Advances in Computer Science and Information Technology (ACSIT)
p-ISSN: 2393-9907; e-ISSN: 2393-9915; Volume 4, Issue 5; October-December, 2017, pp. 296-299

http://www.krishisanskriti.org/Publication.html

G-Cloud – Benefits and Challenges

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Abstract—*The use of Information and Communication Technology (ICT) has good impact on performance of business. Governments decided to use ICT in public affairs in order to improve the performance of public sector organizations by providing proper information and services to their stake holders. The increasing generalization of technology access by citizen brings expectations and demands on government. At the same time, governments are also proactive and are planning new ways of interacting, improving services, optimizing processes and revitalizing democracy by spending amount on it. One of the new inventions is cloud computing, where information and computing services are provided as utilities. Cloud computing is a new way of computing which aims to provide better communication style and storage resources in a safe environment via the Internet platform. The use of cloud based e-government is to help in providing best possible services to their stake holders, and to reduce the costs as in cloud based e-government it is not required to purchase and install the ICT equipments on their own premises. Cloud Computing is the future generation of computing, entrusts services with user's data, software and computation over a network. Its aim is to provide computing, communication and storage resources in a safe environment based on service, as fast as possible, which is virtually provided via internet platform.*

An e-government system needs proper information and communication technology infrastructure, and normally the government has to own, manage and maintain the system and infrastructure, which can be very costly.

This paper deals with the challenges faced by the implementation of cloud computing for e-government. From understanding the importance of cloud computing as new, green and cheap technology is contributed to fixing and minimizing the existing problems and challenges in e-government so that the developed and developing countries need to achieve e-government based on cloud computing.

Keywords*: E-government, SOA, Cloud Computing, ICT, NIST, G-Cloud.*

1. INTRODUCTION

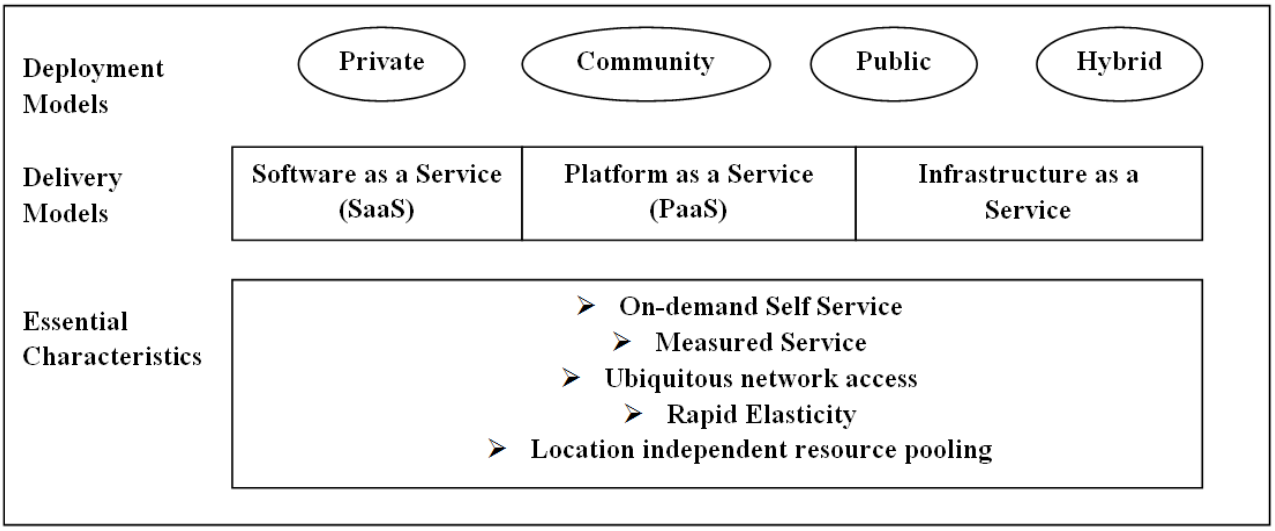
The idea of e-government has emerged from e-business and e-commerce in late 1990's. The use of ICT in business has tremendous effects on performance of business. Advances in computing technology have introduced new concept in e-business and e-commerce. The new evolutionary wave in the space was Service Oriented Architecture (SOA). Cloud Computing is the realization of Service Oriented Architecture. E-government means delivering government information and services to the citizen (G2C) and business (G2B) using modern information and communication technology in order to improve the performance of the public sector organizations and to facilitate citizens and business. This also increases the effectiveness and efficiency of the public sector organizations. The key point is if the government spend huge amount of money in creating e-government system, then it should be effective in terms of reliability, ease of maintenance, cost efficiency and satisfaction of other non-functional properties, but e-government is facing challenges like budget shrinking for the ICT by the governments, increasing demands for information and service by the citizens and continuous advances in technology which puts government under pressure to be innovative. One solution to this is to use Cloud Computing services for e-government. Cloud Computing is a result of continuous research in virtualization, distributed computers, utility computing, networking and World Wide Web and software services.

