. By contrast, our current grid dates from the time when Frank Sinatra was in his prime, before a man walked on the moon, and long before cell phones were invented. And although – as many have correctly pointed out – our present grid is far from dumb, we're still way behind the curve technologically.

EET&D: Clearly, you're not the only one who holds that view, Henry. According to Suedeen G. Kelly, a member of the Federal Energy Regulatory Commission, *"The grid today, according to experts, is a system conceived 100 years ago to let utilities prop each other up, reducing blackouts and sharing power in small regions. It resembles a network of streets, avenues and country roads. We need an interstate transmission superhighway system."* That being the case, how and when should we be expecting this transformation to take place, and what role do you feel regulators are playing – or will play – in this transition?

Johnston: Fortunately, it seems that tighter regulation – or as many characterize it: re-regulation – is going to create new sources of funding. One immediate example is the American Recovery and Reinvestment Act signed into law by President Obama on Feb. 17, 2009. This stimulus package provisions $4.3 billion for smart grid projects and close to $34 billion in related projects such as energy efficiency rebates and loans for renewable energy projects that will have a direct impact on the grid. This investment is key to modernizing the electrical grid, while other major infrastructures such as the telephone network, Internet, transcontinental railway and interstate highway system have moved into the digital age the one network upon which all the others rely is still in the dark ages. The good news in all of this is the incredible opportunity we have to benefit society by adding a layer of intelligence through a smart grid infrastructure.

EET&D: The national electricity grid is a critical infrastructure and at no other time is that more apparent than when we lose it, even for a few hours. For example, the August 2003 blackout in the Northeast United States and Canada caused an estimated $7 billion to $10 billion in economic losses, not to mention the societal stress resulting from days without power. What can be done to prevent the reoccurrence of catastrophic incidents like this in the future?

Johnston: What we need now to bring our electricity grid into the twenty-first century is a smart grid infrastructure that leverages the best parts of the critical infrastructure already in place. According to the Energy Information Administration, in 2008 the U.S. lost 720 million kilowatt-hours per day – enough to power nearly 23 million homes – due to "transmission and distribution losses, data collection time-frame differences, and estimation error." And the Report Card for America's Infrastructure, prepared by the American Society of Civil Engineers, gives the U.S. Electric Grid a rating of D. Clearly, we have a lot of work to do if we're going to transform what we have into a Smart Grid Infrastructure that will sustain us for at least the next 100 years.

EET&D: We all know that's a tall order, so let's take a moment to define what you mean when you say we need to create a Smart Grid Infrastructure…

Johnston: A smart grid infrastructure is the sum of services, devices and software necessary to add a layer of intelligence onto today's 20th century electricity grid such that every point on that grid can talk to every other point and decisions are made either by devices or human beings to fully optimize the process by which electricity is generated and delivered to customers. Henry, would you like to add something here?

Jones: Sure. Smart grid infrastructure can spot and stop energy "leaks," optimize efficiency through better power factors and provide feedback loops that provide the right price signals to normalize energy loads during peak use. Any smart grid infrastructure by definition must be scalable, secure, strategic, simple and standards-based to overcome some of the key challenges to achieving a national smart grid.

EET&D: Okay, let's talk about scale for a minute. In the United States alone, there are 338 million meters in operation. If we are to bring our electricity into the digital era, each and every one of those meters and the millions of devices that connect to them must be smart. Devices need to measure and transmit data, act on incoming information and handle any number of innovative applications we haven't yet even dreamed of. This seems like a Herculean task, am I correct?

Johnston: Yes, this level of scale will require a network that can accommodate the sum of information that will be generated by the Smart Grid. For example, if the 338 million meters already deployed in the United States digitally reported the most basic electricity use information every fifteen minutes, they would generate anywhere from 274 to 548 Gigabytes of information every day, enough to house five library floors wall to wall and floor to ceiling of academic journals.

EET&D: Is it realistic to think we can somehow manage such a high degree of magnitude and complexity?

Jones: Many of the companies claiming to provide Smart Grid solutions today are deploying on the order of thousands of nodes. It's unclear, however, if these networks can scale to support smart grid applications and data when deployments reach the hundreds of thousands or millions in numbers. Based on our experience, only the nation's largest networks can handle the amount of data that will be generated from a fully functioning Smart Grid with millions of nodes.

EET&D: Wouldn't something of this enormous scale also create some pretty dicey security issues as well?

Johnston: As a critical part of our extensive public infrastructure, the nation's energy grid must also be secured, of course. Any failure in the electricity grid can have dire consequences for health and human safety and cause serious economic losses.

The North American Electric Reliability Company (NERC) and the U.S. Federal Energy Regulatory Commission (FERC) can levy substantial punitive fines on utilities for non-compliance with their strict security standards. Moreover, as we start waking up the electricity grid, each access node becomes a communications device, making the entire system more vulnerable to hackers and cyber terrorists who can invade these systems in a variety of ways.

Jones: This all means that any Smart Grid infrastructure has to have the highest possible level of security such as IPSec at every point to create a hardened security covering around the entire infrastructure. If the IP backbone is broken in any part of the network – as in some mesh network and proprietary solutions – the entire system is vulnerable to attack, which could leave utilities exposed to severe regulatory action in addition to the direct consequences of a security breach.

EET&D: Conventional wisdom tells us that Smart Grid deployments are implicitly blanket deployments; is that really true?

Johnston: No, that is simply not the case. Blanket deployments pose myriad problems including backlash from residents due to rising rates, inexperience with a particular geography or prohibitive cost. While there is a time and place for broad deployments the initial stages of Smart Grid infrastructure will more likely be strategic in nature. For example, many people who have solar panels installed on their roofs have no way to accurately measure the power their systems are producing or when electricity is fed back into the grid.

There is also a large rural population where a blanket deployment doesn't make sense. Cities might want to strategically deploy Smart Grid infrastructure where health and safety are at risk, such as in the case for steam monitoring beneath city streets. Smart Grid deployments mandated for government buildings and schools call for concentrated spot deployments. Businesses are generally hungrier than individuals for Smart Grid solutions because they stand to gain more from reducing energy use and managing back up generation more effectively. And from a utility point of view, commercial and industrial customers present high return-on-investment opportunities because they consume much more energy versus residential customers.

EET&D: Can you offer our readers an example of what you mean when you say that high ROI doesn't necessarily mean widespread deployments?

Johnston: Yes, here's a good one: Southern California Edison previously deployed smart meters over a public wireless network that represent just a quarter of one percent of the utility's total meters; yet that small percentage of their total meters accounts for approximately 50 percent of its total revenues. This underscores how the smart grid will start taking shape where it is most needed and spread out from there, not unlike the way that the Internet evolved.

Jones: And another way utilities can be strategic with Smart Grid infrastructure is to leverage the country's largest data networks. These public networks provide a conduit for communicating information from virtually any device to any other device on the network. At today's rates, utilities pay an order of magnitude less than individuals for the same data network used by every person with a cell phone, so the cost of those data transfers are far less than one might otherwise expect.

EET&D: We've been saying over and over that the problems we're facing are big and complicated. How are we going to overcome such huge impediments?

Johnston: True, the electricity grid is complex enough already, so adding Smart Grid infrastructure should be made as simple and seamless as possible. A simple standards-based infrastructure will reduce the risk of developing a work force that is backed into a proprietary system or otherwise inflexible way of doing things. It also minimizes training and retention costs for employees to manage networks that need to last for at least 20 years.

EET&D: What about the work force? We're constantly being told that we may be facing a worker deficit in the years ahead as the huge mass of Baby-Boomers reach retirement age and leave the workforce.

Johnston: It's becoming more evident with each passing year that increasing numbers of utilities are facing skilled worker shortages as Baby-Boomers reach retirement. Compounded by a dearth of R&D investment, utilities haven't had the luxury of attracting the younger generation away from other career options such as Internet or technology companies with big salaries. However, the prospect of building out the nation's Smart Grid infrastructure will offer an attractive career goal for young, inquisitive minds seeking new challenges and problems to solve.

EET&D: But given these declines in the current workforce combined with smaller numbers of graduate engineers and computer scientists, do you think there will be sufficient staff to get the job done?

Jones: It's important to keep in mind that it's not all about the numbers. Technological advancements have allowed the industry to realize huge advances in productivity, not just in the power industry, but in nearly all industries. These new generations of workers are already accustomed to ubiquitous Internet and networking standards – even before graduating from college – and are comfortable using tools like SMS and Web interfaces as part of their every day existence. A simple Smart Grid infrastructure built on standards will greatly simplify training and deployment for the next generation of workers required to replace what the American Public Power Association estimated will be 45 percent of the utility workforce set to retire in the next seven years.

EET&D: We also hear a lot about standards lately – considerably more than usual, I'd say – now that the National Institute of Standards & Technology (NIST) has begun to weigh in on standards compliance for those companies and individuals trying to qualify for Stimulus funding. Where can we expect to see standards – and the standardization process – go from here?

Johnston: A smart grid infrastructure can only be scalable, secure, strategic and simple if it's built on true open standards. IP-based solutions that utilize public wireless networks and deliver grid intelligence to and from any device can easily scale to any size with minimal capital expenditures and be remotely upgraded to interface with new technologies as they are invented and introduced into the market. Anything less than a complete end-to-end IP solution will have limited application and unclear – and potentially unpredictable – long-term costs. Moreover, to do otherwise is becoming an increasingly risky investment, especially given the Obama Administration's emphasis on the use of solutions that use Internet-based protocols and standards as a condition for access to funds from the ARRA, as you just pointed out.

EET&D: Are there specific standards that you can cite as examples that offer tangible benefits?

Jones: Yes, by using public wireless networks in conjunction with industry standards like IP, IPsec, SNMP, IPv6, C12.22 and others, utilities will have better access to government funds, less risk of being left behind from a technology standpoint and can completely avoid the risk of tying themselves to a particular supplier for the next 20 to 30 years.

EET&D: How does one go about choosing a company – or a set of companies – to point the way?

Johnston: SmartSynch has developed a platform and laid the foundations for what we refer to as a "Smart Grid Ecosystem" to provide the most effective solution for utilities, commercial and industrial customers and renewable energy companies. That platform is built on open industry standards that are understood and accepted—while leveraging the public wireless network, which has already been built to a massive scale with billions of users around the world. This allows multiple companies to provide innovation and value to the utility. SmartSynch solutions are interoperable with multiple vendors and networks – which removes limitations of being tied to one partner and fear of a technology or network becoming outdated. An IP-based smart grid communications infrastructure encourages application innovation and delivery of new functionality from the broadest spectrum of participants – akin to how applications are developed and deployed for Apple's iPhone.

EET&D: Assuming that is the direction the Smart Grid build out eventually takes, what are some of the things that utilities and users could reasonably expect to see as a result?

Johnston: There are many, many examples of how such a platform could be mobilized, but let me offer just a few to put all of this in context…

Mapping energy use trends to optimize power consumption is one of the most immediate benefits that require very little additional effort to accomplish. Demand response programs offering incentives for business owners who curtail their facility's energy use during times of peak demand to help them capture tax incentives by reducing their carbon footprint would also be supported. Supporting large-scale intermittent renewable generation initiatives (e.g.; solar panels, etc.) and real-time notifications of power outages so dispatch teams can ensure on-site power quality would also be much easier to facilitate than they are today.

EET&D: What about the outage issues we talked about at the start of our discussion? What can the Smart Grid do for us there?

Johnston: Remotely controlling commercial and industrial customers' back-up generators during the summer, when load becomes critical, to shave peaks in real-time can help avert

outages as well as avoid physical visits to each generator site – a costly and time-consuming task that often simply doesn't get done at all. We saw specific evidence of that when we tried to restore power after the 2003 blackout. A lot of folks didn't know where the generators were, how to gain access to them, how to start them up, and when they finally achieved access – found them out of fuel.

EET&D: What happens if we don't embrace some type of Smart Grid Ecosystem, like the one you envision being needed?

Johnston: Among the most serious pitfalls is that we risk building a Smart Grid "patchwork" rather than a Smart Grid infrastructure, which in the end, isn't very smart. The standards-based ecosystem enables the world's best purpose-built companies to provide their specific expertise in building the various components of the Smart Grid so that each investment dollar spent is amplified. That is, the more experience a company has, the less investment is required from the utility customer.

