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An Overview of Smart Grid Technology

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***Abstract*: - For century, there has been no change in the fundamental structure of the electrical power grid and vehicle networks. Current hierarchical, centrally controlled grid of the electrical grid is not best for growing demand. To address the challenges of the existing power grid, the new concept of smart grid and smarter planet are under research. The smart grid can be considered as a modern electric power grid infrastructure for enhanced efficiency and reliability through automated control, high-power converters, modern communications infrastructure, sensing and metering technologies, and modern energy management techniques based on the optimization of on demand, energy and network availability. While current power systems are based on a solid information and communication infrastructure, the new smart grid needs a different and much more complex one, as its dimension is much larger and needs utmost performance. This paper addresses critical issues on smart grid technologies primarily in terms of information and communication technology (ICT) issues and opportunities. The main objective of this paper is to provide a contemporary look at the current state of the art in smart grid communications as well as to discuss the still-open research issues in this field.**

Keywords: *- Smart grid, power grid, energy, information, communications, management, protection, security, privacy.*

I INTRODUCTION

Traditionally, the term grid is used for an electricity system that may support all or some of the following four operations: electricity generation, electricity transmission, electricity distribution, and electricity control. A smart grid (SG), also called smart electrical or power grid, intelligent grid, intelligrid, future grid, intergrid, or intragrid, is an enhanced version of the twentieth century power network. Carrying power from a few central generators to many users or customers is one of the main and general usage of the traditional power grids. In contrast, the SG uses two-way flows of electricity and information to create an automated control and distributed advanced energy delivery network. The smart grid can be defined as a smart electrical network that combines electrical network and smart digital communication technology. A smart grid has capable of providing electrical power from multiple and widely distributed sources, like from wind turbines, solar power systems, and perhaps even plug-in hybrid electric vehicles.

II SMART GRID COMPONENTS

Intelligent Appliances: Intelligent appliances have capable of deciding when to consume energy based on customer pre-set preferences. This can lead to going away along toward reducing peak loads which have an impact on electricity generation costs. For example, smart sensors, like temperature sensor which is used in thermal stations to control the boiler temperature based on predefined temperature levels.

Smart Power Meters: The smart meters provide two-way communication between power providers and the end user consumers to automate billing data collections, detect device failures and dispatch repair crews to the exact location much faster.

Smart Substations: substations are included monitoring and control non-critical and critical operational data such as power status, power factor performance, breaker, security, transformer status, etc. substations are used to transform voltage at several times in many locations, that providing safe and reliable delivery of energy. Smart substations are also necessary for splitting the path of electricity flow into many directions. Substations require large and very expensive equipment to operate, including transformers, switches, capacitor banks, circuit breakers, a network protected relays and several others.

Integrated communications: The key to a smart grid technology is integrated communications. It must be as fast as enough to real-time needs of the system. Depending upon the need, many different technologies are used in smart grid communication like Programmable Logic Controller (PLC), wireless, cellular, SCADA (Supervisory Control and Data Acquisition), and BPL Key Considerations for Integrated Communication.

Phasor Measurement Units (PMU): This is used to measure the electrical waves on an electricity grid using a common time source for synchronization. The time synchronizer allows synchronized real-time measurements of multiple remote measurement points on the grid.

III CURRENT STATUS OF SMART GRID

The increased efficiency of grid management and improved reliability are also driving deployment and demonstration. Overall, some initial expectations were unrealistic, but benefits have been realized from advanced metering infrastructure and distribution automation. Distribution automation, in particular encompasses measures to enhance monitoring, control and directionality, is the most successful technology sub-category and global investments rose by 23% from 2013 levels.

China has one of the world's highest rates of electricity service interruption and overtook the United States in annual investment in smart grid technologies last year. This growth reflects the importance of reliability and system efficiency as drivers for smart grid technology. Currently, China dominates the meter market with almost two-thirds of global installations. The deployment of smart grid technology in the USA slowed from 2013 to 2014 due to unclear clean energy policy. Europe experienced rapid deployment and France, Germany and UK will lead a push from investment of 55 million per year to 180 million in 2020. Smart grid deployment strategies need to be centered on customers and business models.

Therefore, national strategies that articulate the benefits of smart grids to stakeholders need to be developed. For system operators and utilities, transparent regulations that allow cost-reflective investment in advanced distribution network technologies will be required. Sustained market development can only be realized when technology obsolescence, interoperable technology and system security are solid in the first place. Furthermore, the harmonization of international standards for underlying infrastructure need to be developed and methodologies for quantifying the benefits of smart grids also need to be standardized.

