



SIERRA ENERGY GROUP
The Research & Analysis Division of Energy Central

AMI and DA Convergence:
*Benefits of Growing Your Smart
Grid Infrastructure with a Multi
Technology Approach*

April 2011

Prepared for:



By Sierra Energy Group
The Research & Analysis
Division of Energy Central

Table of Contents

Executive Summary Page 3

Introduction: Utilities “Get Smarter” Page 4

The AMI-DA Technology Solution Page 4

The Multi Technology Approach Page 4

Benefits of Multi Technology Communications Architecture Page 6

Planning for the Future Page 9

Executive Summary

As today's utilities explore new ways to operate more efficiently, the smart grid offers a solution through distributed intelligence, managing energy consumption and measuring the quality of the power back to the utility. This information helps utilities save energy, reduce costs, and increase the grid's reliability and also provides greater transparency to those operating it. Although smart grid investments span a broad range of technologies, today's utilities are focusing on distribution automation (DA) systems and advanced metering infrastructure (AMI) to support monitoring and remote control of the power system.

Historically, utilities have had limited visibility into the operation of the distribution system as it approached the home because the available technology was not cost-effective and it was hard to make the business case. Now, utilities can use AMI to connect previously inaccessible devices and distribution points for little incremental expense on top of smart meter investments. In addition to providing customer data, information derived from AMI helps optimize a utility's business operations.

Today, some utilities are considering a single communications technology for their AMI networks and another for DA communications—or in some cases—a single technology for both. This is a “single technology” approach. In contrast, a “multi communications technology” architecture is one in which multiple communications technologies are used within the AMI and DA systems. By accommodating a variety of network communications technologies such as radio-frequency (RF) mesh, point-to-point or point-to-multipoint networks, and public wireless, utilities can choose the right combination of communications technologies based on varying requirements for performance, price, location, and reliability.

Utilities that adopt a multi technology approach for their AMI/DA communications platforms can reduce risk by future-proofing their smart grid investments and ensuring operational longevity. A multi technology platform can also leverage the benefits of new technologies as they emerge, ensuring that capital investments made in today's infrastructure will generate future ROI.

In addition, a multi technology approach promotes greater scalability for system growth and also allows operators to choose the most cost-effective solution based on their requirements. For example, while cellular options were less economically feasible in the past, they are now being widely deployed in the grid due to today's affordable, pay-for-use data plans.

Some utilities fear that a multi technology approach requires significant work in integration. This is not the case with a true “multi-communications technology” platform. For example, Elster's EnergyAxis[®] System manages the entire network and all connected endpoints through a single head end. Additionally, through AMI and DA Convergence, Elster offers a range of communications options to take advantage of coverage, rate differentials, and varying application needs. This white paper will explore the multi technology approach and the significant benefits it offers to utilities.

Introduction: Utilities “Get Smarter”

Today’s utility industry is continually trying to find new ways to consume less energy and operate more efficiently. The smart grid offers solutions by overlaying the ordinary electrical grid with an information and smart metering system. This system uses two-way digital communications to control and monitor these meters, which then wirelessly transmit end-to-end intelligence about electricity transmission and demand back to the utility. With this information, utilities can reduce peak energy consumption by shifting demand loads and boosting efficiency through improved diagnostics. Utilities can then use this information to save energy, reduce costs, and increase grid reliability and transparency. ABI Research projects that approximately 212 million smart meters will be deployed worldwide by 2014—up from 76 million in 2009^a. Smart meters represent an exciting new technology to save energy, reduce global warming, and address emergency resiliency issues throughout the nation.

The AMI-DA Technology Solution

Historically, utilities have had little ability to obtain data from the grid to see the operating characteristics of major segments of the distribution system—particularly with respect to transformers within neighborhoods—due to the high cost of previously available equipment that was suitable for the purpose. Although utilities have long recognized that collecting information from these devices would prove valuable, the cost of creating an infrastructure specifically for that purpose would have been enormous. Operators are now focusing particularly on DA systems and advanced metering infrastructure to connect previously inaccessible devices and

distribution points. AMI uses smart meters to remotely monitor and transfer energy consumption and power quality data more frequently and reliably. Now, with Elster’s AMI-DA Convergence solutions, smart meters and grid monitoring devices can be installed on power lines, transformers, and even in homes, providing utilities with the transparency needed to observe the workings of the distribution system. As a result, utilities can monitor distribution all the way down to the consumer for little incremental expense to the existing smart metering investment.

In addition to providing a wealth of customer data, information derived from AMI and DA systems can be used to optimize a utility’s business operations such as system engineering, maintenance, and customer service. The end result is greatly improved visibility and optimal control of the power system.