Jones: Also, keep in mind that as the smart grid unfolds, new applications not possible – or even thought of today – will further transform how we generate and distribute electricity. One can imagine a world dominated by renewable energy where generation varies from day to night and the Smart Grid infrastructure can optimize day time (solar) and nighttime (wind) resources across large geographies.

EET&D: Is there a silver lining in all of this for everyone or do the main benefits primarily accrue to utilities?

Johnston: Users and generators alike will have more autonomy to gauge and manage their own piece of the Smart Grid and a new generation of technology innovators including hardware and software developers will add new functionality and applications yet to be created. SmartSynch believes that this level of innovation will only be possible at the enormous scale required if we make smart decisions today.

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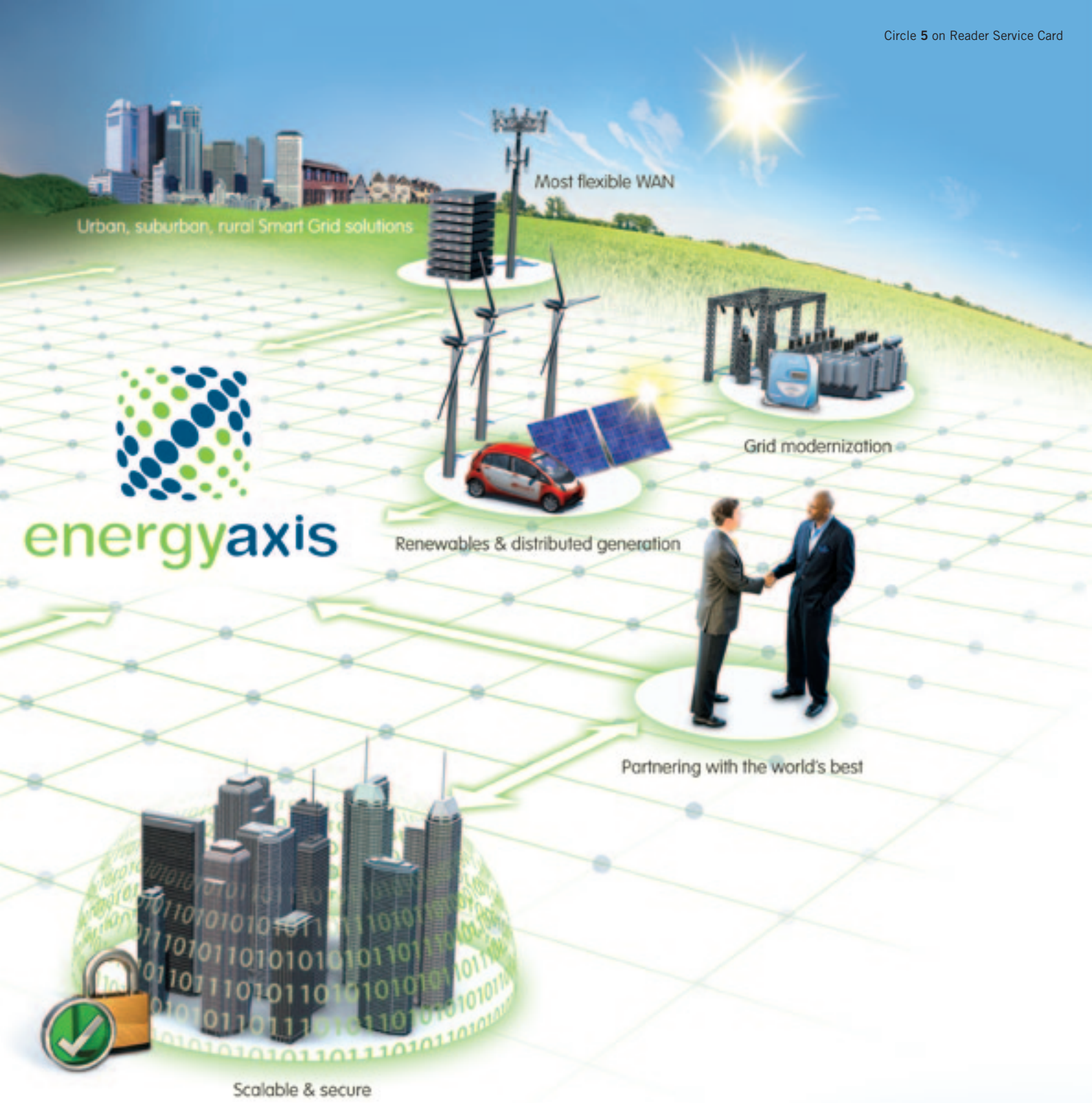


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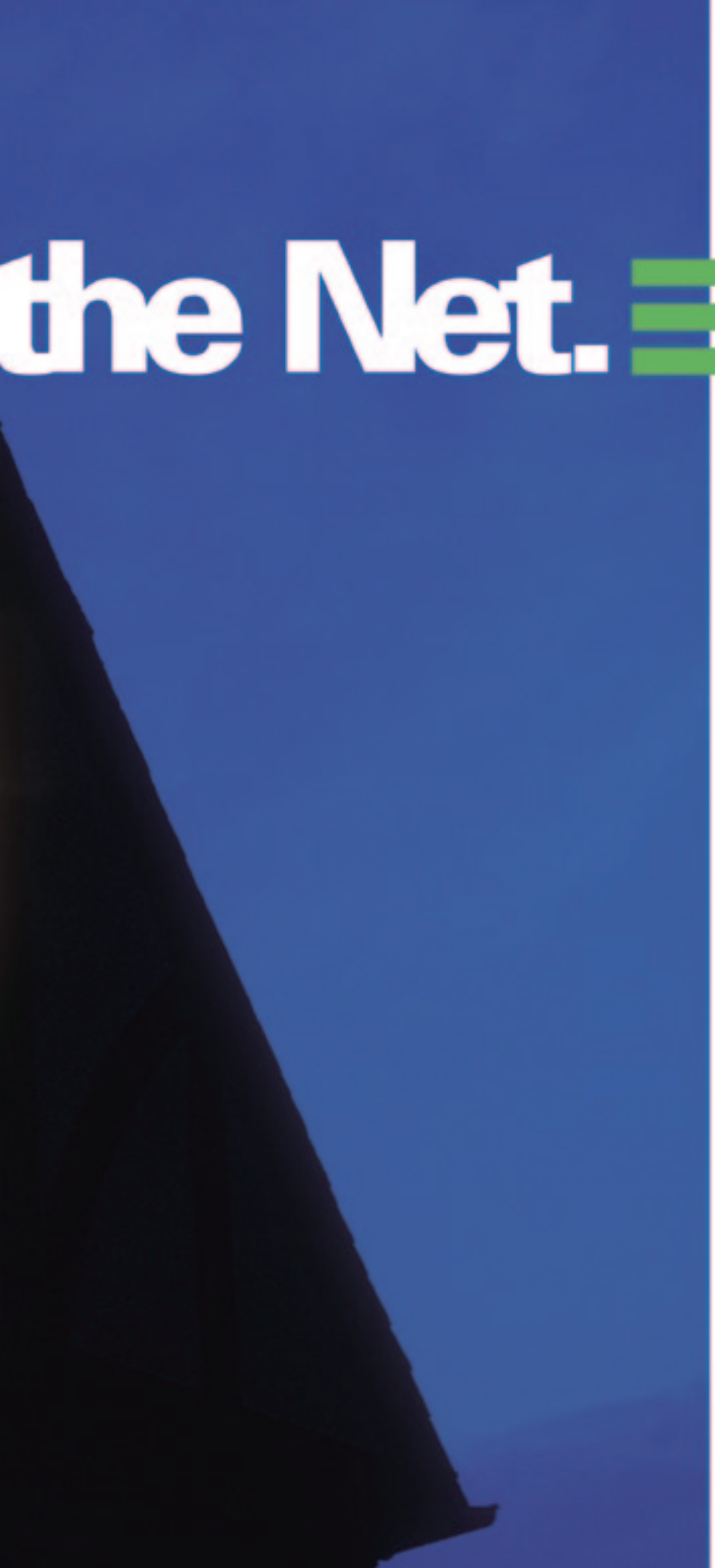

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The Measure of the Future

Validating Field Performance of AMI Systems

By Gareth Thompson, Senior Project Engineer, Enspiria Solutions, Inc.

Accurately assessing the performance of Advanced Metering Infrastructure (AMI) and Meter Data Management Systems (MDMS), during a field acceptance test (FAT) and during mass deployment, is a critical need for today's Smart Grid projects. The phases of FAT and full deployment require mechanisms for validating that the deployed AMI technology performs as expected. Key reasons for field-testing include risk mitigation, business case validation and planning for business process change.

Field Acceptance Testing

Field Acceptance Testing should play an important role in AMI and MDMS deployment. Utilities should use FAT testing as a gate for continued deployment. Moreover, failure to resolve issues discovered during FAT testing should be grounds for halting or terminating continued deployment of an AMI solution.

The FAT phase of a Smart Grid/AMI project will consist of deploying a limited (typically 500 – 20,000) set of meters and communication modules across a selected cross section of customer types (i.e., Residential, C&I, Electric, Gas, and Water, as applicable to the utility) and geographical areas representing communication challenges typical of the utilities service territory.

Including a FAT phase in an AMI deployment project has a number of benefits:

- **Risk Mitigation**
  Test the AMI head end (core functionality and integration components), AMI network and AMI meters to find issues early in the game and allow fixes to be made prior to mass deployment. Deployment of AMI meters for a field trial allows installation issues to be identified and resolved.

- **Contract Enforcement**
  Testing ensures that the AMI vendor can fulfill the contractual obligations and service level agreement (SLA).

- **Regulatory Reporting**
  Real data from FAT makes it easier for the utility to demonstrate to regulators that the AMI system is delivering the planned functionality, performance and savings.

- **System Selection**
  The utility's intent is that, at the end of FAT, results should support the decision to select the trialed AMI technology. FAT results are a key factor in supporting how the technology meets the contractual requirements.

- **Validation of Business Case Benefits and Costs**
  Utilities can use the FAT as a proof of concept to prove out benefits and costs traced to the original business case.

- **Business Process Change Management and Planning**
  During and after rollout of AMI, numerous business processes within the utility will be affected and changed. Some processes will be enhanced with AMI data, and others will disappear.

During FAT, some tests will fail to execute successfully. This allows issues to be identified and resolved while working on a smaller scale before they become large-scale problems. Finding these issues after many AMI meters have been deployed can present huge logistical and financial issues, damage the reputation of those involved and potentially derail the project indefinitely.

Field Performance Metrics

Accurately assessing AMI and MDMS performance requires testing and reporting on three key metrics: Availability, Accuracy, and Events/Alarms.

Availability

Utilities expect an AMI solution to provide a high percentage of data on a daily basis – this is a key decision factor when selecting an AMI solution. However, simply trusting that the solution delivers what is in the contract is not adequate;

delivery should be verified and validated. Availability testing measures and reports the availability of the AMI data – to ensure that the data that is expected to be delivered by the AMI system, and subsequently to any downstream MDMS and/or customer information system for billing – occurs according to the SLA levels agreed to by the utility and the AMI vendor.

Types of availability reports include the following:

- Register read availability
- Interval read availability
- Time-of-use (TOU) availability
- Demand and coincident demand read availability

All of these reports should verify that the expected data is delivered for each data type for a 24-hour period by a given time of day such that it can be used appropriately in other systems. Additionally, reports showing meters that repeatedly fail to communicate data, or meter types that have a high rate of communication failure, are useful in identifying communications, hardware and software issues across the AMI system. Differentiation by customer type is important because a small percentage of commercial and industrial meters accounts for a larger percentage of utility revenue.

While an AMI deployment as a whole might meet availability requirements, a more granular review of data by customer type may identify less ubiquitous but significantly impactful issues. AMI solution performance can also vary by commodity type. While electric interval data, for example, may be available at an expected level, gas interval data may lag. Understanding this differentiation allows utilities and AMI solution providers to troubleshoot functionality issues.

External systems such as Outage Management Systems (OMS) and Customer Information Systems (CIS) depend on timely real-time data from the AMI system for power status verification during storms. Automated tests should be made available to report on round-trip times of the initial request being made to the final response. This ensures that the AMI network and technology can support the time based needs of other systems when OMS operators and Customer Service Representatives are fielding customer issues.

