INTEGRATION IS KEY TO SMART GRID MANAGEMENT

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ABSTRACT

Electric Utilities, in a reactive or proactive answer to the new challenges, are adding more intelligence and complexity in their distribution networks ("Smart Grids"). As the grid becomes more intelligent and more complex, the tools to operate it become increasingly important. To be useful, however, those tools must be fully integrated.

INTRODUCTION

The European Commission recently proposed a comprehensive package of measures to establish a new Energy Policy for Europe to combat climate change and boost the EU's energy security and competitiveness. The package of proposals set a series of ambitious targets on greenhouse gas emissions and renewable energy and aim to create a true internal market for energy and strengthen effective regulation. The Commission believes that when an international agreement is reached on the post-2012 framework this should lead to a 30% cut in emissions from developed countries by 2020. To further underline its commitment the Commission proposes that the European Union commits now to cut greenhouse gas emissions by at least 20% by 2020, in particular through energy measures.

The electric regulatory framework is evolving, advised by the European Commission and the National Energy Regulators, as a boost to face, from an energy, economical and environmental perspective, the new challenges and objectives aiming a sustainable and secure supply.

In this context, each country in Europe is developing and/or has developed new legislation that practically imposes the Electric Utilities an obligation to send accurate information regarding electric infrastructures, service quality and system performance, in order to carry out an efficient planning and tariff revision control.

Electric Utilities, in a reactive or proactive answer to these new challenges, are adding more intelligence and complexity in their distribution networks ("Smart Grids"). As the grid becomes more intelligent and more complex, the tools to operate it become increasingly important. Today the focus centres on uninterrupted internal (decision support) and external (regulatory reports) information flows, advanced computational power, network security and reliable communication. To be useful, however, those tools must be fully integrated.

SMART GRID CONCEPT

Smart Grid is an up and coming business strategy within the electric utility industry. Regulators are driving the discussion around Smart Grid from the need to reduce consumption through energy efficiency and demand response. Utilities need to increase generation capacity to meet rising demand which is opposite of the regulatory direction. Generation plans are becoming a mix of nuclear, oil, gas, green power, demand response, and energy efficiency initiatives (utility and customer). The utilities also need to reduce operational costs while improving management of their existing T&D assets. Customers are being asked to bear the burden of increased rates, accept forced demand response, or take the initiative to voluntarily reduce their demand through the use of new efficient appliances, lighting, or installing smart home controls.

What hides behind the concept of Smart Grids?

There are many definitions available to explain what hides behind the concept of Smart Grids. Find enclosed a definition from DENISE Project[1]

"The Smart Grid integrates electricity and communications in an electric network that supports the new generation of interactive energy and communication services and supplies digital quality electricity for the final customer. In this sense, the electric network must be always available, live, interactive, interconnected and tightly coupled with the communications in a complex energy and information real time network."

Principal characteristics

The principal characteristics of the Smart Grid include the following:

- Self-healing.
- Empowers and incorporates the consumer.
- Tolerates security attacks.
- Provides enhanced power quality.
- Accommodates a wide variety of generation

1 DENISE Project (Distribución Energética Inteligente, Segura y Eficiente) is the main R&D Spanish initiative regarding Smart Grids. This national strategic consortium comprising 16 companies and 9 research organizations is in place to research and develop technologies and information systems applied to the Smart Grid. The project started in 2007 and lasts until 2010, managing a budget of 24 million euros.

options.

- Fully enables electricity markets.
- Optimizes asset utilization and minimizes operations and maintenance expenses.

Key technologies involved in Smart Grid

The key technologies involved in Smart Grid include the following:

- Integrated communications across the grid.
- Advanced control methods.
- Sensing, metering, and measurement.
- Advanced grid components.
- Decision support and human interfaces.

Advanced control methods

Computer-based algorithms that collect data from and monitor all essential grid components, analyze the data to diagnose and provide solutions from both deterministic and probabilistic perspectives, determine and take appropriate actions autonomously, provide information and solutions to human operators and integrate with enterprise-wide processes and technologies. These advanced control methodologies would support such applications as distributed energy resources and demand response dispatch, distribution automation and substation automation (IEC 61850), adaptive relaying, energy management, market pricing, grid modelling, operator displays and advanced visualization systems, to name a few. In addition, they would be integrated into asset management processes and technologies to further optimize grid operations and planning.

