IoT Based Smart Grid Systems.

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Abstract:-

The internet of things is the widely accepted technology that connects everyday object to the internet for providing ease and various functionalities and the Smart Grid (SG) is defined as the power grid integrated with a large network of ICT. The Smart Grid is the combination of billions of smart appliances, smart meter, actuators and sensors etc.

This paper analyze the various accepted application requirement of Internet of Things deployed in Smart Grid and provides effective proposal about diverse technology and standards and of Smart Grid (SG) and it also provide an overview about several applications and driving factors of Smart Grid.

Keywords: - Internet of Things (IoT), Requirements, Smart Grid (SG), Technologies.

Introduction

Smart Grid is the first thing to appear IoT can play a significant role in developing Smart Grids which eventually leads to energy saving. IoT enabled Smart Grids are more about the energy efficiency and the management of energy consumption at the lowest cost and it is most important for our industry.

1. ***Definition of "Smart Grid".***

"A Smart Grid is an electricity network that can cost efficiently Integrated the behavior and actions of all users connected to it – generators, consumers and those that do both in order to ensure economically efficient, sustainable power system with low losses and high levels of quality and security of supply and safety. A Smart employs innovative products and services together with intelligent monitoring, control, communication and self- healing technologies in order to.

1. Better facilitate the connection and operation of generators of all sizes and technologies.
2. Allow consumers to play a part in optimising the operation of the system.
3. Provide consumers with greater information and options for how they use their supply.
4. Significantly reduce the environment impact of the whole electricity supply system.
5. Maintain or even improve the existing high levels of system reliability, quality and security of supply.

A common element to the most definition is the application processing and communication to the power grid, making data flow and information management central to the smart grid. Various capabilities results from the deeply integrated use of digital technology with power grids. Integration of the new grid information is one of the key issues in the design of smart grid. Electric utilities now find themselves making three classes of transformation: Improvement of infrastructure, called the strong grid of china, addition of the digital layer, which is the essence of the smart grid, and business process transformation, necessary to capitalise on the investments in smart technology. Much of the work has been going on in electric grid modernization, especially substation and distribution automation.

1. How Smart Grid Works.

First thing these are two types of smart grid.

1. Traditional Power Grid.
2. Smart Grid.

Unlike a traditional power grid with one way communication, a smart grid is a complex network that implies multiple two way interactions between equipment and participants in the supply chain. The structure enables various scenario of how generated power can move and be managed.

1. *Generate.:* Switch to the smart grid allows using the power generated from different and often distributed sources. It includes traditional power plant, renewable solar and wind as well as plug in electric vehicles and energy storage.

2. *Distribute:* Using a network of transmission lines, substations and automated distribution systems, the power is transformed to the correct voltage range if needed and distributed among the end users.

3. *Use:* End users get broad power managements capabilities and visibility thanks to smart grid applications such as smart meters, sensors enabled appliances, smart sockets, plug, etc. Using these tools consumers become active participants in managing their electricity consumption – use mobile or web apps to monitor and remotely control power usage, configure automated regimes, respond to load changes and control their spending and emission in real time.

4. *Control:* People, utility companies and other professionals in the energy industry expand their controls and management capabilities in a smart grid. Connected homes, communities and the whole cities use electricity and create data on the consumption and loads. This data can be used by any authorized participants in the supply chain. Thanks to data analytics and visualization tools, energy consumption data is turned into insight that makes the basis for future decision.

5. *Store:* Not only do households practice a more prudent energy use, but also store enough power to provide a house in the off grid scenario. Using storage, households save extra energy, choose the loads they need to backup and use this energy in the case of an outage.

2. Why Do We Need Smart Grid

First of all, traditional grids are aging and no longer effective with respect to growing electricity demand. The table showing the basic differences and benefits of smart grid over a traditional.

