A SURVEY ON IOT BASED SMART GRID TECHNOLOGY

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Abstract: *This paper deals with a survey on smart grid which is based on IOT (Internet of Things). This survey tells us the purpose of replacement of existing methodology i.e., electricity grid.Smart grid is one of the important features of smart city modelling. It is an energy consumption monitoring, control and management system. Smart grid technology is based on communication between the vender and consumer. Generally, IOT based Smart Grid is a revolution of the existing electricity grid with the low cost sensor networksAdvancement in high speed communication systems that are coupled with the increased deployment for advanced provide utilities with better information to manage the grid. we have developed a space for IOT where it is user friendly applications like monitoring, control of smart grid. The smart grid technology has been discussed and also about the scope of IT services in IOT enabled grid system. It comprises of a two-way communication where electricity and information are exchanged by the consumer for the utility to maximize efficiency. There are many challenges in switching a conventional grid to smart grid. Smart grids save lot of human resources.*

Keywords: **Internet of Things, smart grid, smart meter, Advanced Metering Infrastructure.**

INTRODUCTION

The Smart Grid (SG) the intelligent and interactive power grid that would be seen in future with largest instantiation of the IOT network. The whole power chain from the energy power plant generation to the final electricity consumers (houses, building, factories, public lightning, electric vehicles, smart appliances, etc.) including transmission and distribution power networks. It will be filled with intelligence and two-way communication capabilities to monitor and control the power grid anywhere anytime at high accuracy. For instance, consider a smart house that will be equipped with smart meters and smart appliances, whereas power generators and electric transmission and distribution networks will be equipped with various sensors and actuators. The main aim of the Smart Grid technology is to maintain a real-time balance between energy generation and energy consumption by allowing a fine-grained monitoring and control over the power chain, by means of two-way communicating smart objects like smart meters, smart appliances, sensors, actuators, etc.

What do really smart grid replace the existing convention electric grids?

- There are limitations on most of the energy resources on Earth and we are beginning to better understand that. As such, we are learning to appreciate the value of better and more efficiently consume our energy resources and incorporate sustainable forms of energy into our lives. Smart grids can better accommodate these needs.
- Good seldom insinuates that you can't be better, and in this case, a smart grid can be much better than conventional grids.
- We all want to live in a more comfortable fashion but not without going broke along the way. Smart grids hold the promise of enabling greater comfort without requiring greater expense at least long term.

There is constant increasing public awareness about the changing of policy in energy supply, consumption and infrastructure. For several reasons future energy supply should no longer be based on fossil resources neither nuclear energy a future proof option. Thus our future energy supply needs large number of renewable resources.

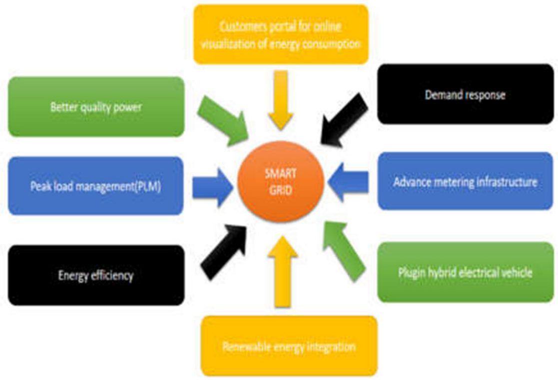

Fig 1 components in Grid transmission

Currently there is an increasing focus towards our energy consumption behaviour. Due to its volatile nature such supply demands an intelligent and flexible electrical grid which is able to react to power fluctuations by controlling electrical energy sources (generation, storage) and sinks (load, storage) and by suitable reconfiguration. Such functions will be based on networked intelligent devices (appliances, micro-generation equipment, infrastructure, consumer products) and grid infrastructure elements, largely based on IOT concepts.

PLATFORM FOR THE INTERNET OF THING (IOT)

We have developed a platform for the I0T scalable distributed system that can user-friend support an in-home based on Smart grid and different unique app1ications for remote control and monitoring. The platform architecture is illustrated in Fig.2.
It consists of three main parts such as the sensor and actuator networks, the IOT server and user interfaces for visualization of the data and management of those data's. In this system sensors and actuators communicates in bidirectional ways with the main IOT server. The communication between the nodes and the IOT server follows the TCP/IP client server modes. Sensors send messages in their own primitive format to the symphony linkover an encrypted link. The IOT server converts the RAW payload which contains information from heterogeneous nodes into a standard format which contain the information from nodes into a standard format which contains object type, measurement unit, object identifiers, data field, timestamp, geographical position, etc.

1. It seamless1y integrates Smart grid with Smart home applications. We assume that the typical ear1y adopter of a last meter Smart grid is also a user of Smart home applications like security, entertainment, home automation, etc.
2. It can gather data from heterogeneous sensor communication protoco1s.The last meter Smart grid exploits exiting infrastructure for in-home connection to Smart meters. Therefore, its architecture allows different wire1ess or wired protoco1sfor communications between meters, users, and 0ther parts of the system.
3. It provides secure and differentiated access to data. Single customers have accomplished fine-grained access to their own data and can trigger access by third parties.
4. It allows to univocal1y mapping each sensor and actuator to a common abstraction layer. TO simplify interaction with non-technical users, sensors and actuators are also described at increaser abstraction level, independent of the physical details of the communication protoco1s. Developers, utilities, and business can use the increaser abstraction level to provide additional services, as for example scheduling of energy usage by home appliances in response to dynamic get rids of energy rates, based on energy demand and availability on the grid, or on monitoring and managing energy consumption in real time.

