SMART METERING FOR THE DISTRIBUTION CONTROL ROOM

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ABSTRACT

Smart meters, the Advanced Metering Infrastructure (AMI) communications networks and the data that is produced are increasingly being used to support the Electric Distribution Control Room and improve Control Room operations. The use of smart meters has expanded beyond billing to become a real-time network of millions of sensors for outage detection, voltage management, power quality events and real-time demand response feedback

Smart meter data, when used correctly, extends the capability of outage and distribution management systems, as well as the engineering design capabilities, and improves overall grid management and operation. Several North American utilities have recognized the importance of Smart Meter Operations and are starting a trend of operating the smart meters as part of the overall Distribution Operations and not as an extension of Meter Reading and Customer Services.

INTRODUCTION

"I've spent hundreds of millions of dollars over four years and what do we have? Meter reads for billing." This quote from a large municipal utility CEO, and one of the earliest adopters of smart metering, illustrates the challenge of smart metering. Smart metering has become a necessary utility technology and, according to many, the foundation or the smart grid. However, it is important to realize that smart meters are not just a revenue meter, but a grid sensor and control device residing at every endpoint of the electric grid with near-real time communications. The hot discussion topics today include Big Data analytics, outage management, CVR and demand response which have nothing to do with billing cycles and register reads and everything to do with the vast capabilities of the smart meter.

This paper discusses the value of extending smart metering beyond billing, highlighting what is possible and how to get there. Those utilities who have adopted smart metering are being pressured by regulators and executive management to realize the promise of smart meters and this paper discusses the challenges and opportunities of operating a smart metering system to support these additional benefits. Using the similar skills and processes honed in the electric distribution control room, this paper describes how smart meter operations will ensure the smart meters deliver consistent and reliable information to all business units.

SMART METERS ARE GRID SENSORS

The smart meter is not a revenue device to be read once a month, but a grid sensor providing energy, power and quality data at a frequency and latency necessary to meet the business needs of the utility and a means to control or limit the energy consumed by the end premise. Today's smart meter measures forward and reverse energy consumption as well as system voltage, detects and reports power outage and restoration and voltage sags and swells, and contains a remotely operable switch for disconnection and reconnection of service.

The smart metering solution, composed of smart meter, data collection system and meter data management, should be implemented to collect and process more than just the data required for billing, but all the data from all the points all the time. Equally important, but often overlooked, the solution must be able distribute the data to the systems which can use the data with a similar high performance and reliability. And, finally, the solution must be operated as a real-time operational communication collection of sensors for utility operations.

Smart Meter Value To Electric Distribution

These smart and communicating grid sensors are being used by several utilities today to dramatically improve their operations by providing functions beyond simple billing, including:

- Outage detection and restoration reporting through direct integration with the Outage Management System.
- Single lights out verification by communicating to the endpoint device to determine if it's powered, and using this information to automatically close outage trouble calls. One utility "pings" over 125,000 endpoints annually to verify power status.
- Real-time voltage feedback to reduce system voltage and circuit demand using conservation voltage reduction (CVR) techniques and tools. Savings of up to 3% have been reported.
- Deferred substation and feeder capacity requirements resulting from improved system modelling and lower margins required for cold load pickup.
- "Rolling blackouts" through individual premise disconnects rather than wholesale circuit disconnects.
- Line loss and transformer load monitoring and management to reduce technical losses, extend asset life and reduce outages.

Expectations of Smart Meters

Every business case for smart meters includes some portion of benefits assigned to the distribution business unit. In some recent cases, this benefit can be a substantial portion of the overall business case. With the completion of the deployment of smart meters, it's the distribution operations and engineering which begins to realize the opportunities and capabilities which can be enabled by these "end of the line" devices. However, many of these distribution groups report that they experience barriers and resistance from the smart meter operators and owners because the smart meter represents the utility cash register and "you can't interrupt billing." This resistance reflects the approach of implementing and operating the smart metering system as a replacement for the old meter reading system. This approach leads to a focus on collecting that data (billing reads) which is required by a subset of the metering devices (meters billing today). These metering groups are focused on operating a metering system for billing.

