MANAGING ENTERPRISE INFORMATION FOR SMART METERS AND SMART GRID

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ABSTRACT

Driven to further increase energy and operational efficiencies and encouraged by government policies and incentives, many utilities are exploring, planning, or already beginning to implement "Smart Grid". Smart Grid implementations can potentially add hundreds of thousands, if not millions, of new equipment and devices to the energy delivery system and infrastructure of the utility. Measurements will be collected from Smart Grid sensors and metering devices at hourly or 15-minute intervals, and some in near real-time, resulting in terabytes of data. Utility commands and controls will be available down to the customer-premise level. How would the utility manage all these new assets, all the new data, and the new advanced functionality to achieve the vision and objectives of Smart Grid? This paper relates to the transformational changes of Smart Grid to the utility enterprise and explores how the utility should prepare itself for these changes through Enterprise Information Management.

ENCOURAGING GOVERNMENT POLICIES

In December 2007, President George W. Bush signed the Energy Independence & Security Act (EISA) to encourage the energy utility industry to develop Smart Grid technologies to improve the nation's energy efficiencies and the delivery systems' reliability. EISA amended the Public Utility Regulatory Policies Act (PURPA) to instruct states to consider societal benefits in approving Smart Grid projects as well as benefits in traditional business cases like operational savings, system reliability and security, and system performance, and to allow rate recoveries of these investments. Furthermore, it suggests that states would allow continued recovery of remaining book values of old assets replaced by Smart Grid. The new energy policy and the economy recovery plan of President Obama continues the EISA policy and include federal investments of over 10 billion dollars in Smart Grid.

SMART GRID

What Smart Grid means is still somewhat fuzzy and varied from one utility to another and from one product/service supplier to another. However, it is a common understanding that Smart Grid would have the following general attributes:

- Adaptive, self-healing – Advanced automation for fault detection, fault location, isolation, and service restoration; voltage/reactive-power (Volt/VAR) control, etc.
- Predictive and proactive – Condition based maintenance, system monitoring with automated workflows, automated proactive alerts to utility and customers of emerging system and service issues, etc.
- Optimized capacity utilization and system performance – Automated load balancing, optimized feeder configuration, volt/VAR optimization, conservation by voltage reduction, data collection for system planning and engineering, etc.
- Interactive with consumers and markets – Enabling Demand Response, Demand-Side Management, and other energy efficiency/conservation programs; facilitating interconnection and management of Distributed Energy Resources (DER), including renewable energy, advanced energy storage, and Plug-in Hybrid Electric Vehicles (PHEV), etc.
- Enterprise integration of information – Data collection, analytics, and presentment to support system planning, engineering, operations, energy management, asset management, and value-added customer services.

SMART METER AND DEMAND RESPONSE

Advanced Metering Infrastructure (AMI), or Smart Meter, and Demand Response (DR) as well as advanced system automation are core enabling technologies for Smart Grid. Beyond automated meter reads for billing purposes, Smart Meters serve as information gateways to customer premises. They provide hourly, 15-minute interval, or more frequent meter reads to support dynamic pricing programs, improve revenue management, proactive customer communications to reveal energy efficiency and conservation opportunities as well as consumption and billing alerts. They may also include control functions like remote disconnect/reconnect to streamline customer operations and demand-limiting or prepayment capability to help customers manage their energy consumptions and budgets.

The Demand Response infrastructure allows the utility to communicate with, and at the customers' option monitor and control Programmable and Communicating Devices (PCD) inside their premises, such as smart thermostats and load cycling switches of air conditioning units, water heaters, pool pumps, and in the future energy storage devices. Smart Meters would become the gateway between the utility's energy delivery system and the customer's Home Area Network (HAN).

ENTERPRISE INFORMATION MANAGEMENT

Smart Grid, particularly with a full-deployment of smart meters and expected market penetrations of advanced Distribution Automation (DA) devices, PCD and DER, adds a massive volume of data that will need to be managed effectively. The data includes asset installation location and other attributes, device configuration, equipment performance, inspection and maintenance history and pending work orders as well as measurements and controls of Smart Grid devices. Effective management of the data throughout the utility enterprise is essential to reducing Smart Grid/AMI deployment costs, sustaining benefits, and perhaps more importantly manage business continuity risks from deploying far-reaching and transformational technologies like Smart Meter and Smart Grid.

To prepare for the inrush of Smart Grid data, even at the pilot stage, the utility should develop holistic enterprise architecture and integration plans to cover the following, equally important, four areas of need in order of implementation timing:

1. Deployment of Smart Grid systems and devices, including smart meter and in-premise PCD as well as advanced system automation equipment – to ensure efficient installation, and timely and accurate asset data capture during installation.
2. Management of the collected data on Smart Grid asset, system and device configurations – to ensure quality control of the data and that the systems and applications that need the data are updated timely.
3. Operation and maintenance of the Smart Grid assets, including hardware, firmware, and software – to ensure that the system, equipment and devices will be properly maintained from day one.
4. Management and use of data collected from the Smart Grid systems to improve the utility business, including operation efficiency, capital planning and capacity utilization, T&D system and energy efficiency, and customer service.

