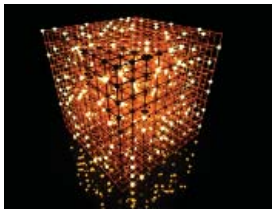

THE ENERNET, THE CONVERGENCE OF THE ENERGY GRID AND THE INTERNET?

By Phil Carroll, P.E., VP Energy
Finley Engineering

(First in a Series)

As utilities are facing exponentially-increasing fuel costs, the importance of, and demand for, conservation and efficiency are growing rapidly. And, of course, demands for reliability continue to increase, not only from customers, but from the North American Electric Reliability Corporation (NERC) and the Federal Energy Regulatory Commission (FERC).

The Smart Grid

One of the most effective tools that utilities have begun to introduce to improve conservation, efficiency, and reliability is the smart grid. With the growing use of the smart grid, the electric power industry is beginning to deploy a lot of intelligence gathering, analysis, and control through the power grid. Many of these tools are being integrated with existing tools. Many of the tools are new. A summary of the most commonly used and effective tools and technologies includes load management, demand side management, control of distributed generation, SCADA systems, smart meters, automated distribution management devices, customer information and billing systems, advanced metering systems, automated outage management systems, and geographic information systems (GIS).

Before the introduction of these tools and technologies and the advent of the smart grid, utilities only had to deal with a few million monitoring and control points on the entire nationwide transmission and distribution system. Now, in addition to the installation of many millions of smart meters, there are many times that a number (billions) of monitoring and control points, both inside the customers' premises and on utilities' transmission and distribution systems, must be managed. In many cases, information needs to flow to these points, and, in most cases, information needs to flow back from those points.

Distributed Generation/Storage

Adding to the challenge for utilities is the explosive proliferation and the recently-growing popularity of distributed generation, such as on-site renewables, storage batteries, and combinations of multiple energy generation/storage equipment, most commonly known as microgrids. The growing use of these renewables, storage systems, and microgrids is creating a new, complex network of small, local generation, replacing the 20th Century electric utility model of large, centralized baseload generation plants and networks of transmission and distribution lines. The result is a newer, stronger power network composed of a number of smaller entities, but which are tied together, and operating in real time, as opposed to large centralized generation that needs to be full-power-moved over many miles and then stepped down.

The Need for Communication

As a result of the introduction of all of the new tools and technologies that are required to manage the smart grid and the new distributed generation/storage networks, the power grid as a whole is gaining an increasing dependence on communication systems for everything in the system.

This demand is a two-way street. That is, getting the most from the tools and technologies, and making sure they coordinate effectively with each other, require real-time, two-way digital communications.

In an interview for "IEEE Smart Grid," Steve Collier, director, smart grid strategies, for Milsoft Utility Solutions, noted: "In addition to the intelligent devices and the telecommunications network that we have been talking about, utilities require enterprise applications to turn the data into actionable information in order to be able to manage a smart grid in real time. These applications will reside at utilities, at consumers' homes and businesses, and at other businesses that will be participating in the smart grid."

One way to manage this communication is for utilities to each create their own proprietary communication networks. However, an effective smart grid cannot be achieved via this type of patchwork of independent, utility-owned telecommunications networks with proprietary data and communications protocols. The reason is that such independent communication systems are likely to severely limit, even prohibit, interoperability between and among each utility's hardware and software systems, and, even worse, across the entire grid.

Enter the Internet (and "Enernet")

In order to effectively manage the massive and complex communication needs of the modern electric grid and all of its components, according to Collier, "We will need a robust, reliable, interoperable, broadband, nationwide digital telecommunications network that can handle literally tens of billions points of monitoring and control in real time."

That is, the information network capable of handling this digital information blizzard must be ubiquitous, self-healing, and have sufficient speed and capacity to monitor and manage billions of intelligent electronic devices within the grid and inside consumers' homes and businesses.

Will the electric utility industry be up to the task of creating this massive, complex, expansive, and expensive communications network? The bad news: No, it won't. The good news: It won't need to, because such a network already exists. It is called the Internet. "No other network can, in the long run, provide the speed, reliability, and interoperability of the Internet," said Collier. "Nor will any other network be as ubiquitous, self-healing, and of sufficient capacity to handle the enormous amount of data that will be moving across the smart grid."

According to Collier, the Internet, both wired and wireless, is already nearly ubiquitous and has proven to be able to handle millions of times more data than anyone originally expected. "It's the only telecom network that can support a smart, self-healing power grid that will involve monitoring and managing billions of intelligent electronic devices distributed throughout the grid from generation through transmission and distribution systems into consumers' homes and businesses," he said.

