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HOW CLOUD COMPUTING BENEFIT RENEWABLE ENERGY INDUSTRY?

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ABSTRACT

Due to the increasing demand of Renewable energy sources (RES), distribution system is predicted to play important role in nearby future.

Although Renewable energy sources are freely available and have a very high value and need to be utilized efficiently in a "sustainable manner". In the future power system Renewable energy industry will play main role in the future power systems. To support the integration of existing conventional power system with

Renewable energy resource's which are widely dispersed power system, future electricity infrastructure must support in which cloud computing can play an important role. Cloud computing the most demandable technology in communication environment. Cloud computing provides a cost-effective solution as Software as service (SaaS). Distribution company can use cloud computing extensively for power distribution as well as cost-effectiveness. The interconnected power pools and grid needs a real time monitoring, controlling and high computational power.

Many devices connected to grid help in exchange of information with power system using cloud computing.

INDEX TERMS

Cloud computing, centralized datacenters, digital twinning, smart grid, scada systeem

1. INTRODUCTION

Due to the increasing popularity of Cloud computing services small- scale as well as large-scale data centers are growing rapidly. One of the main reasons for the growth in the energy consumption is that more and more service provider is shifting their IT workloads to Cloud. The foremost

reason for shifting IT infrastructure to

Cloud is cost management. Demand for green energy is rapidly increasing as society is getting more environment conscious. For building a greener cloud environment around data centers maximum energy efficiency,

and minimal environmental impact are the foremost criteria. Data centers energy management and explicit sources of green energy which will facilitate to carbon footprints is still in its infancy, but will surely gain lot of attention lately.

The main challenge for the infrastructure-as-a-Service (IaaS) is to determine its best trade between its profit using the green energy budget constrain and also contracted Service Level Agreement (SLA) with Service-as-a-Service (SaaS) and energy provider

In renewable energy industry there exists several cloud service providers which will give data centers to efficiently distribute energy needs as per the current need.

2. DATACENTERS

Due to the increase in the demand of renewable energy such as wind energy solar energy, etc. which is located in remote location data centers are essential for proper functioning of energy and management of energy using software and hardware i.e., cloud computing. Cloud computing has promoted large scale deployment of data centers.

Cloud based renewable energy computing cloud ultimately end up reducing consumption at data centers. Green power companies will make their business practices more sustainable, all while Saving money.

The renewable energy produced with the help of cloud computing can also help the data centers to match their required energy needs as data centers consume more energy.

Since the innovation of Cloud computing the idea and demand of data centers has emerged rapidly because it is way easier. For all the progress, there is no time for the cloud industry to take bow or rest on its laurels.

3. ENERGY PROCUREMENT AND INTEGRATION

The integration of electrical and information infrastructures is the basis of a cloud- based energy management system.

Due to the rising demand of green computing and its services most of the green data centers adopted on-site green energy plant i.e., wind turbine solar panel to meet the energy demand. The best place for constructing green energy plant might not have the true potential to build a data center due to the intermittent nature of the renewable sources. Having a small scale renewable plant always gives the advantage to incorporate green energy to the data center to fulfill at least the partial green energy demand if there is not sufficient amount of energy in REC or

Green energy market. Due to being 'natural', renewable energy comes with a higher 'uncertainty' factor, making the plant operations and maintenance processes more complex. With the large-scale integration of renewable energy generation, the distribution of the energy flow in the grid will change, and the energy flow can be reversed

Digital Twinning

Digital twinning is the one of the best IT solutions for renewable energy management. Digital twinning makes virtual copies of physical assets and processes. A digital twin is a code powered representation of an actual wind turbine that is constantly supplied with new data from its physical counterpart through connected systems.

- Estimate performance and profitability under different conditions.
- Ensures real time monitoring and digital inspections.
- Enable fault prediction and dynamic maintenance.
- Facilitate and improve the work of on-site engineers etc.

A predictive algorithm, powering the twin, operationalizes all the incoming data and can be used to model different types of usage scenarios

Algorithms

Cloud computing enables the demand of network access to a shared pool of configurable computer resources such as servers' storage applications services etc. that can rapidly provisioned and released with minuscule management effort or service provider interaction.

Data centers are established all over the world and each of the data centers has thousands of servers through which service providers can remotely manage renewable energy or any other system.

Some major measures taken by the cloud service providers are these

1. Use renewable energy sources.
2. Make data centers more energy efficient, by maximizing power usage efficiency.
3. Can reuse waste heat from data centers and servers.
4. Service providers must make sure that all hardware used must be recycled properly.
5. Using hardware that has long lifecycle a with less toxic materials will reduce waste.

Flexibility

Dividing the entire power system into different control center help to deal with problems occurred during operation. In distributed control scheme, any failure

that can be handled locally will be processed without putting influence on other control area or power systems.

