GE Energy
Digital Energy

Utility Telecom Infrastructure Management

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imagination at work

Introduction

All electrical utility companies have a communications network. It's used for SCADA and to communicate internally, and can also be used to lease to third parties and to provide communications services to end customers. In all cases, this communications network needs managing, in the same way the electrical network needs managing – knowing where the network assets are, how they are connected and how they are performing to deliver services to their end customers.

However, the electric industry is going through a revolution. With world electricity consumption predicted to increase by 87% between 2007 and 2035, and the renewable share of world electricity generation set to increase to 23% by 2035[1], the electric networks of today need to change to accommodate this growth. A more advanced, or "smarter" electrical grid solves many of the challenges facing electricity suppliers – this smarter grid is a combination of the electric network with a communications network that can provide intelligent control, operational efficiency and flexibility, and increased network reliability.

This white paper discusses the challenges facing the electric industry, both managing the existing network and moving towards a more advanced electrical grid infrastructure. It also highlights the central role an advanced asset management solution will play in managing the communications network. Based on this solution, the electric utility will be able to deliver more network reliability, faster response times to outages, reduced costs and increased efficiency.

The Smart Grid Challenge

A smarter grid will deliver electricity from suppliers to consumers using advanced digital technology that will increase reliability, security and transparency while saving energy and reducing costs. To achieve this, the power grid is integrated with a communications network to create an electricity network capable of continuously monitoring its own health and status, generating and transmitting alerts, automatically taking corrective action, and enabling demand side energy management. One U.S. Department of Energy study calculated that modernizing U.S. electrical grids with more advanced grid technologies would save between $46 and $117 Billion over the next 20 years[2].

Implementing integrated communications is essential to a more advanced grid but introduces an exponential number of new network devices and technologies to the electric utility. A more advanced grid cannot exist without an effective integrated communications infrastructure that enables various intelligent electronic devices (IEDs), smart meters, control centers, power electronic controllers, protection systems and user applications to communicate as one seamless network. Indeed there are estimates that investments in more advanced grid communications technologies could be as high as $100 Billion over the next five years[3]. This will require significant planning and management of the resulting communication assets.

Following are some of the challenges facing electric utilities as they move towards deploying an advanced network infrastructure:

- **Increasing energy demand.** Increasing energy demand (expected to triple globally by 2050[4]) will drive the development of an advanced network infrastructure that will require efficient network planning, design and asset management.
- **Network investment is huge.** Detailed planning of both the electrical distribution network and the related communications network is critical to control capital expenditures and reduce on-going operational costs.
- **Bandwidth capacity is a critical resource.** The amount of data required to ensure optimal performance and resiliency of the network will rise exponentially. Planning a reliable, secure communications infrastructure with the capacity needed to carry this data traffic is critical.
- **Communications experts are scarce.** Most electric utilities have limited communications expertise. With the communications network central to the future network, decision support tools to help plan, build and operate the communications network will be vital.
- **Communications network reliability is vital.** For effective network operations, the communications network needs to have the highest possible degree of reliability to support the mission critical data and applications that control the grid.

Communications networks designed for an advanced grid will be based on three options:

- Wireless connections (e.g. WiMax) to the meter with radio frequency "tower systems" as hubs and mesh networks consisting of pole-mounted routers providing the access network
- Communications over medium and low voltage distribution power lines for the access network (e.g. broadband over power line (BPL) or power line carrier) with pole-mounted couplers connecting downstream meters in the electric network to the upstream backhaul fiber network and ultimately tying into the utility's substations and control centers
- Traditional fiber based networks, with some operators already deploying Fiber-To-The-Home (FTTH) solutions

In all cases, the communications network will have the same challenges as any other telecommunications network, including deployment, network management, bandwidth management, Quality of Service (QoS) and security. Indeed, there are grounds for arguing that the telecommunications industry has been through the BSS/OSS adaptation process already and, even at this early stage of network evolution, can teach the energy industry a lot.

When integrated communications are fully deployed, they will optimize system reliability and asset utilization, enable energy markets, increase the resistance of the grid to attack and generally improve the value proposition for electricity[5]. The communications systems utilized in the power industry today are not designed to support these integrated requirements, and as such are not equipped to enable a more modernized power grid. Integrated communications will allow real-time control and data exchange to optimize system reliability, asset utilization, and security.

