Harnessing the Information Flood: a Multi-Cooperative Approach to Meter Data Management

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This article highlights one of the major areas of technology research during NRECA’s Smart Grid Demonstration Project, and is part of a series of articles relaying the events and lessons learned in this groundbreaking effort. The full series may be found at www.nreca.coop.

OVERVIEW

The powerful, new electronic meters almost every utility in the U.S. is installing generate a flood of information. When they are set to log kilowatt-hour (kWh) usage in hourly intervals, each of these meters produces nearly 9,000 times the amount of data of an old, electromechanical meter. And, metering points on the Smart Grid are not limited solely to customer premises. A host of intelligent monitoring devices have also been installed across the electrical distribution system to enable more automated operation, and these too produce unprecedented amounts of data. The challenge is obvious—how does a utility, large or small, manage these vast troves of data and mine for the value buried inside? How can the data be sliced and diced in ways that answer specific questions and meet operational needs?

Great River Energy (GRE), a Minnesota-based generation and transmission (G&T) cooperative, and two of its member distribution co-ops set out in 2012 to develop and test a novel solution to this challenge. Their goal was to create a secure information-sharing framework that allows cooperatives within GRE’s service area to collaborate and coordinate joint programs, such as customer load control or outage management, with more agility than was previously possible. Keen interest was shown by the U.S. Department of Energy (DOE), which awarded a grant of $2.5 million to the project, as part of NRECA’s nationwide Smart...
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Grid Demonstration Project (SGDP). Figure 1 reflects the high level of interest early in the project, including GRE, DOE, academia, state regulators, and a host of utilities.

ABOUT THE PROJECT PARTICIPANTS
GRE is a not-for-profit G&T cooperative which provides wholesale electric service to 28 distribution cooperatives in Minnesota and Wisconsin. Its member cooperatives deliver electricity to approximately 650,000 member accounts—about 1.7 million people. With more than $3.5 billion in assets, Great River Energy is the second largest electric power supplier in Minnesota and one of the largest G&T cooperatives in the United States. Lake Region Electric Cooperative (LREC) distributes electricity to more than 26,000 consumer-members in west central Minnesota. It has an advanced metering infrastructure (AMI) with more than 31,300 smart meters deployed across its 3,200 square mile service territory. Minnesota Valley Electric Cooperative (MVEC) is a distribution co-op headquartered in Jordan, Minnesota. It provides power to 34,000 member-owners across nine Minnesota counties. National Information Services Cooperative (NISC), whose software solutions are used by both LREC and MVEC, was selected for project technical support.

GREAT RIVER’S MDM CONCEPT
GRE has a close and supportive relationship with the 28 distribution cooperatives that are its members. In fact, the G&T sees its role not only as meeting its members’ power supply requirements but also working closely with them to reduce energy demands at strategic times. As Gary Connett, GRE’s director of demand side management, puts it, “We work closely with our distribution co-op members to ensure that demand-side management is an integral part of their resource portfolio.” This is an understatement. GRE’s decades-old, load control program with its member co-ops encompasses more than 100,000 water heaters, 90,000 electric space heating systems, and over 160,000 central air conditioning systems—fully 35 percent of its members’ entire installed base. All told, some 355,000 loads are controllable using GRE’s radio control system. This is extraordinary, considering the aforementioned size of GRE members’ total customer base. Figure 2 illustrates the significant impact these programs have on GRE’s combined system peak.

Figure 1: Roundtable meeting at Great River Energy’s headquarters to launch the multi-cooperative MDM demonstration project in May, 2012. Photo courtesy of Great River Energy.

1 The three cooperatives contributed the remaining half of the $5 million cost of the project. The project report (“Multi-Tenant Meter Data Management: A Systems Approach to Hierarchical Value”) can be found at the Smart Grid Demonstration Project site on www.nreca.coop.
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Collecting and managing the metering data necessary to operate a load control system of this scale and complexity are not easy tasks. Electric co-ops have many different IT systems and, for the kind of joint program GRE runs, the systems must talk to each other and pass data seamlessly, often in near real-time. With most of its 28 distribution co-ops deploying smart meters, GRE believes the solution it is pursuing provides its members with an attractive alternative to installing individual, and uniquely different, meter data collection and management systems. Connett notes, “The metering data are valuable to the G&T as well as the distribution co-ops, so the idea of consolidating all the data into a centralized data warehouse with a unified software solution is very powerful.”

FIGURE 2: Demand response in action at GRE—impact of dispatchable load control programs on a peak day. Graphic courtesy of Great River Energy.

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RESEARCH OBJECTIVES

In order to design and specify an MDMS that meets these specific requirements, the project team had to answer the following questions:

- What business needs must be met by the multi-utility MDMS? The needs of both distribution co-ops and the G&T must be considered.
- What are the functional and technical requirements associated with these business needs?
- What is the potential value of such a multi-utility MDMS to the broader industry (utilities, ISOs, research consortiums, and co-op members)?
- What barriers exist that could hamper development and adoption of this technology solution?

BUSINESS REQUIREMENTS

The essential change brought on by smart meters, as noted earlier, is that far more granular metering data become available. The recording interval in smart meters can be set according to the specific business need; however, it is typically set to log hourly energy usage. For GRE’s longstanding direct load control programs, this opens a world of new possibilities for optimizing the scheduling and dispatch of load shedding. Cycling of water heaters and air conditioners, for example, can be far more precise when operators can see what loads are doing hour-by-hour on particular feeders. To take full advantage of this new

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Data granularity, however, the MDMS must have the following inherent capabilities:

- An information hub that allows data to be managed and shared between utilities and business units within the utilities. In GRE’s case, this means at least 80,000 physical metering endpoints across multiple utility service areas.
- A system that allows data to be normalized across business units, operating functions, and technologies.3
- Features that segment information and limit access as specifically authorized by source, e.g., individual utility or customer premise.
- Ability to integrate readily and cost-effectively with diverse data feeding systems.
- Scalability to deploy across many utility systems incrementally over time.

