Cloud Computing and Power Systems Applications an overview

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ABSTRACT
The fundamental target of this research work is to discuss and analyze the impact of Cloud computing in Power System applications. Cloud process gives another worldview to simple access to bigger scale computing resources over the Internet, along these lines offering an option answer for enormous information handling and overwhelming computational work in power system. At the present discharge, it gives for the most part three capacities including load flow, contingency analysis and ODM (Open Data Model) power system, simulation data transformation services and it is available anyplace around the globe, 24x7, by means of internet. In this paper it has been analyzed the utilization of Cloud Computing (CC) into power system applications due to its crucial advantages of low cost, flexible & redundant architecture with quick reaction. Cloud computing has usefulness to give security, interoperability and best execution required for a substantial scale and complex keen system application.


INTRODUCTION

The electric power industry is one of only a handful couple of enterprises where Cloud computing has not yet discovered much selection, despite the fact that electric power utilities depend vigorously on interchanges and calculation to arrange, work and investigate Power Systems. In this paper it has been investigated the purposes behind this wonder. It had been distinguished an assortment of Power System applications that could profit by cloud figuring and discuss about the security prerequisites of these applications, and investigate the outline space giving the security properties through application layer creation and by means of guaranteed cloud computing. The contend that a mix of these two methodologies will be expected to meet various application prerequisites at a cost that can legitimize the utilization of cloud computing.

With the guideline and consistent extension over the previous decades, Power Systems have created from separated systems interconnected interregional/global connections. Because of nonstop development of power system network, controlling and monitoring of power Systems is unavoidable [1-26]. Also power systems are moving towards renewable vitality sources, the vast majority of which are incorporated into the systems as distributed generation units together. [27] In this way, a larger amount of operation, control and coordination is basic, which depends on vast information handling and requires for a higher performance computing results.

- Integration by configuration: expertly incorporated figure, stockpiling, and systems administration assets so it can convey in hours rather than days.
- Built-in mastery: robotized administration and organization aptitude for physical and virtual assets.
- Simplified encounter: upgraded setups to quicken buy organization and time to esteem for your answer.

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Conventionally, Power system simulation and analysis utilizes a PC of an arrangement of PCs at one physical area. At the point when expansive measure of information are obtained to be prepared for online operation choice support, for instance on-line contingency analysis, computing resource frequently is the constraining component to the take care of such demand of computing serious simulations.[29] The underlying proposed arrangement was parallel handing, yet ended up being to be difficult to-work and costly then the Grid computing was later embraced and utilized as a part of the looks into of simulation, reactive power enhancement, load balancing, steady and security examination and state estimation.[30] Grid service is a covered hopeful arrangement; however, there are some basic issues must be unravelled before it can be transformed into real application.[31] Some are specialized: the setup, design, operation and maintenance and the applications executed on it for the most part request skill or exceptional IT knowledge. In expansion, a few investigations or applications must be rearranged or updated to fit into the grid models in that application keep running on grids are actualized as pack of undertakings applications, work processes and MPI (Message Passing Interface) parallel process. These specialized snags, with an immaculate arrangement, can keep it from more extensive applications both in scholastics and enterprises field. [32] Cloud process, another worldview for figuring innovation and IT administration, can address a large number of issues specified previously. [33]

By method for virtualization innovations, cloud computing gives an adaptable system to offering end clients an assortment of services, from hardware to application level, in this manner specialists can have simple access to extensive appropriated processing resources and totally customize their execution environment, virtually like working on their PCs, without the need of procurement, maintenance or notwithstanding comprehension of refined hardware and high performance computational methods.[34] Other imperative elements incorporate its versatility and pay-as-you-go charging model. Installed with these, it is progressively utilized for scientific applications.

The science clouds extend, started in mid-2008, have demonstrated the practicality of utilizing cloud computing for logical registering and gave early encounters of such new worldview from an exploration purpose of view. It has been connected to the atmosphere research and era expression and cerebrum imaging. In 2009, the U.S. Bureau of Energy (DOE) expressed the Magellan Project and set up a proving ground to look at cloud computing as a cost efficient and vitality proficient figuring worldview for researchers. Alongside this new pattern in different fields, control organizations are starting to show consideration and enthusiasm on it.

Mercury Solar Systems utilizes a cloud computing CRM (client relationship administration) to better meet the customer energy needs. Engineers from the China Southern Power Grid have proposed to exploit Cloud computing to overhaul its energy examination programming (PAS) for brilliant transmitting [35-44].

Despite the fact that there is some early cloud computing application investigates in different controls, as far as anyone is concerned, constrained (none) looks into on using its usefulness in power system analysis have been done. Be that as it may, its low-cost, agility, reliability and scalability make it a potential approach for future power system application. This paper is composed as takes after: In Section II of this paper, an overview of Cloud computing is given. Need of Cloud computing in power systems are given in Section III. In Section IV, Cloud computing and future power systems applications are examined.

