Connected Grids Are Smarter Grids

Utilities are beginning to leverage fiber-powered data analytics to make interconnected smart grids a reality.

By Peter Londa / *Tantalus*

It is widely accepted that a key component of any smart grid deployment is the communications infrastructure that powers the network. The National Energy Technology Laboratory states that the "achievement of the modern grid vision is fully dependent on integrated communications technologies. Without a modern communications infrastructure … the modern grid cannot become a reality. Integrated communications will open the way for the other key technology areas to be accepted and implemented, leading to the full modernization of our power grid."

The quality and reliability of connectivity to smart devices is often the limiting factor in the quality and reliability of the advanced applications that drive true value from smart grids. Although the convergence of telecommunications and energy management through smart grid technologies has developed beyond the initial push to lay the foundational networks and devices to support advanced applications, utilities are now looking to derive quantifiable value from these smart networks and from this data access.

Ultimately, public power municipal and cooperative utilities are focused on delivering value to end-use consumers by maintaining high power quality and keeping energy rates low. According to the Edison Foundation, more than 50 million homes in the United States are now connected to the grid with smart meters; many utilities are actively adopting applications and processes that fully leverage the value of streaming consumption data to all stakeholders, including consumers. Utilities are using technologies such as smart meters to improve customer service and to facilitate more frequent communication with customers. With more access to real-time consumption data and self-management tools, consumers will be better equipped to recognize and adopt behavioral shifts to increase efficiency and save money. (See sidebar on p. 48.)

For utilities with broadband, specifically fiber-connected grids, the always-on and virtually unlimited bandwidth capabilities of fiber present an ideal environment to fully maximize the benefits of smart grid applications. As an enabling technology for a multi-application smart grid platform, fiber affords utilities and consumers instantaneous access to granular data, meeting or surpassing requirements for advanced applications designed to reduce long-term costs, increase operational efficiency and expand utilities' ability to support future applications.

LEVERAGING AN INFINITE DATA STREAM

Gaining access to streaming, real-time data through networks such as fiber to the home (FTTH) is the first step to realizing the vision of a smart grid. The next initiative is to identify the tools and strategies necessary to collect, sort, manage, route and store this data to create actionable intelligence for utility decision makers and consumers. Many utilities implement meter data management applications to manage large volumes of electric, water and

An EPB installer connects a smart meter with fiber.

gas interval data. They analyze and distribute this data to various utility departments through integrated software such as billing, customer management, outage management and GIS. The depth and quality of this analysis is a function of the accuracy and timeliness of consumption data as well as the power of the data analytics engine behind each application.

Sophisticated utility management applications such as distribution automation (DA), real-time pricing and energy forecasting require robust, low-latency, ubiquitous communications to maximize the performance and ROI of each application. A fiber-enabled DA program allows the smart grid to proactively manage itself, diagnose itself and alert utility operators to distribution network events.

Real-time communication with smart devices such as voltage regulators, capacitor bank controllers and fault circuit indicators installed directly on the distribution network provides a deeper level of access and control with more rapid response capability. This proactive management enables utilities to improve power quality, minimize system losses and reduce or avoid peak demand charges – all factors that work together to increase the ROI of smart grids.

SMART GRID DATA AND CONSUMERS

Chattanooga was one of the first cities to implement a municipally owned FTTH network. Since 2009, when the municipal utility, EPB, was awarded the DOE's largest ARRA stimulus grant to accelerate broadband deployment, it has built one of the fastest, most comprehensive telecommunications and smart grid networks in the country. Today, the utility operates an FTTH network and services platform available to the city's 175,000 homes and businesses.

EPB leverages FTTH to deliver triple-play services (voice, video, data) and operate a fiber-connected smart grid from Tantalus. The Tantalus Utility Network (TUNet) provides a management and control solution to intelligent end points such as smart meters and load control devices throughout the utility's service territory. These fiber-connected smart meters are able to upload and download data at speeds 200 times faster than the national average, allowing EPB to gain a virtually instantaneous, dynamic view of the health and performance of its smart grid.

This ability for EPB to view interval data simultaneously with actual consumption is a key differentiator for the utility's smart grid. Rather than receiving access to consumption data in batched files transmitted every six to eight hours or even daily (the standard approach), EPB can analyze data in real time, thus gaining the ability to take immediate action to make cost-saving operational decisions in real time. This self-configuring, self-healing grid streamlines day-to-day operations and

ONLINE ACCESS TO SMART GRID DATA HELPS CONSUMERS SAVE ENERGY

Fiber-enabled smart metering offers great opportunities for consumers and businesses to reduce energy usage. Utilities don't always make detailed meter reading data available to customers; often, they are focused on smart meters as a way to eliminate the costs of dispatching meter readers to customer premises and as an entry point to more complex smart grid applications.