The utility which embraces the smart metering system as a collection of real-time operational grid sensors and plans for the many users of the smart meters and smart metering data will find that the needs of billing are easily met as well as the requests of the rest of the organization. Anyone implementing a smart metering solution should expect:

- Energy consumption information from every metering device every day. In a small percentage of devices, this data may be estimated, but it should be complete for all devices.
- Real-time alerts when a sensor detects a loss of power or restoration of power.
- Real-time alerts when a sensor detects power quality outside of a programmable threshold.
- The ability to set, and change, alerting thresholds as determined by the end use applications and local conditions.
- The ability to request near real-time information from a selectable subset of the endpoint devices.
- The ability to receive aggregated energy and demand information representing customer, geographic or circuit loading.
- Access to a ubiquitous communication network capable of configuring and controlling endpoint devices.

The smart metering solution which meets these expectations and is operated as a real-time communication network of sensing devices will yield benefits to all parts of the electric utility.
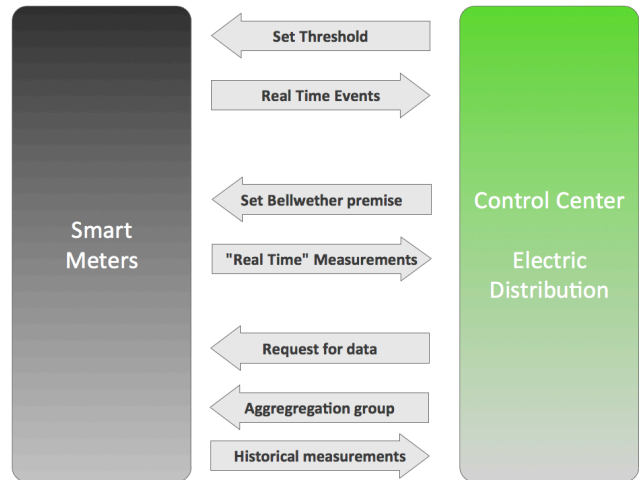
SMART METER OPERATIONS

"Next to electric grid operations, smart meter operations will be the most important function in the electric utility enabling the next generation of benefits of the utility." This unsolicited quote, from an electric distribution utility with millions of smart meters, was provided during an interview of the operations personnel when asked about what was their biggest surprise.

With the increasing importance and potential of the smart meter, the operation, monitoring and management of the smart meter and the AMI communication infrastructure is paramount to enabling the capabilities of these grid sensors and allowing the distribution control room to realize the available benefits. The organization and services of smart meter operations will define the value and scope of a utility's smart meters. The diagram below frames smart meter operations responsibility for the Meter Data Management System (MDMS), AMI HeadEnd Server (AMI HES) and the AMI communication infrastructure.
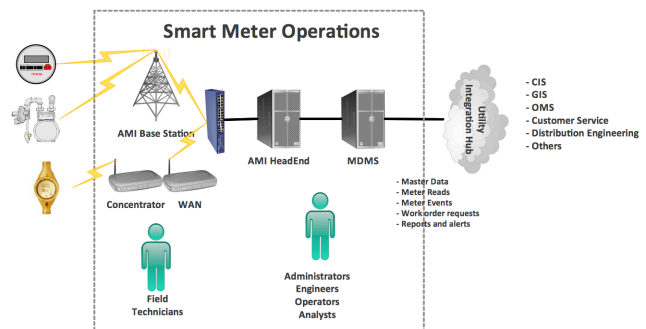
The primary goal of smart meter operations is to provide valid, accurate and complete data to the users and target systems at a format, frequency, latency and reliability consistent with the requirements of each of these users and to maintain the smart meter network availability for communications to any accepted endpoint device at required levels. This approach to maintaining connectivity to all points of the electric grid and ensuring the reliable

flow of accurate information is remarkably similar to the goal of a grid operations group responsible for maintaining the electric grid and flow of electricity. The similarity of focus and commitment to operational excellence is one reasons why some utilities in North America are embracing the approach that smart meter operations should be part of the overall distribution operations organization. As the only 24x7 organization within the electric utility, the distribution control room is naturally extended to include smart meter operations.

