The Migration from AMI to Smart Grid *

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The Smart Grid has become the focus of significant utility marketplace activity, regulatory and legislative direction, and US Federal policy mandates and support. Although innovative initiatives are at work to transform the electric grid of today into an autonomous, self-directed, coordinated system, the vast majority of the current utility programs identified as "Smart Grid" (or in support of Smart Grid) are actually advanced metering infrastructure (AMI) or Smart Metering projects.

It is worth taking a closer look at how well these projects support a Smart Grid vision beyond the core AMI solution, as their foundational ability varies widely. For the systems deployed, utilities and vendors alike must define how the current system can be migrated to encompass a larger vision than was in place when the system was chosen, designed or deployed. In addition to these ongoing AMI projects, utilities that are now evaluating the AMI business opportunity, selecting vendors or implementing AMI programs are faced with the task of defining how their AMI activities support the broader Smart Grid activities within the specific utility and the industry in general.

FOUNDATIONAL NATURE OF AMI

As mentioned above, many utility "Smart Grid" programs are actually AMI or Smart Metering projects. This is not surprising given that most of these projects were initiated prior to Smart Grid becoming a household term. Likewise many of them were initiated prior to the awards of ARRA Smart Grid related stimulus funding.

While these projects may not currently be Smart Grid projects, they are key foundational initiatives for the construction of a smarter grid, as AMI provides interval data collection and limited real-time events to support advanced rates, demand response, operational data capture, and enhanced customer engagement. This foundational nature of AMI is demonstrated in Figure 1, which shows the scope of Smart Grid concerns as published by DOE in its July 2009 update on Smart Grid developments, Smart Grid System Report. AMI sits at a key juncture of many of the Smart Grid applications and concerns identified by providing a ubiquitous communications infrastructure to link meters and other remote devices with utility operational systems and provide a structure for customer engagement. However, as DOE summarizes in its report, Smart Grid technologies, applications and programs encompass far more than AMI (See Sidebar below).

DOE: What makes a grid smart?

DOE describes the smart grid as providing six core characteristics:

- Enables informed participation of customers;
- Accommodates all forms of storage and generation options;
- Enables new products, markets and services;
- Provides power quality for a range of needs;
- Optimizes asset utilization and efficiencies; and
- Operates resiliently.

"The state of smart grid deployment covers a broad array of electric system capabilities and services enabled through pervasive communications and information technology, with the objective to improve reliability, operating efficiency, resiliency to threats, and our impact to the environment."

