Smart grid construction for electricity load management

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Abstract - *This paper deals with the concept of automatic meter reading(AMR).It is a technology used in most of the research areas for collecting energy consumption data and status data using various metering devices such as advanced meters, data longer and embedded meters and thus transferring this collected data's to the central billing system for further analysis. It creates a communication phase between the business and the suppliers. It provides us an accurate billing and user can analyze their energy supplier data directly without the interception of others. The load management or in other words demand side management (DSM) balance the load of electric power on network using an electric load by controlling the load .A technology came to be known as smart grids which were used to maintain a reliable and secured electricity infrastructure to meet the future demand*.

Key Words: *Automatic meter reading (AMR), advanced meters, embeddedmeters, powerlinecommunication (PLC), smart grids.*

1. INTRODUCTION

The government has adopted an alternative solution towards the increasing energy consumption day by day, one among them is came to be known as the smart grid otherwise also known as smart electrical/powergrid, intelligent grid, future grid, intergrid, intragid.the traditional smart grids are used to transfer power from few central generator to many customers' instead smart grid (SG) allows two way communication and electricity to provide automatic power delivery network. it can automatically detect the power failure events.AMR is automatic meter reading has the capability of detecting the temper events and outage occurrence. The data's are consistent and granular for improving the efficiency. If the process of measurement through digital communication network. As most of the electrical energy we consumes today is generated from fossil fuels which is less efficient and causes pollution also emit toxic gas such as carbon dioxide.

SG communication technology provides improved load estimation,control,efficiency,safety and realiability.power line communication(PLC) is one of the grid operators preferred choice due to its advantages.Some of the common PLC includes broadband PLC(BPLC),narrow band PLC(NBPLC), etc has been evolved to improve the performance of SG vision. SG archichecture implemented supports two energy sourses such as renewable sourses such as wind turbines, solar panels, and biogas plant.the non-renewable sourses include thermal power plant, nuclear power plant. This energy sourses are connected to individual digital energy meters.thus the parameters such as current, voltage, frequencies etc can be derived from these individual digital meters.

The collection of meter reading is controlled by internet enabled embedded system. The data is periodically updated into the server which in turn provides web services such as display of meter information.eternet and wireless LAN are widely used communication infrastructure for smartgrid.one major challenge of this power grid is reliability quality as all the users required sufficicient electricity day by day thus leading to blackouts and brownouts. The other challenge facing includes the peak demand which is not stable i.e. the energy demand is not same it is varying. Some of the common comparisons between previous and existing smart grid (SG) is constructed in the given in the above table. One of the purposes for smart grid is reduced in wasteful electricity.

Table -1 Comparison of Existing grid and Smart grid

Existing grid		**smart grid**
Communication	unidirectional	bidirectional
Pollution	High	low
Control	Limited	pervasive
Generation	centralized	distributed
Test	manual	remote
Sensors	Few sensors	Lot of sensors

The three major systems for SG in technical aspects are smart infrastructure system deals with the communication,information,and energy and also supports electricity delivery ,generation and consumption.the other is smart management system which provides advanced management and control services. The last one is the smart protection system which is the subsystem of SG which provides advanced grid realiability servicesand analysis,failure protection,security and privacy protection services.ther are several benefits of developing the SG such as improved relability,efficiency, capability holding distributed power sources and so on.

