



Introduction to Smart Grid

Latest Developments in the U.S., Europe and South Korea

ROA Group White Paper

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1. Introduction to Smart Grid

This ROA Group white paper briefly introduces smart grid and the latest developments in the U.S., Europe and South Korea. Smart grid refers to a next generation electric power network that makes use of IT and high technologies. Compared to the telecommunications networks, the electric power networks have not developed remarkably in terms of creating innovative technologies. However, smart grid by revolutionizing the electric power network and being almost as powerful as the Internet, is attracting many attentions among various industries.

Smart grid is a system that enables two-way communications between consumers and electric power companies. In a smart grid system, consumer's information is received by the electric power company in order to provide the most efficient electric network operations. In addition to the efficient operations of a power plant, smart grid also makes it possible to control power demand and distributed energy, including renewable energies. By installing an intelligent meter (smart meter) on the consumer side, especially households, monitoring the use of energy becomes much easier and even helps to reduce carbon dioxide emissions.

As power failures occur relatively often in the U.S., compared to other countries, there's been an urgent need to renovate the country's power network, and since 2005 research projects and government policies focusing on smart grid and next generation electric networks have been steadily carried out. A definition and detailed description on smart grid is provided in a report titled Modern Grid Initiative, published by the U.S. Department of Energy (DOE)/ National Energy Technology Laboratory (NETL) in January 2007.

The report includes a comparison between today's grid and modern grid (smart grid) by analyzing key issues through 7 characteristics as follows: Self-heals, Motivates & includes the consumer, Resists attack, Provides power quality for 21st century needs, Accommodates all generation and storage options, Enables markets, Optimizes assets and operates efficiently. The comparison according to the 7 characteristics is shown in Table 1 below.

Table 1. Comparison between Today's Grid and Smart Grid (Modern Grid)

Characteristics	Today's Grid	Modern Grid(Smart Grid)
Self-heals	Responds to prevent further damage. Focus is on protection of assets following system faults.	Automatically detects and responds to actual and emerging transmission and distribution problems. Focus is on prevention. Minimizes consumer impact.
Motivates & includes the consumer	Consumers are uninformed and non-participative with the power system.	Informed, involved and active consumers. Broad penetration of Demand Response.
Resists attack	Vulnerable to malicious acts of terror and natural disasters.	Resilient to attack and natural disasters with rapid restoration capabilities.
Provides power quality for 21st century needs	Focused on outages rather than power quality problems. Slow response in resolving PQ issues.	Quality of power meets industry standards and consumer needs. PQ issues identified and resolved prior to manifestation. Various levels of PQ at various prices.
Accommodates all generation and storage options	Relatively small number of large generating plants. Numerous obstacles exist for interconnecting DER.	Very large numbers of diverse distributed generation and storage devices deployed to complement the large generating plants. "Plug-and-play" convenience. Significantly more focus on and access to renewables.
Enables markets	Limited wholesale markets still working to find the best operating models. Not well integrated with each other. Transmission congestion separates buyers and sellers.	Mature wholesale market operations in place; well integrated nationwide and integrated with reliability coordinators. Retail markets flourishing where appropriate. Minimal transmission congestion and constraints.
Optimizes assets and operates efficiently	Minimal integration of limited operational data with Asset Management processes and technologies. Siloed business processes. Time based maintenance.	Greatly expanded sensing and measurement of grid conditions. Grid technologies deeply integrated with asset management processes to most effectively manage assets and costs. Condition based maintenance.

Source: The NETL Modern Grid Initiative

2. Latest Developments in the U.S., Europe and South Korea

2.1 U.S.

In the U.S., in 2005 legal measures were sought to solve the growing energy problem by announcing The U.S. Energy Policy Act of 2005 that aims at supporting innovative technologies to reduce greenhouse gases. It was signed into a law in August in the same year, and contributed to the introduction of AMI/Smart meter. The Act states that

each electric power company should provide customers with time-based rates. Two years later, Energy Independence and Security Act of 2007 was announced in which smart grid is included. According to the Act of 2007, from 2008 to 2020 research and development as well as pilot projects related to smart grid will be conducted at the government level. In addition, the recent economic stimulus package announced by the Obama Government in February this year, states that financial support worth of USD 11 billion will be granted for smart grid. After the announcement, not only electric power companies but also companies like Google and Qualcomm have announced their own plans related to smart grid.

