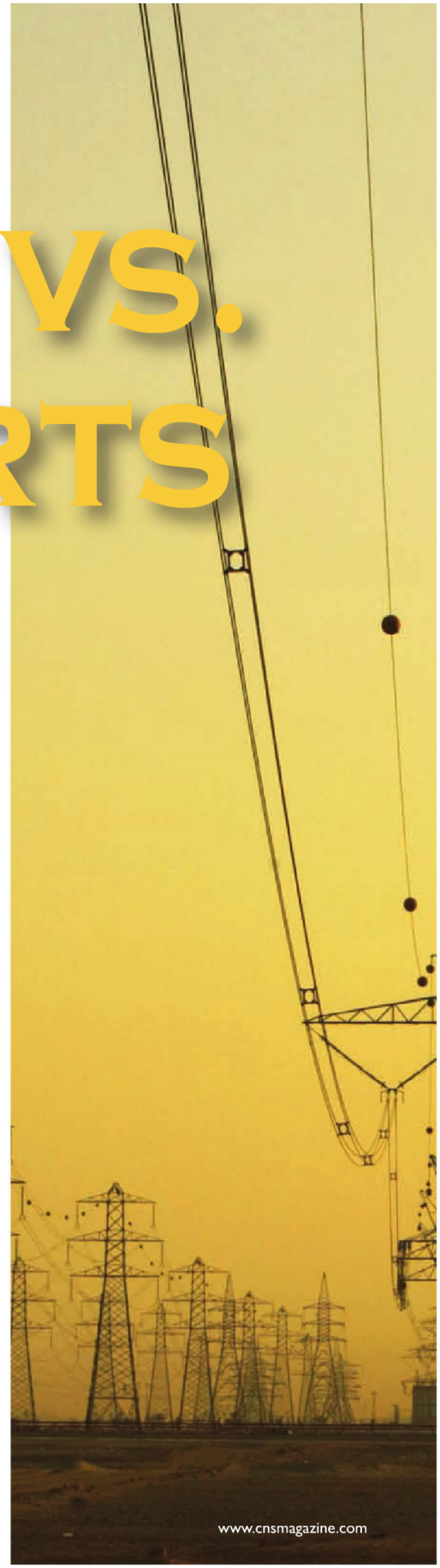
Power vs. Smarts



In order for something as complex as the smart grid to become a reality, old-school utilities have to bump elbows with the latest and greatest in information technology.

By Timothy Wilson

Fiber communications infrastructure is a key enabler for the smart grid, which promises to turn our electrical networks into intelligent systems. With the right infrastructure in place, a smart grid should be able to monitor electrical demand and supply, while also supporting feed-in strategies for multiple energy sources that, in turn, can allow for dynamic tariff structures.

"Up to now, the visible and public view of the smart grid has tended to be smart meters, of which public opinion has been highly polarized," says Ludo Bertsch, president of Horizon Technologies in Kelowna, B.C. "But there is more to the smart grid than smart meters. There is a lot going on behind the scenes in all areas, including transmission, distribution and generation, which are all moving toward making the grid more efficient."

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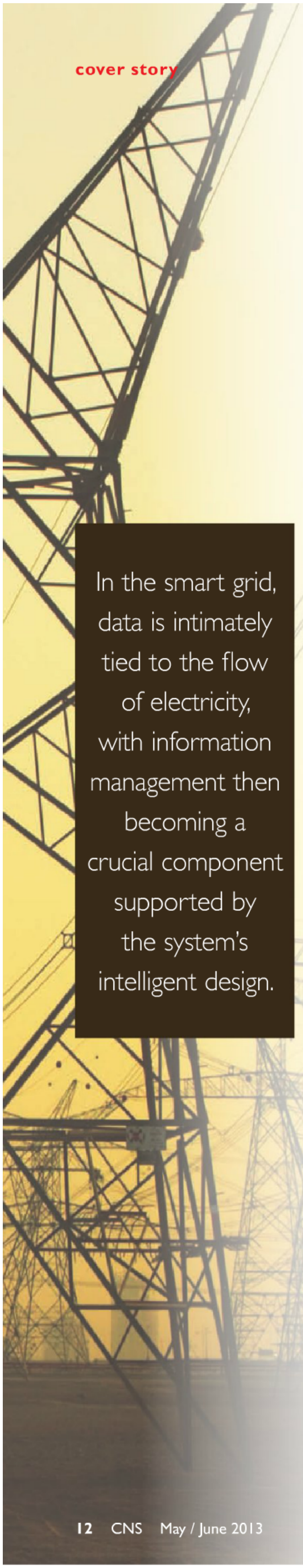

management then becoming a crucial component supported by the system's intelligent design. In order for something this complex to become a reality, old-school utilities have to bump elbows with the latest and greatest in information technology.