The same concept can be applied to On-Demand Read calls to the AMI meters to ensure timely real-time reads all the way to the meter and back to the calling system. An example of an interval availability report is shown in **Figure 1**, produced by Enspiria Solutions' Metrics Tool. The report is calculating the percentage of electric AMI meters that reported all expected intervals for the previous 24-hour period (midnight-to-midnight).

The report calculation associated with **Figure 1** is: *The count of electric meters that correctly reported all expected intervals (i.e., 24 intervals for hourly configured meters; 96 intervals for 15 minute configured meters) divided by the total number of electric meters configured in the AMI network, multiplied by 100.*

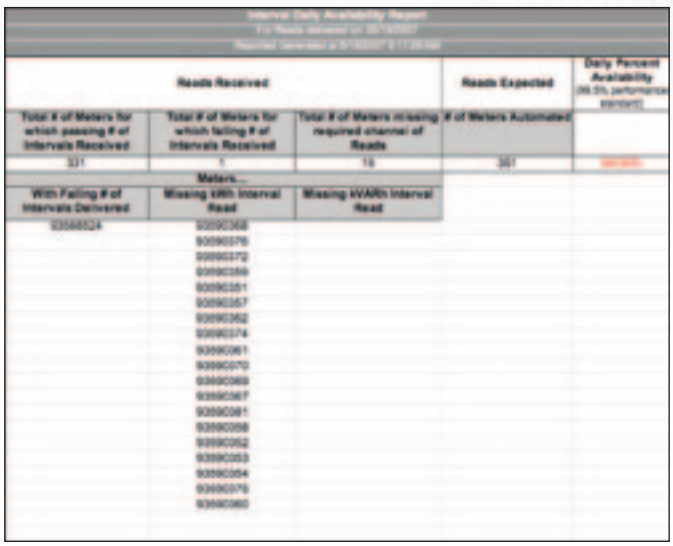


Figure 1 – Sample Interval Availability Report: Availability of Electric AMI Meters

Accuracy

Available data that is not accurate is useless to a utility. Accuracy reporting measures and calibrates the accuracy of the AMI usage data against the utility's existing automated and manual meter reading systems to ensure that the AMI meters are accurately recording data and the AMI system is accurately storing and passing that data to external systems (such as MDMS and then to billing). This becomes an additional data check on the AMI system to support the availability reports. Even if the AMI system is meeting the correct availability percentage levels it must also be accurate to ensure that customers can be correctly billed for their usage.

Accuracy reporting compares time based AMI interval data with time stamped manual meter readings (utilities should continue manual reading until AMI data has proved to be accurate). AMI data is considered accurate if the manual reading is greater than the AMI interval reading immediately prior and less than the AMI interval reading immediately following. The report process creates upper and lower bounding values from register and interval reads from the AMI system and checks that manually recorded reads lie between those bounds. Accuracy reporting can also be used to ensure the accuracy of the AMI data being translated through MDMS to ensure it is accurate relative to the utility manual reads and the original AMI reads from the AMI system.

Events/Alarms
This metric assesses meter level alarms and events to ensure that AMI meters installed in the field are functioning correctly and real-time events such as power outages can be correlated to real world events. This assessment is important, as many business processes will be affected by a full deployment of Smart Metering. For example, these alarms assist in the validation of the business plan, which typically includes items such as voltage management, outage management and theft detection.

Automated Testing and Reporting

Testing and reporting of these metrics can be handled via manual processes using the AMI head-end system tools. However, it is difficult to do this on more than a small set of meters. Using the interval availability example from above, it is easy to see how checking thousands of meters to ensure they all return the expected numbers of intervals each day via a manual process would be very time consuming.

The use of automated tools for these tests allows the utility to perform the tests daily (or even more often, if required) in a controlled and repeatable fashion for a large set of meters. Data may be collected from the head-end, analysis of the data performed and then performance metrics reports created for analysis by the AMI team. Automated tools can also be used to determine that the integrity of the data flowing from AMI to MDMS is being maintained, and to validate that the data being passed from MDMS to the billing system is intact.

Dashboards may be used to report daily results and more detailed reports distributed automatically via email to the AMI team. The metrics reports can be used by the AMI team and AMI vendor to pinpoint sets and/or types of meters that consistently fail the performance criteria. The analysis allows the combined teams to drive out any issues with meter, network configuration and software technologies as well as physical and geographical issues in the AMI deployment area(s).

An example of this analysis is identifying if specific meter types, or meter types with a certain firmware version, repeatedly fail the tests – which could point to issues with the meter software. Another example is where meters located in a specific geographical area fail the tests due to network coverage, indicating that more AMI network or infrastructure should be deployed in that area.

An automated solution that evaluates AMI data should provide audit quality reports of system performance and contractual metrics, in addition to being quick and easy to use. Utilities benefit from a solution that provides both executive-level dashboards for monitoring progress, and detailed report information in a mainstream format that can be used for analysis and troubleshooting. There are several options to consider when looking for automated metrics tools:

- **In House Tools**
  These may require ground-up construction to support reporting around the AMI and MDMS technologies and databases.

- **AMI Systems**
  The AMI head-end itself may provide some tools and reporting functionality; however, the utility often requires an independent assessment of the AMI technology.

- **MDMS**
  The MDMS provides reporting functionality but the timeline of MDMS implementation is often in parallel with the initial AMI FAT timeline.

- **Third-party Tools**
  Analysis and reporting tools can enable the utility team to produce objective reports on the AMI data while also insuring that the tool can be implemented in a rapid and straightforward manner without requiring excessive customization or configuration.

Test Playbook

A test 'playbook' should be developed in the initial phases of the FAT, prior to actual testing. The playbook lists all of the tests – automated and manual, often broken down by meter type – to take place during FAT. The playbook needs to be based on contractual/SLA requirements, for example to ensure that 99.5% of interval reads are being delivered to the head-end system within eight hours of the end of the day. The playbook needs to be developed jointly with the AMI vendor, and the utility and AMI vendor should both agree to be bound by the results.

The FAT data can then be utilized to facilitate system acceptance – the utility shouldn't formally accept an AMI deployment without validating key criteria. The end of FAT can be used as a contract gate for continuing with mass AMI deployment.

Meter Shop and Trailer Testing

Field acceptance testing allows for repeatable availability and accuracy testing across the entire meter population; however, there are other meter and AMI system functions that should be tested in a controlled environment on a more limited basis. These tests can be performed in the meter shop and in a field located trailer.

A 'trailer' test involves placing a trailer containing AMI meters in a field location with AMI network coverage to simulate a set of AMI meters deployed in the field. The trailer can be placed in a location typical of the utility's service territory or even moved around to atypical locations. The meter shop and trailer tests are constructed around a bank or bench of meters that are subject to manually triggered tests to confirm that meter functionality is working as expected.

The testing playbook is used by the AMI team to execute the tests. During the test process, the meters are subject to load/flow, events and other conditions while an AMI engineer and the AMI team monitors network traffic and the AMI system and head-end. The AMI team checks that the resulting data in the AMI head-end is as expected, based on an individual test. If the test does not function as expected, monitoring and recording the meter and network data aids in the triage of any issues.

An example of this type of test would be to reverse the meter in the socket to ensure that a reverse rotation event is sent back to the AMI head-end. If the event is received at the AMI head-end, the meter passes the test; if not then the test fails and analysis is performed to determine the cause of the failure. Based on the data output, the testing playbook can be used to record the results of the tests. It is important to involve the utility employees, AMI engineers and any relevant integration engineers in this phase to validate the required functionality and output of the AMI system.

Performance Management for Full Deployment

While the automated testing is important in the initial testing and FAT phases of an AMI implementation, it is also useful in the full AMI meter deployment phase. Testing should continue throughout full deployment to verify system health and performance. Additional analysis and reporting tools should be added to expand on the information provided by the basic FAT reporting results to support contract enforcement and regulatory reporting.

During full deployment, testing can be performed on the full population of meters deployed to continue to monitor performance against the SLAs. Typically this phase will leverage other Business Intelligence (BI) tools to allow more complex analyses to be performed in the AMI dataset and with other datasets. (See BI & Spatial Analysis section, below).

As part of deployment, testing can also be performed on a subset of the AMI meters (i.e., a different subset than that used in the FAT phase) to ensure that the FAT metrics achieved earlier are repeatable in a consistent manner. This ensures that any tuning performed for the FAT meter population and AMI infrastructure was repeated for newly deployed areas and not specially tuned just to pass SLA levels for FAT.

Using the existing testing tools and reports in this phase gives a larger return on investment on the tools built for the FAT phase. The FAT reporting tools can provide a blueprint for the full deployment phase and for normal operational reporting once full deployment is achieved.

BI & Spatial Analysis

Leveraging spatial data sources with AMI data in the various phases of Smart Grid planning and deployment can provide a foundation for powerful data analyses, including for FAT planning, deployment planning, and deployment and operational analysis.

- **FAT Planning**
  Potential areas for FAT deployment of AMI meters can be identified using spatial data sources to 'score' zip codes, or other areas, based on socio-economic and physical attributes such as meter density, topology, high customer turnover, theft occurrences and rate class. Different attributes may be assigned different weights in the scoring, based on their level of importance to the utility. For example, zip codes with high scores may be more likely to be selected for FAT deployment, as they are more likely to provide a diverse set of conditions to test and validate the AMI technology.

- **Deployment Planning**
  This is similar to the FAT planning but the objective in this case is full deployment planning. Zip codes or other areas can be ranked to plan deployment sequences for AMI. Additional scoring factors may be used during the deployment planning; some examples are high cost to read meters and new customer locations. Certain factors may be assigned heavier weighting since it may be more important to deploy AMI meters to specific areas to get a faster return on AMI investment.

- **Deployment and Operational Analysis**
  Tabular results from the automated AMI deployment tests can be used against spatial data such as meter reading routes, operational divisions and AMI network assets (i.e., towers, collectors and routers) to show availability of meter reads at a geographical level. The spatial data can be thematically displayed to show availability percentages using various map base tools such as Google Earth or Microsoft Virtual Earth.

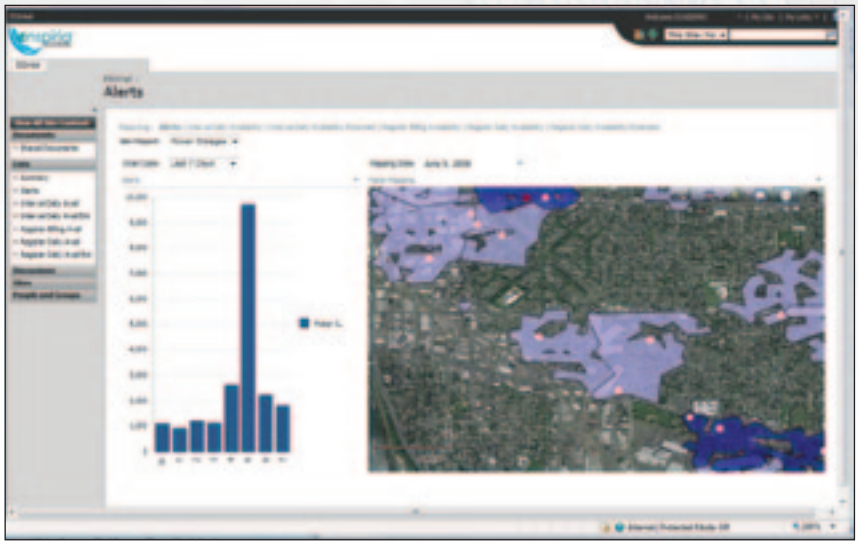


Figure 2 – Sample Dashboard with Thematic Charting of Meter Power Outages

Figure 2 shows an example dashboard from Enspiria Solutions' Metrics Tool, charting meter power outages over a 7-day period. The map view shows the outages plotted against meter reading polygons. The meter reading routes are thematically colored, based on the counts of meter outages within each area. The same routes can be displayed thematically for both availability and accuracy reports.

Assessing the performance of AMI and MDMS technology is critical both during field acceptance testing and during mass deployment. These needs can be met through automated testing and reporting tools that can also leverage spatial data sources to provide powerful data analysis, including for FAT planning, deployment planning, and deployment and operational analysis. Effective performance testing and reporting helps utilities to maximize their significant AMI/MDMS investments and reap tangible benefits over the life of the deployment.