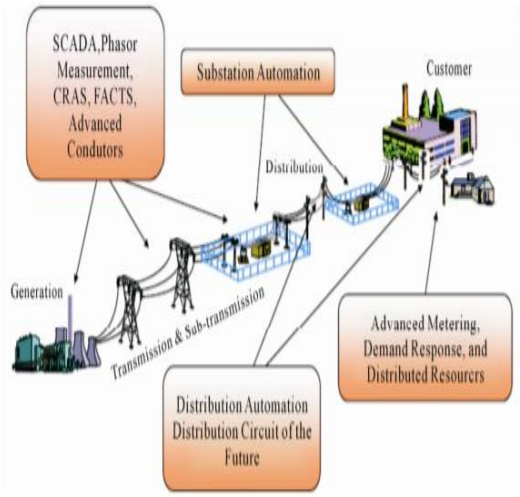

Figure 1. Components of smart grid.

IV COMPARISON WITH CONVENTIONAL GRID

The traditional power grid is basically the interconnection of various power systems elements such as synchronous machines, power transformers, transmission lines, transmission substations, distribution lines, distribution substations, and different types of loads. They are located far from the power consumption area and electric power is transmitted through long transmission lines. The smart grid is a modern form of the traditional power grid which provides more secure and dependable electrical service. It is, in fact, a two-way communication between the utility and the electricity consumer.

Traditional and Smart Grid

Traditional Grid	Smart Grid
Electromechanical, solid state	Digital/Microprocessor
One way and local two way communication	Global/Integrated two way communication
Centralized generation	Distributed generation
Limited monitoring, protection and control systems	Adaptive protection
'Blind'	Self monitoring
Manual restoration	Automated
Check equipment manually	Monitor equipment remotely
Limited control system	Pervasive control system
Estimated reliability	Predictive reliability

The smart grid is capable to monitor activities of the grid-connected system, consumer preferences of using electricity, and provides real-time information of all the events. The key components of smart grid include smart appliances, smart substations, smart meters, and advanced synchrophasor technologies.

Need for Smart Grid

As the smart grid technology is implemented, it will lead to many benefits. It is cost-effective hence will save people money, help conserve energy and improve the environment. The smart gird will eliminate the need for thermal power plants and enable greater use of renewable energy sources, like hydro, wind and solar. In addition, the smart grid will generate new and rewarding careers in the field of green industries and energy sectors. With that in mind, it is essential that everyone and budding engineers be aware of the role this technology will play in our energy future.

Effective roll out of this technology will demand coordinated effort and collaboration among a phenomenal discipline, including communication control frameworks for generation, transmission, distribution, operations, markets and administration supplier.

Aim of Smart Grid

- Provide a user-centric approach and allow new services to enter into the market
- Establish innovation as an economical driver for the
- electricity networks renewal, Maintain security of supply, ensure integration and interoperability
- Provide accessibility to a liberalized market and faster competition
- Enable distributed generation and utilization of renewable energy sources
- Ensure best use of central generation
- Consider appropriately the impact of environmental limitations
- Enable demand side participation (DSR, DSM)
- Inform the political and regulatory aspects

- Consider the societal aspects

Advantages of Smart Grid

- Enabling the integration of clean, renewable generation sources
- Reducing electrical losses
- Increasing penetration of distributed energy resources
- Increasing energy conservation through feedback to consumers
- Improving national security
- Demand-Response reduces stress on assets during peak conditions, reducing their probability of failure
- Deferral of capital investments as future peak loads are reduced
- Ability to switch from gasoline to electricity for transportation (trains/buses/cars/vans)

Disadvantages of Smart Grid

- Biggest concern: security and privacy
- Smart Grid: use automated meters, two-way communications: between a power consumer and provider and advanced sensors. Some types of meters can be hacked
- Hacker: gain control of thousands, even millions, of meters increase or decrease the demand for power
- Not simply a single component
- Various technology components: software, the power generators, system integrators, etc.
- Expensive for consumer

V CONCLUSION

Smart Grid is a concept designed to provide electricity in more efficient way by better allocating electricity according to consumer's wants. It integrated multiple energy sources and avoid over generation as well. In foreign countries, namely the UK and USA, started to implement as they see it as a solution of energy and environment pressure in their own country.

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