Cloud Based E-Government: Benefits and Challenges

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***Abstract*– The use of Information and Communication Technology (ICT) has good impact on performance of businesses. Keeping a successful implementation of e-business in mind, governments decided to use ICT in public affairs in order to improve the performance of public sector organizations in the form of providing best possible information and services to citizens, businesses and other governments. With the passage of time computing technologies have made advancement and governments around the world were thinking to make good use of advanced computing technologies in government organizations. Today most of the countries are facing financial crises and as a result they are cutting extra spending and as a result governments are shrinking ICT budget. E-government is a huge project which requires good amount of money from the government. Some of the new inventions in computing technologies made it possible to reduce costs and increase efficiency and flexibility according to the needs of government sectors. One of the new inventions is cloud computing where information and computing services are provided as utilities. The use of cloud based e-government is to help the governments in providing best possible services to the citizens and businesses, and to reduce the costs as in cloud based e-government they will not require to purchase and install the ICT equipments on their own premises. In this paper we analyzed cloud computing and its applications in the context of e-government.**

***Keywords*– E-government, ICT, SOA and Cloud Computing**

I. INTRODUCTION

The idea of e-government [1] has emerged from e-business and e-commerce in the late 1990s. The use of Information and Communication Technology (ICT) in businesses has tremendous effects on performance of businesses. Keeping the successful implementation of e-commerce and e-business in mind, the governments around were thinking to introduce ICT in public sector. Governments simply wanted to provide information and services using Internet and the Web. The task was not difficult because the concepts of e-commerce were already there. Today almost all countries in the world are efficiently and effectively using ICT for providing public services to the citizens and businesses.

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). As a result of Service Oriented Architecture the establishing and running of business functions were outsourced to online services [2]. Cloud Computing [3] is the realization of Service Oriented Architecture. Keeping use of 'cloud computing in e-business' in mind, we can raise a question - would it be possible to use cloud computing services for e- government domain?

E-government means delivering government information and services to the citizen (G2C) and businesses (G2B) using modern information and communication technology in order to improve the performance of public sector organizations and to facilitate citizens and businesses. This also increases the effectiveness and efficiency of the public sector organizations. The key point is if the governments 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 [4]. However e-government is facing challenges like budget shrinking for ICT by the governments, increasing demands for information and service by the citizens and continuous advances in technology which puts governments under pressure to be innovative. In order to overcome the above mentioned challenges governments should be innovative and willing to adopt new computing technologies. In the light of current economic situation where governments are under pressure to cut extra spending as a result they are shrinking ICT budget. In a situation like this it is difficult to continue with traditional e-government model. One solution to above problems is the use of cloud computing services for e-government.

Cloud computing is a result of continuous research in virtualization, distributed computers, utility computing, networking, World Wide Web (WWW) and software services [5]. Different researchers defined cloud computing in different ways therefore there is no agreed upon definition of cloud computing. The well known definition of cloud computing is, "clouds, or clusters of distributed computers, provide on-demand resources and services over a network, usually the Internet, with the scale and reliability of a data centre" [6].

This study is based on cloud computing and e-government. The use of cloud computing in the context of e-government has been described in detail in this study. The rest of paper is organized as follow. In section II, cloud computing basics have been explained. In Section III, e-government and its benefits have been discussed. Section IV describes cloud computing benefits for e-government while Section V discusses challenges in cloud computing in the context of e-government and Section VI concludes the paper.

II. CLOUD COMPUTING BASICS

Cloud computing is a relatively a new technology which is the outcome of research in virtualization, utility computing, elasticity, distributed computing, grid computing, storage, content outsourcing, security and web 2.0 [7]. 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 centers, table computers, notebooks, wall computers, handhelds etc" [8]. The United States National Institute of Standards and Technology (NIST) described some other important aspects of cloud computing - "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 [9]". This cloud model promotes availability and consists of five essential characteristics, three delivery models and four deployment models.

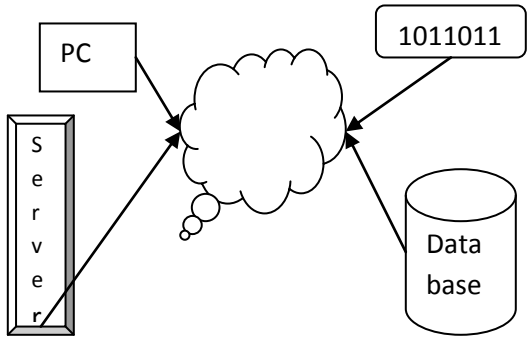

Figure 1: Model of cloud computing applications [10]

Five characteristics of cloud computing are:

On-demand self service: Consumers can use the cloud service i.e., computing capabilities, network storage and application 24/7 without any human interaction with cloud service provider.