Smart Grid System Report
US Department of Energy
July 2009

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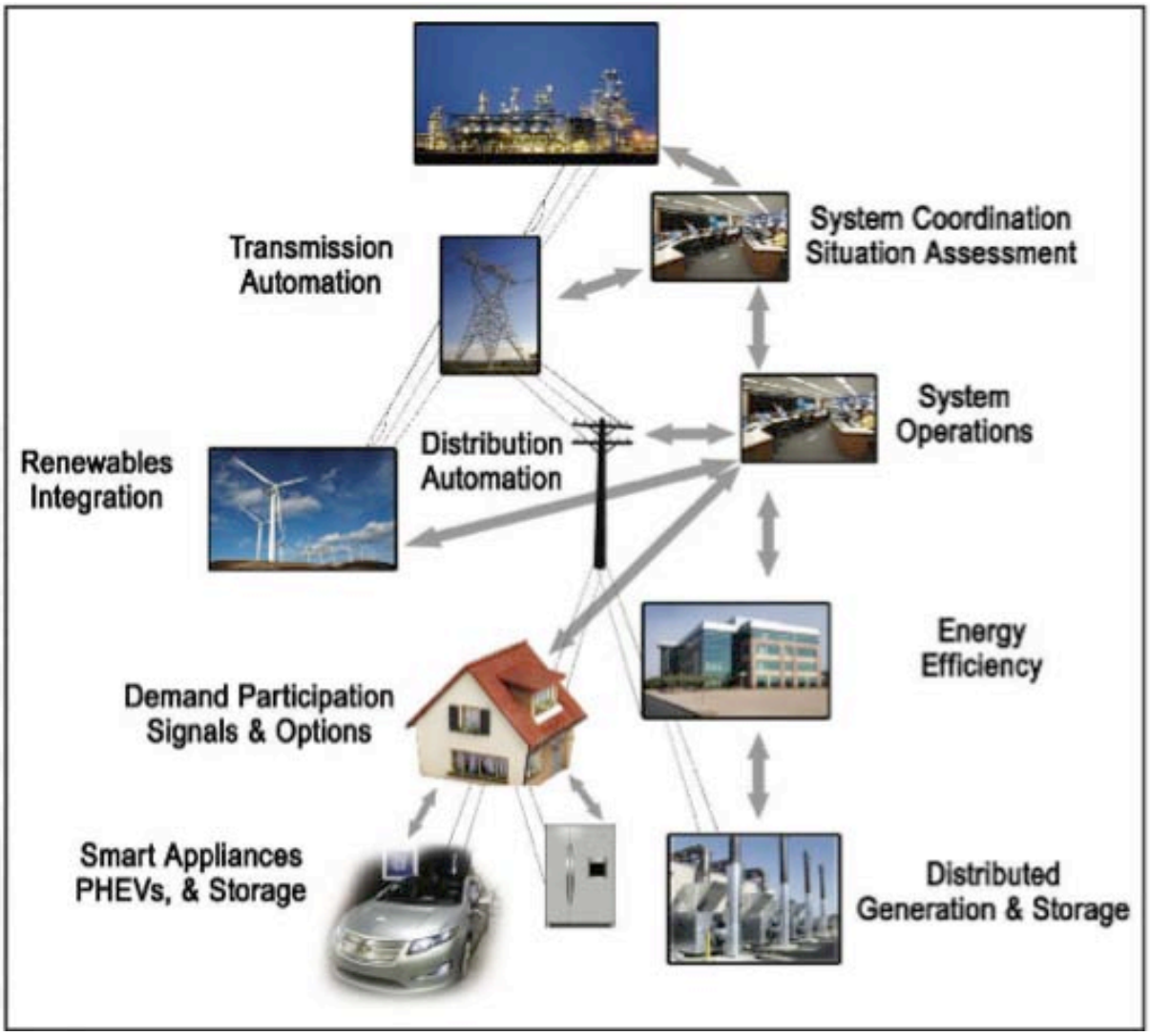

Figure 1. Scope of Smart Grid Concerns (Source: Smart Grid System Report, US Department of Energy, July 2009)

HOW WELL DO AMI PROJECTS SUPPORT SMART GRID?

In examining how well a specific AMI project supports the larger Smart Grid vision, some of the business and technical issues that must be considered include:

Corporate Goals. How do the identified Smart Grid initiatives support evolving corporate goals or visions? Are the primary drivers to support customer empowerment or engagement, renewable generation, operational efficiencies, or other imperatives? While AMI solutions support all of these initiatives, the required focus of the project will shape solution design, application phasing, deployment methodology and more.

Utility Operational Projects. How and where is the AMI project positioned within the utility's operational technology projects? Are new or expanded SCADA, OMS or DMS, workforce automation, or similar projects being implemented? As the Smart Grid includes a vision of a fully integrated future where applications seamlessly exchange information in real-time and make decisions without human intervention, it is imperative that utilities not pursue disaggregated initiatives. A well-constructed and comprehensive information management model is needed within the utility

that rationalizes what types of data is needed, from what systems and in what forms and frequencies in order to rationalize business investment and projects.

Communications Strategy and Architecture. AMI provides a significant communication system within the utility, but it is only one of many potential layers and networks. What are the corporate telecommunications strategy and supporting architecture to meet the significant communications requirements of the grid of the future? The amount of data that will be transported, the real-time nature of the information, and the large variation in required QoS amongst the component solutions makes the creation of an integrated plan critical.

MAKING AMI TRULY FOUNDATIONAL TO SMART GRID

The AMI solution will provide a communications network that covers substantially all of a utility's customers. It is designed to provide two-way, real-time data at performance levels that support customer engagement and utility operations. Therefore, it is poised to be a foundation for aspects of a utility's Smart Grid initiatives.

