Smart Grid – The Internet of the Energy Sector

Introduction

Smart grid is a term used to denote the modern way of power transmission and distribution of electricity grids by making them intelligent using the advanced techniques in communication and IT. The confluence of energy, communication and IT is suppose to make the grid more reliable, efficient, responsive, quality focused, resilient with lesser cost and new value added applications. The main drivers for the smart grid are ever increasing energy demand, global warming due to Green House Gas emission, frequent power black outs, increased efficiency due to grid optimization, technology advancements, limited natural resources, advanced consumer services, security, reliability and power quality.

One example of smart grid technology is the variable charge structure for energy consumption during peak (higher rate) and off peak periods (economy rate). This would help in flattening the load demand curve by automatically switching off the units (ACs, Refrigerator, heating units etc) during peak load period and turning them on when the load condition eases.

Smart grids are all the more relevant to the developing countries like India. India's transmission and distribution losses are among the highest in the world. According to Ministry of Power about half of the electricity in the country is only billed. The financial impact of technical and commercial losses has been estimated at 1.5% of GDP.

Smart grids enable GDP growth, enables the Utility provider in taking steps to minimize the environment impact by reducing carbon foot print, creates opportunities for vendors in bringing new products & solutions to market and finally brings transparency, control and clean technologies to the end consumer

Market

Different market agencies have given the market forecast based on their own interpretation of smart grid market. According to one of the reports, it is estimated to be at $20B in 2008, growing to $40B by 2013 and $100B by 2030. Another report puts the world market figure at $69.3 billion in 2009 growing faster and reaching $171.4 billion by 2014.

Indian smart meter market is estimated to be 100 million nodes alone!

In summary, there is a huge potential smart grid in the decade to come.

Architecture & Applications

The smart grid architecture could be broadly depicted as a 3-tier framework comprising of

- The Physical Power Layer (transmission and distribution)
- The Data Transport and Control Layer (communications and control)
- The Application Layer (applications and services)

The data and transport network allows bi-directional traffic flow from Utility (service provider) to the consumer and vice-versa. The conventional mechanical energy meters are getting replaced with so called smart meters which facilities this. Large scale deployments of these meters constitute what is called as Advanced Metering Infrastructure (AMI) and the network is called Field Area Network (FAN).

Various applications and services using this architecture are expected to provide lot of flexibility, control in the hands of both Utility and consumer. Few examples are: AMI, Demand response, distributed generation, energy storage, Plug-in Hybrid Electric Vehicle (PHEV).

Challenges

Being an evolving technology, there are lots of technology and business challenges with the Smart Grids. Some of the important ones are Interoperability standards, evolution path, business models, and integration of large number of renewable energy sources

Deployment scenario

Currently work is going on in US, Australia, Canada, and China on smart grid implementation. In India, a pilot project is on in Bangalore. The results of this project would be used for nationwide smart grid implementation.

Standards

IEC, ITU, ISO, IETF, IEEE are the main standards organization responsible for bringing out the standards in this area. Beside, several regional and national consortiums are working in their respective geographies in planning, adaptation and regulatory aspects.