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Smart Metering: By Engineer Salah Shyaa Merzah

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Traditionally, commercial and residential energy consumption data has served the sole purpose of allowing the utility company to bill customers. The data was collected manually from meters, with technicians visiting each site monthly, or in some cases, annually. The process was labor intensive, which made it more expensive for the utility and the consumer. Manual data collection also led to errors with meters sometimes being overlooked altogether. However, advancements in automatic meter reading (AMR) technology gave companies the ability to automate the collection of consumption data. This new method of data collection and analysis resulted in lower operational costs and fewer errors. But as the energy market evolved and the value of frequent and accurate consumption data grew, monthly readings just weren't enough.

What Makes This Meter so "Smart"

Conventional AMR systems give utilities the ability to collect monthly billing data from electricity, gas and water meters remotely and automatically via several different communications media including wireless, power line carrier, telephone, etc. Advanced Metering Infrastructure (AMI) technology and smart meters provide utilities with timely and granular data from all meter customers remotely and then apply that data to improve reliability and efficiency, expand customer choices, and create new rates and programs. These technologies offer water and energy utilities similar functionality with interval data collection to build customer load profiles to define who is using how much and when. A smart metering system should also have integrated demand response and load control capability enabled by an open-architecture communication standard in all meters. This gives the meter the ability to connect with smart thermostats, smart appliances, in-home displays, and load control switches for conservation, data presentation and energy management purposes.

What is smart grid?

Smart grid is an infrastructure that allows suppliers and consumers to acquire in real time the energy information they needed, and uses this information to enable the supply,storage,consumption and transaction of energy in the right amount at the right time.

Smart grid components

- **Power network**
  A hardware infrastructure that enables energy sharing between suppliers and users.
- **Communication network**
  A network that enables the sharing of information about energy supply and demand.
- **Financial network**

A network that enables precise transaction by quantifying energy value into price.

Why is smart grid necessary

- Maximaizing energy efficiency
- Motivating voluntary energy conservation
- Building the foundation for the diffusion of new and renewable energy
- Improving the quality and reliability of electric power

Smart Meters, M2M and Cellular Technology

Providing customers with all the benefits of an AMI deployment will require more than intelligent meters and smart sensors alone can offer. System devices will need the ability to communicate machine-to-machine or M2M. M2M technology supports wired or wireless communication between devices. Almost any network can accommodate M2M applications but, while fixed-line networks were once the only viable solution for monitoring fixed assets, wireless networks are now being utilized, too. Wireless technologies like CDMA have become increasingly more robust and cost effective, and are now becoming the technology of choice for utility companies for AMI deployment.

According to one market report, "Growth in the wireless M2M market is accelerating. Shipments of wireless M2M devices in North America reached an estimated record level of 22.6 million units in 2011. The report went on to note that two vertical market segments during this period stand out as those with the most potential for wireless M2M

Wireless versus Fixed-line Networks

Real-time, 2-way data collection capabilities are inherent to the success of any AMI grid deployment and there are differing views on which communications solution is best. Some within the industry argue that while an integrated wireless system (two or more discrete wireless platforms combined) can be cheaply and easily installed, broadband over powerline (BPL) is a better way to solve Smart Grid communications problems. However, BPL has its own myriad problems, not the least of which is system unavailability during blackouts and disasters. That fatal flaw alone is enough to warrant using wireless systems, instead of BPL, to build the communications backbone of a Smart Grid. But, there are other benefits to going wireless. Line crews, equipped with wireless capability repair trucks, would be able to communicate directly with substations and meters, eliminating the need to communicate with a central office. Utilizing cellular networks, a utility will be able to fix problems faster at a reduced cost, while providing improved customer service and satisfaction. Superior, reliable service, through M2M applications, makes cellular the premier enabling technology for the AMI powered Smart Grid of tomorrow.

The Smart Utility Will be a Connected Utility, Next Generation Power and Energy

Mark Cratsenburg, VP of Sales and Marketing shares his views on why the smart utility will be a connected one. Mark, who joined Aeris Communications in 2007, is responsible for all sales and marketing activities.

The energy crisis in the US is driving a major transformation in the business model of how the utility industry operates, requiring rapid and pervasive deployment of reliable, secure, and two-way broadband communications throughout its infrastructure. Utilities and regulators are putting significant amounts of time and energy into the selection of new physical equipment (smart meters and other devices), but are not putting the same emphasis into choosing the right communication architecture that will support the Smart Grid of the future. While there is not a single communications technology that will be appropriate everywhere and for every application, Aeris believes that a strong case can be made for a private and secure network that makes efficient use of public carriers' cellular footprint and bandwidth.