Integrating more advanced grid technologies brings with it exponential growth in the amount of data that must be gathered, verified, stored and transformed in near real time for intelligent responses and decisions support. For instance, merely moving from monthly kilowatt-hour reads to hourly interval meter reads increases data-handling requirements more than 730 times[6]. The accurate, cost-effective design of the communications infrastructure needed to carry this volume of data is critical to deployment success.

Utilities need to make a decision on what communications technologies are needed to acquire and carry this data. For instance, with WiMax technology there is a need to plan these networks in terms of how to provide optimal and cost-effective broadband access to the thousands of meters in a service area. This requires the network (e.g., towers, transmitters, repeaters and backhaul fiber) to be positioned correctly based on coverage area and signal strength calculations to support the data and reliability requirements. Utilities will also be required to manage bandwidth and latency across their smarter grid communications infrastructure, especially for value-added consumer services.

Asset Management Solution

Whether managing an existing network supporting SCADA or a new network to support advanced grid technology deployments, the utility must have a solution for managing their communications infrastructure, just as they do for their electrical infrastructure. Utilities must prepare for this network transformation by having a centralized asset infrastructure system in place that incorporates technology rules and business process best practice. Without this foundation, far too much effort will be spent on manual record keeping and playing catch up after the fact. The system needs to be built upon communications industry standards and well-established workflows.

GE's geospatial network infrastructure management solutions are foundational elements to help simplify the challenges of designing and maintaining the complex assets and configurations of the electric and communication networks throughout their entire life cycle. In particular, GE's Utility Telecoms Infrastructure Management (UTIM) solution is fundamental to managing the communications network within a utility, enabling cost-effective plan, design, build, operation and maintenance of the network. UTIM checks available network capacity, generates network plans to meet demand and produces detailed engineering designs for network build. It also provides a single consolidated cross-network end-to-end view (both inside and outside plant) of the communications network with detailed physical connectivity.

The UTIM portfolio of applications includes:

- Smallworld™ Physical Network Inventory (PNI) - Network planners can model the entire physical network (wired and wireless), both inside and outside plant. The accurate database of record supports the full asset management lifecycle, including network planning, design and build.

- Smallworld Logical Network Inventory (LNI) - Circuit designers can document and design the logical network (network elements and bearer circuits) that run across the physical network to provide communications capabilities. For more advanced grid communications, there is likely to be a fairly standard logical layer. IP/MPLS will be fairly common across the backhaul and distribution access, whether the underlying physical infrastructure layer is fiber, microwave, copper, wireless mesh, or BPL/PLC. LNI will provide:
  - one end-to-end asset/inventory database for all the logical layers
  - capacity/traffic design and planning
  - topology management: SONET, DWDM, GigE, VLAN, VPN, WAN, HAN, etc.

- Smallworld Network Inventory Gateway - Data can be made available across the enterprise, with internet and intranet access to the data in the Smallworld Network Inventory database.

Additionally, the Smallworld portfolio supports integration to other business critical systems within the utility environment. For instance, the Smallworld Business Integrator for use with SAP® ERP facilitates the synchronization and consistency of data passing between both systems and provides functionality for business processes navigating between applications in these systems. More generally, the Smallworld GeoSpatial Server solution is a Service Oriented Architecture (SOA) platform for system integration and business process integration, supporting common business services for utility and communications applications.

Benefits of UTIM

Nearly every component of a more advanced electrical infrastructure, such as Advanced Metering Infrastructure, Home Area Networks, Distribution Automation and Load Balancing and Demand Management relies on a next generation communications network. Therefore, establishing these communications must be the highest priority since it is the first step to building the advanced network infrastructure of the future. Many utilities are using this as a driver to completely revamp their communications infrastructure, upgrading to an all IP-based network that caters for voice, data and control and provides high level communications and data security required for monitoring and control.

This revamp will require significant planning and managing of communication assets. GE's UTIM solution addresses the planning, designing/engineering, inventory, assignment and capacity management of the new communications network. Effective deployment and management of this communications infrastructure is critical to control capital expenditures, lower operating expenses, minimize network downtime, ensure optimal network performance and deliver sufficient bandwidth and capacity to carry the increased traffic on the grid.

