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# Smart Grid Leading to Demand Side Management: A Perspective in terms of Categorizations and Limitations

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**Abstract**

*In order to fulfill all demands of the customers, related to energy, the capacity of the Grid is designed in such a way that, it satisfies not only the average power demand, but also the peak power demand. In this paper, Demand Side Management (DSM),programs which play a vital role in near future Smart Grid (SG) has been considered.DSM aims either at reducing or shifting consumption to shape users' energy consumption profile. In the energy zone, the country is facing severe short fall from the last two decades, and hence effecting not only the economic growth, but also the industrial development. The main goal of DSM is usually to encourage the consumers to use less energy during peak hours or to move the time to use energy in the off-peak hours.*

**Keywords:** Smart Grid (SG), Demand Side Management (DSM), Peak-to Average Ratio (PAR)

## I. Introduction

Generally, conventional electrical energy systems transmit power through power plants to majority of consumers [VI].Usually, from power generation to homes, energy systems are unidirectional. There is a process of electricity generation, once created it is then distributed to the users or people may also call them customers as shown in the Figure 1, that shows the three portions of the electricity supply chain,

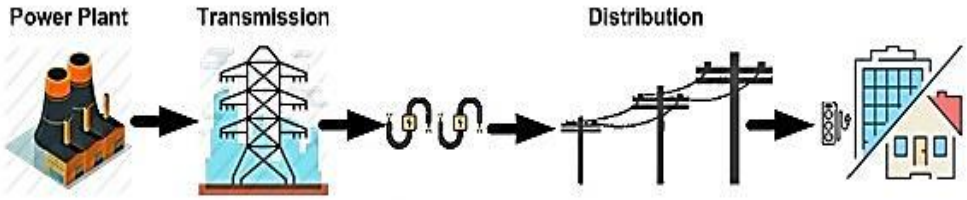


**Figure 1: Traditional Electric Energy Distribution Systems**

which are generation through power plants, transmission system, and distribution of electricity to the end users. Usually, power plants which are generators generate electrical energy, transmittedall the way through high voltage lines which are transporters to distribution centers, and the distributors, where it is stepped down to lower voltages and finally delivered toconsumers[XI].Providing electricity to every customer forms a structure of a network which when connected to other nodes makes a power grid system.

Including new transmission lines will enable the utilities to get more energy from the power plants to your home. Nonetheless, numerous groups don't need new electrical cables in their regions. So in order to create an industrial revolution, the main objective is to promote the innovation of relevant technologies and business models. We call this new approach “Smart Grid (SG)”, which can defined as a system that implements communication and information technology in electrical grid. Such system collects information about the behavior of electrical energy suppliers and users. By deploying the communication based monitoring and controlling architectures, SG improve the customers’ load utilization [XII].

SG can be considered as the supply chain of an improved electrical energy that generated from a high voltage power plant and go through inside home. SGs can be thought as unique power-grid systems which include a smart metering infrastructure, by integrating advanced information and communication technologies that have the ability of sensing and measuring the energy consumption of users [XIV]. To put it plainly, there are numerous power plants that create power utilizing wind vitality, atomic vitality, coal, hydro, petroleum gas, and an assortment of different assets. These creating stations deliver power with specific electrical voltage, which is after that "ventured up" (expanded) toward peak voltages. When such electricity reached up to city, it "ventured down" (diminished) to a substation with lesser voltage intended for appropriation in the region of city. Similarly, when such electrical power become closer to houses, then with the help of local transformer, electrical power is converted to that voltage, which is normally used in homes. Such

electrical power goes through electricity meter. Generally, voltage at home is ordinarily 220-240 volts.

The central concept of SG is to put in the features of monitoring, managing, analyzing, and communication abilities to electrical energy delivery network to increase throughput of the system, whereas dropping the consumption of energy. SG improves reliability, stability, efficiency, and quality of service of the conventional power system. The implementation of SG permits electric power along with high quality and environmental friendliness to be generated, transmitted, distributed, and consumed in a reliable and efficient manner [V]. The SG joins computerized innovation into the conventional electrical framework, which empowers utilities and clients to get data from and speak with the lattice.