The Multi Technology Approach

In the past, utilities only considered a single technology for their AMI network and another for their DA communications such as SCADA (supervisory control and data acquisition) radio. Some of today’s vendors are still promoting the idea of a single communications technology for both AMI and DA. To fully realize the smart

“Multi technology” architectures provide utilities with the freedom to choose communication devices and technologies based upon their unique needs for performance, price, and reliability.

grid's potential, however, utilities should be implementing metering communications platforms that encompass multiple communication technologies.

Multi technology architectures provide utilities with the freedom to choose communication devices and technologies based upon their unique needs for performance, price, and reliability. This might include, for example, a network that can accommodate both private radio and public cellular communications to meet diverse requirements throughout service territories. Multi technology platforms should be built to incorporate a range of standards-based communications options such as wide-area networks (WANs), local-area networks (LANs), and home-area networks (HANs).

Another example involves inter-operating with a variety of network communication technologies such as private radio-frequency (RF) mesh solutions, private point-to-point or point-to-multipoint networks, and public networks such as public wireless. Some utilities may also benefit from combining both private and public networks or shared WANs between DA and AMI.

This white paper will explore the multi technology approach and the benefits that utilities can realize by building an open communications platform.

RF Mesh

Most AMI networks today still use traditional, private, RF mesh solutions for flexibility and cost-effectiveness. For example, Elster's EnergyAxis® System—a unified communications infrastructure with network elements and services for AMI smart grid applications—is an IP-based, mesh solution that uses frequency-hopping spread-spectrum (FHSS) technology on the 900-MHz band. Given the popularity of

mesh networks, both with vendor and utilities, standards are continuing to evolve in this area.

RF mesh is inherently flexible and constantly tests to find an optimal transmission path, rolling to an alternate path when the way is blocked. RF mesh, however, can be blocked by certain objects, such as vegetation or large buildings. Mesh transmission leverages

unlicensed bandwidth so it is both flexible and cost-effective; however, new communications options offer advantages for consideration.

Public or Private, Point-to-Point or Point-to-Multipoint

In addition to mesh technology, some utilities are experimenting with point-to-point public network communications to transmit AMI data direct to the utility using either public or private networks. Compared to mesh, point-to-point

The EnergyAxis system is a unified communications infrastructure that includes network elements and services for smart grid applications, such as data acquisition for AMI, grid management, and demand response (DR). It is an IP-based mesh solution that uses frequency-hopping spread-spectrum (FHSS) technology on the 900-MHz band.

The EnergyAxis system provides valuable features by utilizing a combination of functions built into the network management system, gatekeepers, and network elements.

networks offer a range of data rates up to 3 and soon 4G. Point-to-point communications also offer an advantage for large industrial accounts where greater data amounts are being collected and where demand for information is more frequent.

In the past, point-to-point or point-to-multipoint networks were used less due to high costs—both operationally and first cost. This is changing, however, as public wireless options are increasingly offering affordable, pay-for-use data plans based on bandwidth consumed and the amount of data sent. Public wireless coverage is now more than sufficient to support multiple smart metering applications—T-Mobile and AT&T report that cellular coverage in North America is approximately 96 percent of the population.

Cellular networks now offer lower airtime rates and tighter service-level agreements and are already widely deployed in the electricity grid. Many utilities rely on wireless technology to communicate with cellular-enabled meters at large commercial and industrial customers. In fact, the majority of North American utilities today use public wireless networks (i.e., networks owned by carriers such as AT&T or Verizon Wireless) to backhaul metering information collected at the neighborhood-area network (NAN), which are typically mesh networks, to a central location. With telecommunications companies reducing network pricing, more and more utilities will begin using point-to-point public networks for communicating directly to the endpoint meter.

Choosing a network for AMI/DA depends on which applications are most critical to the utility. For example, applications that require higher-speed, TCP/IP links can leverage low-latency technologies such as wire Ethernet or fiber, while less-bandwidth-intensive applications or those in remote areas can leverage lower-speed technologies as available. No one-size-fits-all approach meets every need and communications architectures that can accommodate a

range of new technologies will ultimately deliver greater flexibility and reduced risk of obsolescence.

Benefits of Multi Technology Communications Architecture

Utilities that adopt a multi technology approach toward their AMI/DA communications platforms stand to leverage the following benefits:

Reduced Risk

The most compelling benefit underlying a multi technology communications platform is risk reduction. By embracing multiple communications technologies and standards, utilities can future-proof their smart grid investments and ensure operational longevity.

A multi-technology platform can capitalize on the benefits of new technologies as they emerge, ensuring that capital investments made in today's infrastructure will generate returns on investment (ROI) far into the future. The EnergyAxis system, for example, is built to scale to various bandwidths and to accommodate multiple telecommunications options, enabling

By embracing multiple communications technologies and standards, utilities can future-proof their smart grid investments and ensure operational longevity.

a utility to plug in the most cost-effective, appropriate technology to suit a particular need or application.

