A Secure Private Cloud Computing Based Framework for Big Data Information Management of Smart Grid

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***Abstract*— Managing and processing big data are the problematic now a days. During the distributed processing handling the big data were very important factor that plays vital role. This paper deals with the bigdata in the field of distributed processing associated with smart grid in the cloud computing. Providing security is an feature in this paper. All the concepts are implemented in real time through the web services.**

***Keywords*— Cloud computing, Smart Grid, Distributed Processing, Web services.**

I. INTRODUCTION

Cloud computing is a pool of virtualized network where the user can access the data in an on demand mode. It delivers infrastructure, platform, and software that are made available as subscription-based services in a pay-as-you-go model to consumers. These services are referred to as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) in industries. The importance of these services was highlighted in a recent report from the University of Berkeley as: "Cloud computing, the long held dream of computing as a utility has the potential to transform a large part of the IT industry, making software even more attractive as a service". Some of the examples for emerging Cloud computing infrastructures/platforms are Microsoft Azure, Amazon EC2, Google App Engine, and Aneka.

Smart Grid and Cloud Computing

1) Cloud Applications for Communication and Information Management: As we have seen in the proceeding sections, a smart grid consists of bidirectional electrical as well as communication flows, primarily enabled with the help of advanced sensor network technology. The smart meters are also deployed at the customers end to communicate with the service provider. Due to this architecture, massive data are generated from both the utility and end-users sides. The management of vast amount of such data is challenging using the traditional data management approaches due to the different constraints (such as processing unit storage and memory). Consequently, cloud computing applications are one of the best methods to control such vast data in order to have a reliable, robust, and efficient smart grid environment.

2) Cloud Applications for Security in Smart Grid: A Smart grid can be conceptualized as a cyber-physical system that connects physical electricity systems and cyber-infrastructure, with the integration of the Internet. This service can communicate with the consumer applications and also provide the backbone for utilities to assimilate content operations. With the presence of online connectivity, smart grids have greater exposure to cyber-attacks that can potentially disrupt the power theft by consumers. This can be done by hacking a smart meter or changing its communication channel to change the reported electricity usage. Additionally, data manipulation is also one of the most security concerns in the smart grid. To overcome these issues we need to implement proper security for secure and reliable smart grid architecture. Security can be implemented on the consumer side, transmission side, and generation side.

3) *Different Security Technologies in Smart Grid using Cloud Applications:* The existing information protection systems for electric power are deficient in handing the ever changing and growing nature of security threats (68]. To address these issues in the smart grid development, researchers proposed several security technologies in terms of cloud computing application [68]-[72].

1) An electric power information security and protection system, based on cloud security, is presented by Yanliang et al. [68]. The authors classified cloud security into two parts: server and client. The clients mainly collect data and take action according to the server responses. On the contrary, the server uses the cloud computing platform to implement the distributed storage, thereby acting as an intelligent decision maker. Then the results are transmitted to the clients through the internet.

A. Figures and Tables

Energy management can also be addressed with the implementation of dynamic pricing. Xuan Li et al. [34] proposed two smart grid related issues: (a) peak demand and (b) dynamic pricing. With the integration of cloud, the incoming jobs are scheduled to be executed according to the available resources, job priority, and other applicable constraints. During peak hours, the messages from smart meters are more than those in the non-peak hours [34]. However, in such a scenario, incoming jobs from users are scheduled according to their priority, available resource, and applicable constraints. With the integration of dynamic bandwidth allotment mechanism using cloud application, these issues can be addressed conveniently. During the peak-hour, the allotted band-width is higher than that in the non-peak hour, so as to serve all the incoming jobs simultaneously.