The SG will enable utilities to bypass electricity throughout the system as impressively and cost-effectively as possibly be expected under the circumstances. It will likewise enable the property holder and business to utilize power as monetarily as could reasonably be expected. SG is better described by two way communication, as well as information and power flows between utilities and consumers. From generation to transmission, distribution and consumers' premises (e.g. households and business premises), It establishes higher intelligence into all segments of the grid [VII].Shopper will have the decision and adaptability to deal with their electrical utilize while limiting their expenses. Albeit satisfactory to address past difficulties, that is inexhaustible mix, disseminated age, request administration, have progressively uncovered the restrictions of the conventional lattice frameworks.

SG makes the electrical framework more solid and proficient by helping utilities to lessen power misfortunes and to identify and settle issues all the more rapidly. SGs provides the assurance of connecting electricity producers, consumers, and prosumers (Hybrid of producer and consumer) to a more efficient, reliable, and sustainable power supply system [XIII]. The keen matrix can enable customers to preserve vitality, particularly now and again when request achieves essentially abnormal states or when a vitality request diminishment is expected to emotionally supportive network unwavering quality. The SG is respond to the wide ranging conditions as well as variational changes and also able to distribute power in more efficient ways by utilizing adaptive signal processing, statistical signal processing and modern information technologies, [1].Generally, the main consideration of SG is to make PC smart that not only better control the grid but also make it automotive as well as more autonomous.

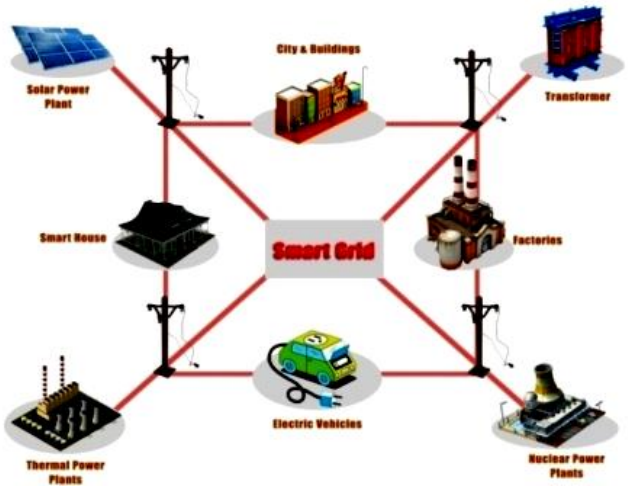


**Figure 2: A Smart Grid Environment**

Figure 2 demonstrates a SG domain which is connecting various utilities. Shrewd gadgets in homes, workplaces, and manufacturing plants can illuminate buyers and their vitality administration frameworks of times when a machine is utilizing moderately higher-evaluated power. This helps purchasers or their clever frameworks to ideally change settings to bring down their vitality bills. Brilliant gadgets on transmission and dissemination lines and at substations enable a utility to all the more effortlessly discover where a blackout, or other issue, is on the framework. SGs can once in a while even remotely adjust issues in the electrical dispersion framework by sending advanced guidelines.

SGs will have to incorporate several key components, e.g. appropriate sensors for ensuring system stability, enhanced communications for real-time control and data flow, smart meters for monitoring real-time usage, and intelligent energy management systems as a control mechanism for the benefit of all the actors connected to the grid in order to make this vision a reality [XIII].The SG can convey control in more proficient ways and react to colossal conditions and variational changes. Extensively expressed, the private SG could react to occasions that happen anyplace in the framework that could affect age, transmission, conveyance, and utilization, and afterward embrace the relating procedures to adapt to them. SG is additionally situated to exploit new advancements, for example, module mixture electric vehicles, different types of disseminated age, sun based vitality, savvy metering, lighting administration frameworks, circulation robotization, and some more.

