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Challenges in Demand Side Management in Smart Power Grid: A Review

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ABSTRACT:

A power system can be seen from two sides i.e. from supply side and from demand side. Now days, Demand Side Management (DSM) is emerging as important part of Smart Grid. In this paper, we study and analyse the challenges seen are load scheduling, peak load management, renewable energy sources connection with the grid, cost optimization etc. The load scheduling can be made by way of an accurate two-way communiqué which has its individual challenges in the power system. Also, few other issues are likely security and privacy which needs a special focus. A special attention has been added w.r.t environmental consciousness. All these challenges need an optimizing approach which can be done with the help of demand side algorithms and game theories.

Keywords:Demand Side Management,Plug-in Electric Vehicle, advanced metering infrastructure, Home Area Network, Electric Spring

Introduction:

We know that the growth of a country is measured in terms of power consumption and electricity use is escalating each year, the power competence possibly will shortly visage its edge as power consumption soon put up the shutters to the limits. Also, the system seems to be further competent if the competence between zenith and off-peak demand can be reduced [18]. DSM involves management in the end side of the customer of the power grid, e.g. definite set of instructions are concerned by which consumers got optimistic to modify their demand to non-peak hours so that their expenditures could be reduced and also enabling smoothen zenith demand thus having a great positive impression on power structure stability and total production cost [18]. In housing type consumers, depending on a contract between the service providing company and consumers, the service providing company can distantly run the operations and power spending of needed appliances in a family unit [5]. An additional category of DSM program is Chosen Load Management Programs [10]. A fresh move towards DSM is using set of instructions so that the users further become lively contributors by motivating consumers to use electricity more reasonably. Conversely, it should be noticed that customers should not have at all concern to follow the set of instructions repeatedly, like,a react to the sudden changes in price [15]. Also, there should be a measure for measurement of automatic load scheduling in DSM. Use of 2-way communiqué in smart grid n network and with well-groomed pricing policy in DSM, motivate consumers in handling their loads remotely or without manual needs. However, applying automatic DSM in upcoming smart grid may face a number of problems. Here in this paper, we made efforts to classify and review the most significant challenges in this field of research. Here the main goal of automatic DSM is Load scheduling of shiftable house hold equipments and appliances for e.g.Kitchen Utensil washer, Clothes dryer, dish washer with Plug-in Electric Vehicle (PEV). If the consumers show interest in accepting delay or flexibility in operation time of their non-important jobs, the Plan Manager manages the load in such a way that all system objectives could be achieved. It is seen that the Implementation of communicationinfrastructure has various limitations in the smart grid. The important aspect of safety and confidentiality has to be noticed in crafting DSM algorithms. With this fact, it is necessary for consumers to do not accept replacing of meters with advanced meters if their privacy is in deep danger. One more aspect of DSM algorithms is fairness. It is assumed by the designers that all consumers had participated in DSM scheme because of monetary benefits, one should remember that fairness should be there toregularise user'sinvolvement. Different definitions of fair system are available. For example if plan manager won't show fairness in determining delay for house hold equipments or appliances or in payments of consumers. Here, we had made an effort in proposinga detailed literature review.

Challenges:

Based on literature survey, there is certain challenge which needs special focus so that a proper demand side management could be done. Some of the challenges are described as below:

1. Load Arrangement
2. Communique
3. Systematic Honesty
4. Safety and Confidentiality
5. Green Surroundings Realization

1. Load Arrangement:

With expansion of smart metering technologies, Demand side management is the need and should be competentenough to get implemented in distribution system of the power system grid. In this type of system, forecast units are fixed which calculate power consumption in smart meters to map the users' energy usage by acquiring data from a control centre. A demand cum response model had been described by SeungHohonglinking one utility company and multiple consumers, focusing at balancing the supply-demand relation and also flattering the total load of the supply system [18]. Onechallenge of competing to meet up the total load demand by active suppliersof the system is also addressed by compiling the DSM problem in two games. Thus one game triesto increase the suppliers' profit at its maximum and the other tries to increase the customers' payoff [5]. Power scheduling can also be done for shiftableequipments& appliances like dish water, TV moisture cleaner, washing machines, electrical vehicles [9]. We can shift the operation time of these equipments if the consumeris ready to beara littledelay in completing the task of that particular equipment or appliance.

