The Contribution of Cloud Computing Technology in Power System

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Abstract: Cloud Computing provides a new direction to power system. As, power system needs a huge computational work, so cloud computing is an easiest solution of a multi objective power system. Besides it is used many areas of power system, there are many applications which are in the need of such a powerful solution. Such a similar problem is "REACTIVE POWER MANAGEMENT", which requires a logic so that with minimal efforts the requirement of reactive power of each utility can be achieved. In this paper, first the application of cloud computing in different areas of power system is reviewed, and which areas are in the search of this tool is also discussed.
Future applications of cloud computing and challenges to achieve the required objective in power system is also discussed. At last, the idea of a cloud computational management of reactive power is presented

Keywords: Cloud Computing, Reactive Power Management, Grid Computing, DG, RES

1. INTRODUCTION

With ever increasing demand of electrical energy over past decades, power systems have developed with various features. To cope up with this ever-increasing demand of power systems, it is approaching towards Renewable Energy Resources (RES) such as wind, solar, nuclear etc., most of which are embedded as DG (Distributed Generation) into the systems. So, modern power system requires a high precision of controllability, operation and coordination, which can be achieved by extensive simulation with high degree of data processing and large data processing. To handle with large data a computing solution is needed and cloud computing serves as boon.

The continuous and recent development in various parts of modern power system and this results need of large amount of data and for handling and calculation of this large data a complete system is required. The required system should be adequate to do such complicated calculations. The development of this system of operation involves following accountable difficulties: from one viewpoint, the extension of interconnected power system and a quicker obtaining speed requires the development of the gathering gadget, making the system dynamic analysis. Expanding measure of information on the data arrangement of information preparing limit of a higher necessity, requirement for more productive information handling. Then again, since the objective of building the business system and implicit diverse years, from wanting to configuration is regularly viewed as the absence of consistency, a substantial number of system securing and gathering of an expansive number of system activity, creation administration and tasks and different parts of the power advertise data.

Customarily, analysis of power system using simulation utilize a computer or an arrangement of computer at one physical area. At the point when a large amount of information is procured to be handled for online task choice help, for instance on-line contingency analysis, processing speed or resources used for computation is usually the restricting component to take care of such requirement of computing-related simulations. Here, underlying given arrangement was simultaneous (parallel) preparing; however, it is difficult to-work and costly. At that point the computing using Grid technology [1] was later embraced and utilized as a part of the looks into of simulation, load balancing, optimization of reactive power, analysis of stability and security, state estimation of distributed network. Grid Computing is a good arrangement, be that as it may, there exists some basic problems that must be tackled before the transformation takes place into real or required application. Some basic steps are specialized: the configured setup, its configuration, operation stages and maintenance procedure and the actuated applications more often it demands expert skills or a well-established IT knowledgeable person. In addition to it, there should be some of the integrable experiments or areas have to be redesigned to work with the models of grid in which multitasking application run on Grid models are implemented as a single unit of applications with multiple tasks, working flowcharts, and parallel processing using MPI (Message Passing Interface). These hurdles of technology, with a solution covering all aspects, can comes into the path of this to use in wider areas in education and industrial areas as well as in different areas.

One most extensive solution of these types of problem is Cloud computing. It is a new and useful structure for technology in computation and Information Technology service, can resolve most of problems that is considered. By methods for virtualization advances, cloud computing gives a elastic component to the end clients an assortment of administrations and services, from equipment to the required

application level, therefore architects can take simple access to substantial appropriated registering assets and totally redo execution condition, virtually for example if they are working on their individual work on their computers, upkeep or even not getting comprehension of complex equipment and elite computational strategies.