Currently in the U.S., over 10 smart grid related projects are being carried out, of which IntelliGrid has been the most notable. IntelliGrid was initiated in 2003 by the U.S. Electric Power Research Institute (EPRI) under the support of Department of Energy. IntelliGrid consists of four different research projects, including architecture, consumer portal, DER/ADA and FSM. The main U.S. companies participating in IntelliGrid are introduced in the table below.

Table 2. Companies Participating in IntelliGrid

Company	Role
GE	GE Global Research participates in high level science and engineering related technology development projects and GE Energy and other core businesses provide IT solutions, power transmission/distribution, and operation system.
Lucent	With the support of Bell Labs, the company uses its existing technology related to communications, optics, software and participates in grid technology to expand its business domain.
Utilities Consulting International	Provides consulting services and research to the power industry on system integration, regulation and standards.
SISCO	Focuses on international communications/integration standards and develops products to be used after standardization.
EnerNex	As a company providing consulting services to the electric power industry, EnerNex is in charge for development and support for smart grid new technologies.
Hypertek	Hypertek is developing technologies focusing on smart electronics products and grid communications.

Source: ROA Group

Table 3. IntelliGrid Project Plan

2010	2020	2030
<ul style="list-style-type: none"> - Enable two-way communications and develop a smart meter. - Develop home appliances and electric goods that support smart grid. - User-oriented operation and inducement of consumers to the power market through the development of Distributed Generation. 	<ul style="list-style-type: none"> - Develop a comprehensive energy system that includes plug-and-play, cooling and heating and humidity control based on consumer demand. - Provide high-quality electric power with automatic measurement of voltage and frequency. - Develop an ultra-conductive power cable for long distance. 	<ul style="list-style-type: none"> - A highly efficient and safe digitalized power system available for everyone. - Enable the nationwide usage of low-carbon, clean energy. - Develop an easy to use energy storage system, available for everyone. - Complete a national ultra conductive power cable network.

Source: ROA Group

2.2 Europe

To realize smart grid in Europe, already various research projects have been launched in related industries, and the amount invested is expected to reach over 100 million euros. The following presents a summary of EU's plans in implementing smart grid in Europe.

- Improve the quality of electric power distribution in EU
- Increase the importance of demand response
- Increase the importance of environmental policy
- Create an environment where Multi/Dispersed Generation coexist with Central Generation
- Create various business models to enable liberalization of electric power
- Introduce timeframe for equipment renewal (replacement of old equipment)

EU has launched various research programs under the name of Framework Programme (FP) that covers research, technological development as well as social and cultural aspects. In FP5, a program launched in 2002, one of the main objectives was to integrate renewable energies with the power network of distributed generation by the end of 2002, while the objective of FP7, which is currently being conducted, is to realize smart energy networks. Smart energy networks aim at realizing efficient electric

power networks, security and reliability by allowing interactivities between the electric power company and consumer, and overcoming technological difficulties in connecting distributed and renewable energies in a large scale.

Through two projects, BUSMOD (BUSiness MODels for distributed power generation), in which 7 companies from 5 countries have participated and CRISP(Critical Infrastructure for Sustainable Power), in which 8 companies from 3 countries have participated, research has been carried out on IT based Distributed Intelligence in order to enable an efficient management of electric power networks.

2.3 South Korea

In South Korea, the government announced 'Green Energy Industry Strategy' in September 2008, and it includes an introduction to Korean smart grid under the area of 'Power IT'. By 2030, the total growth target for green energy industry is USD 300 billion, and the export target is USD 210 billion. The targets for Power IT are USD 23.9 billion for production and USD 16.7 billion for export.

Power IT was launched in 2005 and the Green Energy Industry Strategy announced in 2008 can be seen as an extension of it. Since 2005, Korea Electric Power Corporation (KEPCO) with 6 other organizations has conducted research on core technologies and has been involved in the following additional activities.

- Create a test bed and evaluate new electric power systems and products.
- Emphasize the standardization for Power IT (Korean-style smart grid). Make it clear that in order to accomplish commercialization and integration of Power IT industry, priority should be on the standardization process.