The utility industry has changed slowly over the past century. The biggest concern was managing changes as directed by the market in a timely and orderly manner for increased power generation or new distribution methods. Times have changed. In the upcoming decade, there are many compelling reasons driving the utility industry that simply were not factors in the past.

Major challenges faced by the utility industry in the next ten years include:

Energy demand is projected to increase over 60%.

Over 50% of the utility industry's skilled workforce will retire with job experience and knowledge that cannot be replaced one-for-one.

Global demand and resource scarcities will drive energy costs to unprecedented heights.

Government mandates, carbon caps, and regulations will limit new generation sources to "renewable" and "green" only.

Increases in new government mandates around the reliability of the "grid" itself.

The Industry must change to meet these challenges. The key to success will involve three key capabilities:

Real-time data collection from all end points through a myriad of 'smart devices'.

Reliable, secure, real-time, high bandwidth communications network(s) to deliver information and facilitate automation and remote control back out to the devices.

IT systems including databases, decision support systems, and applications to support automation across the grid that will ultimately drive inefficiencies out of today's business models.

Transformation

Renewable energy provides perhaps the greatest opportunity for the utility industry to meet or exceed "clean energy" requirements. The challenge for the Utilities will be to inject existing and nouveaux energy sources into base load calculations, knowing these new generation sources are not always available when needed.

Many renewable energy sources are unpredictable such as the sun or wind. Renewable energy generation sources must be monitored and managed around the clock, and efficiencies dictate that the system will need to be fully automated. This drives the need for real-time information from a large percentage of end points, two-way communication between end-points, and automation within the T&D infrastructure to shift and shed loads and to avoid rolling trucks into the field.

To complicate the picture a bit further, power generation is evolving from a centralized one-way to a distributed two-way system. "Distributed Generation" typically refers to generating power from many small energy sources that are collectively efficient and located closer to the consumer, then putting this energy back into the grid as supply. Examples include tapping into residential solar panels, windmills, and excess stored electricity in plug-in electric hybrid vehicles (PHEV) batteries. The consumer is, in effect, turned into a producer and reimbursed by the power company with energy credits, rebates or cash.

The opportunity for Utilities to tap into these new energy sources with little upfront investment is tremendous. The challenge for the industry is to manage the fragmentation of control for generation from the original small number of dependable and controlled power generation sources to an open market where consumers become generation sources. This reciprocating market of supply and demand must be managed both at the individual and aggregate level.

Distributed generation requires a real-time flow of information both ways with a footprint that can be installed easily, unobtrusively and quickly. Also, many of the information gathering and dissemination devices will be installed by third parties, or even by consumers themselves. These devices will also be coupled with various meters, thermostats and control panels, and integrated within home energy automation systems.

The adoption of the Renewables and Distributed Generation energy models accelerates the need for automation and continuous communication. Legacy batch-processing systems will migrate to real-time transaction flows that drive pricing, billing, decision support and operational controls for power supply and delivery. This active communications backbone must support:

Two-way communication between nodes;

High bandwidth with low latency reliability across a disbursed terrain;

Distributed real-time processing;

Pervasive connectivity to all device types up and downstream;

Complete end-to-end security;

Ease of use for consumers; and

Simplified deployment that is quick to set up and has no power lines, wires or trenches – wireless.

Transmission and Distribution

As generation moves from the traditional upstream-to-downstream flow of electricity to a model where load is shifting up and downstream constantly, the entire T&D infrastructure must be able to accommodate instantaneous changes. Integrated into this will be a network of new automated monitoring, detection, and switching apparatus controlled automatically and by remote control. The flow of data will be two-way and real-time.

Between the Utility and consumer, two-way load management systems (LMS) communicate with load points and send on/off status, current kW usage, and meter readings back to the controller. With this information the LMS can compute the latest energy consumption figures before and after the shed cycle begins, adjusting the load shed as needed. This process requires ready access to real-time two-way communications between the LMS and load point.

There is a rapidly growing movement in the Utility industry to view potential demand-side savings as a resource to be utilized when needed. 'Smart' Utilities are looking to active two-way demand management programs to both curtail peak usage and use customers' excess as a resource that can be injected back into the grid as needed. Increasingly, peak demand management systems are used to monitor and analyze end-user consumption, and work with the Utility and the consumer to better plan for and carry out demand-side programs as needed.