Obviously, design of an MDMS or any other IT system requires a highly detailed inventory of its business requirements and technical specifications, e.g., how often it must perform each processing task or data transaction, how it acquires data, how data are defined, what processing steps must be performed and when, etc. Detailed functional and technical requirements for GRE’s multi-utility MDMS can be found in Appendix A of the November, 2013 SGDP MDM report.

ABOUT DATA SECURITY AND INFORMATION PRIVACY

Throughout the project, great care has been taken to ensure that metering data entering the central data warehouse are highly secure and that access to these data is granted on a strict, ‘need-to-know’ basis. Technical support partner NISC hosts the single, centralized database for the multi-utility MDMS. The system logically separates metering data by cooperative; moreover, each co-op owns its data and establishes access permissions pertaining to them. For instance, authorized personnel at a distribution co-op may choose to make select meters available for read-only access by GRE. And within an organization, access is granted only to individual personnel performing a given role that requires use of the metering data.

PORTFOLIO OF BUSINESS APPLICATIONS

The multi-utility MDMS demonstration project uncovered a wide variety of business applications of this technology solution in the utility sector. These applications deliver substantial monetary value to utilities and reap a return on the MDMS investment. This investment return can be particularly attractive when the costs of implementing and operating the MDMS are shared among utilities, as is the case with GRE, LREC, and MVEC. Secure, real-time sharing of metering information among partners in such a joint IT solution enables many business applications. Here are just a few:

- Bidding Demand Response (DR) and energy storage resources into the wholesale market.
- Monitoring line losses, transformer losses, and power theft.
- Load forecasting, especially day-ahead for market transactions.
- Accurately billing capacity charges on accounts with intermittent generation, such as wind.
- Calculating carbon reduction by tabulating load reductions by meter groupings.

3 Normalization refers to correction of load data for weather, average number of customers, square footage, or other factors to enhance program planning and decision making. For example, load forecasters normalize peak demands for typical peak-day weather conditions to avoid over- or underestimating future peak loads.
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**MDMS BUSINESS CASE: CREATING VALUE**

The business requirements listed previously describe what GRE’s MDMS system is designed to do. The business value created—financial or otherwise—is being quantified over time by the participating co-ops. Already, the system has enabled operational efficiency gains, improved delivery system reliability, monitoring and verification of controlled load shedding, greater customer engagement and awareness via new web portals, and better, easier-to-create load forecasts. All of these benefits are above and beyond the technical advantages brought on by simplified system integration and expansion over time to encompass more of GRE’s member systems.

**BLUE RIDGE EMC IMPLEMENTS AN MDMS SOLUTION OF ITS OWN**

Blue Ridge Electric Membership Corporation, which serves 73,700 consumers in six North Carolina counties, also participated in NRECA’s SGDP and took advantage of a DOE grant to implement an MDMS. Blue Ridge EMC is deploying Aclara’s MDMS, as well as its Consumer Engagement solution, to address the need to manage its interval load data and to give members access to their hourly usage via a web portal. The co-op has already deployed Aclara’s Two-Way Automatic Communications System (TWACS) power-line communications technology to effectively and efficiently read its 75,000, widely distributed electric meters in the six counties. Together, these technology solutions will provide more precise management of data for billing, and present information to customers that will help them reduce their energy consumption through increased awareness and better analytics. According to Michael Clement, Applications Support Engineer at Blue Ridge EMC, “While our new systems are not yet fully implemented, we think this will be an exciting new era for Blue Ridge and our members.”

**SLICING AND DICING METERING DATA**

The most powerful attribute of the multi-utility MDMS discussed here is likely not its location in a centralized data warehouse on a secure server. Those features are merely prerequisites for creating business value. It is the ability to group metering data according to utility, program, rate class, customer type, substation, feeder, or other common attribute that supports better planning and decision making and adds the greatest value. In GRE’s case, the key to enabling this ‘slice-and-dice’ capability is a concept called the ‘virtual meter.’ What exactly is a virtual meter? It is a grouping or ‘roll-up’ of physical metering points to allow viewing, sharing, and analysis of the aggregated data as if it were produced by a single, physical meter. Virtual meters can be created vertically to represent total usage of a feeder or distribution cooperative. In this case, the logical hierarchy is meters to feeders to substations to distribution system-level. Metering data on feeders served by each substation are summed, hour-by-hour, and substations are summed to create a single, virtual meter for the utility. Virtual meters can also be defined horizontally; for example, all 100,000 meters in a demand response program—such as controlled water heating—can be aggregated to create a single virtual meter showing the total, hourly load curve for that program. It needs to be remembered that when such a virtual meter is created, all of the data granularity coming off the individual, physical meters must be preserved. The kWh usage in the hour ending at 1:00 am on June 4th must be summed across all the meters that comprise the virtual meter, and so on. This was not something that was possible in the pre-Smart Grid world, so there were no IT systems in place to do it.

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CONCLUSION
The implications of the shared MDMS that GRE, MVEC, and LREC have designed and built are widespread and significant, especially for the networked electric co-op community. By co-investing in system development and implementation, and sharing data within a secure facility in ways that insure information privacy, the three Minnesota co-ops have demonstrated a technology solution that is uniquely suited to networking among cooperatives and, thereby, reinforces one of the guiding principles of the cooperative model. While the benefits of this innovation are still being tallied up, it is already clear that the model works and can be replicated by other electric co-ops with similar regional alliances and collaborations.
About the Author

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