The fact that the Internet is so robust is critical to its integration with the electric grid. That is, the Internet is incredibly robust in terms of its bandwidth and data management. And, in order to achieve the operations and efficiencies that are required for the electric grid, the automation that is required will be able to rely heavily on the Internet to create the robust communications network that will work hand in hand with the robust power systems.

The resulting interaction is being referred to as the "Enernet."

In fact, while some utilities are already integrating the Internet into their operations, the full synthesis of electric power and the Internet has already been in place on a small scale in data centers around the country, where communications and power are so important that they are intertwined in a small version of the integration of the power system and the Internet. And, in actuality, this model can be rolled out on a larger scale – systemwide.

Concerns

Of course, while the integration of the power grid and the Internet makes a lot of sense, there are still some concerns.

One is concern for control. As Collier pointed out, the two entities (electric utilities and the Internet), while they have some similarities, they also have some structural and fundamental differences. For example, the electric utility is a cost-plus franchised monopoly business that has been around for over 130 years. The Internet, on the other hand, is a highly-competitive, rapidly-changing technology that has been around just over 20 years. "Utilities are accustomed to owning and controlling all parts of their infrastructure, in large part because they are required to serve customers reliably," he said.

Another significant concern relates to information security. "The issue of customer data privacy is important, and I don't diminish it or denigrate utilities for being concerned about it," said Collier. "However, the entire world's banking industry and many other national and global industries rely on the Internet for commerce with their customers." While the cybersecurity problem is real, noted Collier, these industries have shown that it can be addressed successfully with appropriate technologies and business practices.

In addition, according to Collier, the electric utility industry in the U.S. has a much greater physical security problem than a cybersecurity one. "Our central generation and bulk transmission corridors are sitting ducks for terrorists or vandals," he said. "How do we address this problem? With a smarter grid that enables us to detect, analyze and manage in real time." As Collier sees it, the cybersecurity risk of an Internet-based smart grid is far outweighed by the greater risk of not having the kind of smart grid that only the Internet can support.

Looking Forward

With the bandwidth that is available on the Internet to acquire data in real time, from generation to the end-user's meter, and as utilities start to capitalize

on this data and operate their systems in real-time environments, which hasn't been possible before, the opportunities of the Enernet are significant.

Adding to the appeal is that it is unlikely that the Internet as a whole will ever go down. It is self-healing. This hasn't always been the case with the energy grid. However, the energy grid has been introducing self-healing systems to reroute flows and ensure continuity of service, such that the reliability of the network is becoming very high. In sum, the reliability of both systems - the Internet and the electric grid - bodes well for the long-term reliability of the Enernet as a whole.

If utilities fail to embrace the Enernet, there is a possibility of becoming obsolete, as more microgrids and other local renewable projects come on-line. However, with the Enernet, utilities can reinvent themselves to become active partners in the two-way flow of power and information.

Indeed, customers do want to become independent when it comes to power. However, they also want reliability, and this is where electric utilities come in. Customers want to be sure that the lights come on when they flip the switch. It's one thing to say you will have a solar array, a storage battery, or something similar. However, to ensure reliability, there will still need to be a connection to the power grid. By taking advantage of what the Enernet has to offer, utilities can become coordinators of all of this. The progressive utilities are already beginning to embrace this concept. They see themselves as more than just electric utilities.

The future? Embracing the Enernet will be a little slow at first. The more intertwined these communication data networks and energy systems gradually become, growth will eventually become exponential.

How can Finley help? Finley Engineering has a strong history and background in both energy and communications. We have power engineers, communication/broadband engineers, and our IP group. As a result, we can bring "all three legs of the stool" to our project teams that help utilities gain familiarity with the Enernet.

Phil Carroll, P.E., VP Energy
Finley Engineering Inc.
417-682-5531
p.carroll@fecinc.com
fecinc.com

About the Author:

Phillip Carroll, Vice President of the Energy Division for Finley Engineering, has been providing engineering expertise to the electric utility industry since 1987. Managing multimillion dollar projects around the country, Carroll has been responsible for the design of distribution and transmission lines, material specifications, contract administration, final acceptance and close-outs.

In addition, Carroll has been directly involved in and managed routing, right-of-way and environmental coordination, line design, foundation design, duct-bank design, material specifications, contract administration, and project management for steel, wood, and concrete transmission lines up to 345 kV and underground and overhead distribution lines up to 34.5 kV.