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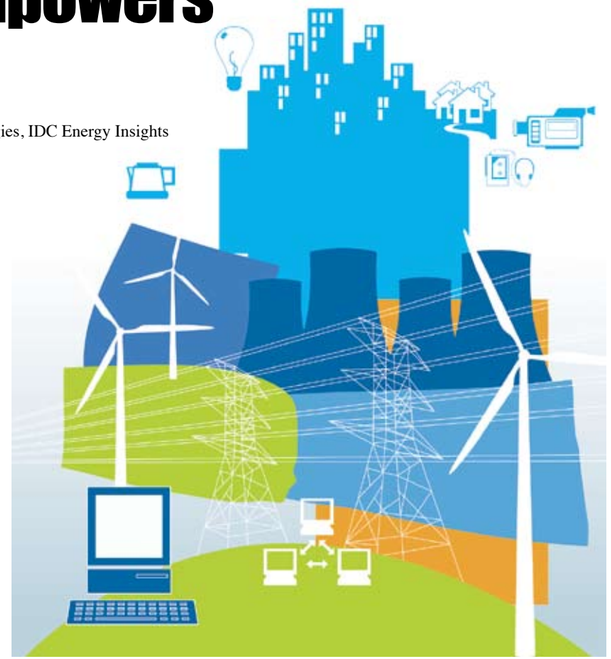
Smart Grids transform the future of utility infrastructure. >>

ICT Innovation Empowers the Smart Grid



By Marcus Torchia, Research Manager, Worldwide Smart Grid Strategies, IDC Energy Insights

Informed customers have a growing interest in energy conservation and alternative resources. At the same time, the power utility industry must reduce costs, streamline operations, and meet stringent regulations. Strengthening the Information and Communications Technology (ICT) infrastructures within the electric power grid are strengthening the utilities to improve upon their most rigorous operational and environmental goals with wide-reaching benefits.

Big Data and analytics, cloud computing, mobility, and the Internet of Things (IoT) are leading ICT into a new era. These technologies allow for Smart Grid investments in strategic programs that span reliability, security, energy efficiency, and retail services.

Huawei brings ICT platforms that deliver carrier-scale performance to the power utility industry in the areas of communication networking, security, storage flexibility, and physical durability.

Industry Drivers for Power Utilities

Globally, power utilities operate under diverse market conditions with varying levels of government regulation, economic growth, and infrastructure maturation targets. The following summary provides a shared view of the factors influencing utility technology investment:

• **Increasing asset utilization:** Generation capacity, for example, increases utilization rates by running plants longer and harder, increasing operating levels from 70 to 75 percent in the Asia region and developing countries and peaking at an 80-percent maximum output in North American, European, and other industrialized markets.

• **Optimizing grid operations:** Expanding automation to the grid's edge with smart devices and networks makes optimization possible via analytics using real-time and near-real-time grid data.

• **Improving reliability:** Investments in grid infrastructure assure more stable generation and faster recovery of distribution equipment.

• **Managing demand:** Networked smart meters and intelligent in-home controls now provide utilities with more options to shape usage patterns at home.

• **Energy savings and reduced greenhouse emissions:** State and national Green House Gas (GHG) emission regulations continue enhancing energy conservation.

Third Platform Drives Innovative Trends

IDC predicted the IT industry's shift to a "3rd Platform" for the next stage in innovation and growth. This new platform is founded on four technology pillars: Big Data & analytics, the cloud, mobility, and social.

• **Analytics:** Transmission operators already use powerful analytics to manage for regulatory compliance to state estimators. Additionally, utilities are looking to analytics for a return on Smart Grid investments and to refine business objectives such as outage mitigation and restoration, theft and fraud detection, and predictive maintenance. In Europe and Australia, retail energy providers have turned to Big Data analytics for demand forecasts and customer segmentation for new service offerings.

• **Cloud formation:** *The 2013 IDC Vertical Communications and IT Survey* found that 23.7 percent of utility respondents use the private cloud and 18 percent use the public cloud. The utility industry is prepared to use cloud computing for Software-as-a-Service (SaaS) applications and, within the next 18 to 36 months, will start implementing the cloud for data storage.

• **Going mobile:** Mobile device usage continues to expand with advances in mobile technology, such as mobile broadband networks, high-resolution screens, and mobile work force management software. Many of today's workers use their smart devices for mobile office functions such as GPS tracking, data collection, recording inspections, and work-order completions.

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• **Smart Grid investments:** The IoT has long been expanding in the utility industry to automate generation and transmission networks. Maintaining decades-old infrastructure is not uncommon for mature power utilities, but the practice presents an increasingly challenging environment to assure reliability, security, and performance. According to an IDC Energy Insights report on the *Worldwide Utility Smart Grid Spending Forecast 2012-2017*, total expenditures on ICT will exceed USD 42 billion annually by 2017.