Sensing, metering, and measurement

New digital technologies using two-way communications, a variety of inputs (pricing signals, time-of-day tariff, transmission curtailments for congestion relief), a variety of outputs (real time consumption data, power quality, electric parameters), the ability to connect and disconnect, and interfaces with generators, grid operators, and customer portals to enhance power measurement, provide outage detection and response, evaluate the health of equipment and the integrity of the grid, eliminate meter estimations, provide energy theft protection, enable consumer choice, and enable demand-side management for congestion relief by the transmission company. In addition, new smart sensors would be applied to various grid monitoring functions, such as intelligent street lighting.

Advanced grid components

These are the next generation of power system devices taking advantage of new materials technologies, nanotechnologies, advanced digital designs, etc., to produce higher power densities, better reliability, and improved real-time diagnostics to greatly improve grid performance. Such technologies include superconducting transmission cable, fault current limiters, composite conductors, flexible AC transmission systems - FACTS (SSSC, TCSC, TSSC, TCSR, TSSR, STATCOM, SVC, TCVL, TVR, UPFC, TCPST), custom power devices (D-STATCOM, DVR, SSTS), advanced energy storage (SMES, BESS), HVDC devices, distributed generation (wind, solar, micro turbines), advanced transformers and circuit breakers, and smart loads.

Decision support and human Interfaces

With the time horizon for operator decisions having moved to seconds, the Smart Grid requires the wide, seamless, real-time use of applications and tools, fully integrated, that transform the grid operator and manager into knowledge workers. This includes the role of artificial intelligence to support the human interface, operator decision support (alerting tools, what-if tools, course-of-action tools, etc.), semi-autonomous agent software, visualization tools and systems, performance dashboards, advanced control room design, and real-time dynamic simulator training.

Benefits in implementing the Smart Grid

- Reduction in congestion cost.
- Reduced blackout probability, and forced outages/interruptions.
- Reduction in restoration time, operations and maintenance due to predictive analytics and self healing attribute of the grid.
- Reduction in peak demand.
- Increased integration of distributed generation resources and higher capacity utilization.
- Increased security and tolerance to attacks.
- Power quality, reliability, and system availability and capacity
  improvement due to improved power flow.
- Increased capital investment efficiency due to tighter design limits and optimized use of grid assets.
- New options for consumers to manage their electricity use and costs.
- Environmental benefits gained by increased asset utilization.

INTEGRATION IS KEY

Currently most utility companies have limited installed capability for integration across the applications associated with system planning, power delivery and customer operations. In most cases, this information in each department is not accessible by applications and users in other departments. Individually these systems provide competitive advantage for each department to manage its autonomous business activities working as “islands”. But the Smart Grid strategy calls for enterprise-level integration of these islands of information to really improve information flow throughout the organization.

As the smart grid is deployed, the largest potential economic variable is in data maintenance. The Gartner

Group reports, “A typical enterprise will devote 35-40% of its programming budget to develop and maintain, extract and update programs whose purpose is solely to transfer information between different databases and legacy systems.” The importance of platform integration and open architecture comes into play here as there are large financial benefits to efficiently leveraging available enterprise information with real-time smart grid operational data through data sharing between legacy systems.

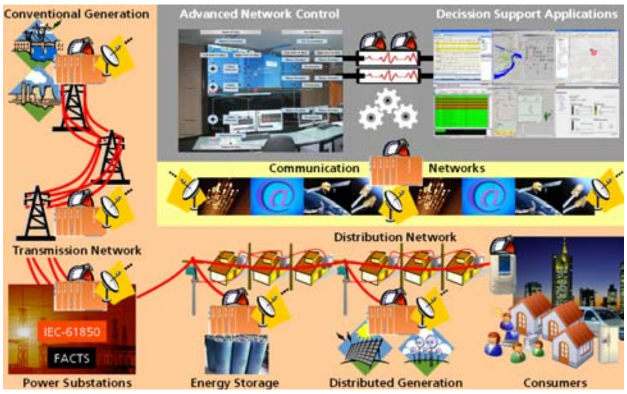

Figure 1: Smart Grid Conceptual Diagram

The technical integration activities will include integration of data and messages associated with real-time events, alarms and other notifications that require immediate attention, and integration of data associated with assets and networks, their configuration, condition, and other operational and business data that can be accessed across the enterprise on a bulk or transactional basis. Thus, on a conceptual basis, the enterprise level information integration for Smart Grid applications can be sub-divided into two general classes:

1. Real-time notifications, control and process integration.
2. Bulk and transaction based data exchange amongst different applications.