Conclusion

Before a utility embarks on the deployment of new networks and the associated thousands of meters per day, it is best to follow a carefully developed process to ensure a successful and risk mitigated project. A Field Acceptance Test (FAT) should be factored into the timeline and budget of the AMI project lifecycle, with much consideration placed on the processes and the goals of the FAT. Notably, the utility should be prepared to delay or stop the project if these goals are not met. ■

About the Author

Gareth Thompson is a Senior Project Engineer at Enspiria Solutions, with 15 years of experience in utility consulting and software engineering/integration. He specializes in assisting utilities with the field-testing of AMI/MDMS technology. Mr. Thompson helps utilities to define and execute detailed plans for AMI benefits validation and risk mitigation, and deploys metering metrics tools and web-based dashboards.

Demand Response Management Systems: The Next Wave of Smart Grid Software

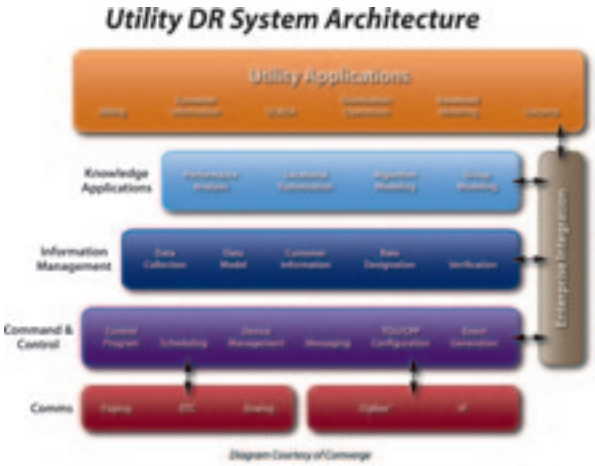
By Arthur (Bud) Vos, Chief Technology Officer, Vice President of Strategy for Comverge

Meeting demand for electricity is just one of the issues facing utilities today. Utilities are pushing to transform as momentum continues toward Smart Grid…

The Smart Grid is an industry transformation – a transformation that is shifting the business and operational models used by utilities from a siloed approach to a more cohesive one. Wave 1 of the Smart Grid infrastructure, occurring now, involves the acquisition and deployment of advanced metering communications systems for 2-way connectivity to energy consumers, communication between the utility and the home.

The second wave, also starting now, utilizes the connectivity established in Wave 1 to collect and manage massive amounts of consumption and performance data. This wave begins the installation of systems that utilize this information for operations, demand response and customer empowerment.

The final wave, Wave 3, tightly integrates the command and control infrastructure with the transmission and distribution control infrastructure for advanced Smart Grid control applications. It's during this wave that the Demand Response Management Solution (DRMS) comes in as the critical infrastructure component – linking the utility back office to its customers.



Demand response (DR) is becoming an ever-increasing asset in the Smart Grid ecosystem. While these assets are critical to the ability of customers to make choices to potentially reduce their energy consumption, they are vital to the operations of many electric utilities for peak load management, economic control and distribution system operations and optimization. Making this linkage between the utility back office to its customers involves more than protocols, standards and common Application Programming Interfaces (APIs). It requires a platform capable of adapting to ever-changing business needs while remaining focused on providing the infrastructure for both command and control as well as customer empowerment.

A New Breed of Utility Enterprise Application

The ability to control, operate and monitor remote assets has fostered a new breed of system called a Demand Response Management System. The DRMS is not much unlike legacy load management systems as an operational system used to control distributed DR resources.

However, new and advanced features will help this new breed of technology keep pace with the momentum toward the Smart Grid:

- Open standards based system rather than a proprietary one;
- Management of millions of endpoints, versus hundreds of thousands;
- 2-way communications and verification rather than 1-way; and
- Integration between the AMI/SmartGrid network and the utility back office systems.

From an enterprise systems point of view, the DRMS falls into a category of an information management system much like the Meter Data Management System and connects the flow of information to the DR devices to/from the utility, leveraging the SmartGrid/AMI network. As the critical linkage between the DR resources and the utilty back office, there are critical functional elements that must be supported:

From an enterprise systems point of view, the DRMS falls into a category of an information management system much like the Meter Data Management System and connects the flow of information to the DR devices to/from the utility, leveraging the SmartGrid/AMI network. As the critical linkage between the DR resources and the utilty back office, there are critical functional elements that must be supported:

- **All Customer Classes**: Utilities investing in DR are doing so across all customer classes. The DRMS solution for most utilities needs to be a complete solution for all customer classes and cases. Additionally, it should represent the state-of-the-art in a portfolio management toolset for these resources.
- **Utility Operations**: The DRMS becomes the link from utility systems such as the Customer Information System and the Distribution Management System.
- **Device Agnostic**: In the not too distant future, the market will be flooded with devices for DR and customer interaction. DRMS platforms must embrace the use of these devices in a agnostic manner, breaking the mould of proprietary systems and control 3rd-party devices.
- **System of Record (SoR) for the Home Area Network (HAN)**: All utilities talk about the system of record for billing systems. The new system will require a complete SoR for HAN devices as well.
- **Platform Approach**: The DRMS platform is not a single solution but rather a platform for the next generation of systems; an expandable system as new opportunities emerge.
- **Multi-Devices, Multi-Protocol, Multi-Network**: Migrating from legacy technologies will require time, patience and a strategy that encompasses the ability to manage legacy systems as well as new systems. Although the feature sets maybe different, the DRMS must manage this transition.
- **Link to Customer Portals and Information Systems**: The DRMS must maintain active records of customer devices and manage them on behalf of the utility. Critical to the success of the DRMS concept is being able to integrate with customer facing systems. These portals provide customers with valuable, decision-making, information.

Current and Future Issues

The need for a DRMS is clear, as are the functionalities required to support the emerging SmartGrid transformation. However, the industry is currently grappling with some looming issues, the most serious of which are those already being considered in current design efforts, such as security. But others – found less frequently in today's headlines – will also greatly impact our work, moving forward.

Security: The North American Electric Reliability Council NERC has implemented standards that are requirements for the security and reliable operation of energy capacity systems, including DRMS systems. Any utility looking to implement large- scale demand response must review and adhere to the standards established by the North American Electric Reliability Company (NERC).

Security beyond the control room and into the homes gets dicey, however. Communication networks need to extend into customers' homes and provide secure access to systems and information about those customers.

In today's electronic age this is enough to make any utility executive nervous. Some of the best electronic security resources in the world are working to ensure that the standards used are robust and reliable. This is exactly why any enterprise solution needs standards and technology that not only works with the latest information technology security standards, but also provides a certain upgrade path once security changes are enacted.

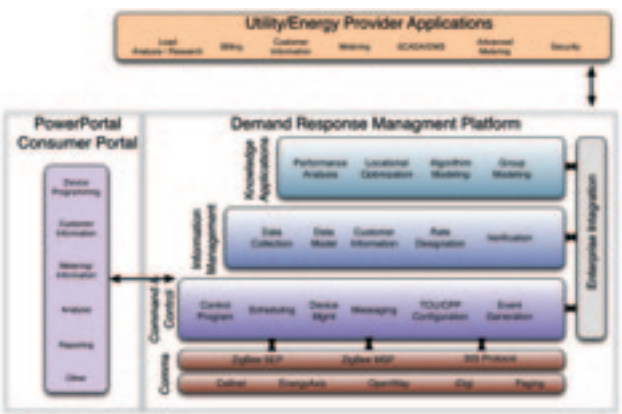
Data Integrity: When Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI) and remote AMR systems were first installed in North America, the Meter Data Management System was born out of necessity to collect and process the vast amounts of meter data being collected. Just like the MDMS industry before it, the DRMS evolution will slowly begin to manage the data coming from and going to HAN devices. Immediately, this raises the question of data integrity across systems without massive data replication. The DRMS must be designed to plug into the Service Oriented Architectures (SOA) of today's back office utility and provide seamless utilization of the data from the Customer Information System or MDMS without data replication.

It's not an easy task. Today's SOA interfaces are still emerging and standardization is only beginning. The industry needs reference installations, which provide the basis for examining the positives and negatives involved in the integration as well as solid performance metrics. A vendor/customer partnership approach enables continuous improvement along a path to an optimal solution.

Multiple Competing Standards: Standards are being talking about all over the world, and it's a confusing world full of new acronyms, players, consultants and companies. While overwhelming at times and competitive at others, standards organizations are all working toward the same goal. Much like industries before ours, the goal is for vendor interoperability and collaboration without the installation of custom systems. Standards collaboration is a must and the industry needs to embrace the work these organizations are doing. Participation is encouraged; but more important are that the conversations occur at appropriate levels of abstraction. It's important for all standards organizations to work at the level that suits the application.

For example, when specifying a protocol the bits and bytes are important, however, when specifying a business integration framework, the bits and bytes are less important with work flow comes taking precedence. It's a delicate balance but one that the industry will need to develop and embrace.

Scalability and the Economies of Scale: All Smart Grid systems are under the scrutiny of "full scale" operations yet only small scale systems are currently deployed, particularly for DRMS systems. As such, the industry should be examining how systems are tested and verified for operations at scale and how the system is designed to operate with large-scale systems. Scalability is a problem that doesn't always scale linearly. In fact, systems operating perfect at 100,000 points may not scale to 1 million points and usually, if they fail, do so miserably.



Unfortunately, there are hundreds of factors that can influence the scalability of a DRMS system, from the hardware to the communications network to design of the application protocol. They all impact how the system must behave to deliver messages to the end devices. Similar to the problems the industry has seen in transmission and control operations, AMI systems needed to work on the scalability of consuming communications ***from*** endpoints over a controlled communications network. The DRMS scalability problem is based on sending commands and controls ***to*** endpoints over a communications network that is not managed by the DRMS itself.

All of these issues point to the necessity for longevity in the industry and experience and knowledge of the technology. While many of these issues will take years to come to resolution, a customer/vendor relationship that is built on a partnership approach that will enable solutions to be established and objectives aligned.

Conclusion

Not all utilities will transition through these waves at the same time and, in fact, many are just at beginning of that process. But the waves of change are clearly emerging. The Smart Grid transformation is in full swing, and the introduction of assets that enable reliability and economic control will create a host of issues and concerns that must be addressed. As such, the DRMS has been born as the information system technology that links the electric utility back office to the consumer. Careful consideration of the technology and partners must be carefully considered, especially while the industry remains in the current state of flux and changes continue to evolve. ■

About the Author

Arthur (Bud) Vos is Chief Technology Officer, Vice President of Strategy for Comverge, a leading provider of comprehensive smart grid, demand management, and energy efficiency solutions for over 20 years. Vos has been extensively involved in the electric utility industry for more than ten years, including the development of demand response offerings based on real-time monitoring and control technology, strategic sales to electric utilities, alliances and joint product and development offerings.

EXECUTIVE Directions

Utilimetrics

Joel Hoiland, Utilimetrics, CEO

For nearly 30 years Joel Hoiland has had a distinguished career positioning and growing industry organizations at the international, national and regional levels. He joined Utilimetrics on a part-time, retained basis in July 2008 with a broad background in retail, wholesale/distribution, supply chain logistics, outsourcing and technology industries. He had worked previously with trade associations, equity firms, association management companies and private businesses before taking over managing the evolution of an organization that much like the industry it serves, was and is, very much in transition. When I met Joel a little over a year ago, he was already very much aware of the challenges of leading an industry association in the midst of change. I found him to be not only willing, but eager to take on those challenges – and most importantly – confident in his ability to overcome them, whatever they might turn out to be. –**Ed**.

EET&D: You and I met for the first time at the 2008 Autovation Conference, just after you came on board with Utilimetrics. At the time, you were still getting acclimated to the industry environment and very much in a learning mode. Now, a year later, you are clearly up to speed and moving forward on several fronts to bring the organization much more into the industry mainstream. But before we get into some of the more recent initiatives that are underway, I think it would be beneficial to start off with some of the basics for the benefit of those who might not be completely familiar with the Utilimetrics organization.