The investment target for Power IT in the next five years is 420 billion won (government: 250 billion won, private: 170 billion won). The South Korean government plans to introduce IT gradually to KEPCO's power network and establish a two-way power system by 2012.

Table 4. Technology Development Target for Power IT Industry in South Korea

Target	Description
10 Core technologies	Intelligent power distribution, electric network communications, ubiquitous technology, Korean-style energy management system, digitalized next-generation power transformation, IT-based large capacity power transmission control system, electric power semiconductor, etc.
Establish a test-bed and develop a next generation electric power system	Establish a test-bed, develop smart metering and system, and standardize two-way communications.

Source: ROA Group

3. Conclusion and Suggestions

For the electronics manufacturers, smart grid opens opportunities in terms of new technologies and products converging energy and telecommunications technologies. At the same time when the interest and expectations for smart grid grow higher, security and privacy issues are becoming a new concern. For the telecommunications protocol in smart grid, most of the IT companies are supporting the use of IP. However, many industry experts are worried that the system will be as weak as the existing Internet network for an outside attack, if IP is used. On the other hand, this can be seen as an opportunity for many companies specializing in security solutions to increase their revenue.

Glossary

ADA	Advanced Distribution Automation
AMI	Advanced Metering Infrastructure
CRISP	Critical Infrastructure for Sustainable Power
DER	Distributed Energy Resources
DOE	Department of Energy
EPRI	Electric Power Research Institute
EU	European Union
FP	Framework Programme
FSM	Fast Simulation & Modeling
IP	Internet Protocol
IT	Information Technology
NETL	National Energy Technology Laboratory
PQ	Power Quality

This white paper is a part of a research report, originally written in Korean. It has been translated and edited by the global marketing team of ROA Group

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Phone: +82-2-543-1644, Fax: +82-2-538-1645. E-mail: research@researchonasia.com. Thank you.

Latest Research from ROA Group, 2009:

South Korean Telecommunications Market: Key Issues and Trends in 2009

Insights on Mobile Device Issues, Bundled Products and New Service Business Models

South Korean Telecommunications Market: Key Issues and Trends in 2009 report studies the development direction of devices and services in the South Korean market. According to ROA Group, 2009 will bring significant changes into the South Korean telecommunications market as KTF, the second largest mobile operator, is going to complete its merger with KT, starting a fierce competition with SKT in the bundled products category. When WIPI, Korea's local and unique platform environment, will be scrapped in April 2009, the introduction of application business models is expected to speed up.

http://global.researchonasia.com/roa/report/report_view.asp?i_report=132

Korean Mobile Market Forecast, 2009

This ROA Group report provides a market forecast for 2009, highlighting the major issues among the three Korean mobile operators, SKT, KTF and LGT, including subscriber growth, churn rate, average revenue per user, and CAPEX as well as competition over the rival network technologies, CDMA and WCDMA. In 2008, Korea's mobile subscriber base reached 45.61 million with the estimated penetration rate of 93.4%. ROA Group forecasts that the increase in subscribers will slow down and become stagnant to reach 46.8 million (penetration rate of 96%) in 2009. In 2009, the ratio of WCDMA users is forecast to reach 57.3% (a 62.4% year-on-year increase), which will exceed that of CDMA users for the first time. Still, CDMA users account for a great share and will maintain a certain level by 2011.

http://global.researchonasia.com/roa/report/report_view.asp?i_report=131

Chinese Mobile Market Review

Key Issues in Late 2008 and Outlook for 2009

Mobile subscribers in China surpassed 600 million in June 2008, and there is no sign that the growth will stop. In other words, about 150 million new users have subscribed to the service for only one and a half years since December 2006, when the total figure reached 450 million. The Ministry of Industry and Information Technology of China announced that the mobile users in China amount to 627 million as of October 2008, while the average net subscriber addition a month posts 8 million until October 2008. By 2020, the total number is expected to surpass 1 billion.

http://global.researchonasia.com/roa/report/report_view.asp?i_report=129

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About ROA Group

ROA Group is a research and consulting company, specialized in mobile and convergence markets in Asia. ROA Group offices are located in Tokyo (head office) and Seoul. ROA Group's main clients are mobile carriers, handset manufacturers, government agencies and global IT companies.

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