In a nutshell, several challenges are faced by the conventional grid, which includes day by day increase in demand for energy, aged infrastructure, security

issues and lack of communication. In order to address these problems, the idea of smart grid has come out which uses dual electricity flow between utility as well as energy consumers [II]. Generally, SG can be considered like an upcoming creation that comprises highly developed skills in three componants of grid, advanced metering infrastructure and cyber security. Such characteristics of the SG eventually boost the reliability, elasticity and efficiency, of an electrical network. Main idea behind SG is switching the conventional power network into an effectual electric grid in terms of electricity as well as cost.

## II. Differences between Traditional Grid and Smart Grid

Conventionally, the term which is used for an electricity system is grid which may support sometime all or some of the subsequent four operations: that are electricity generation, electricity transmission, electricity distribution, and electricity control. Where as Smart Grid (SG), sometimes also known by the following different names, which are smart electrical/power grid, intelligent grid, intelligrid, future grid, intergrid, or intragrid, is an enhancement of the 20th century power grid. Generally, traditional power grids are used to carry power from a few central generators to a large number of users or customers. In contrast, the SG uses two-way flows of electricity and information to create an automated and distributed advanced energy delivery network [VI].

**Table 1: Differences among Smart and Traditional Grid**

| Smart Grid | Traditional Grid |
|---|---|
| Automatic Monitoring | Manual Monitoring |
| Dual Communication | One-way Communication |
| Digital | Electric Machinery |
| Automatic Recovery | Manual Recovery |
| Full Grid Sensor Layout | Small Number of Sensors |
| More User Options | Few User Options |
| Distributed Power Generation | Centralized Power Generation |

Some of the differences between Conventional grid and smart grid are shown in the table 2.1. As compare to conventional grid, the SG is capable of delivering power in more efficient ways and responding to wide ranging conditions and events, by utilizing modern information technologies. Generally, the SG could respond to events

that occur anywhere in the grid, such as power generation, transmission, distribution,

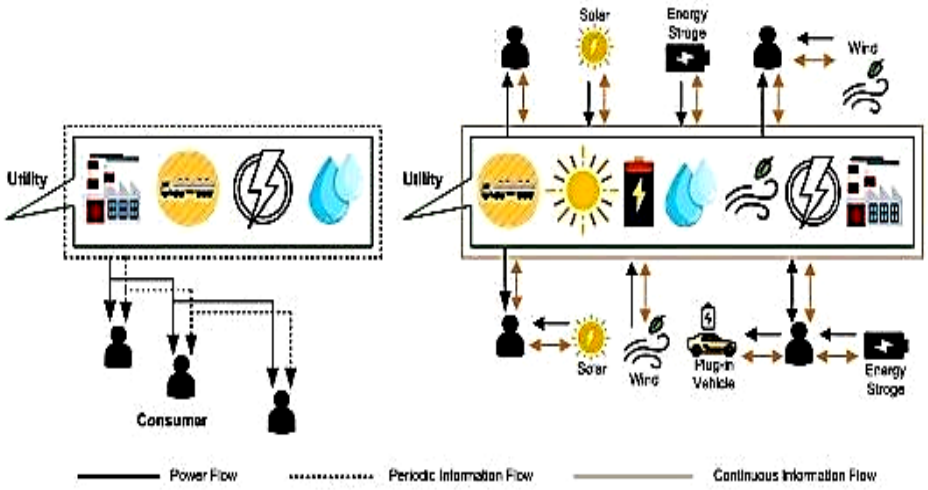


**Figure 3: Traditional Grid vs Smart Grid**

and consumption, and adopt the corresponding strategies. For example, in the distribution grid, once a medium voltage transformer failure event occurs, the SG may automatically change the power flow and recover the power delivery service.

A Smart Grid is a power organizer, that can keenly incorporate the activities of all clients associated with it generators, customers, and those that do both as shown in the figure2.2. The key idea is to promote the innovation of relevant business models and technologies in order to build an industrial revolution [XV].To observe as well as managing the electrical systems, along with integrating bidirectional communication, SG has been formulated. Such a merger will fetch reliability in power amenities, more automation, and secure electricity apparatuses results in increased luxurious level of consumers [IX]. The advent of handy and flexible power loads takes demand up stretched. In the context of this increased load, managing the high demand load becomes momentous.