Network Converges Information and Operational Technologies

A clear path in Smart Grid development follows the efforts to automate greater portions of the power grid from generation to the consumer. The Smart Grid challenges that utilities face include installing and upgrading communication networks, managing heterogeneous devices, ensuring system reliability and security, and maintaining the network infrastructure.

The centralized command and control architectures of power grid design are yielding to distributed intelligence of smart devices including line sensors, smart meters, synchrophasors, transformers, fault interrupters, power control modules, routers, EV automobile charging stations, renewable generation units, and Remote Terminal Units (RTUs).

[Features]

Power equipment and sensing devices with advanced networking connectivity and computing capabilities are transforming the centralized command and control of distributed grid architectures.

A Converged Network Interconnects Transmission

Transmission grids require a high degree of coordination with transmission system operators and interconnections to generation sources for maintaining a balanced, synchronized, and stable grid. Today, Wide Area Network (WAN) performance is more demanding than ever. Two interrelated factors drive this dynamic. First, utility-scale renewable generation, such as wind farms and massive solar arrays, are increasingly being tied to the transmission grid. Often, renewable generation occurs at remote locations; for example, offshore or mountainous terrain for wind, and the desert for solar. The intermittent nature of renewable generation causes voltage drops or spikes as wind speed and cloud cover affect generation rates, often within minutes. Second, Wide Area Situation Awareness (WASA) provides visibility to adjacent transmission grids that may cause cascading outages at neighboring utility sites. WASA gives a utility or transmission operator the ability to identify a small problem in asynchronous phasing before it causes a system-wide collapse.

The requirements for renewable generation and WASA demand sub-second response times that only a wide area, low-latency communication network can provide. Additionally, communication network solutions require implementing a utility's migration path over a multi-year period between the generation plants, substations, and interconnections among utility entities.

The Huawei Transmission and Transformation Communication Solution combines proven Time-Division Multiplexing (TDM) network technology with all-IP networking in a single solution. This approach eases upfront capital costs and disruption risks for the generational transition to IP networking. Moreover, Huawei offers its microwave series products for point-to-point and point-to-multipoint transport and backhaul applications.

Distribution Sensing and Control on the Rise

Power equipment and sensing devices with advanced networking connectivity and computing capabilities are transforming the centralized command and control of distributed grid architectures. Today's distribution communication networks operate well for simple and fast response Supervisory Control and Data Acquisition (SCADA) requirements between substations and control centers. Smart Grids require connectivity and advanced analytics beyond the standards of legacy distribution substations.

Utilities are investing in three major technical development efforts.

First, switchgear distribution automation is being deployed to maintain continuous service around faulty transmission sections due to old equipment and/or weather-related storm damage. Switchgear automation is found in 15 percent or fewer distribution utility substations and feeders in Europe and North America, and even less in the Asia-Pacific, Middle East, and Latin America regions, according to recent research conducted by IDC Energy Insights.

Second, the need for cost-efficient power delivery and energy conservation leads to investments in circuit optimization. By correcting sub-optimal performance in circuits, utilities can reduce generation levels and extend equipment life using analytics such as Volt/VAR optimization.

Third, coordinating grid operations with demand-side management such as Demand Response and customer resources requires rapid adjustments to grid equipment based on advanced and cognitive real-time analytics. Success will require that utilities are able to plug any number of disparate devices into a unified field network throughout the distribution grid.

Smart Grids of the future will hinge on smarter equipment and IoT sensors interconnected to the next generation of communications network infrastructure and propagated by data-derived services.

Utilities are often faced with difficult choices for enabling networked distribution devices. Today's passive consumer will eventually become a more active participant in energy management. While mass adoption is still years away, consumers may become "prosumers" and act as energy suppliers tying their renewable generation capacity back to the distribution grid. This major trend effectively could force changes to the central control architecture by forcing the adoption of a more distributed intelligence in the electric grid system.

The Huawei Distribution Automation Solution is purpose-built to meet the burgeoning needs of Distribution Automation applications such as Volt/VAR optimization and virtual power plants. The sub-second latency requirements are satisfied through a hybrid xPON and LTE network that combines the speed of fiber with the flexibility and low deployment costs of wireless. This approach provides 99.999 percent reliability for sub-100 ms latency in network and SCADA operations. Implemented on IPv6 protocol, QoS capabilities can prioritize and route traffic based on application latency, equipment fault thresholds, or other data traffic segmentation needs. Using rugged equipment and reliable support for utility-specific protocols such as GOOSE, substations can easily be outfitted.

