Available online at: http://www.ijmtst.com/vol5issue10.html

International Journal for Modern Trends in Science and Technology

ISSN: 2455-3778 :: Volume: 05, Issue No: 10, October 2019

Power Utilization in Cloud Computing Environment Using Smart Grid

Dr. Kishor M. Dhole | Dr.Vinay Chavan

S.K. Porwal College,Kamptee, Nagpur(M..S.), India

To Cite this Article

Dr. Kishor M. Dhole and Dr.Vinay Chavan, "Power Utilization in Cloud Computing Environment Using Smart Grid", *International Journal for Modern Trends in Science and Technology*, Vol. 05, Issue 10, October 2019, pp.-54-59.

Article Info

Received on 25-September-2019, Revised on 18-October-2019, Accepted on 25-October-2019, Published on 31-October-2019.

ABSTRACT

Need of power utilization increased day by day, due to large power utilization in IT sectors. This needs to be managed and control. The power distribution in such huge computing environment needs to be properly utilized. This will helps in balancing and saving natural resources. Cloud data centers are powerful computing system which acquire huge amount of electrical energy for running. The consumption of energy can be effectively managed by introducing smart grids. Smart grid works in the manner by collecting information of the energy utilized by the data centers and process it accordingly for getting the maximum throughput with less energy utilization. Smart grid monitors on electricity distribution. This paper is brief study on introducing smart grids in cloud data centers for much more economical cloud model. The paper also proposes a method for better implementation of smart grids in cloud data centers. The paper explains areas through which smart grid implementation will help in huge power saving.

Keywords:- Smart Grid, Data centers, power grid,(DOE) Department of Energy, (IT) Information Technology, (IMS) Intelligent Monitoring System, Smart, Grid Server (SGS), Intelligent Sensors (IS).

I. INTRODUCTION

All over the globe most of the countries including India are suffering from power shortage and generation which is likely to degenerate over the next few years. Lots of technological development is going under research to develop smarter way for managing the power in terms of various fields. In IT sectors and infrastructure management this requires and acquire huge amount of electricity. Data centre in cloud computing can acquires electricity up to small towns for running. Smart grid monitors the power consumption by organization and also interact with market, energy bulk generation unit etc. for distributing information about energy flowing through the system. This information can be helpful in making more energy in greener manner which helps in consuming environmental resources for power generation. Smart grid helps in delivering energy to individual units in economical and secure manner. Clouds infrastructure is very strong and utilizes high amount of electricity, this electricity is managed by smart grids. If smart grids are properly managed by cloud computing then this will lead to a better system for cloud computing and which also save a huge amount of money and manpower. Controlling and economic maintenanceof IT assets are also helpful to reduced by introducing smart grids [1]. The information gained by smart grid can

be managed by clouds the work will be paralleled executed.

II.NEED OF CHANGE FROM POWER GRID TO SMART GRID

Power Grid: In India today's situation of power grids are formed mainly from Generators, networks and loads Utilities will often control the power grid, and sub-stations will also be built to step voltages and ensure transmission.

The Smart Grid: The overall objective is to deliver electricity from suppliers to consumers using digital