As an example, during a peak demand situation C&I consumers can switch to an alternative power source such as their backup generation system or even turn on the backup generation system to export and sell power to the grid, depending on real time pricing. Here, the customer saves money by reducing peak demand priced energy consumption and/or makes money by selling excess capacity back to the Utility. The key to demand management systems is a robust, two-way high bandwidth communications network that is relatively quick to deploy, universal in that it can be used with both similar and disparate consumer premises, high bandwidth, and low cost - all traits of wireless communications.

In parallel with the shift to up and downstream electricity flow, each major element in the T&D system must be monitored and controlled remotely. Smart devices will be retrofitted onto existing equipment wherever possible. One of the biggest challenges in this area is that, unlike meters, the smart devices are highly specialized due to the varying types of infrastructure equipment they need to integrate into. These devices and the communications systems they employ will require specialized integration up front in order to cover the entire T&D grid. As the T&D elements become "wired" for remote monitoring and control, the T&D applications and processes will need to move from manual to automated in order to monitor and keep pace with real-time conditions affecting supply and demand.

Similar to the Transformation scenario above, the T&D communications backbone must support the same items listed.

Smart Metering Programs - Changing the Demand and Consumption Model

Smart meters were one of the first initiatives the industry took towards becoming "smart". The first generation of smart meters was built around the simple automation of manual meter reading (AMR). This was a point solution that met the specific need of reducing meter readers, but could not be directly applied to more advanced or alternative uses. The ROI for this solution was specified against the simple business case of replacing meter readers. AMR did not go far enough in terms of a full set of capabilities that would deliver much broader ROIs, much less impact energy use by the consumer. Many AMR programs were approved and contracted to deploy one-way or one and one halfway wireless communications technologies, all of which had very narrow bandwidth. The limitations of these communications choices are now becoming widely understood, particularly in the context of newer definitions around automated metering infrastructure (AMI), the second generation of smart metering solutions.

AMI adheres to the principle of more functionality and automation with more frequency. AMI is evolving into an end-to-end solution with capabilities beyond AMR - but based on the lessons of AMR. Upon realizing the benefits of reducing or eliminating meter reads, many Utilities identified all of the functions carried out by field personnel that can now be done remotely over the air including service connect/disconnect, outage detection, and meter reads. In addition to automating field service functions with real-time communications, real-time pricing becomes possible.

The third generation of smart metering solutions, which we'll call AMI with Demand Response (AMI/DR), essentially creates a real-time market for electrical power that links supply all the way out to demand, on a real-time or near-real-time basis. AMI/DR involves the full integration of energy usage data (demand), connected to and compared with real-time supply and pricing information to automatically determine how to optimize market conditions. Market conditions can determine changes in supply needs, load control shifts from one area to another, and even voluntary and/or forced reduction of demand usage at the retail level. Some of the AMI base capabilities will move to more real-time intervals, such as pricing. Time of use (real-time) pricing allows customers to be aware of variable energy costs and make voluntary adjustments as to when they consume electricity. Critical peak pricing reaches out to the consumer and allows them to see the real-time price of electricity, and determine what adjustments to make now to how and when they consume energy. Conversely, it also allows the Utility to make profit based decisions around reducing demand versus buying short-term capacity at high demand price points.

Demand Response (DR) enables full command and control over the consumption of electricity. Many consumers, both Commercial/Industrial as well as residential, have voluntarily enrolled into DR initiatives. These incentive based programs allow the Utility to reach out and "turn down" energy consumption in real-time as needed, in effect creating the concept of 'deferred generation' or 'avoided production'. A fully utilized DR system relies on an efficient two-way communications system between the energy source or provider and the consumer.

It is essential that Utilities examine their smart grid initiatives and look deeply at the communications network(s) that will support all generations of deployment, up and down the grid, and over multi-year periods of time. There are many technology candidates that can be utilized to provide this information pipeline. It is very unlikely that only one communications technology will be used by a Utility for all devices in all cases. That said, Aeris believes that a compelling case can be made for specialized cellular networks as a major piece of the communications backbone to support the Smart Utility.

Aeris's ruggedized data-specific cellular network has been in place for over ten years delivering reliable and robust communications to several different industries, including Utilities. What has changed dramatically over the past few years is the improvement of broadband communications and its much lower price points. By matching specialized network services developed by Aeris with the public carriers' investment in pervasive broadband wireless networks, Utilities can speed up deployment time, meet reliability needs, and reduce costs today.