Cloud Data Centers Secure Operations

Responsible for enterprise infrastructure in the back office, IT is the valued critical partner leading security and data management in business operations

[Features]

systems. Several long-arching trends are bolstering the collaborative efforts that need IT to play a prominent role in the Smart Grid. First, smart device proliferation is creating an expansion of IP-addressable devices attached to mission-critical networks. The new cast of devices increases the vulnerability for attacks beyond the closed-network SCADA devices and engineering domain of operations. Second, cyber security is a new frontier for malicious aggression, and utility control systems are the battlefield. IDC Energy Insights revealed in its 2012 survey that 65 percent of IT departments in the U.S. hold some or the entire security budget. Third, data is growing exponentially as a result of smart meters, distribution line sensors, smart transformers, and dozens of other device types. Larger data volumes require flexible storage and data mining analytics with scalability not foreseen for existing IT structures.

Data center strategies are under consideration, and not just for disaster recovery or redundancy. On-premise data centers can be labor intensive. With the Big Data progression, data center management services create a quick way to reduce costs by outsourcing.

Huawei combines the strengths of traditional data centers and cloud computing technologies to support this vision. Huawei cloud data centers provide a range of flexible services, such as Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). In addition, they can deliver end-to-end security solutions, as well as unified Operation & Maintenance (O&M) management platforms. Huawei also offers modular data centers, which let customers choose the equipment, features, and services they want pre-installed in the data centers. The results are a quicker capacity expansion and superb customer experiences.

Overcoming Challenges for Smarter Grids

Utility IT and business unit decision-makers encounter a number of challenges in developing a Smart Grid ICT infrastructure. The following business challenges and considerations can be interrelated and share dependencies:

• Usefulness of existing assets: Evaluation of legacy communication network infrastructure impacts decisions on whether to leverage or replace with a new capital investment, such as SONET/SDH or frame relays.

• Buy versus build: Utilities prefer ownership of their ICT infrastructure. In the case of communication networks, utilities prefer ownership 5-to-1 over commercial carrier services.

• Utilities often face obstacles in assigning the investment costs of a communication network that has multiple projects, applications, and business processes that it will support.

• Governance: Communication networks for the Smart Grid require discussions and planning between Operational Technology (OT) business units (e.g. transmission, distribution, and customer operations) and/or IT network groups.

Essential Guidance for Utilities

First, ensure a governance structure exists that allows IT and the lines of business to work closely together to identify major business objectives and connect all levels of the organization at the earliest stages.

Second, collect the most relevant information about best practices at peer utilities, especially in developing a communication network strategy.

Third, identify the sources of available data and establish a realistic road map for applying analytics.

Smart Grids of the future will hinge on smarter equipment and IoT sensors interconnected to the next generation of communications network infrastructure and propagated by data-derived services. ▲

Case Study

Zhuhai Electric Power

Zhuhai Electric Power, officially China Southern Power Grid, is a state-owned energy utility that provides power generation, transmission, and distribution services to China's five southern provinces. The service area covers one million square kilometers and serves 230 million residents.

Zhuhai Electric's property portfolio includes generation plants and a high-voltage transmission network. These assets are interconnected through its carrier-grade communication network infrastructure, which has achieved high automation levels in generation and transmission.

● Challenges

Zhuhai Electric had been using optical fiber rings over medium- and low-signal carriers. As the utility undertook the expansion of its automated substations and began planning Distribution Automation (DA) feeders and low voltage line transformers, several limitations were identified, as highlighted below:

• System downtime of the fiber optic network is typically difficult to identify and repair.

• Repair costs are expensive for optical circuits that get severed or for equipment failures.

• The utility-owned fiber optic network infrastructure is costly to operate and maintain.

• The fiber optic network is a fixed line that is not well suited for swift device deployment, evolving network requirements, or rapid recoverability.

● Solutions & Benefits

In 2011, Zhuhai Electric began making technology selections for a wireless broadband solution. Analysis led the utility to decide on a pilot TD-LTE project based on several factors, including technical performance, technology adoption, industry standards, and vendor reputation. Huawei was selected for network hardware and management software. The Phase 1 project included one Core Network (CN), 10 Base Transceiver Stations (BTSs), and 65 Customer Premises Equipment (CPE) devices. Huawei's responsibilities included network design, system integration, network construction, and training services. The utility identified several benefits:

• Maintenance workload has been sharply reduced as power on the line can be verified remotely.

• Advanced management tools realized significant savings in the final time and expense costs for equipment installation and launch operations.

• Each terminal is IP-addressable, with real-time status available 24/7.

• Future wireless applications will expand to mobile offices and mobile operations for field workers.