For example, a utility might install RF mesh as an affordable network to reach multiple endpoints in a neighborhood. However, some large customers may need to continually retrieve large amounts of data, in which case a public wireless, point to point connection might make more sense. A multi technology platform, such as EnergyAxis, is flexible enough to accommodate both a point-to-point wireless, as well as a mesh network.

Flexibility for Future Standards

Utilities are concerned about how the standards process will unfold because they need to ensure compliance. The key—once again—is to ensure that the communications architecture is flexible and upgradeable to accommodate new standards as they evolve. For example, to avoid obsolescence, Elster’s EnergyAxis is architected to support future network protocols as they evolve into AMI industry standards. This enables support for new devices as future requirements dictate. Currently, EnergyAxis supports communications with all EnergyAxis and partner devices, as well as EnergyAxis devices using direct WAN connections that support IP or circuit-switched telecommunications such as 3G, Wi-Fi, WiMAX, fiber, ADSL, and broadband-over-power line (BPL) Internet service.

Scalability

A multi technology approach promotes greater scalability for system growth. By providing a distributed framework with both mesh and direct WAN-connected network elements, for example, a platform allows for greater bandwidth scalability. This would allow for a gradual migration from, for example, a large-scale mesh architecture to more direct-connected endpoints as communication costs decline. This scalability

Scalability enables utilities to achieve maximum ROI as they reap the rewards of current systems, while also positioning systems for future expansion.

enables utilities to achieve maximum ROI as they reap the rewards of current systems, while also positioning systems for future expansion.

Cost Savings

A multiple technology platform allows operators to choose the most cost-effective network solution based on application requirements. For example, although cellular metering communications may have been less economically feasible in the past, cellular technology is now being widely deployed in the electricity grid due to today’s affordable pay-for-use data plans. In addition to reduced rates, carriers are also offering service-level agreements, when accompanied by managed, machine-to-machine service platforms that provide the utility more visibility into and control over wireless devices. Telecommunications companies are actively courting utilities and are working to aggregate services under a single rate structure.

Enhanced Security

Two-way communications within AMI/DA systems raise several security issues, including consumer privacy, data integrity, and maintaining continuity of service throughout the grid. A multi-technology communications platform should provide security independent of the technology used. A common challenge has been and will continue to be security management, including management of security keys, as well as events. A platform that allows a common security approach for different communications

technologies, such as a wireless mesh and point to point, eliminates the headaches associated with separate systems while still providing the benefits of a single platform.

Improved Geographic Coverage

An AMI/DA communications platform that supports multiple technologies can be more easily extended across a variety of regions and environments. For example, a utility was attempting to increase its electric footprint by installing lines in remote, mountainous areas. Because it was cost-prohibitive to send technicians to read meters, smart meters were installed; however, the installation sites were too remote for more traditional wireless networks.

Instead, the utility used satellite communications to obtain the meter readings. With a multi technology approach, the network could be built to accommodate satellite, wireless, and mesh in case the areas eventually became more populated so that a more cost-effective wireless or mesh solution could be activated later.

In another example, a multi-technology platform was used to control polyphase irrigation pumps for rice fields and other agricultural applications. These smart meters not only provided accurate meter data but controlled load. These meters used a public wireless network for communication. This same multi-technology platform uses the high performance mesh network with great success for demand