II. An overview of cloud computing:
A. Definition:

The expression "Cloud computing" alludes to any computing ability that is conveyed as an administration over the web. While it incorporates numerous viewpoints (i.e., dispersed computing sources, virtualization, network, data enters, and so on) and there is no definitively licensed definition, it is conceivable to distinguish some key components that describe this innovation through the most often utilized definitions.

B. Examples of Cloud computing:

Get ready archives over the Net is a more current case of Cloud computing. Essentially sign on to an online administration, for example, Google Documents and you can make a report, spreadsheet, presentation, or whatever you like utilizing Web-based programming. Rather than writing your words into a program like Microsoft Word or Open Office, running on your PC, you're utilizing comparative programming running on a PC at one of Google's overall server farms. Like an email drafted on Hotmail, the record you create is put away remotely, on a Web server, so you can get to it from any Internet-associated PC, anyplace on the planet, at whatever time you like. Cloud innovation can bolster the adaptability and execution expected to address portable, social and enormous information requests, yet you need to actualize a cloud framework proficiently. You require disentangled administration of framework that addresses your issues both in usefulness and aggregate cost of proprietorship.
C. **Essential Characteristics of the cloud computing into Power Systems Applications:**

- Fast versatility: Power System server’s capabilities can be quickly and flexibly provisioned to have scalability.
- On-demand self service: A power systems client can uniquely arrange computing capabilities.
- Expansive system get to: Large scale assets are accessible over the system and got to through standard components.
- Measured Service: utilization based charging model where clients basically "lease" virtual assets and pay for what they utilize.
- Resources pooling: The supplier's registering assets are pooled together, with various physical and virtual assets progressively relegated and reassigned by consumer demand.

C. **Three Delivery Levels:**

In light of the level of reflection displayed to the developer and the level of management of the resources, the Cloud Computing can be ordered into three delivery levels, they are Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Figure 1 gives a review and gives the relating delegate organizations and their administrations advertising.

**Infrastructure as a Service:**

(IaaS) means you're purchasing raw equipment hardware over the Net, for example, servers or storage. Since you purchase what you need and pay-as-you-go, this is frequently alluded to as utility processing.

**Software as a Service:**

(SaaS) implies you utilize a total application running on another person's system. Electronic email and Google Documents are maybe the best-known illustrations.

**Platform as a Service:**

(PaaS) implies you create applications utilizing Web-based tools so they keep running with respect to systems programming and equipment gave by another organization. Along these lines, for instance, you may build up your own internet business site yet have the entire thing, including the shopping cart, checkout, and installment component running on a trader's server. Force.com and the Google App Engine are cases of PaaS.

F. **Preferences of Cloud Computing:**

- **Cost Efficient:**
  
  Cloud registering is likely the most cost effective strategy to utilize, keep up and update. Conventional desktop programming costs organizations a great deal as far as back. Including the permitting charges for numerous clients can end up being exceptionally costly for the foundation concerned. The cloud, then again, is accessible at much less expensive rates and subsequently, can essentially bring down the organization’s IT costs.

- **Almost Unlimited Storage:**

  Storing data in the cloud gives you practically boundless capacity limit. Consequently, you no more need to stress over coming up short on storage room or expanding your present storage room accessibility.

- **Backup and Recovery:**

  Since every one of your information is put away in the cloud, backing it up and re-establishing the same is relative.
Automatic Software Integration:
In the cloud, software integration is usually something that occurs automatically. This means that you do not need to take additional efforts to customize and integrate your applications as per your preferences. This aspect usually takes care of itself.

Easy Access to Information:
Once you register yourself in the cloud, you can access the information from anywhere, where there is an Internet connection. This convenient feature lets you move beyond time zone and geographic location issues.

Quick Deployment:
Lastly and most importantly, cloud computing gives you the advantage of quick deployment. Once you opt for this method of functioning, your entire system can be fully functional in a matter of a few minutes. Of course, the amount of time taken here will depend on the exact kind of technology that you need for your business.

III. Cloud computing for power systems applications:
The essential usefulness of a power system is based after processing or controlling and exchanging its data between the power framework applications. In existing frameworks, these data are ordinarily put away in databases, regularly utilizing a Microsoft Access or Relational Database Management System (RDBMS). The Structured Query Language (SQL) is utilized for getting to the database. It turns out to be extremely hard to perform remote operations on the data when they have been put away in a brought together data base. A cloud situation is giving separate layer, SaS layer which permits the data to be accessed effectively from anyplace at any time. [45-56].

A deregulated power environment involves Generation, Transmission and Distribution areas. Every area has as an autonomous independent grid operator known as Independent System Operator (ISO). They are in charge of the everyday operation of the power frameworks. The data sharing and coordination are getting to be distinctly real issues between these divisions while performing power framework operations. As a similarity, in open access electricity market the demand must be served by generation from anyplace in the interconnected frameworks. Cloud service gives whenever anyplace answers for data sharing and integrated issues. The other issue in the present power system is scalability. The power framework operations are utilized by numerous simultaneous users at once. The frameworks must be intended to handle operations by the customers and suppliers with no obstacle to exchange information because of heterogeneous nature. The traditional server farm does not give the dynamic scalability. The cloud environment gives the innate element versatility to the operations of power systems.