Cloud Applications	Smart Grid Features			
	Demand Side Management	Micro-grid Management	Load Shifting	Dynamic Pricing
Demand Response (as in [33])	✓	✓	✓	✓
Peak demand and dynamic pricing (as in [34])	✓	✗	✓	✓
Micro-grid management (as in [44])	✗	✓	✓	✗
Real-time monitoring (as in [35])	✓	✗	✗	✗
Power monitoring and early warning system (as in [46])	✓	✗	✓	✗
Information interaction using Mobile agent (as in [47])	✓	✗	✓	✗
Dynamic Demand Response (D^2R) (as in [48])	✓	✓	✗	✗

Table.1 Comparison of cloud computing applications for energy management.

A Smart grid can be conceptualized as a cyber-physical system that connects physical electricity systems and cyber-infrastructure, with the integration of the Internet. This service can communicate with the consumer applications and also provide the backbone for utilities to assimilate content operations. With the presence of online connectivity, smart grids have greater exposure to cyber-attacks that can potentially disrupt the power theft by consumers. This can be done by hacking a smart meter or changing its communication channel to change the reported electricity usage. Additionally, data manipulation is also one of the most security concerns in the smart grid. To overcome these issues we need to implement proper security for secure and reliable smart grid architecture. Security can be implemented on the consumer side, transmission side, and generation side. The smart grid architecture is more complex than the one for the traditional power grid. The implementation of a smart sensor network, wireless communication, and smart meters increases the complexity in the protection of the information security systems.

Application	Cloud Computing Applications	Future Research Directions
Cloud data warehouse (as in [56])	Multidimensional data analysis in smart grid.	• Define proper access control mechanism for cloud data warehouse to support smart grid architecture. • Establish co-ordination between smart grid and cloud data warehouse. • Build a software platform which support unified data management for smart grid environment.
Information management cloudward (as in [57])	Different domains for cost effective information management cloudward.	• Define a cloud-based model which support all domains simultaneously.
Net-AMI infrastructure (as in [58])	Cloud computing infrastructure for communication and information optimization.	• Define a proprietary protocol for cloud computing to support Ethernet for net-AMI architecture in smart grid. • Implement secure and privacy communication mechanism using cloud based net-AMI infrastructure in presence of radio waves.

Table.2 Summary of cloud computing applications for smart grid information management.

Data Leakage: Data outage can be introduced intentionally or unintentionally. In the presence of cyber-physical attack, unintentional data leakage can be performed by third-party. Even data outage can take place with the help of user for her facility, and is known as intentional data leakage.

Data Management: the choice between data to be discarded and the one to be stored is a major concern. Proper data management mechanism is needed for real-time state monitoring. With the integration of proper filtering method, data can be managed properly.

Privacy: Privacy preserving is one of the most important issues in smart grid infrastructure. Due to the lack of privacy policies, user's personal data can be disclosed to the utility and also to third party vendors.. A proper authentication and authorization process needs to be implemented for securing users privacy.

Cloud Applications	Smart Grid Features			
	Cost Optimization	Data Storage	Dynamic Pricing	PaaS/ SaaS/ Iaas
Cloud data warehouse (such as in [56])	✗	✓	✗	SaaS, PaaS
Information management cloudward (such as in [57])	✓	✓	✓	IaaS, PaaS
Net-AMI infrastructure (such as in [58])	✓	✓	✓	PaaS, SaaS, IaaS
Smart meter data streams in cloud (such as in [59])	✗	✓	✓	IaaS
Smart grid data cloud (such as in [60])	✓	✓	✓	PaaS
Dynamic data center operations (such as in [63], [64])	✓	✓	✓	PaaS

Table.3 Comparison of cloud computing applications for information management.

The smart grid will make use of technologies, such as state estimation,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.

In Smart grid, third parties are also allowed to participate in the real-time monitoring systems. Cloud computing applications are expected to provide adequate security to maintain the privacy of the existing technologies that how this security can be provide, while aloowingthied parties to take part into the systems. Therefore, providing cloud security to prevent outage (third party vendors) to interact with the customer's equipment to control and monitor, while allowing different vendors.