2. CLOUD COMPUTING

The term "cloud computing" is any computing service that is given as a service over the virtual network i.e. internet. As it includes many such areas (i.e., computing resources of distribution, data centers, etc.) and it is not a perfect way to accept a single definition which is well accepted by all, but definition can be understand or can be made by pointing some key features, it is also required to find some of the main properties that links this technology through the most accepted definitions. According to Berkeley perspective of cloud-based computing technology is, it alludes the applications conveyed as administrations of the hardware and system software in the centers of data that give the administrations, at that point the equipment that is used in datacenter with programming is the virtual object that can be called as a Cloud. As indicated by the NIST meaning of distributed computing, it is a working model for embedding and increasing advantages, on demand gives access to a mutual area of designable processing areas that can be quickly changed and redesigned with negligible overlook exertion or a sophisticated specialist organization collaboration.

2.1 Key Properties of Cloud Computing

Frequent flexibility: Properties can be frequently and flexibly provisioned to give required transformations.
Required self-service: A consumer can provisionally have whatever is required.
Network access to wide area: A large amount of resources are there over the network and can be handled or accessed by different mechanisms.
Measuring technique is embedded: A billing model is also embedded in the system where users takes virtual resources for "rent" virtual resources and pays accordingly.
Sharing of Resources: The computing resources of administrators are shared, when distinct physical resources dynamically shared and assigned according to different consumer demand.

2.2 Delivery Levels

A cloud can connect with a customer (client of use) in an assortment of routes, through capacities called services. Over the networks three noteworthy composes, or models of administrations have risen, which can be understand by following figure in which SaaS shows up on the primary spot and IaaS at the last

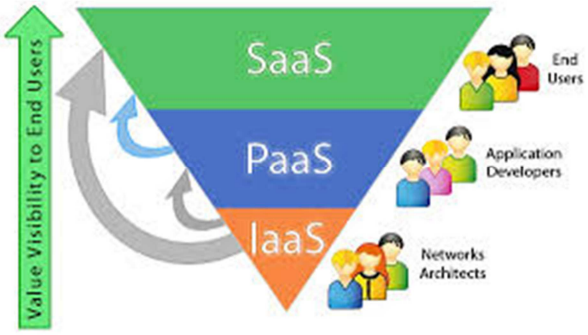

Figure 3.1: Comparative Role of SaaS, PaaS and IaaS

Software model as a Service (SaaS):The Software as a Service (SaaS) model gives foundations based on cloud for software when it is required. Generally, a SaaS arrangement is web-based content that user or clients get to by an internet browser. It can follow any function from the deployment model. The merits of SaaS module are straightforwardness of the module which is made of a program and it is very cost effective as the cloud serves the storing purpose of data, and versatility (clients can include client licenses or seats as required). The drawbacks of SaaS arrangements are the impression of security reasons.

Platform model as a Service (PaaS):The Platform as a Service (PaaS) gives the hardware technology, like, at least one of the servers, database arrangements, developer devices, and network supports, for engineers (developers here) to convey their own particular arrangements. The hardware and software inside a PaaS arrangement are overseen by the server owner. Designers does not have to think about the hardware and operating system. Rather designers can center around their own logics. Infrastructure model as a Service (IaaS):
The Infrastructure model as a Service (IaaS) model gives an imaginary center of data inside the cloud. This model gives servers, information storage based on cloud, etc. Inside this arrangement, developers must introduce their own operating systems. At that point the engineers (or the organization's framework overseer) must oversee the product and equipment simultaneously.

3. REACTIVE POWER MANAGEMENT

The fundamental type of compensation of reactive poweris, to compensate loads of reactive power, is the settled capacitors connected in shunt being very much conveyed over the system andpreferably connected close the loads. This can be guaranteeda good voltage profile amid steady state condition. This may not be satisfactory to guarantee dependability under over-burden. Capacitors connected in shunt are modest however need dynamic abilities, in this way some type of powerfully controlled compensation of reactive power compensation becomes necessary. The angle between the voltages of both ends, controlled by line current (real component), isn't influenced by the compensation using shunt. Including in shunt a reactor rather than a capacitor in will

diminishes the voltage considerably. Rather than mechanical means of switching (utilizing circuit breakers), we can utilize thyristor valves, in this way expanding the control ability fundamentally. This technique is called static VAR compensation (SVC). The essential components in static compensator are reactors and capacitors connected in shunt. These capacitors and reactors can be made variable by using thyristors. Similarly,the capacitor banks are also variable which is of fixed size and of different steps by switching thyristors. In view of these standards different compensators have been produced.