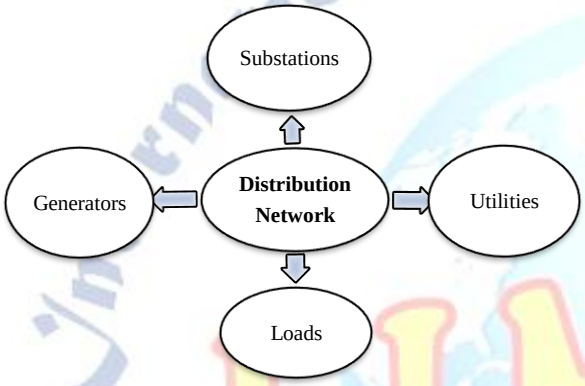

Figure 1: The Power Grid

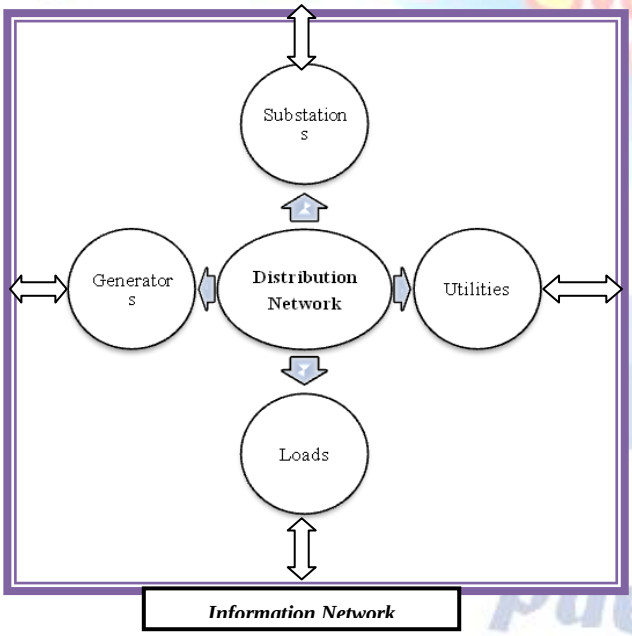

Figure 2: The Smart Grid

Technology to save energy, reduce cost and increase reliability and transparency. A focus on data flow and information management central to the power grid, with the following goals:

- Optimize asset utilization and operating efficiency.
- Accommodate all generation and storage options.
- Provide power quality for the range of needs in a digital economy.
- Anticipate and respond to system disturbances in a self-healing manner.
- Operate resiliently against physical and cyber attacks and natural disasters.
- Enable active participation by consumers.
- Enable new products, services, and markets.

Smart Grid puts information and communication technology into electricity generation, delivery, and consumption. The following elements are critical to achieving this vision:

- Sensing and measurement technologies: To support faster and more accurate response such as remote monitoring, time-of-use pricing and demand side management.
- Advanced components: To apply the latest research in superconductivity, storage, power electronics and diagnostics.
- Advanced control methods: To monitor essential components, enabling rapid diagnosis and precise solutions appropriate to any event.
- Improved interfaces and decision support: To amplify human decision making, transforming grid operators and managers quite literally into visionaries when it come to seeing into their systems.

Integrated Communications: There is a requirement of connecting components to open architecture for real time information and control, allowing every part of the grid to both 'talk' and 'listen' and well-defined communications protocols. (For example, the Internet Protocol Suite(TCP/IP) enabled a common inter-network protocol for web-based communications. Communications will most likely make use of two different types of networks:

- **Access networks:** Typically used by remote devices for communication at the edge of the network. (i.e. WiFi)
- **Backhaul networks:** High capacity, low latency broadband networks that extend the enterprise network to remote areas, bringing the data from the access networks back to the enterprise. Includes both wired and wireless point-to-point and point-to-multipoint broadband systems, fiber and microwave systems. These backhaul networks will form the backbone for all Smart Grid access networks.

III. WHAT IS CLOUD COMPUTING?

Cloud computing (according to NIST) is defined as:"*a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."*
The characteristics of cloud computing includes:

- On Demand Service
- Ubiquitous Network Access
- Location Independent Resource Pooling
- Rapid Elasticity
- Measured Service

In order to achieve a "scalable, demand-based Smart Grid IT Infrastructure", cloud computing solutions and services must be incorporated.

