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An Approach to tackle Smart Grid Data with Existing Resources

Shaikh R.M.[1], Ugale B.A.[2] & Kubal P.S.[3]
[1](Comp Engg. Dept., KVNNIEER Nasik, SPP Univ., Pune(MS , India)
[2](I.T. Engg. Dept,MCOER Nasik, SPP Univ., Pune(MS , India)
[3](Comp Engg. Dept., AVCOE Sangamner, SPP Univ., Pune(MS , India)

Abstract :*Resource Management is one of the most critical problems of data centers. One effective way to tackle this problem is using the optimal way to handle this data and when we talk about the Smart Grid it's become too critical to handle this enormous amount of data. In this paper we are going to suggest the use of cloud computing instead of building a new data center and also focusing on the cyber security of the same. We can use the existing resources to handle this data. We know the electrical network is much bigger than the computer network and the data generated by the houses are tremendous in nature. Then we are going to make an approach to tackle this data with existing resources in an effective manner.*

Keywords *- SSS Algorithm, SG, Cloud Storage, AMR, AMI*

1. INTRODUCTION

Handling the huge amount of data is not an easy task and when we talk about such system which will generate 1.5 GB of data per day and the amount of these data generator are huge in nature. Then we need to think about the storage too. In this paper we are going to focus on the Electrical Grid having smartness. In short Smart Grid. In short Smart Grid is the electrical grid having some smartness which is achieved by the real time data from the different domestic user and the data from the house hold meter is Analyze for taking the better decision. But the problem is handling the huge data with existing resources ensuring it security. Because tampering the user data leads to loss of money and privacy too. In this paper we first discuss about the smart grid operation and then we focus on the current scenario and in last section we will focus on the data handling and security technique.

2. SMART GRID

According to the definition of Wikipedia A smart grid is a modernized electrical grid that uses analogue or digital 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.[1] and according to the definition we can understand the criticalness of the smart grid data and also can understand the various sources of the data. The smart grid not only takes the data from the users it also take the data from the other sources.

2.1 Why Smart Grid

The United States electrical grid, consisting of over 5,000 power plants, over 200,000 miles of high-voltage transmission, and over 5.5 million miles of distribution lines, is one of the most complex machines in the world. However, the electrical grid has evolved surprisingly little over past 50 years while the population has grown and the equipment using electricity at the other end of the lines has become increasingly sophisticated.[2] Indian power sector is growing at an enormous pace so to build and operate such a power system is a challenging problem. National Smart Grid Vision in India strengthens the entire range of associated monitoring and control network which carries the MWs across large distances, along with reductions carbon emissions and cost and service quality improvement. To implement this vision we need to educate and involve consumers regarding the processes like automation of meter-billing, reduction of AT & C losses by smart meters [3]. As our country is agricultural based, many of India's 15,000,000 irrigation pumps are powered by electricity that is provided free or at a nominal tariff with their own technology and policy. High loads imply high scope of control and measurability with limited size and length of feeders [4].

To upgrade the ring main units for the supply of distribution network, Distribution Automation System (DAS) is used. Network communications facilities like identification of performance metrics and core smart grid networking operational requirements. Distribution Grid Management focuses on maximizing performance of feeders, transformers, and other components of networked distribution systems. There should be rapid planning and integration strategy in which the planning task is producing the automation platform for the real system including storage behavior, power electronics, control functions, and operation Modes etc. Doing this will solve most of technical and economical planning and integration tasks of Energy Storage Systems into electrical grids. In our country, initiatives taken towards direction of grid are headed by IBM - Indian Institute of Technology, Bombay (IITB) in the Intelligent Utility Network (IUN) research, Northern Region Load Dispatch Centre, New Delhi, BESCOM and Reliance Energy Ltd., Mumbai which will ensure reliability, locality of services, government and power suppliers leading their way in electricity for smart energy future[5]. The goal of this work is to design data aware strategies for data-intensive computing that allow for shorter running times, decreased amount of data transmitted and smaller storage space in order to reduce the power needed.[6]

3. DATA MANAGEMENT ISSUE

The smart grid utilizes sophisticated sensing, embedded processing, digital communications and software designed to generate, manage and respond to network-derived information. The very asset that makes an energy grid smart—its wealth of data—also is the barrier that makes it difficult to manage. This explosion in data reflects the fact that a smart grid involves not just more detailed meter information, but a wide range of intelligent devices and data types. To put this in context, if a legacy grid produces data equivalent to one copy of Charles Dickens' novel,A Tale of Two Cities every second, a smart grid can produce 846 copies (or more) of Leo Tolstoy's War and Peace every second. Data is the fundamental currency of the smart grid. A clear understanding of how this data is generated, what it consists of and the benefits it can be used to deliver is critical to realizing the fullest possible returns from smart grid investments. In general, data management design in any context should optimize outcomes in two ways. First, it should extract clean, consistent and well-understood information that drives targeted benefits for the business. And second—having identified those benefits—it should minimize the costs of infrastructure needed to obtain and process the data necessary to deliver these benefits.[7]