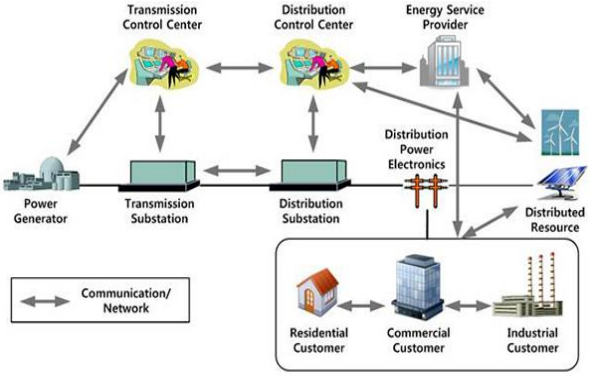

Fig.1. **NIST smart grid conceptual model**

2. RELATED WORKS

An advanced Metering Infrastructure(AMI) which is meant for improving the energy efficiency and constructing an self-healing and reliable protection grid against the natural disasters. There is a NIST model of SG which .As per this models the SG Supports various beneficial features. The NIST conceptual model is given in fig1.the various domain and operators in NIST are customers, market, service providers, operation, bulk generation, transmission and distribution. Customers as we know that they are the end users of electricity. The various operators and participants in market place is what a market. The operators performs the operation or manages the electricity supllies.transmission are the carriers of distributes electricity to and from costomers.As we already discussed about the three systems that an SG support namely smart infrastructure system, which is responsible for information, energy and communication and which is further divided into three they are smart energy subsystem, smart information subsystem, smart communication subsystem. Smart management system, it is a subsystem of SG which provides management, control services and various other functionalities. And smart protection system, it provides an advanced grid technology that detects the failures and provides security.

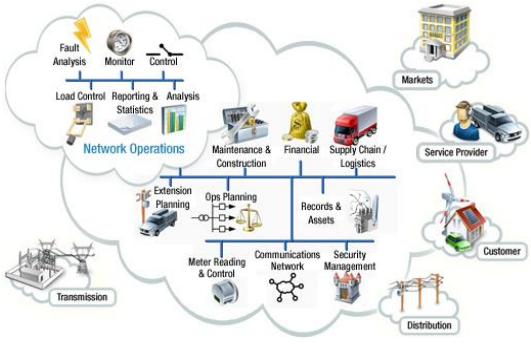

Fig.2. Web of thing in SG

The service provider within the web of things provides services to the servers such as displaying of the information displayed on the metering devices, location of the home connected by the grid, and by means of embedded devices scheduling the power sources to the individual home and so on. The users only need to know their username and password to gain access to computer connected to the internet. The individual supply of power is controlled by the source charger and this source charger is controlled by the embedded devices in turn.

3. Communication network of Smart Grid over a narrow band power line

A Smart Grid supports two kinds of communication one is wired network (WN) which includes optical fiber and powerline.the other is wireless network (WLN) which includes ZigBee, Bluetooth and satellite. The Smart Grid is subdivided into three wide area network(WAN),Neighborhood area network(NAN) and Home area network(HAN).a good Smart Grid technology not only needs to be pervasive ,scalable and reliable but also must have quality of services(QoS).A Narrow Band Power Line(NBPL) is considered to be good cost effective choice for an SG. Power Line Communication (PLC) is one of the utility preferred for most of the SG applications. Which is classified as narrow band PLC (NPLC) and broad band PLC (BPLC) on depending upon their operational range.NPLC operates on a frequency is varying in different countries. Another communication medium is that distribution line carrier which is different from BPLC and NPLC.there are several noise problem arising in PLC .so in order to compensate it a hybrid of contention (CSMA/CA) and reservation (resource reservation) MAC protocol has been introduced to improve the performance and roburtness.The DLC consist of a convergence layer that accompany a modem that ensures smooth and transparent transmission between the nodes. The convergence layer control three planes they are the management plane which configure and control the parameters of each layer. The context plane which manages the data packet unit (DPU) travelling over the signaling plane in terms of security and QoS. The last one is the signaling plane which carries IP PDUs that are received from the power line physical layer.

4. SECURITY IN SMART GRID COMMUNICATION

certicate is valid then the VA sends the positive reply. The other security measure is the trusted computing which allows any device to join in the grid network and to verify the authorized code that is running on the system. It is the one which is well documented and available on demand. The security in smart grid differs from one application to other. The most important necessities among them are confirmation, trustworthiness and accesibility.some of the security requirements for smart grid is mentioned below they are:

1. Data confidentiality and integrity

The smart grid must provide data confidentiality and integrity by protecting the transmitted message. It is done by constructing a fabricated

channel that allows the user to communicate in the insecure environment.

2. **Mutual authentication**

The smart grid must be authenticated which means that all the connected nodes should be authenticated to one another. For an event which required an authentication must be accompanied with the key generation.

3. **Availability**

It is a kind of robustness that a smart grid supports. It prevents the shutting down of the entire system that is Denial of Services (DoS) must be eliminated.

4. **Access control**

It is the vital part of the smart grid which guarantees the secrecy and the confidentiality of the system.the access to smart grid is limited to the authorized parties.

5. MAJOR COMPONENTS OF SMART GRID

The major components that support the functionality of the smart grid are as follows

1. **Smart meter**

One of the major functionality of smart meter is that it details and recognizes the total electricity consumed. It also monitors the power quality and determines the power that outranged.