IV. INTEGRATED HYBRID CLOUD CONCEPT

This "Ecosystem" is based on an integrated hybrid Smart Grid Cloud consisting ofthe following:

Smart Grid Private Cloud:

- Developed and owned by the Department of Energy (DOE) and to be used primarily for energy data management, reporting, and analytics.
- Services will be based on standardized data collected from utilities nationwide and maintained in a secure environment due to sensitivity.
- Services can be provided to stakeholders (such as State Governments, Local Governments, and Utilities) through a web-based environment so that energy reporting and analytics can be performed in a standardized, approved, and reliable manner
- Data and service access will be restricted by DOE through well-defined security access controls and end-user authentication.
- By offering aggregated, centralized data management services, the Department will have comprehensive energy data visibility and transparency reflecting real-time conditions across the United States.
- "Data as a Service" model will enable DOE to continuously monitor the health and performance of the Smart Grid and to support energy management decisions quickly and accurately. DOE will also be able to use this aggregate, real time data to perform trend analyses, forecasting, demand planning, infrastructure planning, and to immediately detect outages, shortages, and performance issues.
- Command and control functionally will reside with DOE – enabling centralized administration of services and the supporting IT infrastructure.

Public Cloud: The DOE Smart Grid private cloud will be supported by common and fully
Integrated IT infrastructure services procured from public vendors.

Motivation: It is based on the following factors

- Cost Savings: Decreased need to spend large sums of money into developing and managing an IT infrastructure
- Pay per Use: Ability to pay more when there is a spike in demand and a need for increased capacity – and will pay less when there is decreased demand.
- Carbon Footprint Reduction: No need to build redundant data centers and server farms.
- Leverage Existing Technologies: Use of commercially available solutions for Geospatial imaging, mapping, and weather forecasting solutions – which can be combined (or "mashed up") with energy data collected by DOE to enhance analytics and visualization capabilities.

V. DATA AND THE SMART GRID

A major component of the Smart Grid initiative is accurate and timely information that can be analyzed in order to make rapid decisions. The gathering and analysis data will raise consumer, state, and national "situational awareness" of energy needs to allow all stakeholders to make better decisions.
Smart Grid connects consumers by means of the right price signals and smart appliances. By enabling consumers to automatically reduce demand for brief periods through new technologies, and motivating mechanisms like real-time pricing, the grid remains reliable and consumers are compensated for their help. Consumer participation provides tangible results for utilities which are experiencing difficulty in sitting new transmission lines and power plants.

VI. Role of smart grid in cloud Environment

Current cloud computing environment does not consider the power constraints. The heating and cooling is not considered by testing the data

centers environment. Large Data centre can acquire as much electric power required for running a small town [2], [3]. The power consumption of data centers are totally depends on the overall data processed by data centers. Data centers are not configured with energy and powers source management. Data centre are not configured with this kind of services. Data centers act as a house for several component such as networking components, data storage component etc. This all component utilizes the energy and it's important to manage this electricity. A data centre can occupy one room of a building, one or more floors, or an entire building. Most of the equipment is often in the form of servers mounted in 19 inch rack cabinets, which are usually placed in single rows. A smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. The smart grid uses of technologies that improve fault detection and allow self-healing of the network without the intervention of technicians. This will ensure more reliable supply of electricity, and reduced vulnerability to natural disasters or attack. Implementing cloud industries, with smart grids two-way communications and advanced sensors, will improve the efficiency, reliability and safety of power delivery to cloud data centers.

VII. PROPOSED ARCHITECTURE

The architecture proposed for smart gird implementation in cloud environment is a conceptual model based on the basic study of smart grid and cloud environment. The proposed architecture for introducing smart grid in cloud is shown in figure 3. This shows an interaction between cloud data centre and smart gird. Smart gird in cloud will monitor theoverall energy consumed by cloud data centers. Data centers and smart grid integration will increase huge amount of power which has been utilized unnecessary by different components and services of data centers. Underlying all these technical approaches is a common challenge. But the next level of data centre energy optimization will lead to green computing environment. Seeing more and more integration of energy data into the way data centers are run today with a huge loss of power which can be consumed by the proposed model. The proposed architecture integrates smart grids in cloud environment which work in manner to the electricity used by different data centers for particular organization and which requires a lot of effort to manage. The number of electricity consumed by smart grid will be used with several other organizations. This results in saving of natural resources. Many different concepts have been used to model intelligent power grids [4], [5]. They are generally studied within the framework of complex systems. In a recent session the power grid was considered within the context of optimal control, ecology, human cognition, glassy dynamics, information theory, microphysics of clouds, and many others. But if appeared in cloud computing can make smart grid works in saving huge amount of energy. With smart grids customers can choose their electricity suppliers, depending on their different tariff methods, the focus of transportation costs will be increased. Reduction of maintenance and replacements costs will stimulate more advanced control. Smart grid precisely limits electrical power down to the residential level, network small-scale distributed energy generation and storage devices, communicate information on operating status and needs, collect information on prices and grid conditions, and move the grid beyond central control to a collaborative network.