The utility will need to assess how their existing information systems and their integration as well as current business processes, can support these areas of need, and devise an implementation roadmap to address gaps. Such assessments would include the following questions, for example:

- Can GIS or existing GIS models support the new Smart Grid devices and their possible configurations? What changes will be needed?
- Where would the Smart Meter and various Smart Grid devices be maintained – GIS, Enterprise Resource Planning (e.g. PM or DM of SAP), the meter asset management module of Meter Data Management (MDM), SCADA/DA, etc.?
- Would the Smart Meter installation and configuration data be managed in CIS, MDM, GIS, or other applications? How about PCD and Demand Response devices?
- Do the existing Work Management System, or Field Force Automation/Mobile Workforce Management applications need to be changed to accommodate the deployment, inspection and maintenance of the Smart Grid devices?
- What enhancements to Energy Management System, Distribution & Outage Management Systems will be needed to leverage the Smart Grid capability and data to improve system operations?
- What measured data needs to be stored, and where – in GIS, MDM, SCADA/DA, others – and what analytics would be needed to provide useful information for T&D asset planning and management, energy portfolio optimization, etc.?

- What enhancements are needed in CIS and customer web portals to analyze the metered data and support Demand Response program and other value-added services?
- Are the utility's current cyber security and information protection policies, guidelines, and processes adequate in light of the expanded distributed command and control capabilities as well as the detailed customer usage information data that are becoming available? Do existing system and prospect technology products, and their implementations and integration, provide adequate security measures in their products?
- What are the impacts on the utility's organization and business model? How can they be better aligned with the Smart Grid technologies and paradigm?

QUANTA TECHNOLOGY

Quanta Technology consultants have helped a good number of utilities address the above and other related issues and develop a strategic and yet pragmatic enterprise architecture and integration plan, managing the demand of the Smart Grid/Smart Meter/Demand Response on IT systems and applications, organization and business processes, and IT and communication infrastructures. Integral to the plan is a risk management strategy as well as a defensible, documented business case with realistic resource, budget and time requirements.

Energy utilities and industry organizations that have benefited from the combination of industry thought leadership and hands-on experience of the Quanta consultants include, for example:

- Baltimore Gas & Electric. Provided consulting services to BG&E to develop the strategy, architecture, business case, implementation plan, and technology evaluation for AMI, Demand Response, HAN, Information Systems, including Customer Energy Portal. Continue to support the BG&E AMI regulatory application and fine tune the AMI and Demand Response business case
- BC Hydro – Develop advanced Distribution Management System plan as part of the Smart Grid strategy, specify technical requirements, and support technology selection.
- Department of Energy (DOE) – Developing architecture framework and technical specifications of a communication network to support the North American Synchro-Phasor Initiative (NASPI).
- Duke Energy – Studying impact and benefits of Demand Response and DER portfolios on system planning and engineering.
- ERCOT – Provided advisory services to ERCOT on real-time state estimation & LMP analysis for system efficiency and congestion management.
- Hawaiian Electric. Developed MDM specifications and vendor evaluation. Supported regulatory filing for AMI, fine tuning business case and facilitated contract negotiation with AMI vendor.

- MidAmerican and PacifiCorp – Provided advisory support, including project management, technical specification/requirement, and software design, to deploy energy efficiency & DSM program management system, with customer portals.
- National Grid – Developed blueprint for "Distribution System of the Future," addressing the needs and requirements of protection, automation & communication infrastructure over the next 20 years.
- Northern Virginia Electric Cooperative – Providing technical support to Northern Virginia Electric Cooperative, including studies of the impacts of PHEV, and help anticipate the effects of equipment, load curves, automation, customer communications, and "Smart Grid" system.
- Oncor Electric Delivery. Provided consulting service to Oncor to develop strategy, roadmap, technology specifications and evaluation for Smart Grid applications that integrate SCADA, DMS & advanced applications, AMI, BPL, DA, etc.
- Pacific Gas and Electric Company – Supporting development of the overall Smart Grid strategy; with a comprehensive set of smart grid applications for General Rate Case addressing technologies that cover from transmission, distribution, to customers.
- PEPCO Holdings. Provided consulting services to PEPCO to develop strategy & architectural plan for Distribution Automation & Smart Grid
- Sempra Energy – Helped Sempra develop the AMI strategy, architecture, information systems, business case, implementation plan, and technology evaluation. Supported the technical specifications and procurement process for implementing AMI as well as Sempra's OpEx 20/20 Utility of the Future strategy. Supported regulatory applications. Continue to provide AMI technology advisory and regulatory support.
- Southern California Edison – Investigated the operational and dynamic impacts of increased wind & renewable capacity and how SCE can integrate and operate these increased resources; evaluate different energy storage technologies to be used with wind energy.
- Southwest Power Pool – Reviewed and evaluated a Special Protection Scheme (SPS) for Southwest Power Pool for the summer season of 2011. The SPS expected operation was reviewed as defined by Entergy transmission planning standards.