The following table summarizes the key benefits GE's UTIM solution offers to meet the new business challenges facing the electric utility:

THE BUSINESS CHALLENGE	THE UTIM SOLUTION
Address the wide spread introduction of distributed generation and intermittent power flow from renewable energy sources.	Provide intuitive and proven design and engineering tools to develop a communications network infrastructure to manage the variable supply of distributed, renewable energy.
Ensure service reliability as energy demand increases.	Design the communications infrastructure to ensure it delivers the data needed to manage the electric network to meet increased demand.
Reduce costly outages and move from inefficient scheduled maintenance to proactive grid asset support.	Provide up-to-date knowledge of network assets with a comprehensive network inventory to support pro-active network maintenance.
Reduce delivery losses in distribution systems. Present grids operate with reliability engineered through over-capacity, wasting energy.	Manage an integrated communications network that supports device-monitoring solutions and delivers real-time information about grid conditions and performance, enabling greater utilization of available network capacity.
Reduce the cost of planning and building a common, converged communications infrastructure network.	Enable the fast and efficient development of an advanced communications network infrastructure.

Customer Examples

GE's UTIM solution is built upon a comprehensive and successful track record in utility and telecommunications networks, with hundreds of customers, thousands of end users and millions of network connections. In particular, many utilities around the world use GE's Smallworld telecommunications solutions to manage their communications infrastructure. For example:

- A major North American electric utility is using Smallworld as its long-term solution for capturing its network assets, using PNI, LNI, and GE's electric products in its network environment.
- A large energy supplier in Australasia has rolled out a utility specific next generation telecommunications platform, including Smallworld solutions. According to the supplier's managing director, "to build a smarter electricity network, we first needed to create a single, reliable telecommunication backbone."
- A national electricity provider in the Asia Pacific region uses Smallworld Physical Network Inventory to manage its internal communications network. This is integrated with Smallworld Electric Office which manages its electricity network.
- A major utility in North America successfully uses Smallworld solutions to manage both its electric transmission and communications networks. Smallworld Physical Network Inventory has been fundamental to managing its fiber-optic network and reducing the time needed to perform a number of key business processes.

And finally, GE itself has recognized the value of its own solutions. GE's Lentronics™ business (part of its Digital Energy business) has chosen Smallworld Logical Network Inventory and Smallworld Physical Network Inventory as the path forward for its VistaNET™ (NMS) customers to address the strong demand for circuit design and traffic/capacity management.

Summary

GE's UTIM solution for managing the communications networks that electric utilities will need to meet the business challenges of the next generation power network will provide several competitive advantages:

- Deep and broad domain expertise - GE has more than 10 years of experience providing telecommunications solutions to more than 120 customers worldwide. Combined with extensive knowledge of the electric transmission and distribution industry, GE can offer unparalleled expertise to customers.
- Proven telecoms network engineering capability - GE has become an industry leader for designing and engineering the telecommunications networks of telecommunications service providers throughout the world. Smarter grid communications networks face the same challenges as major telecommunications networks and require a mature, proven solution to meet this demand.
- Comprehensive technology coverage - Advanced grid communications will be based on a standard logical layer - IP/MPLS will be common across the backhaul and distribution access. GE's UTIM solution will be able to manage all logical technologies (SONET/SDH, DWDM, GigE, VLAN, VPN, etc.) needed for grid communications. GE's solution will also support the entire physical infrastructure (fiber, microwave, copper, wireless mesh, BPL/PLC, etc.) of the smarter grid communications network.
- Best-in-class solutions - GE provides best-in-class solutions to help customers reduce network capital and operational expenditures by:
  - Improving network utilization through greater knowledge of how the existing network assets are currently used.
  - Reducing network capital expenditures through cost-effective network upgrades, reducing new build costs by up to 20%.
  - Reducing operational expenditures through efficient planning and engineering and increased workforce productivity, reducing planning time by up to 30%.
  - Accelerating response to network outages through accurate knowledge of network location, reducing network downtime by 25%.

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