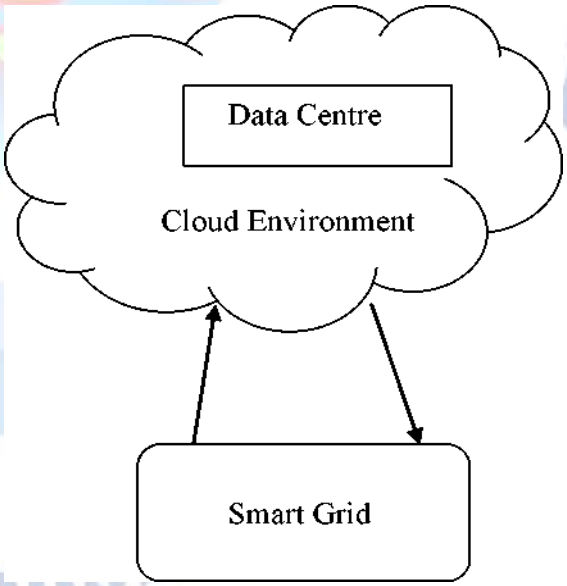

Figure 3: Proposed Architecture

IV. DESIGN COMPONENTS OF SMART GRID

The proposed study gives design view of Smart Grid in figure 4, which includes the following components

- Smart Grid Server (SGS)
- Intelligent Monitoring System (IMS)
- Intelligent Sensors (IS)

VIII. Benefits of Smart Grid

Smart grid and its implementation in terms of cloud computing environment is mentioned below

A. Consistency

In terms of consistency after implementation of smart grids in cloud will result higher in performances and low power usage [6]. The smart grid will make use of technologies that improve fault detection and allow self-healing of the network without the intervention of technicians. This will ensure more reliable supply of electricity, and reduced vulnerability to natural disasters or attack.

B. Load adjustment

Smart grid consist feature of load adjustment which helps in reducing the different load from different data centre attached to cloud computing network. The total load connected to the power grid can vary significantly over time. Although the total load is the sum of many individual choices of the clients, the overall load is not a stable, slow varying, average power consumption. Imagine the increment of the load if a popular data starts access by the millions of user which will draw current instantly. This situation can be handled by smart grid load adjustment.

C. Advanced services

Smart grid consist some advance feature as with other industries, use of robust two-way communications, advanced sensors, and distributed computing technology will improve the efficiency, reliability and safety of power delivery and
use [7]. It also opens up the potential for entirely new services or improvements on existing ones, such as fire monitoring and alarms that can shut off power, make phone calls to emergency services, etc. this all can be implemented in cloud environment.

D. Competence

The competence factory is also been considered in smart grid for power distribution in cloud data centers. A smart grid aims to manage these situations which require an efficient system. Electricity distribution can harm various devices evolved in the network and need to be managed in reliable and efficient manner so for the same smart grid are managed to design this type of situations.