	TRADITIONAL POWER GRID	SMART GRID
METERING	EECTROMECHANICAL, SOLID-STATE.	DIGITAL/MICR OPROCESSORS.
COMMUNICATION	ONE WAY AND LOCAL TWO WAY COMMUNICATION.	GLOBAL/ INTEGRATED TWO WAY COMMUNICATION.
CUSTOMER INTERACTION	LIMITED.	EXTENSIVE.
GENERATION	CENTRALISED.	CENTRALISED AND DISTRIBUTED GENERATION.
POWER FLOW CONTROL	LIMITED PROTECTION MONITORING AND CONTROL SYSTEMS.	WAMPAC, ADAPTIVE PROTECTION.
MONITORING	"BLIND"	SELF-MONITORING
RESTORATION	MANUAL	AUTOMATED SELF-HEALING
OPERATION AND MAINTENANCE	CHECK EQUIPMENT MANUALLY	MONITOR EQUIPMENT REMOTELY
CONTROL	LIMITED CONTROL SYSTEM CONTINGENCY	PERVASIVE CONTROL SYSTEMS
RELIABILITY	ESTIMATED: PRONE TO FAILURE AND CASCADING OUTAGES	PREDICTIVE: PRO-ACTIVE REAL TIME PROTECTION AND ISLANDING
TOPOLOGY	RADIAL	NETWORK

3. Innovative Smart Grid Technologies :-

The operation of smart grid relies on a broad range of technology and infrastructure solutions. Smart grid based on IoT and data technologies is prevailing and includes several important components.

1. *Smart sensors and meter :-* These are the very basic components of smart grid that enable continuously create and report status data to enable monitoring and control. Smart meters accumulate energy use data and show the full picture of energy consumption in the house.

2. *Automated Distribution :-* Advanced distribution systems use real-time data to dynamically respond to the changes in loads, detect blackouts and correct power distribution to enable both safety and economic savings. This is the part where smart grid using IoT introduce automation and self-management.

3. *Charging stations and smart storage :-* In this concept of smart grid, energy storage and charging stations play an important role. Not only do these technologies allow households to safety go off in case of outages or accident. They also reflect the growing demand for independent residential renewable systems.

4. Various Application Requirements of IoT Deployed Smart Grid.

1. IoT is widely deployed in various types of e- health application and provide various facilities for coping with health issues.
2. IoT can be used for monitoring, plant area monitoring, coal material monitoring, pollutants and gas emissions monitoring, power prediction, energy consumption monitoring, pumped storage power plant monitoring, energy storage, power connection etc. In the various area of power generation.
3. IoT is deployed for transmission line monitoring and controlling equipment managements, tower protection, distribution automation and intelligent substations.
4. IoT is basically used for smart meter and smart power consumption, multi-network convergence, electric vehicles charging energy efficiency monitoring and management.
5. High reliability AMR based on IoT:- Auto meter reading systems plays an important role in smart grid. It is system responsible for collecting. Processing and real-time monitoring power consumption information intelligently.
6. Smart patrol based on IoT :- The patrol of the power transmission, substation and distribution equipment is mainly conducted manually at a regularly time. It is based on IoT enabled wireless sensor network and can help positioning equipment by identifying labels, thus improve the standardization and regulation of patrol works.

5. Smart Transmission Grid (STG) :-

1. 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.
2. The goal of unique vision of smart Transmission grid is to promote technology innovation to deliver reliable, flexible, continues, inexpensive and sustainable electric power to consume.

6. Features and characteristics of STG.

FLEXIBILITY	INNOVATION AND DIVERSE GENERATION TECHNOLOGIES, ADAPTABILITY, MULTIPLE CONTROL STRATEGIES, SYSTEM UPGRADATION.
CUSTOMIZATION	SMART CONSUMER, MARKET LIBERTY, TRANSPERANCY.
SUSTAINABILITY	ECO- FRIENDLY, ALTERNATIVE ENERGY RESOURCES, DECARBONISATION.
RESILIENCY	RAPID RESPONSE, ROBUSTNESS, REAL-TIME ANALYSIS, SELF-HEALING.
INTELLIGENCE	SELF AWARENESS, ONLINE MONITORING, SELF-HEALING, SYSTEMS SECURITY.
DIGITIZATION	FAST AND RELIABLE SENSING COMMUNICATION, EFFECTIVE PROTECTION, USER FRIENDLY, VISUALIZATION.