However, a new report shows that customers who have access to their meter data conserve more energy. Mission:data, a coalition of technology companies that deliver consumer-focused energy savings for homes and businesses, recently published The EmPOWERED Consumer**,** a report that documents how consumers' access to their energy data can help reduce energy use in buildings.

"Our challenge is how to reduce energy use in homes and buildings, and new data-driven technologies have emerged as one of our most powerful tools to better manage that use," says Jim Hawley of the coalition.

"More than 50 million advanced meters in the U.S. can provide consumers with detailed information about their energy use, enabling consumers to use new energy management technologies to achieve big energy savings. The problem is that many states have not provided consumers with access to their own data from these ratepayer- or taxpayer-funded investments, missing a big opportunity for their consumers to save energy and money," says Michael Murray, also of the coalition.

Three states – California, Texas and Illinois – provide consumers access to their detailed energy usage data from their smart meters free of charge. This access enables household energy savings averaging up to 12 percent or more, compared with attic insulation, which reduces average energy use up to 7 percent, and with buying new, energy-efficient appliances such as water heaters, which may reduce use by 1 or 2 percent. Consumers are beginning to realize significant energy savings, often at a fraction of the cost of traditional energy efficiency programs. Because U.S. buildings represent one of the largest sources of greenhouse gas emissions, the savings enabled by consumer access to energy data represent an opportunity to cost-effectively address the issue of climate change.

In an example from Texas, a resident using Energy ScoreCard, a Web-based service that pulls real-time data from his smart meter as well as weather and smart thermostat data, kept his home cool while reducing use of his air conditioning unit from 11.4 hours to 5.8 hours per day. He can also take advantage of new time-of-use rates that give him free electricity after 9 p.m., all made possible by Texas' advanced metering deployment and data access.

The report recommends that states and utilities take the following measures:

- Consumers should have access to their electricity usage "interval data" provided via the utility's website in standardized formats such as Green Button Connect. In states with smart meters, data is typically made available the following day in 15- or 60-minute increments for commercial and residential customers respectively.
- If advanced meters contain a Home or Premises Area Network (HAN/PAN) radio, consumers should be able to access their real-time usage data through that radio. This method provides highly detailed, real-time usage information directly to consumers or service providers.
- To ensure that energy management tools can provide consumers with accurate estimates of dollar savings, consumers should have access to their detailed billing and tariff information in machine-readable format.
- Consumers should be able to easily share this data with companies they choose to provide them with energy management services. The process by which consumers authorize third parties to receive their data should be simple and convenient, and regulatory commissions should allow third parties to lead the authorization process.

– BBC Editors

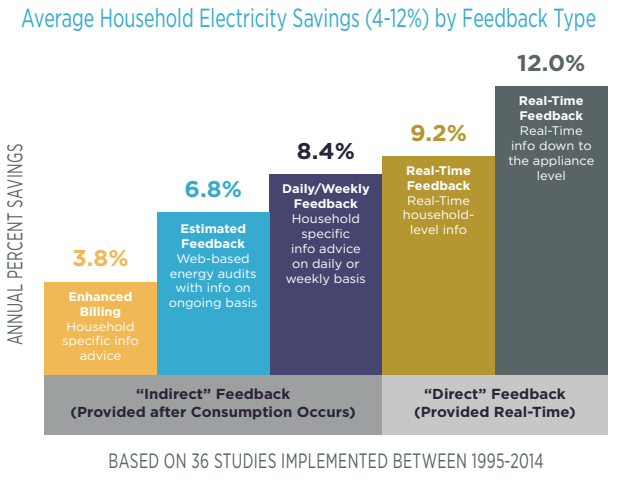

Table 1. Source – ACEEE. This table provides a numeric range of achievable energy savings in homes enabled by varying types of data in conjunction with technology tools.

is easily scalable to support additional devices and a broad range of energy applications.

Each intelligent end point is equipped with a software-defined radio that allows the utility to make modifications and new feature enhancements to devices through remote firmware upgrades. This feature ensures that EPB's smart grid investment is inherently safeguarded from day one. With this future-ready platform, EPB will be able to implement additional network features and improvements – such as interoperability with non-TUNet devices – with the existing network infrastructure, further reducing operational expense and increasing ROI.

Each end point also has an embedded distributed computing processor with a multi-core, Linux-based operating system and 32 MB of memory. This means EPB's grid can support future growth and the addition of numerous value-added applications on the same technology hardware platform. This advantageous position creates more certainty for the utility as future needs are defined and increases the ROI of existing investments now.

