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Smart Grid:The Future Of The Electrical Energy

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ABSTRACT:

This paper is about the smart grid,which is said to be future of next generation power grid,Addressing the entire process of power generations through substations to distribution and the feedback loops along the way necessary to provide the computerized intelligence which is used to establish the 'Smart Grid'.Both the state and national level governments have recognised a need for modernising the electrical energy system and to establish the smart grids at each and every region .The existing electric system is built on a one-way flow of energy and information from sources to end-curves; however, the future smart grid will allow several channels for the flow of electricity and information on the flow of current throughout the system.The necessary aspects that we are going to discuss in this paper is about the improving energy efficiency,various management objectives,reducing cost,technical challenges facing in deployment and implementation.

KEYWORDS:

Smart grid,control,distributed generation,economics,storage and demand response.

I.INTRODUCTION:

Technically,the term grid is used for an electrical system covering these four aspects: electricity generation,electricity transmission,electricity distribution and electricity control.

Smart grid has different names such as powergrid,electrical grid,intragrid,future grid,intelligrid and smart electrical grid.Supplying power from few generators to a large number of suppliers and delivering to the customers is one of the thing in power grids.Coming in contrast with the Smartgrid(SG) it uses the two-way flows of electricity and advanced network operations for better efficiency of power generated from the supply(power grid).

Let us compare the existing grid and the smart grid in the below table;

Existing Grid	Smart Grid
1.Manual monitoring	1.Self monitoring
2.Manual restoration	2.Self restoration
3.Limited control	3.Pervasive control
4.Few service choices	4.Many service choices
5.Centralisied generation	5.Distributed generation
6.Electromechanical	6.Digital
7.One way communication	7.Two way communication

Using newly equipped technology,the SG is capable of delivering power in more efficient ways and used for different conditions

For example,if any medium voltage transformer failure happens in the distribution grid then the distribution of power is denied. In such a case the smart grids automatically change the power flow and recover the power delivery service.

Let us perceive another example of demand profile shaping.Since lowering peak demand and smoothing demand profile decreases the total plant and capital cost requirements,in the peak period of electricity utility can activate real-time pricing to ensure some areas to reduce their power demands,so that the total demand profile full of peaks can be shaped to a smoothed demand profile.

More specifically the smart grid uses the two way communication,cyber secure technologies and

computational intelligence in an integrated method across electricity generation,transmission,substations,distribution and consumption to achieve a system that is clear,clean,safe,secure,reliable,recessive and sustainable.

II.TECHNOLOGIES USED IN SG:

Based on our requirements we are using different technologies for smart grid For smart grid applications we are using programmable logic controllers simply we can say PLC , wireless , cellular ,SCADA i.e, supervisory control and data acquisition for integrated communication communication.

Now we will briefly discuss these technologies that are used in grid management.

Programmable Logic Controller(PLC):

Programmable logic controller simply we can say it is a general purpose controller.

Programmable logic controller used in meter:

The repetitive tasks can performed by using the traditional programmable logic controller.The tasks are reliable and these tasks can perform at low costs.The smart meter is realised by the PLC is incorporating within an electrical meter.The communication bandwidth can be improved by using PLC within a smart-meter and also can improve the lower processor scan-time , code efficiency and effectiveness.

PLC generally performed metering measurements and monitoring solutions.The concept of distributed logic can realised by the programmable logic controller with the meter.we can use the simple programming software for localized control :

- The advantage of the PLC is modular.
- The PLC is an industrial computer control system.
- It always monitors the current position of the input devices and it takes the decisions based on a custom program which controls the states of output devices.
- Specific processes, machine functions or even an entire production line can be automated by these controllers.
- It is used in mechanised automation often.

Wireless technologies used in smart grid:

Wireless technologies are very suitable for the use of communications in highly populated areas with large amounts of distribution lines.

Here we can take few things to use the wireless in smart grid applications those are:

- Bandwidth
- Latency
- Security
- Reliability

These four main aspects are considered for using wireless in smart grid applications.

BANDWIDTH:

Every device needs to remain stall to allot for services planning.Bandwidth needs to be homozygous for all devices.

LATENCY:

If any communication delay occurs in any system it will be useful to know the information in smart grid the time critical applications run on fiber,because of this only latency is not a big problem.

SECURITY:

Networks should deject and observe unauthorised access , measure and modification , to both data and physical smart grid resources reduction mechanisms include incorporating multiple , threat-specific layers of defense onto the network , based on the behaviour and context of each potential threat.

RELIABILITY:

The monitoring analyses and control capabilities that come with a modernised smart grid improve the reliability , economics and distribution of electricity.

III.CELLULAR TECHNOLOGY:

Energy supplies have two important cellular technology options , those are

- Second generation(2G)
- Third generation(3G)

Cellular technology is also called WAN technology. This is a wireless technology from so many years that energy suppliers used wireless WAN solutions to communicate with concentrators monitoring large numbers of meters in NANs. NANs means neighbourhood area networks. Gradually , they are using cellular technologies that play an important role in smart metering deployments and the smart grid as a whole.

Now present situation mostly, cellular point-to-point smart metering infrastructure are part of global system for mobile communications(GSM) networks and these are use the general packet radio service(GPRS) data services , a low cost 2G solution for evaluate the enhanced data rates for GSM evolution (EDGE) .