Smart meter placed in the home


스마트미터 (SCP用)
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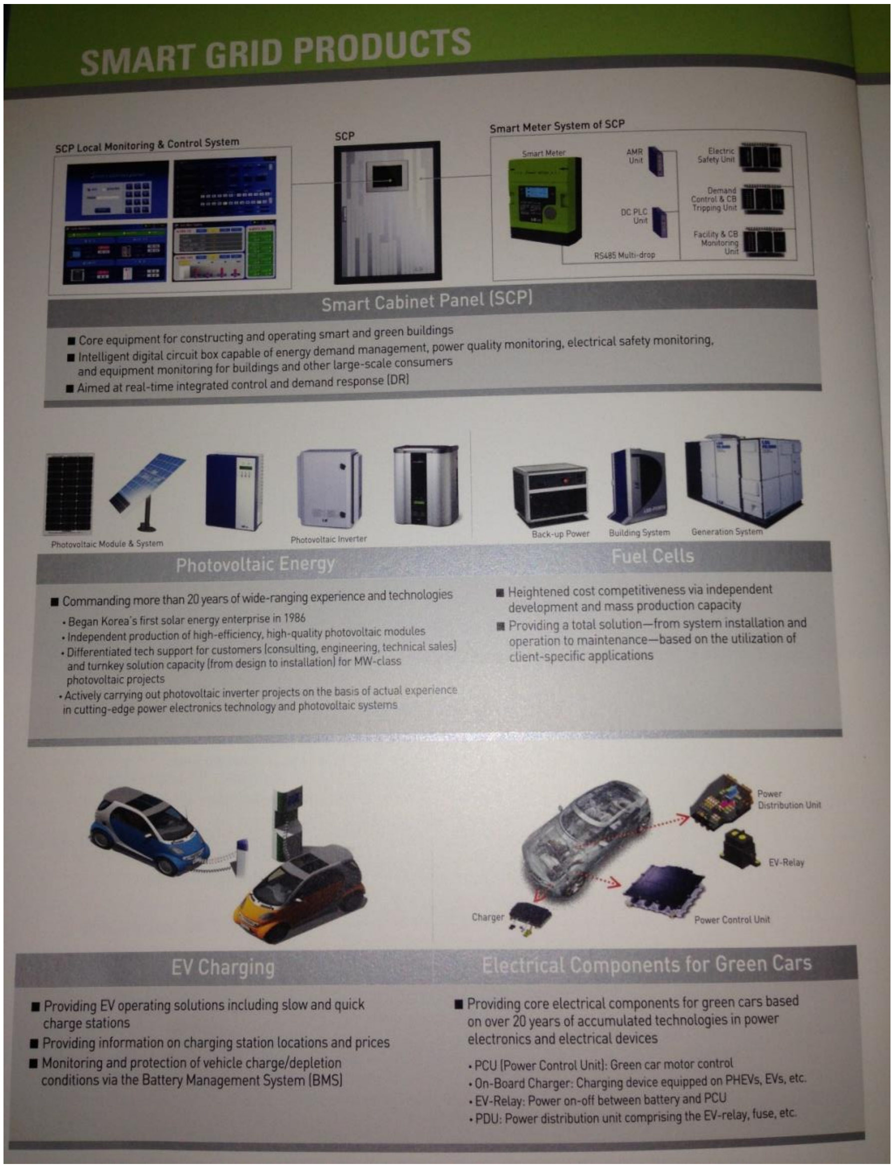
LS산전

Disply unit placed in the home


SMART GRID PRODUCTS

SCP Local Monitoring & Control System
SCP
Smart Meter System of SCP
Smart Meter
AMR Unit
DC PLC Unit
RS485 Multi-drop
Electric Safety Unit
Demand Control & CB Tripping Unit
Facility & CB Monitoring Unit

Smart Cabinet Panel (SCP)

- Core equipment for constructing and operating smart and green buildings
- Intelligent digital circuit box capable of energy demand management, power quality monitoring, electrical safety monitoring, and equipment monitoring for buildings and other large-scale consumers
- Aimed at real-time integrated control and demand response (DR)

Photovoltaic Module & System
Photovoltaic Inverter
Back-up Power
Building System
Generation System

Photovoltaic Energy

- Commanding more than 20 years of wide-ranging experience and technologies
  - Began Korea's first solar energy enterprise in 1986
  - Independent production of high-efficiency, high-quality photovoltaic modules
  - Differentiated tech support for customers (consulting, engineering, technical sales) and turnkey solution capacity (from design to installation) for MW-class photovoltaic projects
  - Actively carrying out photovoltaic inverter projects on the basis of actual experience in cutting-edge power electronics technology and photovoltaic systems

Fuel Cells

- Heightened cost competitiveness via independent development and mass production capacity
- Providing a total solution—from system installation and operation to maintenance—based on the utilization of client-specific applications

