Preparing for the Future: How Asset Management Will Evolve in the Age of the Smart Grid

Executive summary

Most utilities struggle to organize information about their distribution network assets. Operations, engineering, accounting, and other business functions all use different tools and systems, forcing grid operators to synchronize separate databases. This paper presents an improved approach to managing grid assets by establishing a ‘single source of the truth,’ eliminating special-purpose databases, utilizing spatial databases, and incorporating a workflow management tool to support database updates.
Summary

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Executive summary

Asset information is critical to the efficient and safe operation of the grid. But utilities have struggled to organize information involving the wide variety of assets that support operations, engineering, accounting and other business processes. With asset management functionality spread across several software applications, grid owners have been forced to maintain multiple databases and synchronize them.

Further, utilities often try to adapt asset management systems initially intended for power stations to management of the grid, which is geographically distributed, where the topology of the network can change frequently, and where a vast amount of asset information is being added each day through meters, home automation devices, sensors and other hardware.

Efficient and effective distribution network asset management can be realized by unifying asset data and seamlessly integrating data systems and applications to create, in effect, ‘a single version of the truth’. Reducing the versions of asset data reduces process complexity, the potential for data errors and the costs associated with database duplications. Incorporating spatial and workflow technologies furthers smart grid benefits by empowering the utility to use its asset data to support a wide variety of operational and engineering requirements and enterprise business processes.
Introduction

As the cost of plant operations escalates, utilities are increasingly focused on managing their assets for efficiency and effectiveness. With many approaches and technologies available for asset management, most grid companies utilize a variety of software applications and business processes for this purpose. Now, as Smart Grid operation becomes a sustainability goal, asset management is entering a new phase; new types of enabling assets are being added to the network and the definition of critical assets is expanding and changing. At the same time, the high cost of asset maintenance and replacement, and the new capabilities for using information to optimize asset use are contributing to the evolution in asset operations and maintenance.

In this paper, we briefly analyze the tools and practices in place today and examine the requirements imposed by the impending Smart Grid asset revolution. We present a concept for improving asset management by streamlining IT operations, integrating systems, and interfacing these operations with the business processes associated with asset management. The business benefits of improved asset management are especially attractive in the Smart Grid era, enabling grid owners and operators to manage and leverage traditional plants and incorporate new, innovative and intelligent devices for optimal performance.
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The State of Asset Management in Utilities Today

Electricity utilities have a variety of software tools available to manage their assets, ranging from Asset/Work Management Systems — often called Enterprise Asset Management, or EAM systems — Geographic Information Systems (GIS), Planning Systems, System Control and Data Acquisition (SCADA) systems, Distribution Management Systems (DMS), and Fixed Asset Accounting Systems — often called Plant Accounting or Continuing Property Records, or CPR, systems. Each of these tools has a particular business application:

• **Asset/Work Management Systems** – These systems, which have been available for more than two decades, enable engineering recordkeeping; the creation and tracking of maintenance schedules; supplier information, in some instances; and related project/work order information that chronicles the history of the asset, from initial construction/assembly through retirement.

• **GIS** – These systems are used primarily to track the location of assets once they are installed and operational. They also can be used to track connectivity of electrical devices, that is, to determine network topology. GIS is often seen as a software application on its own; in fact, it is a technology enabler for asset information and various computations regarding assets.

• **Planning Systems** – Planning software solutions contain a mathematical construct of the network, based on the asset configuration and the demand at each network ‘node’. These planning systems use a model of the assets, which generally is built separately from the asset management/GIS systems at the utility.

• **SCADA** – These systems maintain sufficient asset information to enable dispatchers to operate the network. This information includes operational characteristics, connectivity to other devices, and telemetry information regarding the load on those devices. SCADA systems use real-time information telemetered from the electricity network within a second of actual occurrence in the field.

• **DMS** – The Distribution Management System adds a layer of modeling and computation onto the real-time depiction of the network to realize analysis and optimization. DMS asset models require more-detailed electrical parameters and less physical asset information.

• **Fixed Asset Accounting** – Fixed asset systems manage the property records of the business. These records are used in computing depreciation values; rates, via a regulatory process; and property values in case of loss or replacement. Assets are added to the fixed asset ledgers when initially assembled or constructed and then removed at retirement.
Utilities have struggled with managing these disparate systems, often implemented independently from each other and by different parts of the organization to meet different business needs. For example, engineers generally implement asset management and GIS systems, accountants implement fixed asset systems, and system operations organizations implement SCADA/DMS. The systems are generally acquired from a variety of suppliers, sometimes each from a unique supplier. They might be based on different programming languages, databases and human interface formats.

Because all of these application software systems have been used for several years, the individual systems are mature and often have a large user base. Some have been integrated by utilities to create a stronger asset management framework, but virtually all of these interfaces are 'project-ware' and not integration products that are supported and upgraded by the respective software developers.

Nearly all stakeholders involved will admit that assets are duplicated in these disparate systems, resulting in redundant effort, conflicting values and higher cost. The industry has responded by collaborating to develop ‘standard’ data models, such as the Common Information Model (CIM) of EPRI/IEC, and common integration standards for exchange of asset information, including the IEC 61968 and MultiSpeak® standards. More recently, development of standard integration architectures such as the Microsoft® Smart Energy Reference Architecture (SERA) have added to the tools for integrating asset systems.