HOILAND: Let me give you a quick history of how we have arrived at this point since our formation 22 years ago…

The first industry forum on automatic meter reading was held in Denver in 1986, followed by an Automatic Meter Reading Steering Committee meeting held later that year in Atlantic City, NJ. Formation of the Automatic Meter Reading Association – most people quickly came to know it as "AMRA" – was announced in Philadelphia and was incorporated in New Jersey that very next year with Don Schlenger, Ph.D., named as the Association's first president. Don would eventually become the Association's first Executive Director just two years later, in 1990.

EET&D: Not long after that is when I first became aware of AMRA myself. I attended my first conference a few years later and remember listening to a presentation Don Schlenger gave, explaining that AMR wasn't really about replacing meter readers. It was quite an enlightening experience for me – one that got me personally interested in the metering industry.

HOILAND: And we've certainly seen a lot of changes since then. In fact, 1988 turned out to be another year of "firsts" with the first National Automatic Meter Reading Symposium held in Traverse City, Michigan and the first Automatic Meter Reading Association Annual Meeting held in Dallas. The first AMRA newsletter also was published that year. Things were ramping up pretty fast for such a young organization.

EET&D: Things didn't exactly slow down after that very much either, did they?

HOILAND: No, they didn't. By 1999 we had put our first Products and Services Directory online, and at our annual symposium in Tampa in 2000, we included specific programming for International delegates for the first time – giving real substance to the "international" part of our identity.

EET&D: When did the transition from AMRA to Utilimetrics get started?

EXECUTIVE Directions

HOILAND: The latest chapter in our evolution started in 2004 when our annual conference was renamed Autovation® to underline the fact that we were changing along with rapidly escalating changes to the industry itself. And when AMRA celebrated its 20th anniversary in 2007, the Association name changed to Utilimetrics. That change eventually led to putting Utilimetrics on a completely independent footing recently when we left an association management company and became a stand-alone trade association. In March of 2009, I joined as the first full-time Chief Executive Officer of Utilimetrics – a newly created position – as part of that transition.

EET&D: So that brings us to today, just over a year since you assumed that position, albeit on a part-time basis initially. Can you tell us something about the organization today and perhaps also share your vision for its future?

HOILAND: First and foremost, Utilimetrics is an international trade association for smart metering and innovative technologies. Our mission is to bring utilities and consumers together through technology. As the world's premier utility technology association, we provide a voice for utilities, and we are the go-to resource on innovative and emerging technologies. And on a broader scale, we are a cutting edge resource for corporations, utility departments or authorities, associations, public interest groups, consumers and others who are vested in the development and application of smart energy and resource technologies.

EET&D: Now that you've had a chance to get settled in, I'm sure that our readers would like to know a little bit about how Utilimetrics is moving forward. Can you share some of that with us?

HOILAND: As you might expect with all of the changes going on across the utility industry, the surge in smart metering, and the Stimulus Bill – there's quite a lot going on. When I came on board a year ago we had to start with the basics, since we had not previously been a standalone organization. But after working through a logistical process that I'm sure anyone who has ever set up a business can appreciate, we now have a new office and a new full-time management team of very capable professionals.

We have staff members who are experts in transnational instructional design, event management, utility communication, strategic positioning, public policy and membership-sector marketing. Our new team is dedicated to the mission of education, collaboration and advocacy for utility technology solutions.

EET&D: Now that Utilimetrics is into its third decade of service and you are at the helm, what kind of objectives have you laid out for the future?

HOILAND: Our objectives for Utilimetrics focus on organizational growth through expanded services – particularly in the areas of education, on-line resources, advocacy and transnational professional programming. We will also have an emphasis on organizational effectiveness through improved board alignment, enhanced staff capability and a three-year business planning process. Finally, we will continue to pursue strategic alliances.

EET&D: What are some of your priorities for Utilimetrics over the next year or so?

HOILAND: My top priority is to keep adding value by addressing the critical needs of our members as they wrestle with new technology and business transformation that is besieging the utility industry. That is an ongoing multi-faceted objective, which includes – among other things – new capabilities such as a new and improved Website with greater functionality; the launch of weekly e-Newsletters; continuation of weekly Public Policy Reports; timely webinars; and the creation of an Education Research Foundation.

EET&D: It sounds like you have enough on your plate to keep you busy for quite awhile and that Utilimetrics will have considerably broadened its scope and elevated its stature in the process.

HOILAND: Our plan is to position Utilimetrics as the primary source for information about smart metering and innovative technologies including advanced metering, communications, utility automation and data management solutions, as well as being the voice of the industry. With everything that's taking place in the industry right now, our Utilimetrics management team believes we can serve a higher purpose while also adding value for our members – and that's exactly what we intend to do.

The Energy Web

By Eric Miller, Senior VP–Solutions, Trilliant Incorporated

Twenty years elapsed between the creation of the Internet in 1969 and the 1989 invention of the World Wide Web by Tim Berners-Lee. It took another four years until the introduction of Mosaic 1.0, the first commercial Web browser, and a few more years before the term "Web" became a household word. Today, forty years after its creation, the population of Internet users is estimated to be 1.5 billion, almost a quarter of the entire world's population.[1] A similar progression is unfolding with an "Energy Web" that has obvious parallels to today's World Wide Web.

Like its counterpart, the Energy Web provides an infrastructure for wide-scale communications, but with a singular focus on upgrading today's one-way electrical distribution grid to a Smart Grid; one that provides two-way communication allowing for increased energy efficiency and the integration of renewable resources. The Smart Grid's importance stems from the need to manage increasing energy demand without having to construct expensive, new energy generation as well as U.S. foreign policy objectives regarding carbon emissions and national security. These goals, however, can't afford to wait another forty years for the development of the Energy Web.

The Internet is infrastructure that uses a browser as the lens through which consumers and businesses access the standard unit of value: information. Similarly, the Smart Grid is the infrastructure upon which the Energy Web is today taking its first steps. In essence, the Smart Grid is to the Internet what the Energy Web is to the World Wide Web. Meters, thermostats, transmission lines, home appliances and more are combining to create a personalized view into Energy Web's standard unit of value: energy.

The vision for the Energy Web looks something like this: energy produced locally is transmitted and used globally. Solar energy from the Sahara Desert delivers power throughout Africa; wind power harvested off the Irish coast powers not only the local economy, but is also sold to Hong Kong or Delhi; geothermal energy from places like California, Nevada, Idaho, and Oregon steps up to meet America's growing electricity usage. Energy captured everywhere and distributed where needed, when needed.

And there's more. The Energy Web means that consumers are able to personalize their energy consumption. Think of consumers' energy preferences in the same way you do a mutual fund. They are comprised of numerous elements, some risky, some not. Tomorrow's consumers can subscribe to a low-carbon energy plan that includes a mix of renewable resources, allows their local utility to automatically adjust the thermostat or air conditioner during severe conditions, and choose the "green grid" button on the washer to schedule operation at any time within the next twenty-four hours based on sustainable resource availability or percentage of carbon content.

Alternatively, consumers can opt for a "9-to-5" energy package that relinquishes control of home energy while that consumer is out of the house, even or a "healthcare" package for elderly or handicapped individuals that are not in a position to make energy sacrifices.

Because consumers have become accustomed to personalized Web services, it's logical to assume that they will want to subscribe to sustainable resources and clean energy if it's simple and affordable. The Energy Web will be organized into roles and resources that respond in predictable patterns, much the way browsers define generic services, but Web pages personalize.

Dynamic energy consumption will become a transparent process, with access points consisting of everything from the home thermostat to a cell phone to a Web page. Want the lights to automatically turn on when the GPS device in your phone is within 200 yards of your home? Simple. Want to turn the air conditioner off via your Web-based energy console when you're stuck working late? Done.

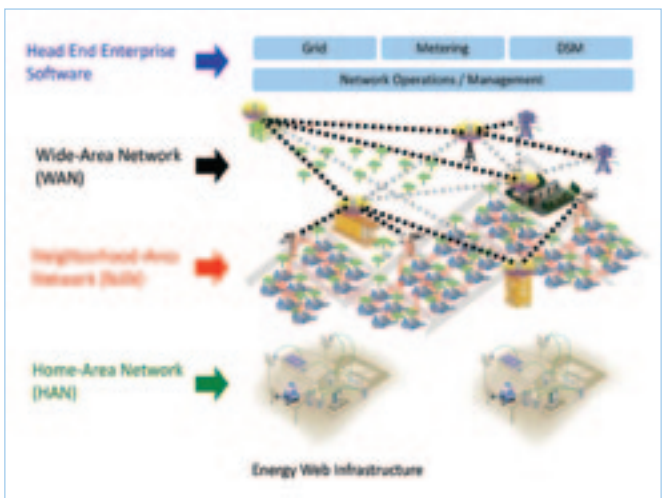
[1] http://www.50x15.com/en-us/internet_usage.aspx

From Here to There

So how do we turn this vision into reality? For starters, we need a common goal and a mandate. In large part, President Obama's stimulus package – the American Recovery and Reinvestment Act (ARRA) – has captured the commitment to the Smart Grid by solidifying the need for increased energy efficiency and outlining the goals of a growing incorporation of renewable energy.

The challenges facing the energy industry are vast and the impact on our environment and the global economy is clearer than at any other time in recent history. This means that the public is watching, and the opportunity to evolve from a rate-only business to a rate-plus-value business is also present.

Already, there has been significant progress. Unlike the World Wide Web, the Energy Web can emerge locally, in regional pockets. As one utility begins to implement their Smart Grid strategy, the opportunity to layer consumer-facing applications on that grid is readily available. We've seen this in Ontario, Canada where Hydro One is in the final stages of a province-wide Smart Meter deployment. We've also seen it Louisville, Kentucky, where E.ON USA has improved the energy efficiency for their users by approximately 30%.



To expand and replicate these activities globally, the following Smart Grid characteristics and standards need to be in place:

Security. Like any critical communications infrastructure, business and consumer security needs to be assured.

Interoperability. Energy is harvested locally, but exported globally. Connecting a global system of consumers, utilities and energy providers requires a common, interoperable playing field.

Flexibility. Utilities are charged with building out an infrastructure to support applications that haven't even been imagined yet.

Scalability. Scalability is best accomplished through an open application platform; a modular, open architecture and the incorporation of multiple standards-based solutions.

Reliability. Electricity was the world's first 'always on' network. Keeping it that way is vital.

Security

Smart Grid security must meet the most stringent of utility requirements, both with respect to protection of data and protection of the communications network. These are distinct and separate functions.

Both instances require open, standards-based authentication and encryption solutions. Access to the network and to data needs to be authenticated and have privacy policies and procedures in place. And all of these procedures also need to be verified by industry experts.

Existing standards such as ANSI C12.22 provide application layer security and AES (Advanced Encryption Standard) assures message privacy via 128-bit encryption. Data collection policies can further strengthen appli cation and network security.

Interoperability

We know from history that industry innovation is stifled without adherence to comprehensive standards and interoperability. The sheer magnitude of change ahead of us cannot – and will not – be supported by a narrow set of proprietary supplier frameworks. If we are to innovate, we must invest in a robust infrastructure that will deliver early results while supporting the future through scalable and universal connectivity as well as application integration serving utility operations and consumers.

If we pursue piecemeal strategies as we have in the past and walk into the future blinded by our old habits and tactical initiatives, the risk that we will not be able to manage information and energy capacity in a volatile future increases dramatically and the opportunity for sustainability of growth will pass us by.

Interoperability is not an ideal. It is an imperative for sustainable and economic change management. If we consider the sheer magnitude of connectivity inherent in the Smart Grid and application development needed to support our future, we must embrace interoperability and compatible standards.

Moreover, interoperability must not be based on proprietary AMI or any one supplier's definition of networks. Rather it must ensure wide-scale energy efficiency, consumer-oriented demand management, enterprise operating efficiency, universal grid networking, and yes, real-time metering from a choice of advanced metering suppliers using interoperable industry standard connectivity.

Some utilities have chosen open standards solutions based on IEEE and Internet Protocol (IP) compatible networks, emphasizing energy conservation and demand management along with advanced metering. Connecting these elements without standards is very challenging. It requires placing all of the risk with a few suppliers and investing in massive integration and migration, with an obsolescence risk that possibly replaces all of these proprietary assets at a later date or inhibits adaptability to increasingly complex conditions.