2. Communique

DSM algorithms may easily used in smart power grid with the help of asuitable two-way communication structure. This communication structure for demand side management has generally two components. First one is the Structural network for advanced metering infrastructure (AMI) who consists of electricity service providers and technically smart meters. Smart meters require to commune with each other and also with service provider to swap the necessary data for the load arrangement, particularly the cost signals which are transferred from supplier to the power consumers to the load demand which is sent from users to the provider [15]. Wireless, one of the Communication technologies [2] is a necessary candidate for the communication infrastructure. Here, the electric power scheduling can be formulated as an optimization problem including continuous variables and integers. An optimal scheduling scheme can be defined by analysing the optimization problem. Alternatively, the total deploying cost of PLC technology is quite low still it may have some issues in high data rates. Another half of communication network for applying DSM algorithms is the network for communication of home appliances with smart meter which is called Home Area Network (HAN). However, the smart electricity meters or EVs as well as erstwhile parts of the smart grid require a trustworthy and competent communication infra-structure. Also, problem of scheduling the Electric Vehicle (EV) battery charging is modelled as a Markov decision process with unknown transition probabilities [2]. It looks that the upcoming potential smart grid communication infrastructure will include diverse technologies for diverse parts of thestructure. Also, to organizesuitableexpertise in smart grid communication infrastructure is a well knowndifficulty. Some of the problems in arranging each one of these technologies, such as safety, execution and confidentiality.

3. Systematic Honesty:

The most necessary feature to promote a consumer to give in system programs is Systematic Honesty in consumers' electricity expenses. Therefore, system become more honest if the consumers which give more contribution to the systemwillpay less than others [4]. In [12], authors believed that the costing shouldbe based on the kind of consumers and equipments, and the capability of customers to recompense.But, Honesty cannot be acceptable in such type of criteria as in general [11]. In [8], the worth of consumers' flexibility may be reflected in billing mechanism (in terms of buying delay) in scheduling the system programs is tough to execute in reality. In [10], reasonable honesty oriented billing machinery is offered in which consumers need to pay depending on their own flexibility in accommodating delay on completing the task of their house hold equipment. Here, authors describea honesty index for estimating the honesty of the projected algorithm. The authorsillustrate that achieving honesty in consumers' payment may reduce the power system optimality. Although, here is aexchangelinking optimality and honesty. In other words, in [11] the authors define the honesty is freshlywell thought-out in DSM. A authentic honesty criterion must be define to measure the honesty of the algorithms. The subject of honestyis one of the attributes which is very much necessary in choosing a appropriate DSM program in practice.

4. **Safety and Confidentiality:**

   In current researches [20], Safety and Confidentiality are significant areas in smart power grid. Now days, Cyber security is occurring as a new challenge in smart power grid network. Therefore, in DSM programs, it is of utmost importance of the safety of the exchanged data, e.g. cost signals and the total load of consumers, are aanxiety of designers. The cyber attacker may get the accessibility of the software of DSM algorithm which may results intheft of data and may enter in users' isolation or could manage to alter data.

5. **Green Surroundings Realization:**

   Green Surroundings Realization means to refer to specific psychological factors related to individuals' propensity to engage in pro-environmental behaviours. Chiu emphasised on increased environmental consciousness and relate the need for electric companies to changeconventional generators by renewable energy sources which already have space now a days in consumer's homes. The projected framework seeks to attainutmost benefits for both consumers and electricity companies. According to him, this is a new thought of its kindof first attempting to deal with the time- dependent problem for smart grids and also considering environmental benefits by using renewable energy. His numerical analysis shows that his proposedstructure can drasticallycut peak time loading and economicallystable the power system energy distribution [3]. Here Solanki shows excerpts of technical writings issued in the area of Electric Spring (ES). ES is slowly growing as aimportantconstituent of smart grid technology so that there can be effective demand side management. This offers stability to the power grid by giving reactive and active power compensation along with power quality is also enhanced by the means of harmonics mitigation, by droop control and reducing the neutral current by means of reducing imbalance in the system.

This will result in offering a good alternate to statcom. In ES, it is seen that the load has been bifurcated into two parts based on its criticality and importance enabling to act as smart load. ES is connected in series with the non critical load and together this arrangement is connected across critical load, and hence this whole arrangement results in stability of the grid, in the existence of discontinuous renewable energy sources (RES). ES included in the smart load can be distributed at different locations and acts in union without useof Information and Communication Technology (ICT) in between the two electric springs. The drawback of this paper is that the writer left the non-critical load for intermittent voltage which may result in heating and burning of household appliances. Also, due to huge quantity of residential load appliances, the approach may not give satisfactory results [15].

Conclusion:

In this paper, an exertion had been made to ponder request side difficulties in control framework. DSM expects to have a viable administration of the heap in the brilliant brace. Thus, here we evaluated the booking calculations and their difficulties with assorted perspectives. For applying DSM calculations, there is dependably a need an appropriate correspondence foundation. DSM calculations are winning in accomplishing their goals basically if the power clients contribute in these means towards viable power planning. The clients require a consolation to take an interest in DSM, in type of financial motivating forces in a simply reasonable way. Here, we had an examination on decency in planning load administration calculations. There is likewise an examination on the essential issue of security and protection in keen network. Likewise, a unique consideration is given to natural awareness which is raising concern now days. All in all there are far reaching investigates in DSM and corresponded fields, yet at the same time there are various difficulties here of research also.

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