First, Operational Processes and SLA

Most utility projects are implemented in the classic waterfall methodology of requirements, design, build, test and move to production. A smart meter project, however, is different in that operations doesn't commence at the end of the project, but upon the installation of the first smart meter. So, while the smart meter project team is designing interfaces, configuring information systems and building business processes, the smart meter operations team will define a complete set of operational procedures and roles and responsibilities targeted at operating a real-time communication network and processing large amounts of data. The operations must develop a Service Level Agreement (SLA) which establishes performance measures and expectations. The SLA allows the smart meter clients (those systems and business users within the utility as well as retailers and end consumers) to know what they can and will receive. A typical SLA will include:

- Smart meter systems availability > 99.99%
- AMI network availability > 99.9%
- Smart meter data for billing > 99.5%
- Smart meter and sensor data (validated and/or estimated) daily by 8:00AM > 99%
- Smart meter real-time data available within 15 seconds
- Smart meter control/response within 15 seconds
- Identify and failed smart meter endpoint devices within 2-5 days of failure

In addition to communicating expected data and service performance to the business units, the SLA (just like electric reliability indices) proves a measure of the operational performance for continued improvement.

Smart Meter Operations = IT-OT Convergence

The utility industry is not immune to the trend of convergence of Information Technology (IT) and Operational Technology (OT). A smart meter operation not only highlights this convergence, but, because smart metering is new to the utility, it relies and benefits from the cooperation of these environments. The smart meter solution involves several enterprise class information systems and integrations with up to five critical utility systems, including Customer Information System (CIS), OMS, Distribution Management System (DMS), and

Geographic Information System (GIS). The real-time information and communication systems comprising smart metering, as well as the real-time integrations, requires the standards, monitoring tools and expertise of the IT organization while the complex data management, data analysis and technical knowledge requires the operational skills, big picture view and attention to detail of the OT personnel.

The smart meter operations organization includes application administrators, smart meter operators and data analysts. The application administrators are responsible for the configuration, monitoring and management of the AMI HES, MDMS and other information systems comprising smart metering. The smart meter applications are highly configurable enterprise applications with powerful consoles which require administrators to keep the applications tuned and working properly. The smart meter operators are responsible for the day to day monitoring, management and troubleshooting of the endpoint devices (millions of meters and thousands of communication devices), as well as the monitoring of the plethora of data processing services and exception tasks. The data analysts are responsible for the queries and data analysis to create reports and identify trends in performance and opportunities for improvement. All smart meter operations personnel must be fluent in the principles and applications of smart metering as well as the business processes of the electric utility.

OPPORTUNITIES AND CHALLENGES

As introduced above, several utilities have discovered that the operation of the smart meters and communication should be performed in coordination with, or as an extension of, the distribution control room. The real-time integration of smart meters with the distribution control room systems (OMS, DMS, CVR), as well as the expectation of availability for real-time operations such as disconnect, requires that the entire network and system be monitored and operated at all times with a reliability independent of time of day. The electric distribution operators will depend upon the access and data of the smart meters to enhance the ability to monitor and manage the electric network and close coordination with smart meter operations increase the performance of both networks.

The utility should avoid the mistake of treating smart meters as billing devices which operate in a batch mode and a focus on billing cycle. By operating the smart meters as real-time devices with continuous availability, billing will experience all of the reliability. Additionally, the operations personnel, as well as those designing the interfaces and processes, must have a complete understanding of the smart meter capabilities and the integration of the data into these real-time systems. Failure to consider all of the uses can lead to problems with data and, ultimately, disabling of critical functionality of the smart meter.

SUMMARY

A utility implementing smart metering is really deploying a real-time operational communication system with smart controllable sensors at every service point on the electrical grid.   When implemented and operated properly, this system will help your utility understand more, than ever before.   Only by implementing and operating the smart meters and communication network with this viewpoint, will the utility be able to realize the full potential of smart meters.

The electric distribution control room is one of the beneficiaries of the data and access that smart meters provide. It should take responsibility for the operation of these smart meters, in cooperation with a nimble IT organization.   Expanding the responsibilities of the distribution control room to include smart meter operations will allow all smart meter clients to recognize reliable electricity data with the same quality as the delivery of reliable electricity.

BIOGRAPHY

John O. Wambaugh is an internationally recognized smart metering expert and has been involved in the planning, deployment, operation and maintenance of smart metering systems for over 20 years. Mr. Wambaugh, Sr. Vice President with Utility Integration Solutions (UISOL), is responsible for advising utilities on the implementation, integration and operation of smart metering and smart grid. Mr. Wambaugh has implemented and operated smart metering systems and meter data management at more than 20 utilities across North America, Australia and Europe.