"Utilities have been operating for decades with high availability supported by radio networks," says Rob Barlow, president of WireIE in Richmond Hill, Ont. "Now they need to overlay a communications network on top of the distribution system in order to collect data points and make informed decisions. It can be overwhelming. What does all the data mean, and where do you prioritize?"

Barlow sees the goal in terms of grid automation. To get there, utilities familiar with 40-year equipment lifecycles are facing upgrade requirements to their physical infrastructure, and an expectation that they embrace information and communication technologies with faster depreciation cycles.

This is complicated by the fact that in Canada each utility is at a different starting point depending on its regulatory environment, the state of its infrastructure, and the availability of varied power sources such as hydro, thermal, wind and solar.

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Making the old new again

"There are global concerns for carbon emissions and the requirements to integrate a greater percentage of renewable generation," says Rick Geiger, executive director of utilities & smart grid at Cisco Systems Inc. "These are generally distributed in nature, and require changes to utility operating models. They challenge the legacy electric power supply chain, which never contemplated sources of generation interconnected at the distribution level."

Geiger echoes Bertsch in saying that the smart grid is not a single entity, despite the fact that the focus is often on smart meters and residential energy management. To tackle the larger challenges requires a holistic view that includes all source and distribution points. To figure that out, a systemic approach is a must.

"There are a number of maturity models and other metrics for smart grid progress," he says. "In addition to advanced metering and energy management, the maturity models look at security and NERC-CIP compliance, advanced distribution automation, and advanced control models. There is also the integration of smart meters into operational systems, including outage management systems and availability, and the deployment of support for distributed energy resources. These include electric vehicle charging, distributed wind and solar, and distributed storage." That is a tall order. As a result, these days the smart grid is very much a work in progress, with utilities rarely embracing one massive project to implement all the required elements. Size can also be a factor. In Canada utilities vary greatly, from Hydro Quebec with more than four million customers, to Saskatoon Light and Power, with only 60,000.

"Canada's utilities also differ widely in their degree of vertical integration," says Geiger. "Some might have complete ownership of generation as well as transmission and distribution, whereas other companies might be generation only, transmission only, or distribution only."

For its part, Cisco has its own GridBlocks architecture, which serves as a framework against which the business and operational goals, as well as electric power supply chain and communication assets, can be mapped with the priorities of a utility, its regulators, and its customers.

"GridBlocks helps in the analysis," says Geiger. "It provides guidance within the largest possible context, making sure that mistakes and omissions don't occur."

This big context approach is key, but also one of the reasons why the promise of the smart grid is its greatest challenge. Utilities are reluctant to commit to a complete transformation of their grids, yet piece-meal approaches with limited — or poorly conceived — fiber outlays can be a tough sell from an ROI perspective.

"One stumbling block is that every time a utility asks for money, people expect their rates to go down," says Barlow from WireIE. "It is hard for them to justify investments without that in mind, but the business case is also about saving on attrition."

The economics argue for taking the long view. A smarter and more stable grid that requires fewer people to take care of it is going to save money over time, but it will not bring down rates right away. And though saving money on linesmen may not be what comes to mind when people think of the smart grid, Barlow points out that there are fewer and fewer people employed in the field, and they are harder to find, too.

"Investments in information technology could alleviate this problem," he says. "We need to have a transformational discussion, not only one that's about saving money quickly."

However, no utility can afford to replace their vast legacy infrastructure at once. Smart grid projects are undertaken according to priority and necessity, with utilities often not getting credit for being aware of the challenges and opportunities, or for the fact that the immensity of their systems forces them to work over long timeframes.

Smart takes flight

If there is one lesson that North American utilities have learned, it is that if you do not pay now, you pay later. Canada, for example, cannot afford to put all of its grid underground, but that means rural areas can face higher maintenance costs and blackouts during wind or ice events. Consequently, putting in place the technology to support a smart grid that reaches far and wide will certainly require more cabling, but it also means a lot of communication will go through the air.

"Communications is key and typically contact with a substation will be via fiber or fixed wireless such as microwave," says Bruce Orloff, IBM Canada Inc.'s Smart Grid Leader. "End devices and intelligent electronic devices (IEDs) will be connected via wireless technology."

From there, to ensure the best quality of service (QOS) a utility has to determine to what extent it wants to build out its own wireless network, and to what extent it wants to rely on cellular companies.