In contrast to conventional power grid, where consumers are considered as passive consumption points, SG treat end users as dynamic entities, which participate in the grid operations and affect programs implemented throughout the system. Furthermore, SG is able to learn and adapt accurately as well as rapidly to the inherent uncertainties in the power system demand and supply process, through proper planning and management of suppliers and consumers[V]. At the point when added to the current foundation, these innovations will give gigantic measures of information about utilization, voltage, the strength of framework and numerous different parts of the power supply to the control focuses. With enhanced

correspondences, the smart framework settles a large number of the issues recorded above, and gives advantages to buyers and providers.

## III. Literature Review

In [4], the author proposed an imaginative constant DR calculation which was introduced to manage vitality utilization administration issues in office by considering stackelberg amusement. Proposed technique could instigate less vitality utilization amid high power cost and accomplish proficiency in stack administration for an office with immaterial calculation load. Later on, initial, a general guideline for picking viable estimation of βi can be examined by utilizing broad reproduction and test investigations. Second, the possibility of including and vitality stockpiling framework in the SGDR will be examined.

In [I], researchers clarified the SG possible implication. Such review comprehensively examines the innovations employed as component of SG. Noteworthy programs of SG have been surveyed, with three remarkable frameworks: which are elegant communications system, intelligent security system in addition to intelligent system of management.Results made obvious that SG participation go ahead to improved supply of electricity services, clean environment, and modernize the living standards.

The authors in [X] proposed a decentralized framework wide load administration way to facilitate HLM modules in a brilliant circulation matrix. The approach was concocted to profit customers, as well as advantage the vitality specialist co-op by altering load profile of the framework. The HLM modules keep on sending load change proposition until the point when the time no further change in framework stack profile is accomplished. Union and optimality of the arrangement gotten by the proposed approach were demonstrated. Execution of the approach was checked by applying it to a gathering of clients. The outcomes show that the proposed approach furnishes the vitality specialist organization with incredible advantages without trading off clients' cost and solace. It was demonstrated that the approach meets in almost no time and its run time is free of the framework estimate.

The researchers in [XVI] analyzed the advantages and chances in cloud as well as mist to facilitate asset administration of SG. Additionally, the model which associates mentioned areas is proposed. In addition for managing effective asset, distinctive load adjusting procedures are utilized, comparatively, for cloud-god based keen lattice engineering, RR, throttled and PSO have been considered. Reenactment comes about demonstrate that the general execution of PSO is better when contrasted with different systems.

The researchers in [XIV] proposed savvy lattice being the cutting edge control framework that joins control foundations with correspondence arrange advancements. In any case, because of the dynamic power requests and irregular sustainable power source assets, request side administration is a key factor in improving framework execution. Another shrewd matrix administration plot was proposed by together utilizing the gathering and booking calculations. In light of the essential idea of the coopetition diversion, the proposed approach can acquire a fantastic answer for an intricate brilliant network circumstance. In this way, control age cost could be restricted whereas fulfilling prerequisites of personage apparatuses. Likewise, calculation has been composed within disseminated online design exclusive of focal controller. Such loom is reasonable in favor of extreme down to earth execution in certifiable shrewd lattice activities. The recreation comes about show that the progression of our proposed plot prompts a viable arrangement while successfully dealing with the vitality utilization vacillations.