As a supplier of network infrastructure and Smart Grid solutions, we know first-hand that we simply cannot build our business to support this complex and wide-scale industry without using off-the-shelf technology, robust networks and innovative secure protocols. We feel that it is imperative to focus on making multiple standards work together in a utility-grade network rather than pushing a lock-in on customers by embracing on a select few standards.

Flexibility

In order to create self-sustaining consumer behavior and distributed energy resources, the command-and-control side of the Smart Grid must be augmented by balancing strategies that allow the consumer to personalize their energy usage.

This flexibility requires a normalized data model for simplified integration. On the utility front, such flexibility manifests itself in processes such as time-of-use (TOU) scheduling; real-time on-demand and scheduled reads; the incorporation of multiple rate plans, group plans and multiple calendars; and open APIs for billing, CIS and OMS integration.

On the consumer front, the Energy Web will take the form of a self-service, customizable model for energy consumption. Transparency and flexibility will go hand-in-hand, as each consumer will choose the method through which they access their energy consumption.

A particular challenge of building in Smart Grid flexibility is the long horizon of utility applications. Web-based applications and services can be built, deployed and retired in a matter of months. Silicon Valley doesn't typically think in terms of decades-long time frames. But that is exactly how utilities need to envision and architect their Smart Grid infrastructures.

Scalability

Utilities need to ensure that their Smart Grid communications infrastructure provides enough headroom to meet the needs of tomorrow's utility applications. In addition, to ensure that assets are not stranded, devices need to be 'firmware upgraded' over-the-air.

Because the communications network and devices that a utility deploys today are expected to last for well over twenty years, they must support applications that have not yet been imagined. Just as no one imagined at the dawn of the Internet that combinations of Internet, Web and communication standards would lead to YouTube or Twitter, utilities need to prepare themselves today for applications they can't even imagine.

This is best accomplished through an open application platform; a modular, open architecture and the incorporation of multiple standards-based solutions. The Smart Grid and the Energy Web, like the Internet and the World Wide Web, is composed of multiple standards. Embracing only a few of these standards will only lead to utility Balkanization in the future; that is, a collection of small, mutually hostile factions that will wind up serving no one properly.

Reliability

Individuals and businesses hold utilities to a far higher standard of reliability than they do their ISP or phone carrier. Having your electricity interrupted like a bad phone connection can have disastrous consequences. To assure the levels of performance needed, standards and best practices need to be in place from the meter to the head-end, from the utility (supply) to the consumer (demand), and across every access point in a complex and comprehensive infrastructure.

To maintain electricity's 'always on' capabilities as the underlying infrastructure becomes more complex, as consumer energy consumption becomes more transparent, and as demand continues to surpass capacity, is one of the most important challenges of the energy industry today.

Conclusion

The Smart Grid and the Energy Web will be driven by the evolving needs of customers and the increasing density of distributed and sustainable forms of energy. Utilities need a widely-dispersed and high-performance Smart Grid network to unify operations.

The energy consumer needs tools to effectively use new assets such as electric vehicles and sustainable generation. All the while business needs ways to better implement green and sustainable practices. Efforts like these, done in concert, will help to reduce carbon emissions and improve capacity utilization.

Today's World Wide Web is a tapestry of complex and protean standards. Comprised of standards around markup languages, style sheets, object models, communications, connectivity and more, and run by no single entity, the Web is undoubtedly the most successful global network of all time. But without the standards in place today that simultaneously fostered its growth and breadth, the Web would very likely have faltered. Where the World Wide Web came to rely on TCP/IP, HTML, CSS and more, the Energy Web will come to rely on standards such as TCP/IP, CIM, ZigBee, ANSI C12.19/22, and others.

Yet unlike the World Wide Web, the Energy Web can reach critical mass in smaller, localized implementations. Ontario, Canada is arguably the largest Smart Grid implementation in North America and is well on its way to a mature Energy Web. We are seeing these pockets of maturity evolve around the world, and it is one of the most promising and gratifying developments of the past few years.

As the world increasingly turns its collective gaze on our industry, it is important to recognize how much progress has already been made. Our industry will not be subject to the twenty-year gap between the birth of the Internet and the development of the World Wide Web. Issues around energy consumption, foreign policy and carbon emissions simply can't wait that long. ■

About the Author

Eric Miller is Senior Vice President, Solutions for Trilliant Inc. His career in the energy industry spans more than twenty-five years, combining entrepreneurial, strategic, marketing, and product leadership in the areas of enterprise software, energy efficiency, customer data collection, renewable energy development, and wholesale power marketing. Prior to joining Trilliant, Eric was Vice President of Software for Itron and Vice President of Strategy for Silicon Energy.

Grants as a Funding Mechanism for Sustainability Strategies

By Lynn Adams, Vice President, R. W. Beck

Driven by customer demands, legislative mandates and macro-level market trends, utilities are expanding beyond initial efforts to "go green" to include comprehensive, analytically based enterprise-wide sustainability plans. Utilities with plans already in place as well as those still considering their strategy will gain value and potentially save money by matching their sustainability activities to funding opportunities through the American Recovery and Reinvestment Act (ARRA), as well as other grant funding opportunities.

Particularly now, with local budgets stretched thin, familiarity with grant funding is increasingly important. In fact, ARRA can be viewed as merely a funding mechanism for an overall sustainability approach. Those utilities that see sustainability as an integral and strategy-based approach will be best positioned to act on various opportunities as they arise.

Many electric utilities are taking decisive steps to develop a comprehensive enterprise-wide sustainability strategy. Once initial strategy elements are in place, such as a clear, policy-aligned vision, quantifiable goals and tangible metrics, a utility can then consider multiple grant opportunities as part of their financing mix. Based on the strategy development work that such utilities have already done, they are well positioned to act.

In one example, the optimization analysis of various energy efficiency options provided input to the strategy required for the Energy Efficiency and Conservation Block Grants at the city level. In another example, having done the background strategy work to develop a business case for full deployment of Advanced Metering Infrastructure (AMI) resulted in a high degree of preparedness for leading a Smart Grid Investment Grant application. And for yet another utility, their strategy development identified the best match as pursuing a Weatherization Assistance Program grant.

Developing a Strategy

A strong sustainability program is enterprise-wide and aligns with the overall goals of the utility; this is not as much a "land rush" mentality purely focused on one area of current stimulus funding as a long-term strategy that results in associated opportunities now and as they may evolve over time. An issues-based planning process that is grounded in the concept of the triple bottom line – integration of economic, environmental, and social aspects as illustrated in **Diagram 1** – forms the basis of the direction.

Each utility will develop a tailored set of strategy elements, which will serve as the guide for all sustainability activities – including decisions related to grant funding opportunities.

Diagram 1: Triple Bottom Line Provides a Best Practices Framework

The first step in accessing grant funds is to develop an integrated sustainability strategy and comprehensive plan. At best, a long-term strategy is based on a sound understanding of the various drivers – regulatory, customer and financial. Developing background knowledge from the customer's point of view, often involves conducting market research and various analyses to fully understand customer perceptions and associated need for an enhanced focus on sustainability.

After surveying its customers, one multi-service utility provider discovered a "green gap" – a significant chasm between customer desire for environmentally conscious behavior and their perceptions of utility performance, as illustrated in **Diagram 2**.

Supported at the highest organizational levels, the "green gap" became a call-to-action, which resulted in the development of an enterprise-level initiative. Again, the development of such a strong baseline analysis and strategy directly supports grant-funding applications.

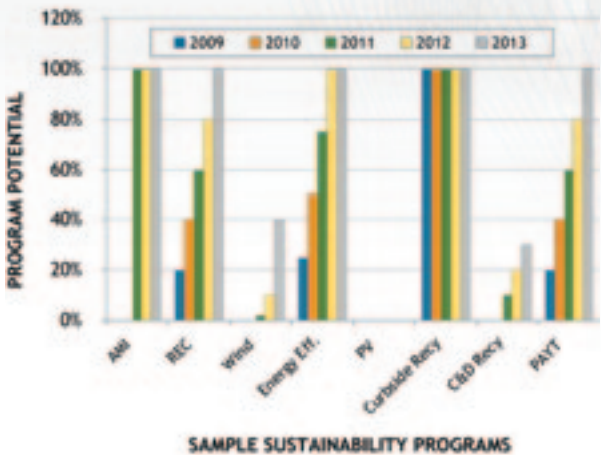
Diagram 2: Market Research Highlights a "Green Gap"

Identifying Programs

Another critical step in creating a comprehensive sustainability approach is to analyze various programs to identify the most cost-effective portfolio to meet the utilities' goals. Several existing and potential programs can be analyzed using various decision support tools, such as R. W. Beck's *Optimity* model.

Using such an optimization model allows simultaneous evaluation of a variety of factors including program performance in terms of greenhouse gas reductions, renewable portfolio standards, customer adoption/penetration rates, use of renewable energy credits, and a variety of goals and limitations, such as financial resource availability, customer costs and limitations on rate increases. **Diagram 3** shows a sample output of this model. Again, having such work finished makes targeting and prepared grant applications more streamlined.

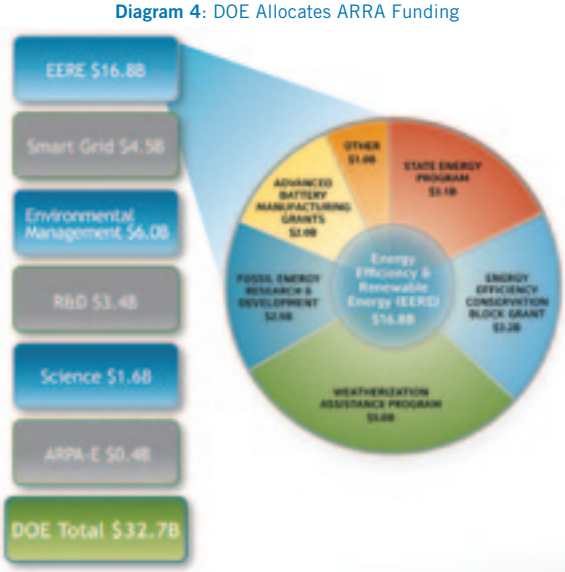
Diagram 3: Optimization Analysis Defines the Next Best Dollar Spent



Grant Funding

Once a utility has a sustainability strategy in place, investments must be made to implement the plan. The financial resources can be drawn from a variety of sources including the usual sources (e.g., rates); however, in today's constrained economy, the consideration of funding sources must also include grants as a sustainability funding mechanism. ARRA illustrates the opportunity, with money flowing to Smart Grid Demonstration and Investment Grants, Energy Efficiency and Conservation Block Grants, Resource Assessment and Interconnection Level Transmission Analysis and Planning, Weatherization Assistance, Transportation Grants, and Energy Efficiency Information and Communication Technology. The US Department of Energy (DOE) allocates ARRA funding, as shown in **Diagram 4**.

Diagram 4: DOE Allocates ARRA Funding



State energy offices are active and have various pools of money that they are obligated to distribute. Although not as significant in terms of dollar volume as the large programs directly granted through the Department of Energy, there are other grant funding sources as shown on the matrix in **Diagram 5** and the bullet list, following.

Accessing ARRA Funds

How does a utility access this money to fund its sustainability plan? Utility management needs to conduct a careful review of ARRA and other grant allocations while considering all aspects of its sustainability plan as well as the stated objectives of the granting agency. The details of each federal grant are clearly stated in the Funding Opportunity Announcement (FOA); all such announcements are available through various government web portals such as *www.grants.gov* and others.

Competitive grants require a utility to articulate its value differentiators, bearing in mind that DOE (the funding agency for ARRA) typically receives many more times the applications than it has resources to fund. This is where the development of a strategy map can be of great value as it focuses the organization on its core messages. The ability to successfully compete for such grants is a key reason that having a strategy with strong background analytics already in place serves a utility well.

For one utility provider, its sustainability approach and program optimization analysis led it to a set of confident decisions about which program to pursue. One such program undergoing preliminary business case evaluation was an AMI deployment. When the Smart Grid ARRA funding announcement was issued, this utility was well positioned with a "shovel ready" project that it could modify/expand to fulfill the DOE requirements. Another example includes a collaborative state-wide Smart Grid initiative that started developing a comprehensive strategy prior to the issuance of the final DOE announcement.

In addition to federal programs, states across the country are offering funding sources for sustainability programs. Utilities need to keep in mind these local programs and consider them as potential funding opportunities as well. The DOE alone has announced 24 grant opportunities, so the scope of stimulus funding opportunities can quickly become overwhelming.