Power Distribution Unit
EV-Relay
Charger
Power Control Unit

EV Charging

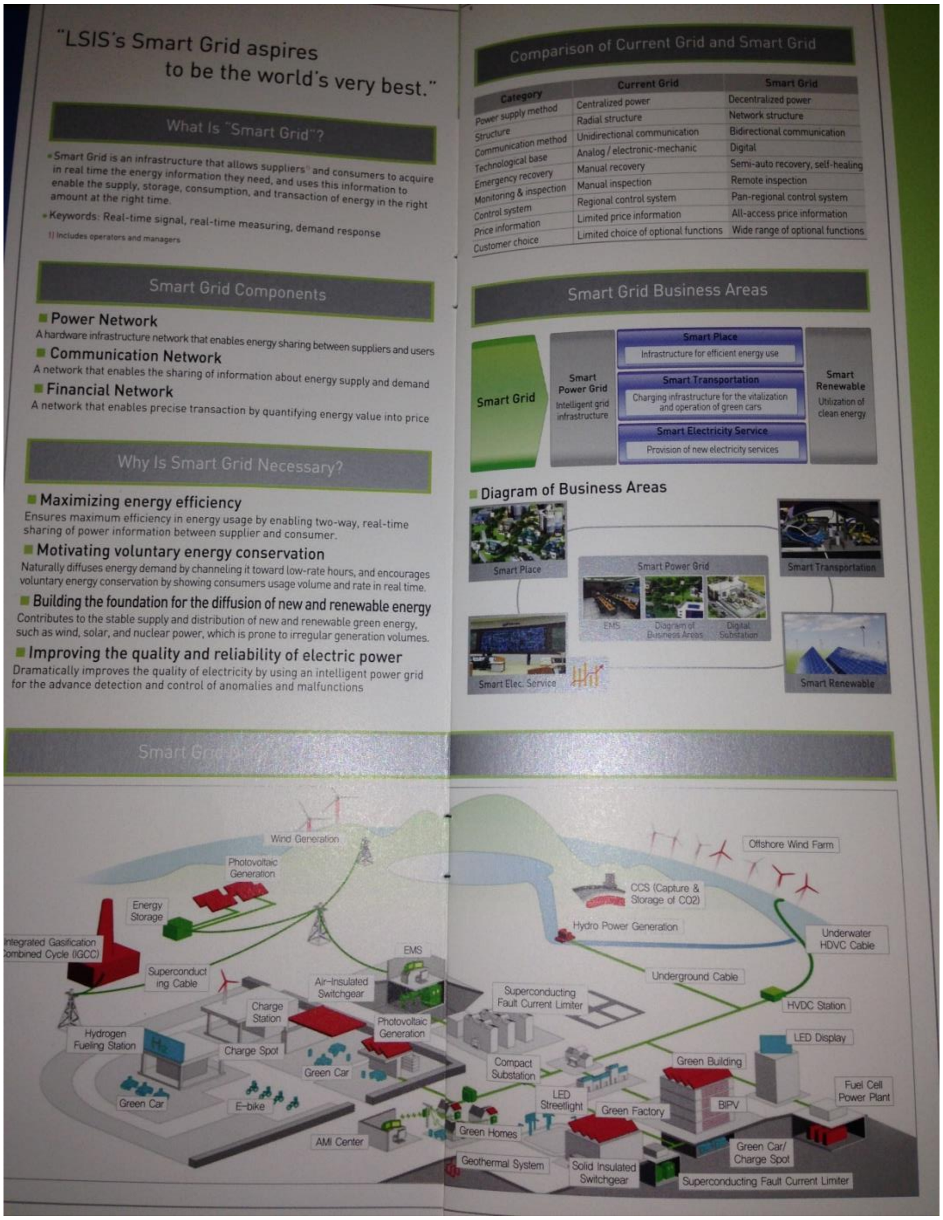
- Providing EV operating solutions including slow and quick charge stations
- Providing information on charging station locations and prices
- Monitoring and protection of vehicle charge/depletion conditions via the Battery Management System (BMS)

Electrical Components for Green Cars

- Providing core electrical components for green cars based on over 20 years of accumulated technologies in power electronics and electrical devices
  - PCU (Power Control Unit): Green car motor control
  - On-Board Charger: Charging device equipped on PHEVs, EVs, etc.
  - EV-Relay: Power on-off between battery and PCU
  - PDU: Power distribution unit comprising the EV-relay, fuse, etc.

Smart grid products

Smart grid solution



Smart grid diagram

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