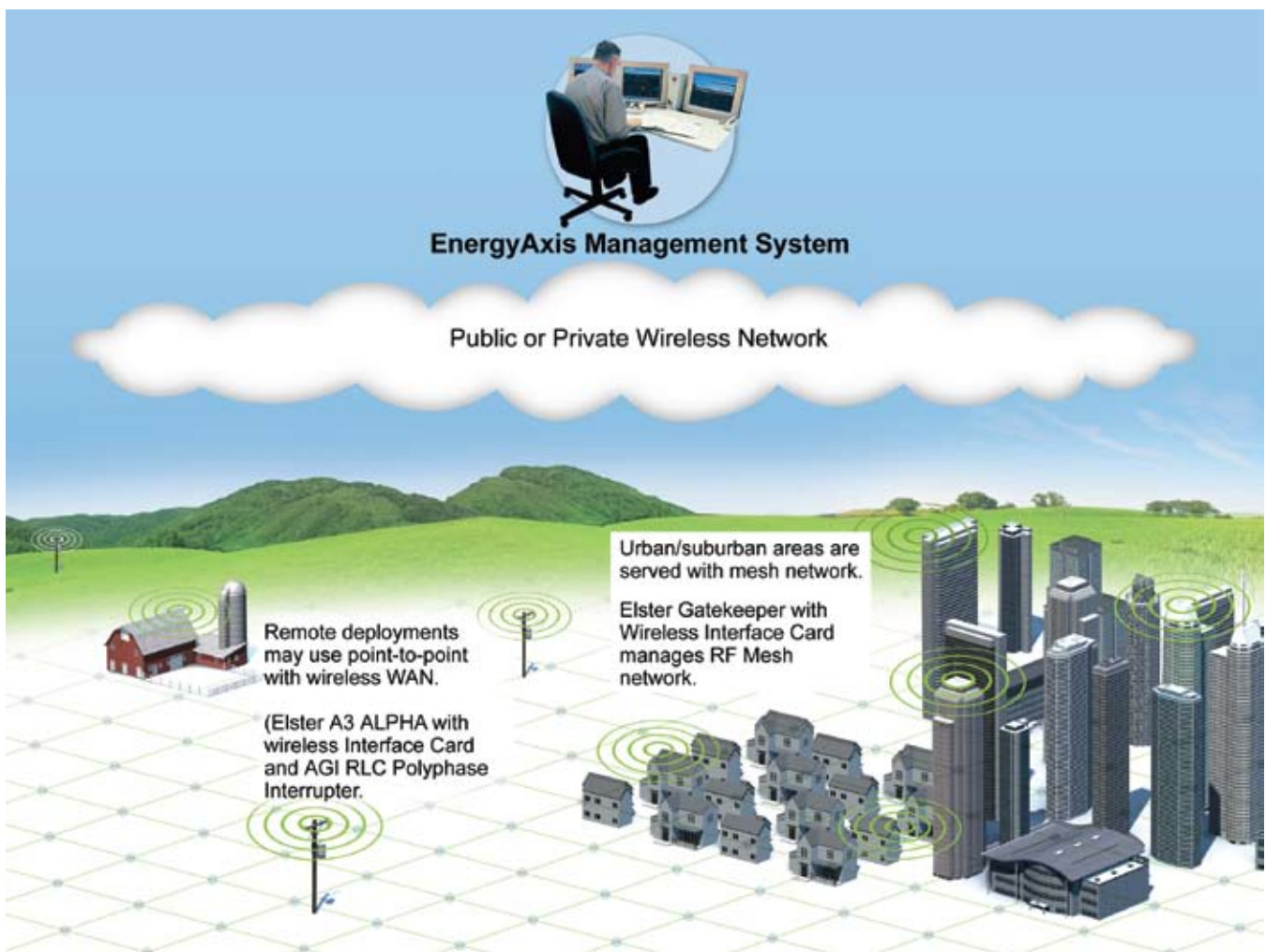


Figure 1: AMI solutions architected for multi technology communications offer utilities cost efficiency and future flexibility.

response and meter reading in another region of the utility's service territory.

Greater Manageability

Some utilities are concerned that a multi technology approach will require a great deal of integration. Elster's EnergyAxis System, however, manages the entire network and all connected endpoints through a single head end. (See Figure 1) Through its unified multi technology platform, EnergyAxis offers a wide range of communications options for the WAN, LAN, and HAN—all of which can be used in the same deployment.

The same system can also support the concurrent deployment of multiple communications options. For example, applications that require higher-speed links can leverage low-latency technologies such as wire Ethernet or fiber, while less-bandwidth-intensive applications, or those in remote areas, can leverage lower-speed technologies as available. Additionally, some endpoints can be directly connected to the head end, such as WAN-connected meters, DA devices, and other smart grid elements. Because the network can be managed with a single head-end interface, the end result is easier network manageability because integration efforts with other back-office systems, such as outage management and billing systems, need only occur once, reducing initial work as well as ongoing support.

Planning for the Future

AMI and DA pose a significant investment for utilities so it is best to create an open architecture that will support new technologies as they emerge. With the advantages offered by new and evolving technologies, there is no one "best" communication option and no need to focus on only one technology. To unleash the full potential of the smart grid, utilities should adopt a multi technology approach toward

building their communications platforms. In this way, AMI solutions can be integrated with a broad range of private and public, wired and wireless networks to suit a variety of environments and requirements. This approach ensures built-in interoperability with new standards and compatibility with existing technologies, such as SCADA.

A multi technology approach ensures built-in interoperability with new standards and compatibility with existing technologies, such as SCADA.

Choosing a multi technology communications platform to support smart metering initiatives is important, but it is equally critical to work with technology partners who provide broad-based expertise, who are committed to incorporating multiple, useful technologies, and who offer solutions to effectively bring these technologies together. These partners should demonstrate years of experience working with a variety of communication technologies, platforms, and services. Such partners will also bring established relationships with public wireless operators to the table. Ultimately, from a business standpoint, vendors who offer a multi technology business model assure utilities a stable partnership for the long term because they can easily adopt and adapt to future marketplace shifts or technology breakthroughs.

Endnote:

a. Smart Meters for Smart Grids," ABI Research, January 2010.