## ASPECTS OF SMART GRID

The working of different aspects of SG in current research through a diagram is shown in the Figure 4. SG integrates electricity and communication on power system network which supplies digital information on the real time network operation for the

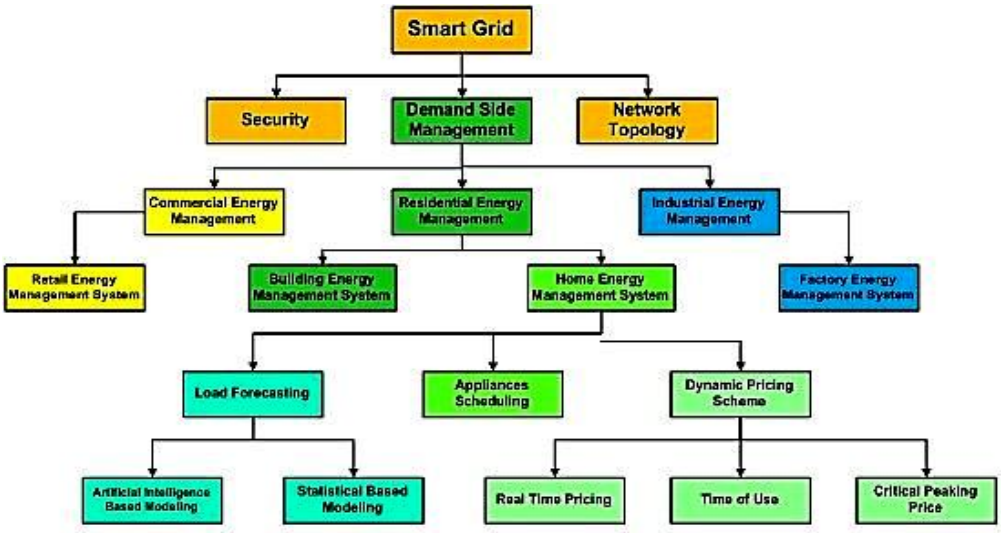


**Figure 4: Different Aspects of Smart Grid**

operator and consumers. The use of SG technologies in power generation side can

efficiently enhance not only the ratio of intermittent clean energy generation as well as but also the energy utilization in power system. SG can make a significant contribution of energy saving in power grid links.

**DEMAND SIDE MANAGEMENT**

In order to satisfy all energy demand from customers, the grid capacity needs to be designed for satisfying the peak power demand rather than the average power demand. This usually requires in the installation of new power generation and transmission infrastructures. To overcome such a problem, DSM programs have been proposed to control the energy consumption pattern of the users with the aims at reduce the Peak-to-Average Ratio (PAR). Some characteristics of DSM are as follows:

- **Cost Reduction**

NumerousDSM and vitality productivity endeavors have been presented with regards to coordinated asset arranging and went for diminishing aggregate expenses of taking care of vitality request.

- **Improvement in Environmental Aspects**

Vitality productivity as well as DSM might be sought after by accomplishing natural or potentially social objectives by decreasing vitality utilize, prompting diminished ozone harming substance outflows.

- **Network Concerns and Reliability**

Enhancingas well as additionally deflecting issues within power organize diminishing interest in ways which keep up framework dependability in prompt spanalong with more extended duration concede requirement on behalf of arrange growth.

- **Markets Enhancement**

Hereand now reactions to power economic situations ("request reaction"), especially by diminishing burden amid times of high market costs caused by lessened age or system limit.

A vitality client may have numerous explanations behind choosing a specific DSM action. For the most part these future monetary, natural, showcasing or administrative. The above focuses are communicated in a marginally extraordinary manner, from which DSM benefits to customers, endeavors, as well as the general public could be acknowledged by:

- Decrease in money spent by customer on electricity bills.
- Minimizing the rationale for new power plant
- Motivation for economic growth
- Reduction in air pollution.
- Decreasedreliance on sources of energy foreign in nature.
- Decrease in rates applicable in peak hours

**Origin of DSM**

In order to achieve energy balancing or additional services, DSM is a way to take advantage of demand elasticity. The new opportunities offered by SG technologies, become an increasing issue for electrical systems and hence such flexibilities can be an effective way of minimizing peak electricity demand. Such opportunities could permit to keep away from using expensive power plants, with high variational costs along with essential air emissions [III]. Flexibilities will be crucial to ensure the network reliability, with an increasing part of fluctuating renewable production sources. Therefore, DSM could offer significant environmental, economical, and reliability benefits. The inspiration driving the implementation of DSM is clearly unique for the different gatherings included. Therefore for utility companies, the reduction or shift of a customer's energy demand could mean avoiding or delaying building additional generating ability. Taking clients into consideration, DSM facilitates them by decreasing electricity charge by effective as well as preservation techniques. On account of modern clients, it will result in decreased creation expenditures and an enhanced focused item. For residential clients it implies getting spare cash being utilized on rest of the family unit items.