Fig. 1 User Login in Windows PDA Device and Available Menus.

Fig 3 Hosting of Web Services

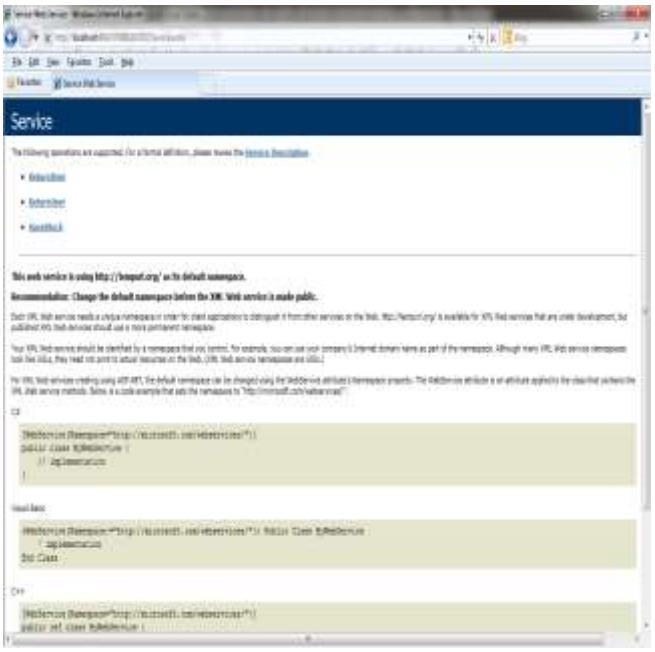
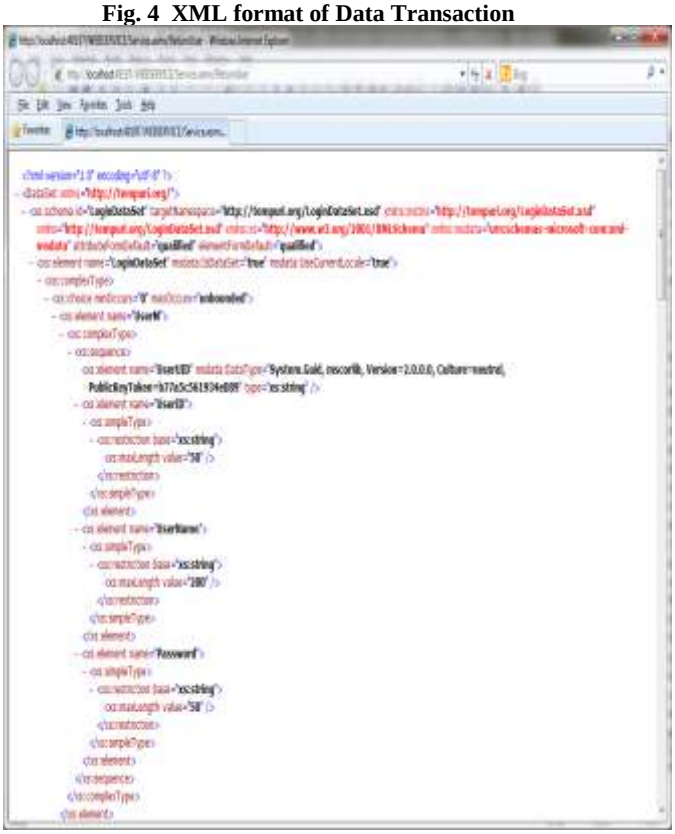


Fig. 4 XML format of Data Transaction



CONCLUSION

In this paper, we completed an integration part of cloud computing with the smart grid environment. The real time use of the cloud computing applications in smart grid and related to traditional power grid management, despite the existence of some technical challenges inherent of cloud computing. This gives more memory and storage to evaluate computing mechanism for energy management and cost optimization. In future energy management, information management and security management works can be extent.

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