2. BASICS OF CLOUD COMPUTING

Cloud computing is a relatively new technology which is the outcome of research in virtualization, utility computing, elasticity, distributed computing, grid computing, storage, content outsourcing, security and web.

IEEE Computer Society defines Cloud Computing as: "A Paradigm in which information is permanently stored in servers on the Internet and cached temporarily on clients that include desktops, entertainment centres, table computers, notebooks, etc"

According to National Institute of Standards and Technology, USA (NIST): "Cloud Computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of services (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction".



Cloud model consists of five essential characteristics, three delivery models and four deployment models.

Five characteristics of Cloud Computing are:

- **Broad network access:** Resources are virtually accessible via the Internet regardless the location and the device used.
- **On-demand self service:** Consumers can use the cloud service ie. Computing capabilities, network storage and applications 24/7 without any human interaction with cloud service provider.
- **Rapid elasticity:** Cloud computing has the ability to scale resources both up and down as needed. The cloud appears to be infinite to the consumers, and the consumer can purchase as much or as little computing power according to their need.
- **Resource Pooling:** Physical and virtual resources are assigned and re-assigned to the consumers according to their demand using multi tenant model.
- **Measured service:** Controlling and optimizing resource use by assigning a measured capability appropriate to the type of service.

Three delivery models are:

- **Cloud Software as a Service (SaaS):** In this the provider manages all the resources and the consumer only uses it as per their need. It is very cost effective, especially as the licensed software are very expensive, the consumer can use the application provided on the cloud by the service provider.

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- **Cloud Platform as a Service (PaaS):** In Platform as a Service there are already deployed and configured IT resources which are available over Internet. The tools provided can be used by the developers to develop their own services and applications. The customers of the cloud can use the features available as per their need. That is only the services they require they can avail off and rest they can leave. Thus the user keeps the application with him and rest all the infrastructure like OS, server, database, network, storage etc, are on the cloud.
- **Cloud Infrastructure as a Service (IaaS):** In Infrastructure as a Service model the responsibility of the storage, network and server lies with the provider whereas the consumer can only control the database, application and operating system. Thus, the consumer does not have much control over the services given by the provider.

Four cloud deployment models are:

- **Private:** Also called as internal cloud. Private cloud is operated only for particular organization. It may be managed by the particular organization itself or third party cloud providers.
- **Community:** Community cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns.
- **Public:** Cloud services are available to the public and owned by the organization selling cloud services, for example, Amazon.
- **Hybrid:** Hybrid cloud is a composition of two or more clouds.

3. E-GOVERNMENT

E-government is a digital interaction between a government and citizens, government and business/commerce, government and employees and also government and governments/agencies. This digital interaction consists of governance, information and communication technology, business process re-engineering, and e-citizen at all levels of government.

World Bank website provided definition of e-government as: "E-government refers to the use by government agencies of information technologies(such as Wide Area Networks, the Internet and Mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government". E-government is a huge information system project to be built by government, and offers electronic services to four types of customers: Businesses, Citizens, Employees and government itself.

United Nations (AOEMA Report) defines: "E-government is defined as utilizing the Internet and the world-wide-web for delivering government information and services to citizens."

Top 10 countries in e-government development

Rank	Country	e-government development Index Value
1.	Republic of Korea	0.8785
2.	United States	0.8510
3.	Canada	0.8448
4.	United Kingdom	0.8147
5.	Netherlands	0.8097
6.	Norway	0.8020
7.	Denmark	0.7872
8.	Australia	0.7863
9.	Spain	0.7516
10.	France	0.7510

The ultimate goal of the e-government is increased public services in an efficient and cost effective manner. E-government helps to simplify processes and makes access to government information more easily accessible for public sector agencies and citizens. E-government allows government transparency because it allows the public to be informed about what the government is working on as well as the policies they are trying to implement. E-government is an easy way for the public to be more involved in political campaigns. It could increase voter awareness, which could lead to an increase in citizen participation in elections. It is convenient and cost-effective for businesses, and the public benefits by getting easy access to the most current information available without having to spend time, energy and money to get it.