Utilities could consequently be considered as the main thrusts of DSM usage yet electricity clients ought to likewise be roused in utilizing vitality all the more effectively, accordingly decreasing their vitality request and along these lines their vitality costs. Customers may likewise have the capacity to exploit any extraordinary impetuses offered by service organizations, and may take an interest in programs offered by the utilities (and perhaps upheld by government). Further improvement in cooperation to client satisfaction as well as DSM could very well be accomplished through establishing Distributed Energy Storage (DES), along with Distributed Energy Generation (DEG), as well as Distributed Energy Generation and Storage (DEGS) systems [VIII].

Taking everything into account, in view of the discourse "Why advance DSM?" and considering the main impetuses behind DSM, makes it conceivable to follow the justification of different DSM endeavors into two primary classifications:

- Reduction in cost in addition to environmental intensions
- Network in addition to authenticity intentions.

**DSM Advancement**

DSM suites can endorsedas well as employed at variousaspects of civilization, including:

- Authorityset of laws.
- Servicesprogrammes.
- Energy consumer involvement.

All of the above mentioned classes havetheir self-critical part to act. In any case, ideal outcomes could be acquired through organizing each one of theseclasses. Government organizations can compose different strategies as well as directions, and give endowments to these projects. DSM is able to handle the communication framework between utility as well as consumers. It also facilitates byincorporating distributed resources of energy for the purpose of optimizing energy consumption profile [II]. Utilities can actualize these viably through different projects, ideally with tweaked programs created and worked as a team with the end-clients i.e. the vitality customers.

**Categorization in DSM Measures**

Majority DSM measures remain established through utilities or ultimate consumers themselves. Services endeavor to urge vitality clients by changing request profile, which isachieved through positive duty motivations enabling clients to plan request exercises during an era that will lessen their vitality costs [VII]. This supports utilities through circulating the request far away to pinnacle time frame. Now and again, negative impetuses (punishments) are charged for the proceeded with task of wasteful gear with superfluously high loads: this is planned to urge clients to overhaul hardware and along these lines lessen electrical request.

Mechanical endeavors will regularly think about an extensive variety of conceivable activities to decrease the utilization of a wide range of vitality. A direct lessening in vitality utilization will typically diminish costs, and a move of interest to an alternate time may decrease costs if a fitting duty is accessible.

## IV. Limitations

In creating nations nearby for the most part a low consciousness of vitality proficiency and DSM programs, and hence advertising is important to advance these. In the administration zone of a service organization, the divisions and end-clients that

can profit by DSM should be recognized, modified projects created (and their cost viability assessed) and afterward an arrangement to market and execute the projects should be readied [IX].

Numerous modern and business organizations still have not completed energy audits to gather dependable data on their present activities. While this might be because of a disappointment by administration to value the possible advantages forenergy productivity, a small number oforganizations will essential gifted work forceset to carry out reviews.

It is basic that,legitimate money related analysis of vitality productivity transformationstandcompleted, howeverplanning to establish DSM exercises. Like, an excessive amount might set forprimaryhardware expense used by DSM programs. Additionally, there is regularly a discernment that electrical vitality is a little part of a general cost and thuslyslightmotivationsettle up with DSM procedures to adjust.Wherever powers are involved, appropriate surveyspossibly not accomplished in order to judgepossiblecost of energy variations.All ventures should be defended as a component of the technique of discoveringDSM venture stores. This spreads on together to reserves through organization inner assets as well as towards stores through subsidizing establishments or banks. Without a skillful assessment of a venture, it willbehard to get stores endorsed, inside or remotely. The inability to get stores are a standout amongst the most essential difficulties of executing DSM ventures.

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