> EPB's smart grid detected a large electricity consumption surge at a residential location. A service rep proactively called the customer, enabling her to avoid a hefty unexpected bill.

Since the completion of its smart grid deployment in 2013, EPB reports that its smart grid network is reliably delivering highly accurate, 15-minute interval consumption data 96 times every day from smart end points that connect more than 175,000 residential and commercial locations. These interval readings from a mix of residential, commercial and industrial customers are delivered to the utility control center at reliability rates that exceed 99 percent. This data is integrated into data analytics–driven applications for proactive outage management, DA, net metering and load management, strengthening the effectiveness of each program and of the city's grid as a whole.

This universal telecommunications and smart grid strategy has been proven to maximize the productivity

CHATTANOOGA'S SMART GRID CERTIFIED AS SUSTAINABLE TECHNOLOGY

In January, Chattanooga's fiber-enabled smart grid became the first major power distribution system to earn Performance Excellence in Electricity Renewal (PEER) certification. The certification identifies Chattanooga as a "showcase example of sustainable electric distribution system design and a power industry leader."

PEER is administered by Green Business Certification Inc. (GBCI), which also administers the LEED program for rating green buildings; it is a framework for defining, assessing and verifying the sustainable performance of electricity delivery system design and operations. It also drives the vision of the U.S. Green Building Council (USGBC) to transform power systems and the electricity sector as a whole.

"Cities like Chattanooga and companies like EPB [Chattanooga's Electric Power Board, which builds and operates the smart grid] are proactively working to set the bar higher in sustainable electricity," says Mahesh Ramanujam, chief operating officer of USGBC and president of GBCI.

To earn the certification, EPB conducted an assessment that took more than a year. It reviewed 69 criteria for operational effectiveness, customer contribution, reliability and resiliency, and energy efficiency and environment. EPB's fiber optic communications backbone, self-healing automation, state-of-the-art data management system and advanced metering infrastructure are at the core of many of these criteria.

Chattanooga scored 294.3 points, nearly 23 percent higher than the score needed to earn the designation. It earned perfect scores in 18 of the 69 criteria.

"Having the most advanced electric system in North America continues to be an excellent recruiting tool for new industry," says Jim Coppinger, Hamilton County mayor. "There is stiff competition among communities to recruit clean, high-tech industries, and Hamilton County is well positioned to remain on the A-list of businesses looking to expand and create family wage jobs."

– BBC Editors

and responsiveness of the utility. EPB reports that since implementing smart grid applications, the utility now experiences 60 percent fewer outages and is able to provide proactive customer service.

In one recent instance, EPB's smart grid detected a large electricity consumption surge at a single residential location. Customer service representatives proactively contacted the resident, who then pinpointed the cause of the issue as a malfunctioning heating unit.

"We were able to alert the unsuspecting customer in time for her to take action and avoid a hefty bill that she was not expecting because there was a piece of equipment that was malfunctioning," David Wade, executive vice president of EPB, said recently. "We've built a great platform to give us and our customers a wealth of data to detect problems earlier and to better manage our power grid for reliability and efficiency."

POSITIONING COMMUNITIES FOR THE FUTURE

The immediate benefits of broadband-enabled smart grids are clear: Increased access to real-time interval data drives deeper data analytics and produces more reliable and effective information to decision makers both in the utility and in homes. Taking this a step further, the ability of the network to use distributed computing capability to intelligently analyze data at end points offers even more opportunity for grid automation and self-care. As consumers become increasingly connected via smart personal devices, their expectations of data access and device control also increase, and utilities will need to be equipped to respond to this demand.

Gartner estimates that in 2016, 6.4 billion connected "things" will be in use worldwide. As utilities look forward to future needs and challenges, the rise of the Internet of Things will play a role in utility operational decisions today, in the near future and tomorrow.

For utilities, this includes many familiar devices, such as smart meters and smart load controllers. However, this definition is being expanded to a broader range of smart grid devices, such as street and area lighting controllers, smart thermostats and intelligent appliances. As utilities further develop their smart grid road maps, the scalability, security and reliability of the foundational networks and applications will continue to be crucial. These attributes will define how efficiently smart grid networks and applications can work together to analyze vast amounts of data to produce actionable intelligence.

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The definition of "smart grid" continues to develop and expand as the interconnectivity among smart networks, smart devices and smart applications increases. Each utility must take a holistic view of how each application will work within a smart technical and business environment, as the migration path to a fully automated smart grid is largely unique to each utility.

In the end, the most successful smart grid deployments are those that integrate disparate devices, applications and processes to increase efficiencies, streamline operations and increase communication among all stakeholders. Taking care to consider all stakeholders is a key factor in creating long-term mutual value and success. ❖

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