Industry standards such as IEC61850, IEC61968 and IEC61970, web services and other technologies and tools for system integration under service oriented architectures (SOA), will also play an important role in integration.

Implementation of Smart Grid will require integration of processes and information across multiple systems and applications within utility system operations, planning, engineering and customer services, in order to really leverage the implementation of the Smart Grid.

TELVENT’S RESPONSE

Telvent is addressing the market needs through the creation of the Smart Grid Solutions Suite (SGS). The Smart Grid Solution Suite helps utilities transform their grid into one that distributes electricity more efficiently, economically, reliably, and securely.

Telvent’s SGS suite focuses on business and technical development that creates additional value for customers based on Telvent’s highly integrated secure infrastructure and advanced applications. It delivers energy efficiency in the grid, improved customer service, reduced duration of outages, and demand response functionality never before possible.

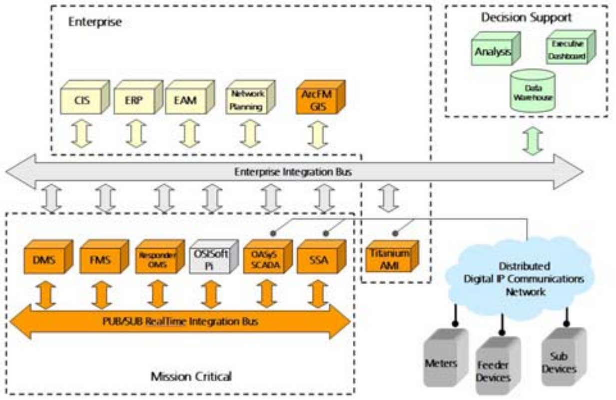

Figure 2: Telvent’s Smart Grid Solutions Architecture

The SGS suite consists of three major parts, each leveraging and building on Telvent’s existing technologies in supervisory control and data acquisition (SCADA), distribution management (DMS), enterprise geographic information systems (GIS), outage management (OMS), advanced metering infrastructure (AMI), remote terminal units (RTU) and communications:

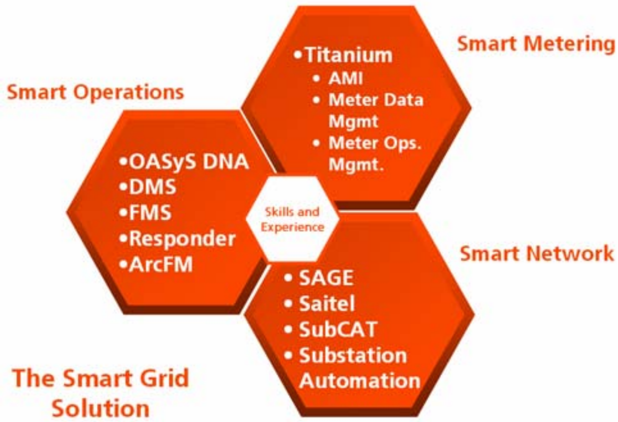

Figure 3: Smart Grid Solution

- **Smart Metering Solution:** Titanium AMI software coupled with industry-leading meters.
- **Smart Operations Solution:** ArcFM™ GIS, Distribution Management (DMS), Feeder Management (FMS), Responder OMS, and OASyS SCADA.
- **Smart Network Solution:** substation automation platforms, feeder and pole mounted RTUs, and IEDs.

All three of these areas will utilize intelligent hardware and software devices creating an order of magnitude increase in the volume of data made available to the utility. The challenge is to provide the applications and the intelligent analysis tools to make use of this data, turn it into information, and make it available to the business areas of the utility to improve their daily operations.

The integration allows our customers to respond to new distributed and renewable generation capacity coming on-line and to use volt/var control to add "virtual generation" to their network. Additionally, the SGS Suite enables them to implement effective demand response strategies at the consumer level, and thus, respond to all requirements of a modern distribution utility and maximize business value.

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