Creating a matrix, such as the one in **Diagram 5**, helps match sustainability strategy to various grant dollars. With this matrix, utilities can recognize relationships between current and planed projects and various funding programs.

Diagram 5: Grant Opportunity Matrix Matches Programs to Funding

Capital Initiative	DOE Funding		State Govt Funding	Tax Incentives
	Grants	Loan Guarantees		
Smart Grid	✓	✓	✓	
Transmission Modernization	✓	✓		✓
Renewable Generation			✓	✓
Energy Efficiency			✓	✓
Low Carbon Fossil	✓			✓

This sample matrix illustrates one example of several funding opportunities and the match of various programs to funding sources. Although the details represent only a simple snapshot in time of various funding possibilities at the federal and state level, this represents the many and varied possibilities.

For example, one municipal utility included the following detailed list as possibilities on their grant matrix.

Energy Related Programs
- Energy Efficiency & Conservation Block Grant
- Small Hydropower Loan Program
- Renewable Energy Rebates & Grants Program
- New Energy Economy Development
- Clean Cities
- Smart Grid Demonstration
- Smart Grid Investment Grant Program

Infrastructure Programs
- Capital Investment Grants for Transit Projects
- Broadband Loan Program

Social Programs
- Community Development Block Grants
- Community Services Block Grants
- Homeless Prevention and Rapid Re-Housing Plan
- Public Housing Capital Fund Formula Grants
- Neighborhood Stabilization Program
- Capital Funding Recovery Competition
- Juvenile Accountability Block Grant
- Justice Assistance Grant

Moving Forward

Although many of the current grant application deadlines are fast approaching or in some cases have already passed, utilities should not discount government funding if they have missed a particular deadline. As discussed above, there are many potential funding sources and others likely to surface over time.

Moving forward, grant funding can be considered in the financing mix for almost all sustainability-related projects. Government investment in sustainability may well continue in the coming years, so there is the ongoing potential for a long-term opportunity as part of the overall resource pool. Particularly in today's economic and political climate, utilities would be well advised to become familiar with the challenges and opportunities of grant funding and consider it as a routine part of their business strategy.

About the Author

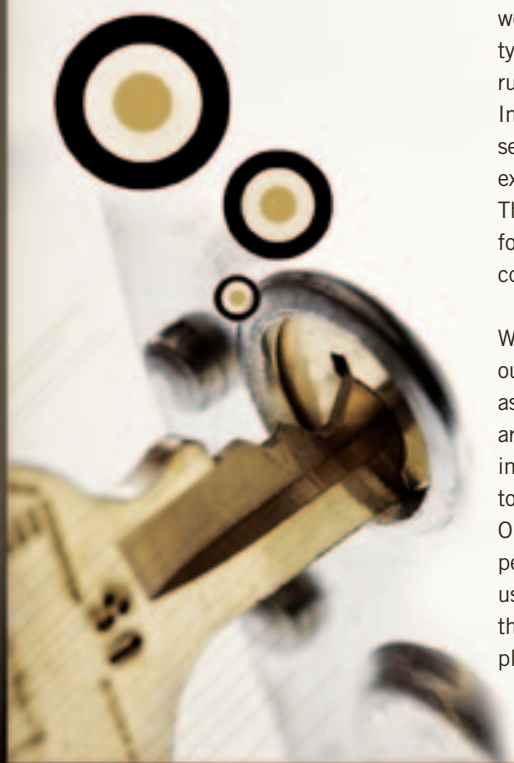
Lynn Adams is a vice president at R. W. Beck, an SAIC company, where she leads the firm's utility business consulting initiative. Her recent work has focused on integrating sustainability approaches in response to legislative, political and market demands. She co-authored "The Art of Strategic Leadership," which defines a planning methodology to develop an efficient and effective business direction.

SECURITY SESSIONS

Volume 1 No. 2

By William T. (Tim) Shaw, PhD, CISSP

Security is a seemingly simple word with an equally simple dictionary definition: "safety", "freedom from worry" and "protection." (Thank you Merriam-Webster!) Unfortunately the process of first obtaining, and then maintaining, security is anything but simple these days. When professionals discuss 'security' they usually dissect the issue into three main components: physical security, electronic (or cyber) security and operational security. Some experts break it down even further, but for my part I find those three categorizations to be adequate.



Most of us know something about physical security. That is why we have locks on our doors and put guards at the front gate of sensitive property areas. Most of us even know at least a little bit about operational security, even if we don't recognize it as such. Keeping some types of information confidential and having rules and policies about abuse of email and Internet access are examples of operational security. But few people have much personal experience with electronic/cyber security. That is something usually left to the technical folks in IT. So why all the recent concern and commotion about security?

Well, the events of 9/11 drastically changed our view of security. It proved that we weren't as secure as we thought, and that there are people willing to go to great lengths to inflict massive destruction and even death to innocent people just to make a point. Oklahoma City showed us that these sorts of people weren't just foreign zealots. Those of us who utilize the Internet (and who doesn't these days?) realize that it is a dangerous place as well. Criminal groups on the Internet seek to steal your identity and then your life savings – often through elaborate schemes designed to appear benign if not beneficial.

One result coming out of 9/11 was that the federal government recognized that our country has a lot of vital national infrastructure (e.g., bridges, dams and transmission lines) and contains numerous potentially dangerous or essential industrial facilities like petrochemical plants, refineries and power plants. All of these represent a potential target to people and groups who are willing to use violence to advance their cause.

These could be terrorists who want to ruin our country or activists who want to draw attention to their pet causes. The Department of Homeland Security (DHS) was established to address this issue, and within the DHS there are now several sub-departments who's mission is to address the security of various industries and specifically identified national infrastructure.

For those of us in the Electric Utility industry, one of the most obvious results coming out of this effort has been the series of evolving recommendations (now requirements) coming out of NERC. Initially there was standard 1200, then came 1300 and now the nine rules known as the CIP (Critical Infrastructure Protection) rules, which are intended to establish and maintain adequate security for the bulk electric power system as well as other so called critical cyber assets. Moreover, NERC CIP standards attempt to provide guidance regarding all three aspects of security: physical, operational and electronic/cyber.

Specifically, CIP-005 requires a utility to establish an "electronic security perimeter" within which all critical cyber assets must reside. Setting aside the thorny question of what truly constitutes a "critical cyber asset," one might ask: What is meant by an electronic security perimeter? The answer is somewhat complicated, but let's start with the rudiments of the problem.

In order for a remote attacker to gain access to any type of computer or computer-based device, there has to be a communication channel between the attacker and the computer/device. The Harry Potter books are wonderful stories, but in real life hackers and other evil-doers do not have magic wands. If there is no communication channel into a system, then it is impossible to remotely harm that system. (Some people use the term "air gap" to describe maintaining a disconnected, independent network.)

That said, today there are all sorts of communication channels and system interconnections we need to be aware of, and the goal of CIP-005 is to locate all of them and either place suitable protective mechanisms (e.g., a "firewall") on those channels, or eliminate them entirely. This is the cyber equivalent of putting up roadblocks and checkpoints on every road leading to a given town, so that nothing enters or leaves without being inspected.

While at first this scenario might sound easy to implement, think about the added complexity if those trying to gain access to the town surreptitiously had access to alternative – and perhaps unconventional –transportation such as a helicopter or an ATV. Well, today's communications options are not unlike that. Aside from obvious telephone and internal and external LAN and WAN connections there is the possibility of utilizing wireless networking using WiFi, Cellular or WiMAX technologies – all of which present new and sometimes unique challenges to conventional protection methods and technologies.

For example, a laptop computer within your electronic perimeter and attached to a SCADA system LAN could have a cellular card installed that permits the creation of an ad hoc connection to the Internet through the cellular system. That same possibility exists for using an integral telephone modem to "dial-out" to the Internet. If you have installed a WiFi (wireless Ethernet) access point, anywhere on a LAN inside your security perimeter, then a technically proficient attacker could establish a wireless connection through that portal, if it is not adequately defended. Notably, hackers have an annual competition regarding the greatest distance over which one of them was able to make a connection to an access point – that distance record is currently over twenty miles! They also have access to a surprisingly robust and constantly expanding array of tools for breaking into unprotected or inadequately protected wireless networks.

A commonly forgotten communication channel is one of the oldest unintended access points known to computer science. The "Sneakernet" is a quasi-humorous name collectively given to the manual transport of files and software between computers using portable media. In the bad old days, that media might have been a deck of punched cards or a spool of magnetic tape. Today it can be a USB "thumb drive" or a CD/DVD platter. In fact an amazing range of devices can be used to transport and deliver files and programs to a computer: other (laptop) computers, PDAs, digital cameras, MP3 players, digital video recorders and even many of the color printers on the market today.

Precisely how a "sneakernet" connection could help an attacker penetrate your critical systems depends on the objective of the attacker. If they can place a bit of well-designed "malware" onto a computer inside your security perimeter, such a program could spread around to other interconnected systems until it found an outgoing network connection, which it could then use to establish a covert communication channel to the attacker — not at all an unrealistic scenario!

The usual protective approaches taken to establish an electronic security perimeter are designed to keep the bad guys out. But they may not identify the malware that has already gotten in via sneakernet from establishing an outgoing connection. For example, if an attacker were to infect a thumb drive with some really sneaky malware and leave it in some area where that your employees are known to congregate – for example, your building lobby or a coffee break area — the odds are very good that someone will eventually carry it inside and plug it into a computer.

Protecting the established electronic security perimeter is complicated by these added factors of wireless, dial-up and portable media. And unlike "fixed" network connections that can be addressed with a suitable firewall or any of several other technology-based countermeasures, these "unconventional" holes in your security perimeter are far more difficult to manage. It often turns out that these can be best countered through employee training and the application and enforcement of clear policies and procedures. I'll be addressing that subject matter in a future column. ■

About the Author

Dr. Shaw is a Certified Information Systems Security Professional (CISSP) and has been active in industrial automation for more than 30 years. He has authored two books ("Computer Control of Batch Processes" and "CYBERSECURITY for SCADA Systems") and continues to write extensively on a wide range of technical topics, issues and trends. He is currently Principal & Senior Consultant for Cyber SECurity Consulting, an industrial automation, security and technology firm. Inquiries, comments or questions regarding the contents of this column and/or other security-related topics can be emailed to *timshaw@industryconsulting.org.*

ZigBee-based HANs for Energy Management

By Skip Ashton, Sr. VP of Engineering (Ember Corporation)

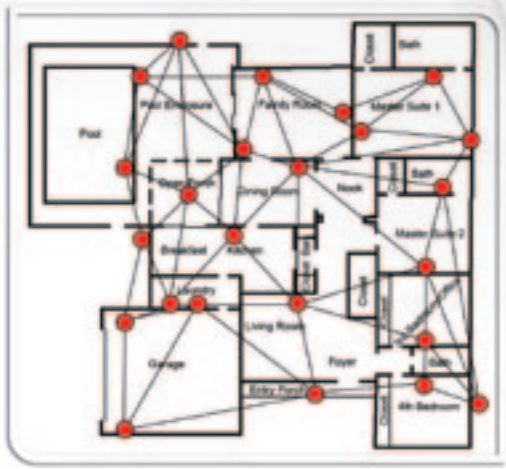
The Smart Grid loses immense value unless there are smart homes to plug into it. The good news is that Home Area Networks (HANs) – the most critical smart home piece – are becoming more prevalent as new wireless home automation and energy management products for controlling entertainment, lighting, climate and security systems hit the mass market.

"Whole house" automation systems that were once the domain of only upscale homes are making significant inroads into middle class homes. New wireless technologies combined with low-power, low-cost hardware have made HANs affordable and easy for the average homeowner to install. And various broadband and wireless telecom service providers are beginning to offer "home awareness" services that can enable access and control of connected home systems over the Internet or cell phones. These wireless networking technologies are being integrated to enable a truly Smart Grid solution for more efficient energy management while enhancing comfort, convenience and security at the same time.