Smart grid technologies promote renewable energy source integration. This results in big amount if data handling and processing issues, due to the dynamic and disturbed nature of sources and loads. If operations are coordinately handled for generating sources and loads in such environment is challenging and also requires substantial support for meeting the disturbed storage and processing requirements. There is also immense potential in cloud computing that can easily handle and address those issues. The architecture for the smart grid data storage applications has been realized in open-source cloud platform. Open stack cloud test bed has been set up for the deployment of applications and tested the performance under varying work

4. SMART GRID STATUS MONITER

Smart grid monitoring in cloud computing will help the service providers for monitoring data. The amount of state data such as primary as well as secondary equipment, real time online data, inspection records, basic information, operation data and test data will be increasing greatly in the environment of smart grid. This method is better than the traditional method of monitoring applications. The architecture of cloud computing platform of the status data proposed to meet the need of smart grid condition monitoring. For this need a software package cluster technology, suitable for monitoring conditions of smart grid.

The working of electric power system involves transmission, generation, distribution and usage of power simultaneously. The main drawback of electric power system is that it can't store energy in large amount. Therefore, in production of electricity through renewable energy the control should be real time, consistent and more reliable of hierarchal management, hierarchal control and disturbed processing. In cloud based economic power dispatching model, the utility and customer interact through cloud, and the functions for cloud optimization are performed in the cloud. Cloud appears to be an information system which gathers data from the utility and then process the data and gives the output to utility and customers.

The importance of building information management system in the smart grid

is rapidly increasing. Information management system of each entity is improved to provide high-quality services. The number of entities increases according to coverage area of building. Cloud computing-based information management system will help in lessen burden of each entity by a system manager, a centralized server. To monitor the consumption of power and environmental information sensors entity with 8bit microcontroller and Low-cost power are used. The digitally controlled smart grid enables the integration of `all the different sources of generated power for the transmission as well as distribution for power consumers.

Basically, conventional smart grid is always based on Demand response model (DR). Demand response applies to adjustment in end-use consumers electricity needs to determine their regular consumption pattern in response to change in electricity price over the time.

Many researchers proposed a cloud-based demand response (CDR) model for rapid response time in large scale delivery. Energy management system and meters used to record energy consumption must be smart in cloud management system. The cloud-based demand response uses data centers to contact publisher or client.

Overhead issues such as cost of implementation and section of suitable strategies could rise.

5. SCADA SYSTEM

Scada system is a supervisory control and data acquisition system which is comprised of hardware as well as software.

The system monitors and the renewable energy plant from a remote location as well as network and process equipment in local as well as in remote operation. Scada system gathers and process real time-data from those operations, interacts directly from process equipment's through a human machine interface (HMI), also stores process values and event locally and forward the data via concentrations for consolidation and can use centrally.

Scada systems can be used for broad gauge of application such as power, gas, oil, water, beverage and food plants, datacenters and building automation, and manufacturing facilities.

1. **Components used in SCADA system:** The main components that is compulsory for this system is Remote

terminal units and programmable logic controllers, Scada servers, communication system and networks i.e., (fiber-optic cables, satellites, coaxial metal fibers, high frequency radio etc.), Scada workstation which requires Human machine intervention for operations.

2. **Distributed Architecture:** Supervisory control and data acquisition system are basically designed with multi nodal hierarchical architecture. For water distribution network s, for instance, a single SCADA system manages the entire distribution network from a central location using the data from the field equipment deployed throughout the city or the region. The hierarchical server architecture allows each resident Scada system to send signals to the central Scada.

3. **Scalable Architecture:** The main feature of the Scada system using cloud computing is that it offers unlimited scalability. It is easy to grow the system as needs and evolve over time, which helps in expanding it into previously unforeseen areas and also integrating it with other systems that may or may not already exist. It is also possible to evolve the system from small to large by increasing the number Scada servers.

6. RESEARCH METHODOLOGIES

HYBRID MODEL

A model may include both descriptive and analytical components. A descriptive model's logical relationships can be examined, and conclusions can be drawn to reason about the system. Nonetheless, logical analysis yields quite different conclusions than a quantitative chemical investigation of system properties.

We first conducted a poll of people utilising an online form creator and data collection service to acquire information regarding people's awareness.

7. PUBLIC SURVEY

We deployed our data gathering utility, often known as a survey bot, to a variety of people and collected information on various facets of their understanding of cryptocurrencies.

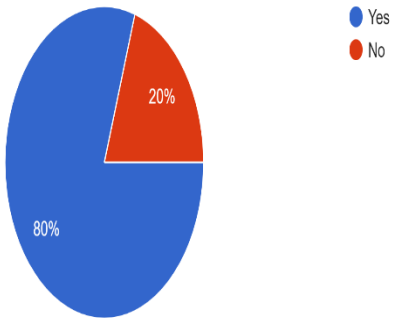
7.1 QUESTIONNAIRE

- Are you familiar with the concept of Cloud computing?
- Do you use cloud services on your mobile or laptop?
- Are you familiar with the concept of SCADA system?
- What do you think as the major benefit of using cloud computing in renewable energy industry?