The power engineers need to deal with the parameters, for example, real power, reactive power, voltage and frequency for the steady operation. To store and keep up these parameters in a cloud, endeavours must be taken to guarantee the data is remained careful, in transport, manipulating and storage. The Service Level Agreements (SLA) might be executed between the supplier and customers to keep the data in a sheltered and secure way in the cloud service. The cloud service needs to give more reliable to the customers as the number cloud specialist organizations have gotten to be increased. In power system, the computation amongst customary and Web empowered applications has turned out to be cross-train in nature. Utilizing the present Information Technology (IT) ideas, the applications can be summoned from anyplace by the clients. The extent of services of power system computing covers entire lifecycle of power system development research about that incorporates Power System componentization, service displaying, service creation, service realization, service annotation, service deployment, service discovery, service composition, service delivery, service-to-service collaboration, services monitoring, services optimization and as well as service management. The aim of power system service is to receive late IT services and computing innovations to play out the services more productively and successfully.

IV. Cloud computing and future power systems:
The convergence of the power utilities in the level structure or deregulation policy thinking of more enthusiasm for the remote monitoring of distributed generation unit. Furthermore, with the presentation of web and correspondence advancements has accommodated for distribution network operators an achievable reason for the design and implementation of centralized structure for their distributed monitoring and control application. The amazing improvement adds to an expansion the pertinence of power systems design and operation in many research fields. One of the zones that has profited from such advancements is energy management systems.

However the incorporated control approach is no more extended adequate to manage with these unlimited distribution networks which call for more advanced smart grid applications. Such a smart grid applications requires an efficient and reliable communication environment to enable monitoring and control the power grid, and additionally suit other local controllers in finding an ideal arrangement of control actions. Likewise, require
more computational capacity. Building new infrastructure which manages huge data by utilizing all the accessible resources over the web.

The power organizations to exchange data and information between various nodes in the power systems network using Supervisory Control and Data Acquisition systems (SCADA) technology. This system includes Energy Management Systems (EMS) and Distribution Management Systems (DMS). A portion of the activities performed by EMS are transmission control, network analysis, load forecasting, power generation and control. Distributed computation, monitoring and control is a proficient technique to manage modern, and complex decentralized power systems within a short period of time. In the future, the power system utilities will get the huge amount of power from the Renewable energy resources. This mind boggling situation requires a considerable measure of data exchange between the nodes and high computational ability. In addition, smart grid has automated systems that give productive and smooth data exchange for monitoring and control of the widely distributed power resources. Therefore, cloud computing can give future power system needs, more computation power, which can be tended to by using all the accessible processing resources. Also in smart grid applications, the cloud technology used to manage smart meter data for EMS. For instance, Amazon EC2 platform is intended for the developer or clients who need to take the benefit of the performance offered by the cloud service. It offers the reliable environment to implement the principal case machine and operate it as per the requirements. The Cloud-based power systems programming architecture normally comprises of 3 levels as appeared in Figure 2: One level comprises of the remote simulation server which runs a software that simulates a model of the power system network and performs estimations, the second level is the web server that handles communication between alternate levels, and the web browser is the third level for parameters of input and displaying results.

**Fig. 2: 3-level architecture for web based power systems analysis**

MATLAB power systems solvers, for example, MATPOWER may likewise be gotten to on the web by running them on an application server with MATLAB introduced and afterward utilizing a intermediate scripting language, for example, ASP.NET to communicate with the web browser. Another online cloud application is Inters which depends on Google Drive™ spread sheets for data and results yield, and a Google Apps™ script communicate with a Java based simulation engine. The 3-level design is executed for practical reasons that simulation of software packages which are not prepared for web demonstrating use a web server as an interface. The main necessity for web access is to upgrade of communication and data transfer. Another practical explanation is that the programming dialects utilized for building sites are notes intense or as deliberate for computation as those used for building simulation software. Additionally, the power system customer applications (MATLAB, JAVA) are to get to the stability services in a cloud computing environment. The power system services in a cloud environment as shown in Figure 3.
The power system customers can access their required services by paying for what they use with minimal investment costs in cloud environment. This environment can adopt by power sectors for running their power system applications keeping in mind to enhance the effectiveness of their operations demands.

Conclusion:
Cloud service, describing scalability and pay-as-you-go demonstrate based service, gives a cost-effective and flexible approach to utilize vast scale computing resources. In this paper, the inspiration driving this pattern is talked about and a short presentation of Cloud Computing is given. In the blink of an eye it gives Load flow, contingency analysis and data format transformation service and it gives clients the capacity to run their analysis anywhere, 24 x 7, by means of the web. Likewise, it ought to be noticed that more and further looks into will be required for better application of cloud computing in power system.

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