Table no.1:- features and characteristics of STG.

7. *Information and Communication Technology (ICT) :-*

1. Various limitations of classical power system such as poor visibility, poor response of mechanical switch and lack of automatic analysis.
2. For the transmission and communication of information and data between the utility system and smart consumer, wired and wireless modes are operated, on the basic of various factor, each wired and wireless mode of the communication has their own advantages and disadvantages.

8. *Application of smart grid :-*

1. Smart grid plays very important role in modern smart world technologies. Following are the most common application.

FUTURE APPS SERVICE	REAL TIME MARKETS.
BUSINESS AND CUSTOMER	APPLICATION DATA FLOW TO FROM END USERS ENERGY MANAGEMENT SYSTEMS.
DISTRIBUTED GENERATION AND STORE	MONITORING OF DISTRIBUTED ASSETS.
GRID OPTIMIZATION	SELF- HEALING GRID:- FAULT PROTECTION, OUTAGE MANAGEMENT, REMOTE SWITCHING, MINIMAL CONGESTION, DYNAMIC CONTROL OF VOLTAGE, WHETHER DATA INTEGRATION, CENTRALIZED CAPACITORS, BANK CONTROL, DISTRIBUTION AND SUBSTATION AUTOMATION ASSETS PROTECTION, ADVANCED SENSING, AUTOMATED FEEDER.
DEMAND RESPONSE	ADVANCED DEMAND MAINTENANCE AND DEMAND RESPONSE, LOAD FORECASTING AND SHIFTING.
AMI	PROVIDES REMOTE METER READING, THEFT DETECTION, CUSTOMER PREPAY, MOBILE WORKFORCE MANAGEMENT.

Table no. 2:- Common application of smart grid.

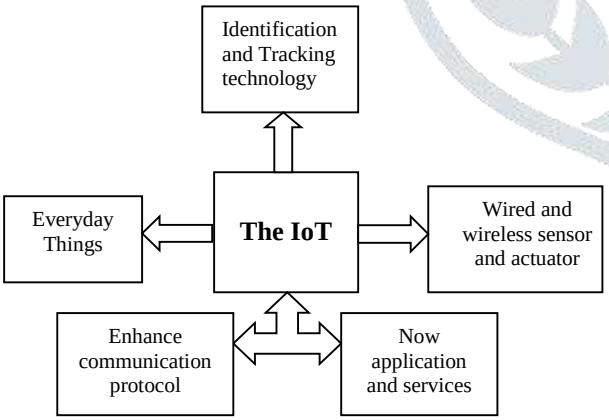

Fig no.3 Structure of the Internet of Things

CHALLENGES

1. One of the biggest challenges of implementing millions of new devices for the smart grid is that each of this device could become a potential target for hackers, being in this sense security a vital point to be solved with full safeguard against intrusion by a third party.

2. Ukraine attack is a wake-up call this attack was relatively short-lived the next one might not be.

3. To deployed IoT enable local smart grid numerous sensors have to be installed and the amount of transferred data will be significant. Big data management and storage is a big challenge.

4. Efficient interoperability between different communication networks is also a main concern of smart grid deployment.

CONCLUSION

This paper has been addressed an overview of IoT technology and it's various uses in the smart grid technology. By applying Internet of Things (IoT) technologies, various intelligent service can be created. The development of most aspects of the smart grid would be enhanced by applying IoT. There many driving factors that increase interest to switch from conventional power grid systems as it provides very effective measures of delivering electric power to various consumers.

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