3.1. SOLUTION FOR THE DATA MANAGEMENT

Before smart grids, the data that a utility would collect from its customers frequently amounted to little more than a monthly meter reading: one data point a month per customer. The advent of AMI has increased the level of data collection dramatically. The Columbia Water and Light Department, for example, has a pilot where meters provide data on around half a dozen household circuits every minute. That is more than 43,000 data points per customer per month.

3.2. BIG DATA POSES A MAJOR PROBLEM FOR UTILITIES: NAMELY, WHERE DO THEY PUT THE DATA AND WHAT DO THEY DO WITH IT?

Cloud-based delivery of IT infrastructure, platforms and software on an 'as a service' basis means that instead of having to invest upfront in a data center, a utility could instead just hire the capacity it needs from a service provider. The answer to the first part of the question is increasingly in the creation of dedicated data centers, the key components of which are summarized in table 1. When considering data center deployment, significant consideration needs to be given to the following factors:

1. Because of the value of the information, data centers typically have some form of contingency for disaster recovery. This increases the level of capital expenditure, which may be problematic for utilities carrying out smart grid roll outs.
2. Visualization allows all available resources to be pooled and reallocated, which can improve efficiency and return on investment (ROI), but requires additional technology and complexity.
3. Cloud computing provides access to virtual resources located anywhere, which can further improve efficiency and ROI but can lead to concerns over data security and integrity (since data could end up in foreign jurisdictions).
4. Cloud-based delivery of IT infrastructure, platforms and software on an 'as a service' basis means that instead of having to invest upfront in a data center, a utility could instead just hire the capacity it needs from a service provider.[8]

4. CLOUD AS A SOLUTION TO DATA MANAGEMENT AND STORAGE

Cloud computing is a new method of shared infrastructure and its applications such as security and privacy which can combine huge system resources to provide a variety of different services. It proposes to transform IT to reduce implementation, maintenance costs and complexity while accelerating innovation, providing faster time to market and infrastructures on demand. It is internet-based computing whereby shared resources like software and information are provided to computers and devices-on-demand like electricity grid. It aims to the perfect system with powerful computing capability through a large number of relatively low cost computing entity using the advance business models like SaaS (Software as a Service), PaaS (Platform as a Service), IaaS (Infrastructure as a Service) to distribute powerful computing capacity to end users' hands. Smart is used to reduce an electricity end- user's use of the electric grid during times grid is high i.e. During peak electric demand periods). Storage could be used to time-shift electric energy generated by renewable. Energy is stored when demand and price for power are low therefore the energy can be used when a demand and price for power is high and output from the intermittent renewable generation is low. To supply power without any distortion, use digital technology to improve reliability, security, and efficiency of the electric grid with full cyber- security and data centers have the potential to provide energy efficient operations without sacrificing the performance levels that are currently provided by data centers.

Table I. Cloud as a solution to Data Management

Component	**Function**	**Main Vendors**
Data Center Facility	1 Dedicated custom-built housing 2 incorporating redundant power and cooling system 3 High speed network connection and physical security to guard against unauthorized access.	Telecommunication or IT service Provider
Storage Array	To provide data storage functionality.	EMC NETApp IBM
Storage Area Network Equipment	To connect server, storage, and external network resources.	Brocade CISCO QLogic
Database Systems	To data management and Analysis	Microsoft Oracle IBM
Virtualization System	Efficient use of discrete storage and computing resources	VMware eNlight Citrix Microsoft

By implementing this technology, losses occurring due to energy thefts can be reduced to the great extent. To integrate "smart" appliances and consumer devices with proper management standards for electricity storage and peak-shaving technologies are introduced. The main target is to develop general and exceptionally flexible integration strategy for the integration of distributed energy storage systems based on standard flexible soft- and hardware platforms. The main focus should be on small to medium sized storages which are installed closely to distributed energy resources. The smart transmission grid will be capable of delivering electricity to customers securely and reliably in the case of any external or internal disturbances or hazards.