2. **Phasor measurement**

There arise the waves on the smart grid this device measures the incoming waves in the grid using synchronization source that provides real time measurement on grid which is known as synchrophasor.

3. **Information transfer**

It is one of the major components which establish the two way communication to home application. The protocols such as ZigBee, bluetooth, infrared are popular among them.

4. **Distributed generation**

It means using the power technologies which are closer to the user. The advantage of such distributions are reducing cost, increases the reliability, and expanding the energy option.

6. CHALLENGES FACED BY THE SMARGRID

Lots of risks have been gathered to transform the current power system to smart grid. Many of the utility companies and other participants are still facing the same challenges. They include interoperability, cognitive accessing the unlicensed spectrum .The other challenges other than this includes are

- The monitoring and control operation of the smart grid.
- As the system deals with both renewable and non-renewable sources most of the renewable sources are not stable.
- The present infrastructure of the smart grid is considered to be inadequate.
- Lack of policy and regulation related to the smart grid such as like off peaks, peak tariffs, so on.

7. SMART GRID IMPLEMENTATION

The process of implementation involves two major steps one is authentication and the other is encryption process. The detailed description on the two processes is described as follows

Authentication

As the validations are not stable we need to adopt a smart grid secure protocol (SGSP) which provides the shared validation and information confidentiality. This is the area which examines SGSP hand shaking. Three areas are included in this area they are supplicant or the remote station, authenticator or access point, and the authentication server. It is one of the confirmation that implies the supplicant and the authenticator identifies one another and thus generate some of the shared secrets to generate the key validation server can execute either in a single device with the authenticator server or by means of different servers thus a connection between the confirmation server and authenticator initiates.

Data encryption

Cryptography is one of the most important technologies for protecting the data from unauthorized access. It includes two processes one is encryption and the other is decryption. The process of transformation of message to be protected is called encryption and the transformed or encrypted messageis called cipher text. At the receiver side the encrypted text is decrypted.

Digital signature

Digital signature is the process which enables the digital signing of the message by the sender. on the receiver side the receiver can verify the identity of the sender known as the authentication. The receiver can prove and the sender cannot deny that the message has been send by a specified user. The receiver cannot modify the message and can claim that it is the message received from the sender.

8. FUTURE ADVANCEMENT AND IMPLEMENTATION OF SMART GRID

WIND ENERGY

The smart grid generates and integrates lot of small electrical heats pumps. So as per the demand side it coordinates and controls the generated heat pumps. As if the wind mills are utilized accordingly then it would satisfy the electricity needs of the country.

ELECTRICAL VEHICLE

There is a great achievement towards the development of electrical vehicles due to the invention of smart grid. Due to the use of electrical vehicle there is a significant reducing in usage of fossil fuels thus reducing greenhouse effect

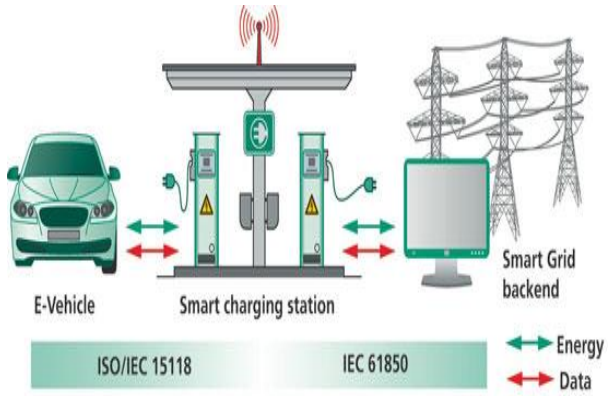

Fig.3. Smart grid technology in electric vehicle

9. CONCLUSION

This paper gives a brief overview on smart grid ,an important power control on next generation.manty new technologies have arrived sensing,supporting,the human interfaces. This smart grid is new and its initial cost is more we don't know its present status. Smart grid technology is smarter for us as we know about the electricity consumption; you will have more control over its usage and billing. It provides a clear estimation of greenhouse gases associated with electrical usage. The system will also improve and provide how renewable energy sources are integrated with electric grid. Thus we need to start planning for future today, by building smarter grids and providing people smarter ways to control energy consumption.

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