The overall improvement of the efficiency of energy infrastructure is anticipated from the deployment of smart grid technology, in particular including demand-side management, for example turning off

IX. Purpose of SMART GRID

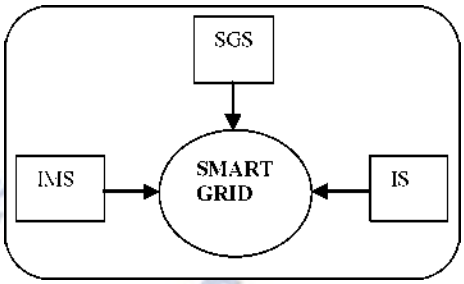

FIGURE 4: Components of Smart Grid

air conditioners
during short-term spikes in electricity price [8], [9]. The overall effect is less redundancy in transmission and distribution lines, and greater utilization of generators, leading to lower power prices. In present scenario protection of environment is a global issue for human being. The whole world tried to reduce the effect of global warming. In this context, every one tried to consume and control wastage of energy. Thus proper utilization of energy resources is need of an hour in cloud environment. This motivates to save energy and its distribution in efficient manner, which may fulfils the dream of Green Energy. Smart power Grid may plant intelligent sensors at data centers and at local premises, which helpful to control complex power management and send control signals back to the grid station to accumulate energy. In the future view of Smart Grid made possible by applying sensing, measurement, and control devices by using intelligent systems via cloud data centers. This also helpful to optimize electricity production, transmission, distribution and consumption of electricity through Smart Grid in cloud environment.

X. Conclusions

Implementation of smart grid will basically change the way of power utilization in cloud computing environment. This motivates to improve energy consumption towards green computing. The proposed concepts explain in the paper describes about smart gird and its implementation which is research based on decreasing the power utilization by huge IT architecture. The proposed architecture based on implementing such structure which can manage the power distribution by introducing smart grid. This imposes the need for smart grid technology to minimize the power losses which is a

recent issue across all power distribution utilities in world. Existing power sector is not in the order and requires close monitoring and improvement. It is required to strengthen the existing architecture using advanced technology for better power utilization for better services. This paper concludes with the purpose and benefits of smart grid in cloud computing environment.

ACKNOWLEDGMENT

I would like to express my special and sincere thanks of gratitude to my guide, Dr. Vinay Chavan Sir who gave me a golden opportunity to write this important paper. This paper may obliging for Green Computing, which also helped me in doing a lot of research in this field and I came to know about so many new things, I am really thankful to him.

REFERENCES

[1] David Tebbutt, Martin Atherton, and Tony Lock" Green IT for Dummies" 2009.
[2] Xi Fang* , Satyajayant Misraf, Member, IEEE, Guoliang Xue, Fellow, IEEE, and Dejun Yang "Managing Smart Grid Information in the Cloud: Opportunities, Model, and Applications" 2010.
[3] Richard L. Sawyer "Calculating Total Power Requirements for Data Centers" White Paper.
[4] Kenneth P. Birman, Lakshmi Ganesh, and Robbert van Renesse "Running Smart Grid Control Software on Cloud Computing Architectures".
[5] Hongseok Kim, Young-Jin Kim, Kai Yang, and Marina Thottan "Cloud-based Demand Response for Smart Grid: Architecture and Distributed Algorithms".
[6] David Tebbutt, Martin Atherton, and Tony Lock" Green IT for Dummies" 2009.
[7] Sadia Fayyaz ,Muhammad Mohsin Nazir "Handling Security Issues for Smart Grid Applications using Cloud Computing Framework" vol. 3, no 2, February 2012.
[8] Janina POPEANGA "Cloud Computing and Smart Grids" Database Systems Journal vol. III, no. 3/2012.
[9] Hongseok Kim et al., Cloud-based Demand Response for Smart Grid: Architecture and Distributed Algorithms, Smart Grid Communications IEEE International Conference, 17-20 Oct. 2011.
[10] S. Rusitschka et al., Smart grid data cloud: A model for utilizing cloud computing in the smart grid domain 2010.
[11] Parag R Kaveri, Vinay Chavan, and Hemant Deshmukh "A study on resource oriented cloud computing", International Journal, 2(6), 2012.