4. BENEFITS OF CLOUD COMPUTING FOR E-GOVERNMENT

By sharing ICT capabilities in the cloud; individuals, businesses and government agencies are able to leverage their resources more efficiently and effectively. Individuals use cloud computing for email, content and information sharing; file storage and payment services, etc. Businesses use cloud computing for basic office tools, project management, collaboration and design of custom applications. Government agencies use the cloud computing largely to improve the quality of public services they provide to citizens through e-government solutions. One of the key benefits of cloud computing is usage based models, in which use would pay only for the resources that need. Another key benefit of cloud computing is scalability – for example cloud based storage services can easily manage very huge amount of data which is difficult to manage in the traditional databases.

- **Availability and Accessibility:** Citizens are playing a vital role in the success of e-government projects. Citizens want the governmental information and services to be available 24/7 to them. In cloud computing applications and information are hosted online therefore it has high availability and citizens can use them at anytime and from anywhere.
- **Cost Saving:** In cloud based e-government system, public organizations do not need to purchase and install the ICT equipments and software on their own premises, which normally they do in traditional e-government system. The public sector organizations use applications provided to them by the cloud service providers which eliminates the upfront capital expenditure.
- **Rapid Elasticity:** Different cloud deployment models ensure that the cloud based e-government implementations can be aligned closely with business needs and ICT strategies of the organizations. Public sector organizations can easily choose hybrid cloud computing model and get benefits from both private and public cloud models.
- **Green Technology:** The use of ICT systems in the public sector has created a negative impact on the eco. So that rate of carbon dioxide increases and requires more power consumption. Cloud Computing is relatively good in energy consumption and provides eco-systems through virtual services.
- **Unlimited Storage:** Storing information in the cloud gives you almost unlimited storage capacity.
- **Disaster Recovery:** Disaster recovery programs in clouds provide more options than traditional disaster recovery model for organizations to restore information very quickly and effectively.

As a result, governmental budget on ICT expenditure can be reduced. Expenses on ICT resources can be easily calculated using pay-per-use method to charge the utilization of resources. The government can also save money on the cost of maintenance of resources since this is shifted to the cloud provider.

5. CHALLENGES FACED BY E-GOVERNMENT BASED ON CLOUD COMPUTING

An effective e-government system should be reliable, economical and easy maintenance. When third parties are storing and processing sensitive data, it is obvious that concerns related to trust would be there in the mind of e-government's stake holders.

- **Privacy:** In cloud Computing data and information is not stored and processed locally at the enterprise premises. In fact third parties are responsible for storing and processing of data at their own sites. In a situation like that individuals are concerned about the privacy of their personal data and information.
- **Lack of user control:** The lack of user control and ownership are important issues in trust. When we have less control over our assets then we trust the system less. In cloud based e-government system data will be stored at third party data centres where we have less control over data and cloud computing providers have complete access to sensitive data.
- **System Failure:** Service failure is also affecting the trust of the users in cloud computing. There are some public services which should be available to citizens 24/7 but these services are unavailable to the citizens at sometimes.
- **Auditing:** Cloud providers currently do not offer detailed auditing possibilities where the auditing becomes essential in situations where compliance to specific regulations or policies must be verified.

The first issue is the government losing control of data. Since data are stored in the cloud, can the government trust cloud providers to protect data on the same level. Trust cannot be established easily, especially if there is no third party that can guarantee the security and privacy of data or information stored in the cloud.

The second issue is security and privacy. Security problems may happen in servers within the cloud, the client machines, and the network.

The third issue is performance, especially for data intensive computation as client machines are geographically distanced, which could be a thousand miles away from the cloud. Also Internet speed will definitely affect the performance. The possibility of data transfer as well as the number of users accessing the data increase may complicate the performance and costs as data transfer consumes communication bandwidth.

6. CONCLUSION

For the last two decades, e-government has attracted government around the world. Today almost every country in the world has developed and implemented e-government system in order to improve the performance of public sector organizations. The key idea behind the e-government is to provide public services to citizens and businesses efficiently and effectively. The performance of cloud based e-government systems is better than the traditional government systems. Cloud architectures will help the government to reduce operating costs and increase end user satisfaction levels. Since information and applications are hosted online in cloud computing that is why they are available from anywhere and at any time. E-government includes the use of electronics in government as large-scale as the use of telephones and fax machines, as well as surveillance systems, tracking systems such as RFID tags, and even the use of television and radios to provide government-related information and services to the citizens. E-government enables anyone visiting city website to communicate and interact with city employees via the Internet with GUI, Instant messaging, audio/video presentations, and in any way more sophisticated than a simple email letter to the address provided at the site and to enhance the delivery of government services to benefit citizens, business partners and employees. From this paper it could be concluded that developing and even developed countries have critical sustainable development in this economic and critical situations and the best way to accomplish this matter is the use of green and cheap technology which is the Cloud Computing.

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