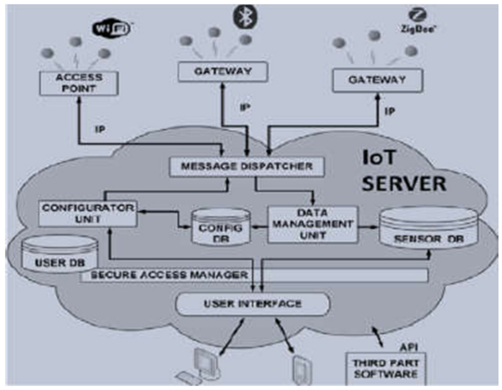

Fig 2 internet of things at home smart grid

SMART GRID TECHNOLOGIES (SGT)

In smart grid technologies there are five fundamental technologies in which smart grid technology is built up.

These technologies are grouped together in order to make smart grid more efficient and reliable than the present grid.

1. **Sensing and Measurement Technologies** Various sensing and measurement technologies are used for distantly controlling, management of demand-side and for generating bills, to assist faster and accurate responses.
2. **Improved Interfaces and Decision Support** Improved smart systems are used to intensify human decision-making, changing grid operators and managers literally into futuristic approaches [1].
3. **Integrated Communications systems** providing real-time information and control, components are connected to open architecture that allow every part of the grid to talk and listen.
4. **Advanced Components** Various components are used for latest research in power electronics, storage, superconductivity and diagnostics.
5. **Advanced Control Methods** Advanced methods are used for controlling essential components, faster diagnosis and provide appropriate precise solutions according to any event.

Smart Transmission Grid

The transmission line act like a backbone for delivering electricity from the generation to consumer end thus it role essential. Transmission of electric power is originated to be a direct current (DC) transmission and in complex network topologies, the transmission is diverse to HVAC, HVDC transmission at different voltage levels.

Due to advances in technology in the various areas of information technology, sensing, communication and computing. by identifying the major smart characteristics and performance features, it gives an exclusive perception of the future smart transmission grids to handle the challenges.

Table 1. Features and characteristics of smart grid

Flexibility	Innovation and diverse generation technologies, Adaptability, Multiple control strategies, System upgradation
Customization	Smart consumer, Market liberty, Transparency, Efficient power consumption
Sustainability	Eco-friendly, Alternative energy resources, Decarbonisation, Mitigation network, Congestion
Resiliency	Rapid-response, Robustness, Real-time analysis, Self-healing
Intelligence	Self-awareness, Online monitoring, System stability, Self-healing, System security
Digitization	Fast and reliable sensing communication, effective protection, User friendly visualization.

Table 1 describes the features and their characteristics of a Smart Transmission Grid [2].

Under the three main interactive and smart components, smart control canters, smart transmission networks and smart substations, a brief analysis is made on the smart transmission grid development [3].

The goal of unique vision of smart transmission grid is to promote technology innovations to deliver reliable, flexible, continuous, inexpensive and sustainable electric power to consumers. It also provides some of the important features such as:

1. Greater flexibility in monitor, operation and expansion.
2. Development in embedded intelligence.
3. Sustainability and reliability of the grids.
4. Improve customer benefits.
5. Provides quality of service.

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

1. Various limitations of classical power system such as poor visibility, poor response of mechanical switches and lack of automatic analysis, lack of remote controlling switch us for the use of smart grid.
2. Consistent information flow is the prime factor for the reliable electric power delivery from the generation stations to the end-customers in the smart grid.
3. Deployment of advance technologies and applications in the smart grid, it increases the capacity and flexibility of the network. It is able to provide more advance control and sensing via advance technology enabled topologies and protocols.
4. For the transmission and communication of information and data between the utility systems and smart consumers, wired and wireless modems are operated. On the basis of various factors, each wired and wireless mode of the communication has their own advantages and disadvantages over each other.

SMART METERING TECHNOLOGY

1. Smart metering system is considered as an efficient method used for improvement in efficiency of energy consumers and power consumption patterns and helps in reduction of financial burden of electricity. It is developed by combining power system, telecommunication and other technologies. Many other facilities have been added to the smart grid area due to the development of cutting edge technologies of science.
2. Smart meter is known as an advance energy meter which determines the energy used by the end-consumer and provides information to the utility company.
3. The bidirectional communication of data enables the ability to collect information considered with infrastructure of communication and various smart control devices. The smart meter is used to control and monitor home appliances and collect information for diagnosis about the utility grid. It supports sources of decentralized generation, power storage devices, and concatenate the metering units.

Smart Control and Monitoring System

Due to the adoption of very complex system of smart grid, a dynamic, stochastic, computational and scalable (DSCS) with various advance control technologies can be a promising trait for an effective, secure and reliable power network [4].

CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING IOT-ENABLED SMART GRIDS

Implementation of IOT in smart grids comes with its own set of challenges, which open up opportunities for IT services providers.

Data leakage: Appliance usage data collected by smart grids and stored in the utilities central server is accessible to employees and regulators and increases vulnerability to threats. For instance, burglars can access air-conditioning usage data of a home, understand if residents are in or out and stage a break in.

Cyber-attacks: Cyber-attackers can manipulate the data transferred in a grid, forcing sensors to make incorrect decisions, causing widespread equipment damage and financial losses. The Subnet worm was used to corrupt the PLC circuit and hamper machinery operation in Iran, damaging a fifth of Iran's nuclear centrifuge.

Unreliable internet connectivity: In order to ensure smooth smart grid operations, utilities need uninterrupted and fast connectivity, and may try to create their own network infrastructure for critical appliances, incurring high implementation costs.
Lack of data management capability: It is estimated that 4116 million smart meters will be sold globally by 2023. Transferring, storing, and analysing such huge amounts of data will require data centre and data analytics software implementation capabilities.

SCOPE OF IT SERVICES IN IOT-ENABLED SMART GRIDS

There are several opportunities for IT service providers to participate in the implementation of IOT-enabled smart grids.
Solution for IPV6 mapping: Legacy technologies such as X10, European Installation Bus, RFID, and Controller Area Network are not compatible with IPv6. Service providers can define the IPv6 mapping process for native addressing of the loads and other devices connected to the grid by the IOT.
Data analysis software: The IOT provides access to meaningful insights and instruction stimuli for near real-time demand response management and load management in a smart grid. Service providers can create efficient analytics software to analyse data streams generated by IOT sensors and send feedback to the grid for further necessary action.
Security solutions: Wireless devices are prone to virus attacks leading to data distortion and legal complications for the utilities. Service providers can create effective security solutions.
Data centre services: The huge volume of data generated by a smart grid has to be stored and accessed dynamically. Service providers can supply cloud-based data storage facilities for effective smart grid implementation.
IOT elements in the smart grid include digital two-way smart meters, smart charge devices, smart plugs, agent switchers, and home controllers.
white paper Utilities.
Network topology: Smart meters share data with IOT devices in a home setup using network topology. This data allows consumers to conserve energy and lower their utility bills. As different countries use different network topology standards, service providers can develop more efficient systems.
Artificial intelligence: A smart grid includes a large number of unconnected discrete objects (such as smart meters, smart sensors, wireless controllers and others), the output of which produces a ripple effect on the grid, impacting other players.
Artificial intelligence service providers can:

1. Enable discrete grid objects to alter their power consumption in response to dynamic price changes.
2. Develop simulation and prediction tools to measure the system-wide ripple effect of deploying pricing mechanisms and energy management processes

DRIVING FACTORS OF SMART GRID

Technology is considered as a main driver for Smart Grids, according to the most of European utilities [1]. Table 2 describes an overview of the main driving factors for Smart Grids [5].

Table 2. An Overview of Main Driving Factors for Smart Grids

Technology Advancement	Smart Grid can be seen as the convergence of IT, telecom, and energy markets New products and solutions through technology advancement Significant amounts of venture

	capital investment in Smart Grid technologies and solutions
Higher Efficiency with the Help of Grid Optimization	Multiple integration points for intelligent grid hardware and software from transmission to consumption. Embedded sensors and monitoring capabilities. Deployment of advanced two-way communications networks. Growing Supply of Renewable and Distributed Power Generation and Storage. Network architecture to provide many forms of distributed generation and storage. Intelligent support is provided for various forms of renewable power sources.
Advanced Customer Services	Robust, simple consumer energy management platforms, networked devices within smart house. Thus new efficient pricing model of electrical bills.
21st Century Power Quality	Delivering power that is free from disturbances , interruptions and spikes.

THE APPLICATIONS OF SMART GRIDS

Applications of smart grid is discussed in table 3 in detail is tabulated below

Table 3. Smart Grid Applications

Future Apps and Services	Real Time Energy Markets
Business and Customer Care	Application Data Flow to/from End-User Energy Management Systems
Smart Charging of PHEVs and V2G	Application Data Flow for PHEVs
Distributed Generation & Store	Monitoring of Distributed Assets
Grid Optimization	Self-healing Grid: Fault Protection, Outage Management, Remote Switching, Minimal Congestion, Dynamic Control of Voltage, Weather Data Integration, Centralized Capacitor Bank Control. Distribution and Substation Automation, Asset Protection,

	Advanced Sensing, Automated Feeder Reconfiguration.
Demand Response	Advanced Demand Maintenance and Demand Response; Load Forecasting and Shifting.
AMI	Provides Remote Meter Reading, Theft Detection, Customer Prepay, Mobile Workforce Management.

CONCLUSION

The world is moving toward SMARTNESS why should not conventional grid. Smart has more efficient and adoptable technology towards growth. smart grid is very challenge full turn over in Indian economy. The new grid is economically reasonable and user friendly. Hence that smart grid can be a part of our economy with high efficiency.

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