Households consume one-fifth of the nation's energy each year, with 60 percent of that consumption in the form of electricity. At the same time, utilities are struggling to manage the peak energy demand dilemma, where about 10 percent of electric generating capacity exists only to be used less than one percent of the time. However, huge cost savings, reliability improvements and energy efficiency gains can be achieved within homes and across the energy grid without having to build additional power plants if energy demand can be made to respond dynamically to the available energy supply. In fact, to do less is no longer an option from either a financial or environmental perspective.

The U.S. Federal Energy Policy Act of 2005, California's Title 24 and similar initiatives across North America, Australia and Europe are driving requirements for smart metering and end-to-end demand response systems to be implemented across the grid. Deployments of smart meters are already in full swing at many utilities and have received a further impetus with the stimulus program, which places a huge emphasis on modernizing the grid, both for the present and the future.

ZigBee implements a decentralized, self-forming and self-healing mesh network topology



To this end, utilities are deploying Advanced Metering Infrastructure (AMI) systems that connect smart home HANs back to the utility's central office. AMI uses 2-way smart meter communications technology to send and receive information and commands between the home and utility. Inside the home, HANs connect communicating thermostats, load switches, lighting systems, in-home displays and automation devices to the meters (or a separate gateway).

This network allows for the collection and distribution of information to consumers and other parties in addition to the utility itself. It can be used for multiple purposes, including time-of-use (TOU) pricing information, demand-response actions and remote service disconnects. By utilizing the intelligent monitoring and control capabilities of HANs, consumers can be better educated about their energy use patterns and energy demand can be made to respond dynamically to the available energy supply. As a result, consumers and utilities alike can realize substantial cost, reliability, and energy efficiency benefits, without sacrificing comfort.

Enter ZigBee…

Tying these two parts of the network together is ZigBee, a global wireless networking standard designed specifically for control and monitoring applications. ZigBee is an ultra-low power wireless networking technology that makes it practical to embed wireless communications into virtually any smart energy or HAN device – from smart meters and climate controls to lighting ballasts and smoke and security alarms – all without the prohibitive cost and disruption of installing hard wiring.

ZigBee enables devices to self-assemble into robust wireless mesh networks that automatically configure and heal themselves and enable many individual devices to work for years on battery power alone. Moreover, ZigBee compliance not only offers a wireless control technology for smart energy, home automation, commercial building automation, and a wide variety of other sensing and monitoring applications, but ZigBee has now emerged as the preferred standard for HAN applications as well.

The ZigBee standard took a big step forward for HAN energy management with the introduction of the ZigBee Smart Energy (SE) Profile early last year (2008). The SE Profile defines the standard behaviors of secure, easy-to-use HAN devices such as programmable thermostats and in-home displays. ZigBee Smart Energy offers utilities a true open standard for implementing HAN communications. It also benefits consumers by allowing them to manage their energy consumption wisely using automation and near real-time information, while having the ability to choose interoperable products from a diverse range of manufacturers.

ZigBee-enabled HANs also let homeowners and utilities communicate in real time and collaboratively manage energy consumption, especially during times of peak demand. During these periods, the AMI system and HAN can work together for better communication between consumers, businesses and utilities and even automatically manage high-load devices in participating homes, such as changing the thermostat setting of the HVAC system. Utilities save big by not having to build new power plants, which also cuts CO_2 emissions. Homeowners save money through lower bills and attractive rebates while helping communities avoid the ravages of rolling blackouts.

Many vendors have already announced ZigBee SE Profile certified products, including Landis+Gyr, Computime Limited, Comverge, Energate, Greenbox Technology, Itron, LS Industrial Systems, Co. Ltd., PRI, Tendril and Trilliant. Encryption technology vendors like Certicom are also providing the strongest possible wireless network security for AMI/HAN deployments. Strong security is critical for utilities to ensure that only appropriate HAN devices are authenticated and connected to the utility network. In this way, energy providers can distinguish between HAN devices directly under their control as part of a formal demand response program and other consumer devices that might exist in the home.

Typical ZigBee Radio Module (with internal attenna and external connectors)

For example, a fully integrated home automation system can be configured to receive public pricing information and messages from the energy provider and then take pre-programmed actions, based on current pricing levels. But only specific authenticated devices may be permitted to participate directly in provider-initiated direct demand response actions.

ZigBee technology is simple to use and can be easily incorporated into a wide range of HAN devices. In contrast to earlier home networking technologies, ZigBee is highly scalable, robust and capable of supporting hundreds or even thousands of devices in a single network. And, it's extremely tolerant of interference from other radio devices including Wi-Fi and Bluetooth. In fact, some of the most popular home automation products ship with both Wi-Fi and ZigBee built into the same device.

HAN/NAN Configuration

A HAN-enabled smart home often connects to the energy provider through a neighborhood area network (NAN) of smart meters to an aggregation point, and a backhaul network that connects the aggregation points to the utility's back-end IT systems. In a typical HAN deployment, the smart meter serves as the Energy Services Portal (ESP), the gateway between the ZigBee-based HAN and the energy provider's NAN. In some instances – especially in deregulated environments – the ESP may be a separate gateway that connects to the energy provider through a local broadband connection or local cellular network. The meter may still participate in the HAN, but necessarily as the ESP. In these and other cases, the ESP can easily communicate with a variety of ZigBee-enabled devices.

Load Control Devices

Load control devices are generic plug-in devices for monitoring and controlling high-current appliances in the home, such as air conditioners and pool pumps. In the near future, consumer appliance manufacturers will offer next generation "smart appliances" embedded with ZigBee technology to extend AMI device control even deeper into the home. For example, GE Consumer & Industrial announced it will develop an integrated and interoperable system that will enhance GE's demand responsive appliances capability to communicate over metering and broadband networks.

Why ZigBee is Best for HANs

Wireless networking - rather than wired technologies – is a key enabler for HANs, not only because of dramatically lower installation costs, but because it allows the use of battery-powered devices not directly connected to home power lines. Wireless can also integrate gas and/or water metering systems, which in any case require the use of wireless, battery-operated communications. These are among the reasons the analyst group, ON World, estimates that utilities will spend $1.6 billion on wireless sensor network technologies – predominantly ZigBee – for smart metering and demand response by 2011.

Just as Wi-Fi grew to meet the demand for wireless data networking, ZigBee has emerged as the dominant standard for energy monitoring, control and management networks. ZigBee is designed specifically for highly reliable, low-power and low-cost control and monitoring applications. Similar to the way Wi-Fi specifications leverage the IEEE 802.11 standards, ZigBee is built on top of IEEE 802.15.4 radio standard, which defines the physical and Media Access Control (MAC) layers, typically operating at 250 kbps on one of 16 selectable channels in the 2.4 GHz band, which is uniquely unlicensed in most of the world.

The ZigBee Alliance

ZigBee standards are specified by the ZigBee Alliance, comprising more than 300 member companies, including some of the best-known global brands. The Alliance uses independent labs to test, verify and certify ZigBee platforms and products for conformance to the specifications. To earn use of the ZigBee Alliance logo, which assures protocol-level interoperability, developers must start with a "ZigBee Compliant Platform," consisting of a silicon and software stack combination that has been tested by one of the Alliance-designated test houses.

ZigBee has prevailed over earlier proprietary offerings not only for its technical superiority, but also because it is the only complete, mature, open, multi-vendor standard available today, allowing designers many different platforms to choose from across the value chain.

Conclusion

It is often been said that the cleanest source of energy is the energy not generated in the first place. That's why conservation is touted as a cornerstone of the nation's future energy program. Yet utilities are already struggling to manage the peak energy demand dilemma, where approximately 10 percent of total electric generating capacity exists only to be used less than one percent of the time. HANs will be instrumental in the success of Smart Grid initiatives to meet these energy conservation and demand response challenges. ZigBee wireless technology is a critical element of these communication systems, providing the robustness and reliability, low cost, security, and ease-of-deployment required making it all work together and deliver tangible benefits. ■

About the Author

Skip Ashton brings over 15 years of experience in new product development to his role as Senior Vice president of Engineering at Ember and Chair of the ZigBee Architecture Review Committee. Skip is responsible for management of the Ember chip design, hardware, software and quality assurance teams. Prior to joining Ember, he was Director of Engineering at MPM/Speedline, producing screen printers for electronics manufacturing, and Manager of Program Management at Avici Systems, a producer of high-speed Internet routers. Skip graduated with a mechanical engineering degree from Georgia Institute of Technology and spent five years in the US Navy Nuclear Program.

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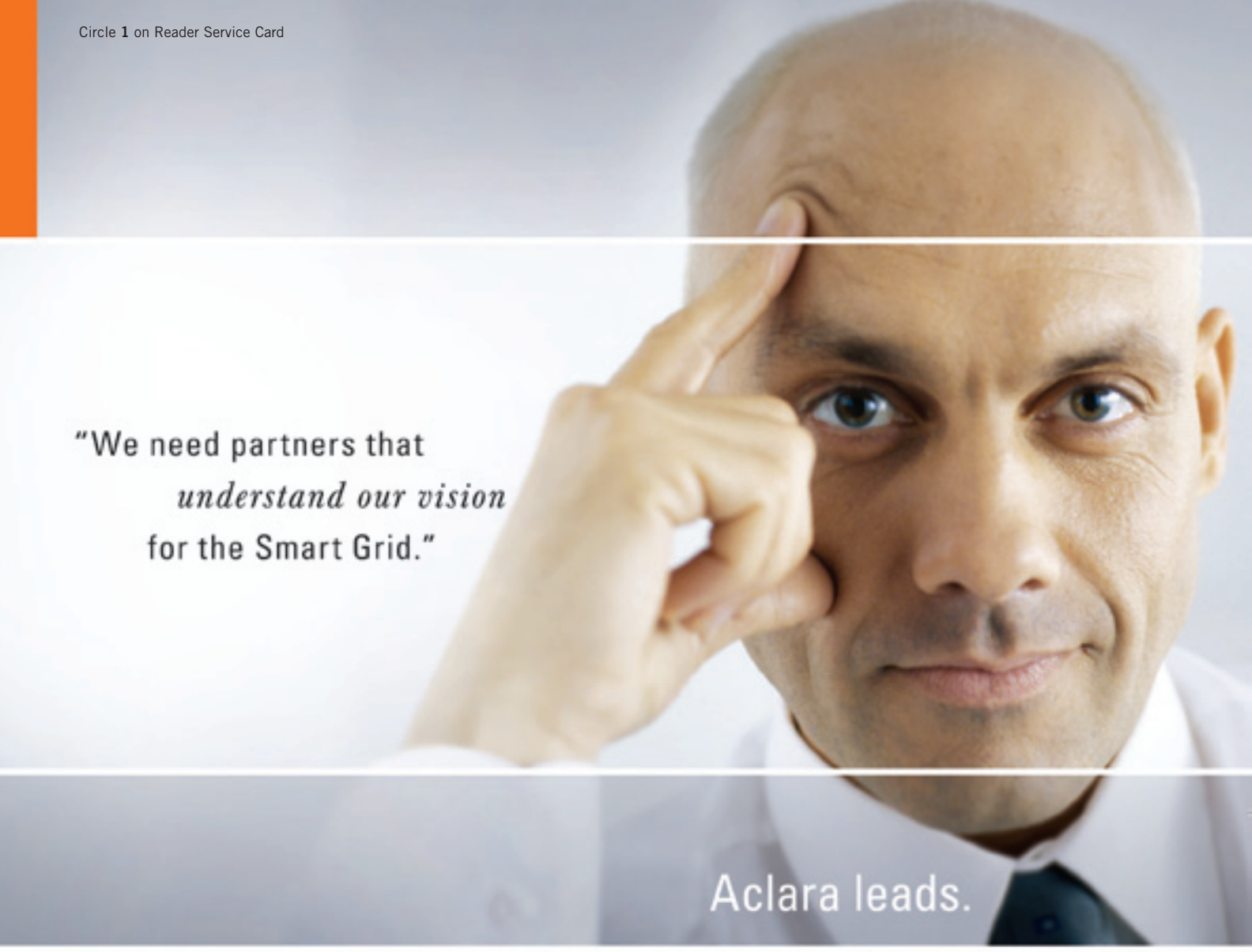

Aclara understands that utilities need to do more than collect data. We are driving a future that integrates AMI, SCADA, distribution automation, and more into an Intelligent Infrastructure™ with the capability for communications and control. With the strength of our solutions for electric, gas, and water utilities, we understand your vision. With our network we will take you there. Aclara Leads.

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