But adoption of standard models, messaging frameworks and architectures has been slow, for a number of reasons. The maturity of asset system software packages, including all implementation project-ware, is a barrier. Vendor compliance and alignment with standards has been spotty. Most importantly, asset management systems applied to the distribution side of the business have been as diverse as the business practices used to operate them. In fact, the industry has generally not paid the same amount of attention to distribution asset information as it has to the data involved with transmission and generation assets. However, with the advent of the Smart Grid, that inconsistency must change.
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The Advent of Smart Grid

The underlying business drivers for a smarter grid have forced utilities to recognize the need to manage distribution grids more effectively. Some of the most important factors include:

- **Demand patterns are changing.** Electricity consumers are adding new kinds of appliances and other devices, including electric vehicles, to the grid at growing rates, changing the previously reliable consumption patterns. In addition to devices that directly attach to the grid and consume energy, electric vehicles can also connect through charging stations, creating a different business relationship for the customer with the utility. While electric vehicles are a significant element in the change that is occurring within the distribution system, there is no doubt that consumers of all types are increasingly relying on electricity in their daily routines.

- **Additional telemetry devices are being deployed on the distribution network.** These devices — including meters, smart home devices and others — are generally used for sensing and data telemetry. A large number of new assets associated with the distribution network are being added, including the end-devices and the telecommunications systems that telemeter data to the utility’s IT systems.

- **There is an added requirement to understand the topology of the distribution network.** Utilities that have paid limited attention to the real-time understanding of their distribution networks are finding that, in the era of Smart Grid, it is important to manage that network topology more precisely. This network management is needed to extend the asset life and to provide reliable service downstream.

- **Generation is becoming more distributed.** Distributed, ‘green’ generation is growing throughout the world as a result of environmental concerns about large fossil fuel plants contributing to global warming. While some of these new distributed generators, such as large wind farms, are linked to the transmission grid, they also are connected on the distribution network to provide power to local consumers. This development adds more complexity to the distribution network and operation of those assets in a reliable and sustainable manner.

As a result of these developments, there are additional assets in the distribution network with additional attributes not typically involved before. In this environment, the use of disparate technology systems with large numbers of interfaces and multiple versions of assets that require constant synchronization becomes even less viable. To achieve Smart Grid operation, utilities must move in the other direction — towards ‘a single version of the truth’ for their asset-intensive software applications.
Smart Asset (Information) Management

In parallel with implementing a smarter grid, stakeholders must also implement a smarter approach to managing the assets of that grid. In broad terms, there are four important steps to realizing efficient and effective asset information management in the age of the Smart Grid:

1. **Establishment of a ‘single version of the truth’.** Utilities need to target the future and take the steps necessary to improve data integrity related to distribution assets. With a ‘single version of the truth’ and a strong workflow, data is entered once. Then, this data can be shared across all platforms that need it if they are based on standard models, integration techniques and reference architectures provided by industry vendors who recognize this critical need.

   ‘A single version of the truth’ does not mean that all assets must be modeled in a single physical database. With all of the software applications involved, consolidation at that level is not foreseeable in the near term. Instead, the utility should reduce the number of physical databases and make certain its business processes update data as new information is received in a manner that assures data integrity across the enterprise.

2. **Elimination of the use of special purpose databases for smart grid assets.** Utilities should consider using the same asset management software used for power equipment to manage the additional assets associated with Smart Grid implementation — the smart devices, communications equipment and the equipment needed to manage distributed generation. Reducing the number of systems involved in managing assets of any kind will greatly simplify the IT environment.

3. **Establishment of spatial databases to manage smart grid asset information.** Today’s database technology manages today’s asset information reasonably well, but the needs of the Smart Grid suggest that data maintained in a spatial context will be more useful in managing the topology of the network that is based on manually entered or telemetered data. Further, it is easier to create reports, charts and graphs from spatial information than it is to create maps from traditional asset databases. Connectivity and network topology are far more easily represented and maintained in a spatial database context.

   In addition, spatial databases support more than map creation and performing simple geographic analyses. With software applications added to the basic GIS, the utility can manage the topology of its electric grid based on information sourced from both human input and telemetry. Once the topology is known, the spatial information can be used to compute a topology model of the grid which then allows study of potential outages, contingencies and the identification of other problems such as voltage issues. Finally, mobile GIS, or GIS in the field, enables data capture where the changes are happening and reduces the cost and potential error of updating the database, after the fact, from marked-up paper maps. Data collected in the field is more timely and supports the ‘single version of the truth’ concept.

4. **Establishment of a workflow management tool to support database updates.** Utilities have yet to make extensive use of workflow software in their IT environments. Instead, business processes are more directly and manually programmed into applications software. For many reasons, most utilities have operated in a vertical, or silo,
configuration, where experts in an area manage the business functions in that area. Business processes within those verticals tend to be very strong but lose that strength when crossing boundaries from one vertical area to the other. WorkFlow Management software connects multiple software applications to support robust and successful cross-vertical business processes.

The utility using such workflow tools is assured that a single change in an asset is replicated across other databases that contain the same asset. For example, when a pole is replaced, the update to the spatial database will also update the asset management and fixed asset accounting systems, and, if desired, the planning and SCADA systems as well. Similarly, when a normally-open switch is closed, the network configuration is changed immediately, and software evaluating the state of the distribution network based on the new configuration is initiated.
Conclusion

Smart Grid implementation involves more than adding smart meters, smart line devices and customer-owned assets to utility infrastructure. The Smart Grid also challenges existing asset management norms and is prompting utilities to streamline the management of asset data and the processes involved in updating that data — to adopt ‘a single version of the truth’. Leveraging standard integration tools and architectures, as well as spatial and workflow technologies, will allow the seamless management of network assets that supports a Smart Grid-level of functionality — and the resulting benefits — for utilities.