A fast self-healing capability will enable the system to reconfigure itself dynamically to recover from attacks, natural disasters, blackouts or network component failures. Online computation and analysis will enable the fast and flexible network operation and controls such as intentional islanding in the event of an emergency. We can monitor and display power- system components and performance across interconnections and over large geographic areas in near real time. To reduce the amount of time needed to access the data, data replication can be utilized to avoid remote file access. Much of the astronomical amount of energy consumed by data centers has been wasted on idle or underutilized resources. The gap between peak and average workload has resulted in very low average server utilization in current data centers (mostly between 20%—30%)[4]. The processes for utilities, business, industrial and residential customers to cut energy use during times of peak demand or when power reliability is at risk.

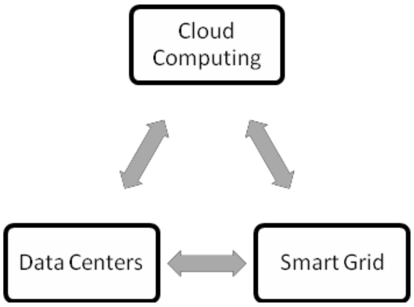

Fig.1. The interactions between cloud computing systems and smart grid through distributed data centers.

Grids are expected to let utilities optimally manage the electric power capacity and load within their service area leading to more sustainable energy use in the long term. The interactions between cloud computing, data centers, and smart grid are illustrated in Fig. 1[9]. The energy-hungry data centers are key elements of the cloud computing. They are also expected to have major impact on the internet and affect routing and congestion control algorithms. Due to their enormous energy consumption, data centers are expected to have major impact on the electric grid by increasing the load at locations they are built. This leads to an increasing interest in devising resource management algorithms among data centers that take into account power grid-related issues such as the changes in electricity price during the day at different regions with different time-zones by dynamically shifting the computation load towards data centers which are located in regions with cheaper electricity[9][4]. Power system cloud computing for Smart grid is to realize the intelligent modules of smart using cloud computing as the underlying technology for smart grid information exchange to reduce the complexity of system simulation.

The benefits of cloud computing are:

1. Minimum downtime and optimized life cycle costs through online monitoring and control of all grid assets.
2. It provides necessary software's applications to the users just paying according to their usage.
3. Reduction in CO_2 emissions through grid access of large wind, hydro, and solar power plants.
4. Significant improvement of customer processes and services [10].
5. Active management of power generation and load profiles of buildings.
6. It provides unlimited data storage for storing User's data.
7. Users can access the data from the c l o u d

5. CYBER SECURITY FOR SMART GRID

Smart Grid is facing many risks from cyber Vulnerabilities smart meter, zone management protection procedures and security assessment. It is necessary to develop standards to prevent smart grid security risks [11]. Direct information sources include consumer smart meters that transmit power usage and smart appliances data, sensors at transformers and distribution stations, and customer information systems used for billing. New models for demand forecasting use direct and indirect information from diverse sources along with data mining and machine learning techniques for more accurate, adaptive and real-time predictions. Smart Grids have a greater exposure to cyber-attacks that can potentially disrupt power supply in a city. This means that ensuring privacy of personally identifiable data within the utility's information integration platform is of growing concern.[6].

5.1 DATACENTER LOAD MANAGEMENT

The ability to dynamically adjust the performance of com- puter components proportionally to their power consumption is called Dynamic Performance Scaling (DPS) [21]. It is possible to adjust the computer supply voltage when it is not fully utilized. Based on this idea, many techniques are adopted. In this algorithm, the nominal MIPS (N) for each host represents the maximum computing capability of the host at the maximum frequency, while the host load (C) represents he current load of the host in MIPS. The load on host h is computed using 1, which is equal to the ratio of as shown in equation no 1

$$load(h) = \frac{\mathcal{N}(h)}{C(h)}$$

(1)

maximum computing capability to current load. The datacenter load is computed using below equition, which is equal to the average load on all its hosts.

$$load(DC) = \sum_{\forall h \in \mathcal{H}} \frac{\mathcal{N}(h)}{C(h)} / Size(\mathcal{H}) \quad (2)$$

Using this output we can make decision for which algorithms and technique we have to use to fulfill out requirement [12]

6. CONCLUSION

Reducing load on the data center the secondary issue of the smart grid and the security is the primary one. In this paper we try to give the optimize way to develop a smart grid using existing recourses and also give different technique to handle that critical data without losing it integrity and power consumption.

Requirement for Cloud resource providers not only to decrease operating costs, but also to improve the system reliability. Most resource-intensive companies growing demand for high performance computing infrastructures.

In this paper we try to focus on the different technique which can used to save data center load and try to give an easy solution to tackle such huge amount of data. The cloud computing environment and also disused about the effective algorithms which can be use to utilized the available resource in an optimized way.

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