However there are some critical technical issues that must be adequately addressed during the technology and solution evaluation stage – and for those utilities that have already deployed AMI solutions, it is strongly recommended that these utilities perform a critical analysis of their solutions and their ability to meet the needs of a smarter and more automated grid.

In order for AMI systems to truly be foundational for a broader Smart Grid, they must at a minimum address the following issues:

- LAN/NAN Design
- Accommodating Future Demands
- Robust Prioritization System
- Supporting Security Requirements.
- Network Management
- Utility/Vendor Alignment

LAN/NAN Design. The design of the AMI Local Area Network (LAN) or Neighborhood Area Network (NAN) systems must be designed and built to accommodate communications traffic requirements beyond premise metering demands. This could include transformer meters, line monitors, faulted circuit indicators and other devices suitable for the AMI LAN/NAN. First generation AMI systems have been focused on the metering traffic alone and may not be capable of fully meeting increased requirements imposed by additional monitoring and control devices without network upgrades.

Accommodating Future Demands. Within the AMI system itself, additional requirements and bandwidth will be necessary over time. Utilities may not be doing enough to anticipate future demands and making accommodations for future demands in their choices of architectures, systems and vendors. While all of the future demands on the system cannot be identified today, certain strategies can be adopted today that lowers the risk of the unknown. These steps include identifying how the AMI solution as installed can be upgraded to handle unanticipated additional traffic. Depending on the architecture chosen — can additional spectrum be obtained, are more collectors required, or must additional solutions be overlayed? No utility can afford to present its regulators with a plan to replace a recently installed AMI system because of a failure to adequately access future requirements. The industry seems to have accepted the ubiquitous "remote download capability" as the catch-all for future support requirements, but the needs could surpass the capabilities of immature remote download/upgrade functionality.

Robust Prioritization System. What is the message prioritization capability of the AMI

system and what flexibility exists for future enhancements to this design? During large outage conditions or other significant system disturbance, the amount of traffic from all of the disparate sources could easily overwhelm the AMI system so it is essential that a robust prioritization system be available to ensure that the critical traffic is provided a high degree of service than lower level data gathering exercises.

Supporting Security Requirements. How will the substation or distribution automation traffic component of a smarter grid with its higher QoS, lower latency, higher availability and more rigorous security requirements be supported in within the context of the AMI solution? The security implications can best be defined through the work undertaken by NIST and evolving NERC/CIP guidelines and will be forever evolving. In fact, multi-tier architectures that physically separate traffic with different core telecommunications service requirements may be better long-term solutions than attempting to co-mingle all envisioned traffic on a single network.

Network Management. The AMI solution has a critical network management component. How will the non-metering traffic running on the network be managed? Things to consider include how the system supports traffic segmentation, multiple independent channels, distinct destinations for different data and can each traffic flow have separate service level commitments.

Alignment of Utility and Vendor. An AMI initiative, as with most Smart Grid projects, depends on the synergistic cooperation of many internal utility stakeholders as well as selected vendor partners. A key factor in selecting the external AMI partners should be how well they can articulate a Smart Grid perspective and how closely aligned their vision is with the utility.

In the end, it must be remembered that what constitutes a Smart Grid is not whether the latest exciting applications are deployed, how many remote sensors and automated devices are installed, or the available system bandwidth and communications speed. The true measure of how well the utility has achieved a Smart Grid is the extent to which the new solutions, available information and disparate systems are integrated into a coordinated effort to allow the utility to observe and act to better manage existing and future utility, and perhaps non-utility, assets. It is imperative that utilities evaluate their AMI initiatives and solutions in light of the emerging Smart Grid attributes and requirements.

About the author

Kevin Cornish is an Executive Consultant for Enspiria Solutions, a Black & Veatch company. He has over 25 years of experience in the utility field, with particular expertise in Smart Metering and Advanced Metering Infrastructure (AMI) solutions, Demand Response and Energy Efficiency programs, and Smart Grid and related technologies. He has led strategy and business case development for utilities across North America examining the full breadth of AMI solutions: AMI technology, MDMS, demand response, distribution automation, and implementation requirements. Kevin holds an MBA in Marketing and Telecommunications Management; an MS in Electrical Engineering/Power Systems and a BSEE in Electrical Engineering & Computer Science.