IV.ADVANTAGES:

1. First advantage of smart grid is energy savings through reducing consumption.

2. By using a smart grid we can know about the consumption of the energy meter at any time so we can easily know the real consumption. With the help of this we can maintain better consumption and power can be adjusted to meet the real need of each consumer. Because of these we can reduce our consumption thereby power loss will be reduced.

3.Second advantage is better customer service and more accurate bills.

4.Another important advantage bills are more accurate which is offered by telemanagement systems.

They always show the real consumption of each month instead of estimates and also reduce the cost of the old systems of manual energy meter readings. And with the help of this problems can be easily identified and we can find the solution very quickly. Thereby we can improve customer service , and the remote management system can automatically report all problems or incidents to the electric company. By this it can respond faster to users

5.The other advantage is fraud detection and technical losses .

- Telemanagement systems can more accurately identify fraud. The new energy meters with PLC PRIMC-communications have systems that identify the opening of the terminal strip cover and sound an automatic alert both managers of the grid warning of potential fraud .

6.The next advantage is its reduced cost .

7.Smart grid can collect more information or data compared with the manual energy meter reading system so by this it can permit the data analysis techniques.

8.The next advantage is levelling of the demand curve (peak reduction).

9.Advantage in reduction of carbon emissions.

So we can say the smart grids have a sustainable future.

V.DISADVANTAGES:

1.High cost because of installation of analog meters by more sophisticated electric meters.

2. There is a lack of regulatory norms for standards of equipment used in smart grids.

3. Lack of official technology documentation.

4. Continuous correspondence system bought to be accessible .

5.Some brilliant meters can be hacked which can be utilised to increment or decrement the interest for power .

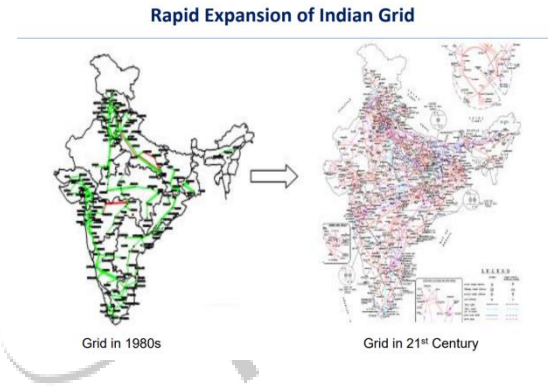
6. It is costly to introduce brilliant meter contrast with customary old meters .

Here comes the list of typical problems and optimisation solutions for smart grid :

Optimization Problems	Currently used Techniques	Next Generation Techniques
Unit Commitment / Hydro dispatch	Dynamic Programming (DP)	ADP & its variants
Control Coordination	Decomposition Optimization	ADP, AHP, and EP methods
Machine Controls and Stabilization	Optimal Control	ADP and Evolutionary Programming
Optimal Reconfiguration	Mixed Integer Programming	Dynamic Stochastic Optimal Power Flow (DSOPF) and its variants
Loss Minimization	NLP and Interior Point methods	
Economic dispatch for Large Systems	NLP, DP methods	
Locational Marginal Pricing	LP methods	ADP
Data Mining	State estimation (SE)	ADP and EP methods
Optimal Sensor Placement	IS methods such as ANN	ADP and DA

VI.EVALUATION OF SMARTGRID :

This include how vast the use of smart grid is evolving from 19s to 21 century :



Economics in Smart grid :

In 2009 , the US smart grid industry was valued about $21.4 billion by 2014 , it will extend upto $42.8 billion . Smart grid was given success to the US , the entire world market is expected to grow at a faster rate, swagging from $69.3 billion in 2009 to $171.4 billion by 2014 .

The size of the smart grid market was valued at over US $30 billion in 2017 and is set to expand over it . CAGR to hit US $70 billion by 2024 . Growing need to digitalise the power sector driven by ageing electrical grids infrastructure will stimulate the global market size . According to the International Energy Agency(IEA) , global investments in digital electricity infrastructures was over US $50 billion in 2017 .

A 2011 study from the electric power research institute concluded that investments in smart grid technology in the US will raise up to $476 billion over 20 years but will provide up to $2 trillion in customer benefits over that time . In 2015 the world economic forum reported a transformational investment of more than $76 trillion by members of the OECD is needed over the next 25 years .

If smart grids are deployed fully in across the US the country expects to save USD 130 billion annually

VII. CUSTOMER DEMAND AND RESPONSE

Loads Many people, especially in the public sector, consider the Smart Grid to be nothing if not Advanced Metering Infrastructure (AMI), including– Automatic Meter Reading (AMR). More advanced features of an integrated AMI includes a Distribution Management System with full control, monitoring and Geographic Information System (GIS) interfaces. In addition, AMI Smart Grid systems provide consumption control at the customer site, distributed load management, and 2- way communications (c.f.,Mahmood, Aamir, and Anis, 2008). AMI and Home Area Networks (HAN) provide added Demand Response functionality such as automated control of refrigerators and/or air conditioners by the utility and curtailable load based on electronic communications only. Many conumerutility intermediary companies provide automated curtailment programs through subscription services. Certain "Self Healing" capabilities more common to the Internet can be built into automated reconfiguration regimes, as for example demonstrated in Tsoukalas, and , Gao 2008).

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