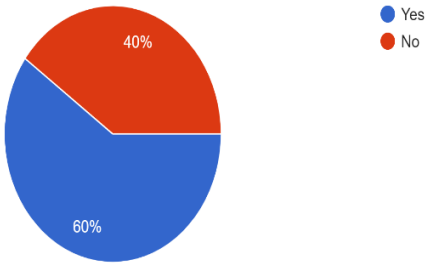
- Do you think cloud computing can help the renewable energy industry?
- Can we centralize the data centers of renewable energy using cloud computing?
- Cloud computing companies that you are aware of?

7.2 RESULTS

When people were asked if they were familiar about the concept of Cloud computing, about 80% of the people were aware about its existence as it is widely used all over the world.

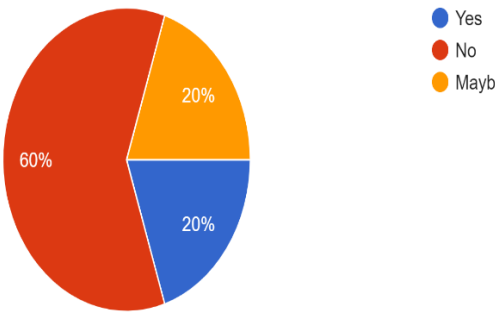


When we asked them do, they use cloud computing on their mobile/laptop about 60% of the people uses cloud computing in their devices and about 40% don't use cloud computing



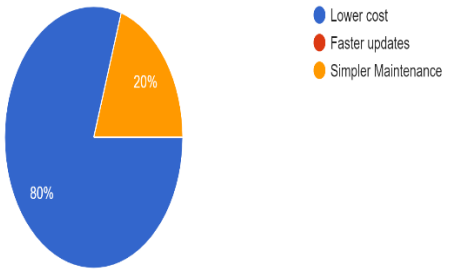
On being asked if they know about the SCADA system i.e.,

- 60% of people know how Scada system works.
    - 20% of people don't know of the Scada system
    - 20% of people aren't aware of this system and they are not sure about their view points

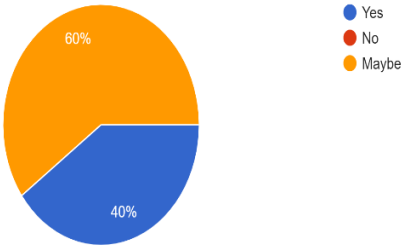
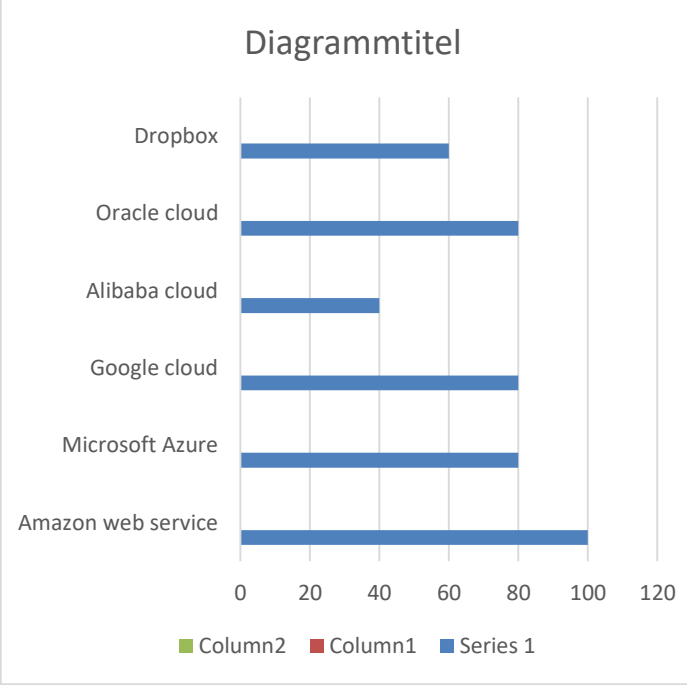


When people were asked what they think as the major benefits of cloud computing if they are used for renewable energy industry?

- 80% of the people in the survey thinks that using cloud computing in renewable energy will help in Lower cost
- 20% of the people in the survey thinks that by using cloud computing in renewable energy will help in the maintenance
- No people in the survey thinks that faster updates are as much beneficial as cost cutting and maintenance.



When people were asked can we centralize the data centers of the renewable energy industry using cloud computing 60% of the people aren't sure of the answer 40 % of the people thinks that we can centralize the data centers using cloud computing in renewable energy industry



When asked about the cloud service provider they know about 100% of the people in the survey were aware of the Amazon web service about 80% of the people were aware of the Microsoft azure also 80% were aware of google cloud service 80% were aware of oracle cloud 60% were aware of drobox and about 40% were aware of Alibaba cloud