3.1 Key measures involving reactive power and voltage control

Key measures involved in this matter include:

1. The voltage received by the equipment connected in the system does not outperform a specific limit.
2. The stability of the system, generally influenced by control of voltage and reactive power, is expanded which takes into account the most extreme use of the transmission system.
3. The efficiency of the transmission lines is made ensured by lessening the flow of reactive power with the goal that the resistance and reactance can be reduced to an essentially least level. Specific devices are distributed in the system for voltage control on the grounds that reactive power transmission is most drastically averse to happen over more distances. The fundamental difficulties to accomplish the above key focuses are picking and organizing the best possible equipment.

4. AN OVERVIEW OF CLOUD COMPUTING AND POWER SYSTEM:

Numerous researchers have investigated and obtained numerous accomplishments about cloud computing innovation applications in the power system. Some of which are clarified underneath:

4.1 Simulation of Power System in transient condition

The power system transient simulation server in light of technology based on cloud computing will convey to system, and the organizations which require a application which have control over Simulation of Power System in transient condition, which just need a PC connected to the Internet. Using a Web based program, they can get to the predetermined page of server, after check of character, the fundamental data of the main grid can be transferred to the server database, and in the wake of playing out the predefined estimation, the computed structure transmitted back to the program to show a same time. Clients can likewise run their own power system information required to figure the editor so on [8].

4.2 Google Engine basedApp on InterPss Cloud Edition

InterPSS center simulation engine gives the computing and investigation ability, it keeps running inside the Java Virtual Machine (JVM) of Google Engine App after it is sent in the cloud based on Google, in that it gives the capacities to reaction to the requests, with respect to various types of analysis related to power system, i.e. power flow of alternating current, and so on from the clients. With the assistance of the Application Programming Interfaces (APIs) given by GEA, a site (http://cloud.interpss.com) is set as remarking end, empowering client to transfer the information for preparing, characterize the investigation case [2]. Datastore, Google's dispersed database framework, is likewise used to spare the go-between record or information and in addition the investigation case if the clients select the alternative.

4.3 Cloud Computing in Smart Grid

The execution of electricity management of shrewd homes in the cloud. In this application clients take after power utilization continuously and in addition tariff plan recommendations, dynamic investigation of power utilization through charts, computation and use of penalties, issue invoices every month and furthermore a show of money related explanation audit and notice through work area alarm and messages [9].

4.4 Cloud computing for Load forecasting application

The electrical load forecasting application is led by South Westphalia University, Department of Automation Technology [10]. In this work an Electrical Power Load determining application is actualized in Amazon Cloud processing stage. The Matlab based load estimating application utilizing artificial neural system is sent in the cloud and on the neighborhood, PCs having comparable figuring limits with the relating cloud computing occurrences. The computational execution of nearby PC equipment is contrasted with the proportionate EC2 examples and the outcome demonstrates that the superior exhibitions of distributed computing over the neighborhood PCs.

4.5 Miscellaneous

Reference [5] proposed the cloud computing innovation application to meet reliable access to information and superior processing in the gigantic lightning, furnishing with the system architecture and plan of the lightning data cloud. Reference [6] proposed the data-intensive storage method from an arrangement of information focuses to information space in view of cloud computing, and this strategy was approved plausibility in the cloud research centers of the national system organization. Reference [7] proposed and outlined a calamity recovery framework mix cloud stage from foundation programming, infrastructure service, application administrations, and supporting applications for disaster recovery.