"Latency can be an issue, and some applications like video can be data hogs," says Orloff. "But video can have real value monitoring unmanned substations, and also for ensuring personnel safety."

To make it all work requires standards, and an understanding that a lot of the heavy lifting will be done by back office applications tying in grid operations, asset management, and customer domains — areas that have traditionally been in their own silos.

For a big company like IBM, which has spent the past year running simulations and tests with Hydro One as part of its Advanced Distribution System (ADS) project, a partner ecosystem is crucial to addressing the overall challenge.

"For example, we partner with Schneider Electric for distribution management systems, and then integrate the back end with Hydro One," says Orloff. "On top of that, IBM has a huge

Rick Geiger: When it comes to smart grids, a holistic view is needed.

software portfolio, specifically around big data and advanced analytics."

It is the wireless to fiber capabilities supporting IEDs which really extends the reach of the smart grid, and which will be driving huge amounts of data into back office systems. This data is not unstructured, but it is nonetheless varied, and, despite a general understanding of rate fluctuations, not always predictable.

"As far as communications and wiring, most of the work has been on wireless, although wired communications such as powerline and twisted pair are also important, including big advances in communications rates," says Bertsch from Horizon Technologies. "The main areas for fiber are for backbones, and high quality audio and video."

Inevitably, Multiprotocol Label Switching (MPLS) is also part of the solution, given its ability to direct data off of communications networks and its support of divergent technologies. MPLS can provide multiple services and facilities for the virtual separation and management of traffic, resilience, and security.

"It can also guarantee levels of service and provide a way to converge multiple communication links into a single manageable operational network fabric," says Geiger. "The multiple goals of smart grid require the interconnection of many of these formerly siloed systems."

He notes that as IP technology has grown in capability and declined in price, it has also become the technology of choice. Like many technologies, it comes with substantial security concerns, but its capabilities make it the ideal technology to support smart grid initiatives.

"Utilities today are burdened by the operational and maintenance costs of aging and sometimes obsolete communication systems and protocols," he says. "At the same time they are being required to modernize and secure their infrastructure. IP and MPLS provide robust capabilities the utilities need at costs that are much more economical than continuing to support a multiplicity of legacy systems."

Along with its GridBlocks architecture, Cisco has its connected Grid Design Suite (CGDS). CGDS is not specifically aimed at IEDs running their own software, but provides the ability to work with electric and network connectivity in a way that power and communication engineers can both understand.

"Of course this incorporates IEDs as well as any other equipment found in a substation, but the previously unmet need is not so much the fact that IEDs run different software," says Geiger. "It is that communication engineers must provide architecture, design, configuration management and operations to support the electric power architecture and electric power operation of the substation."

For the Smart Grid to become a reality, these views have to be united so that communication engineers can understand power needs, and vice versa. With that in place, a comprehensive, end-to-end view of the entire electric power supply chain is possible, moving beyond generation, transmission, distribution and delivery to incorporate distributed energy resources and energy trading.

And all those smarts should make for a more stable, environmentally sound, cost effective grid — perhaps one that will bring those pesky rates under control, too. **CNS**

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A brief history of the Grid

The electrical grid in North America is more than a century old. It began in the 1880s and the 1890s with the competing interests behind Thomas Edison's direct current (DC) and George Westinghouse's promotion of alternating current (AC). When General Electric put its weight behind an AC-supported grid, the tide shifted, resulting in the buildouts that formed the basis of today's electrical system. Throughout the 20th century the plan was then to distribute electricity to as many locations as possible.

"The whole idea was to focus on supply," says Dr. Kenneth Wacks, an energy management consultant who sits on the U.S. Department of Energy GridWise Architecture Council. "And with supply as the paramount concern, we saw a number of government policies to encourage electrification. It wasn't until the 1990s that policy makers became concerned that there could be a squeeze on supply."

In fact, Dr. Wacks says that the projected growth in demand had some thinking that North America could end up experiencing energy shortages by the late 1990s. That did not happen, but it did result in a number of policy makers asserting the importance of taking a balanced view that looked at more than supply.

"At the time, the technology to do the monitoring was not there," says Dr. Wacks. "It required a lot of telemetry for distributed measurements and communications. In the 1990s we didn't see the expected growth in manufacturing demand for energy — instead we saw a shift to services and the information economy. However, there was still concern about the environmental consequences of an over-reliance on coal and oil."

There was also an interest in making the grid more reliable and efficient. With the emergence of Internet-based technologies, which could make the grid "smarter," the United States Department of Energy created the GridWise Architecture Council in 2004, with President Barack Obama famously referencing the importance of a smart grid in his first state of the union address in January 2009.

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