Table 1: Comparison of Cloud Computing Applications for energy management [4]

Cloud Applications	Smart Grid Features			
	Demand Side Management	Micro-Grid Management	Load Shifting	Dynamic Pricing
Demand Response	Yes	Yes	Yes	Yes
Peak Demand and Dynamic Pricing	Yes	No	Yes	Yes
Micro-grid Management	No	Yes	Yes	No
Real-time monitoring	Yes	No	No	No
Power monitoring and early warning System	Yes	No	Yes	No
Information interaction using mobile agent	yes	No	Yes	No

5. FUTURE SCOPE

In this paper utilization of cloud computing in Reactive power administration is exhibited here. As Reactive power administration is the essential concern now a days. To oversee receptive power distributed computing is utilized as one of key measure, as voltage stability, power factor, usage of reactive power, effectiveness relies upon reactive power and reactive power can be overseen by adjusting this innovation. It can be executed by controlling diverse customer frameworks by server framework. At this place client systems refers to different customers, and server system refers to the main supply end.

Up to now most of the researches are concerned with management of active power, and even if it is regarding reactive power then it is mostly related to decreasing reactive power as it introduces unnecessary losses. For example, if there is a transformer at no load condition is operating in a system then it is a source of lagging reactive power so in this situation a decision which is normally taken is to shut down it. But by the approach of reactive power management using cloud computing transformer at no load condition is generator of lagging power factor and it fulfils the reactive power requirement of some other customer (referred as client here). So instead of generating lagging reactive power separately, already generated reactive power can be used to balance the requirement.

A next common example can be taken for better understanding of this approach that if one client has some arrangement of leading reactive power and if this information is somehow communicated to other users then a different user can use appliances that causes power factor lagging as the first user can sell him leading VAR so as to improve its power factor. So overall the burden of supply end of satisfying individuals demand will be ended, and all the different clients will first compensate their own requirement and if there is any external need only that need will be required to fulfilled by the server.

6. BENEFITS AND CHALLENGES

Cloud Computing has many potential favorable circumstances in the research areas of power system and industrial areas. For mainstream researchers, it is a cost-effective superior processing asset, and for SaaS and PaaS models permit enough required control and customization with respect to investigation. What's more, as in contrasted and the customary work area programming, no extra programming arrangement, equipment redesign and support is required. Additionally, once an examination-based application is distributed over people in general cloud, the developer(s), as well as all the viewpoint clients around the globe, can profit a ton from computing using cloud. For the different power organizations, it fits their prerequisites in its dynamic versatility empowers their task frameworks (e.g., EMS, DMS) to effectively take care of the processing demand in typical activity and the top amid the possibility. It can likewise be utilized to convey very much required functions over the web based network utilizing the Software-as-a Service display, when control investigation programming, e.g. EMS, conveyed in datacenter or the Cloud in headquarter, distinctive examinations and every level task can depend on it, accordingly making basic information for all investigation and activities possible.

It ought to be noticed that cloud computing is at the early step of a long staircase, and there are issues and difficulties are required to be looked for its reception in power system for scientific and commercial purpose, particularly from an administration and security perspective. In the first place, this is another model for registering, and a large portion of the heritage frameworks in control organizations presently are not good with it, and an intense move is required for innovation. Second, if there should arise an occurrence of open cloud, since information are put away and prepared in the Cloud, the two specialists and utilities in power system always remains concern for their information related to security, security issue is an another imperative issue which may influence its wide acknowledgment except if totally tended to.

7. CONCLUSION

Subsequent to examining the likelihood and focal points of cloud computing in control framework investigation, this paper displayed application distributed computing in reactive power administration, set forward by this paper, the cloud computing engineering gives another state of mind for the power framework examination application usage. In any case, there is requirement for additionally enhance in future work, for example, the cloud-matched parallel algorithm dynamic designation of load and circulated information procedure of the cloud

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