Broad network access: Cloud computing capabilities are available on Internet which can be accessed through standard mechanism by both thick and thin clients (laptops, mobile phones, PDAs etc).

Resource pooling: Physical and virtual resources are assigned and re-assigned to the consumers according to their demand using multi tenant model.

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.

Measured service: Measured services are one of the essential characteristics of the cloud computing where services and resources usage is constantly monitored, controlled and reported for fair pay-as-you-go model implementation.

The three cloud delivery models are:

Cloud Software as a Service (SaaS): Cloud consumers use software applications, but do not control the operating system, hardware or network infrastructure on which they are running.

Cloud Platform as a Service (PaaS): Cloud consumers use the platform upon which applications can be developed and executed.

Cloud Infrastructure as a Service (IaaS): Cloud consumers use basic computing resources such as processing power, storage, networking components or middleware on demand.

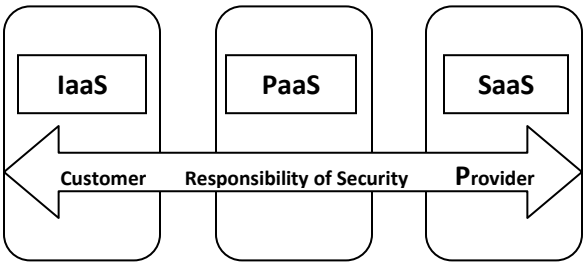

Figure 2: Cloud Architecture [21]

Four cloud deployment models are: Private or internal cloud, community cloud, public cloud and hybrid cloud.

Private: 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 (e.g. mission, security requirements, policy**,** and compliance consideration).

Public: Cloud services are available to the public and owned by an organization selling cloud services, for example, Amazon.

Hybrid: Hybrid cloud is a composition of two or more clouds (private, community or public).

Cloud computing has several potential benefits. By sharing ICT capabilities in the cloud**;** individuals, businesses and government agencies are able to leverage their resources more efficiently and effectively [11]. 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. The government agencies use the cloud computing largely in same way as businesses, in addition to improve the quality of public services they provide to citizens through e-government solutions [12]. Cloud computing offers several benefits over today's famous computing model in which organization purchases all the computer equipments and software and then operates them by itself [6]. One of the key benefits of cloud computing is usage based model, in which user would pay

only for the resources they used. Also the individuals, businesses and governments would not install and configure the expensive machines and applications at their own premises which results into reduced capital expenses. 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. The Cloud computing also offers flexibility and freedom, which means the customers can easily change the service providers without any hassles and will enjoy more up to date solutions.

III. E-GOVERNMENT AND ITS BENEFITS

Electronic government or simply E-government means the use of ICT in order to provide public services by the government to citizens, businesses and other governments. The ultimate goal of the e-government is to improve public organization performance and provide best possible services to its stakeholders i.e., citizens, businesses and other governments [13]. Efficiency and effectiveness of the public organizations are two main objectives of the e-government. The concept of e-government was first introduced in 1990s when public organizations were under pressure to use modern information and communication technologies in order achieve the two objectives i.e. efficiency and effectiveness. Today almost every county in the world is making good use of modern computing technologies in order to provide governmental services to its citizens and businesses, and also to interact with other governments.

Like any other technology, e-government should also be innovative. Innovative in a sense that e-government should make good use of the latest ICTs, which ultimately increase the efficiency and effectiveness of the public sector. With the advances in ICT, it is possible to develop an effective and efficient e-government system. The traditional e-government model is also effective however its effectiveness can be further increased with the use of new innovative computing technologies like cloud computing.

IV. CLOUD COMPUTING BENEFITS FOR E-GOVERNMENT

E-government service platform based on cloud computing takes advantages of cloud computing environment providing the following benefits to citizens and government.

A. 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. One of the main aims of the government in providing the governmental services online is that citizens and businesses can access these services around the clock. That's why the e-government system should be accessible at any time and from anywhere. Cloud computing is on the Internet therefore it is always available and consumers can access the e-services 24/7 with just one PC and Internet connectivity [17].

B. 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. The cost of ICT services for public organizations and individuals also reduces in cloud based e-government systems because they lease ICT resources and services according to their needs instead of investing in these resources [18]. The cloud computing 'pay-as-you-go' approach also reduces the operation costs for the public sector organizations.

C. Efficiency

Providing public services efficiently and effectively to citizens and businesses is one of the main benefits of e-government. The use of cloud based e-government system makes the task easier for the government in order to improve e-services delivery. Also in such a system it is also possible to create new solutions which are not technically and economically feasible without the use of cloud services [19].

D. Flexibility

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 [20]. Public sector organizations can easily choose hybrid cloud computing model and get benefits from both private and public cloud models.

E. Scalability

One of the main stakeholders of e-government system is citizens. With the passage of time citizens are attracted more and more towards e-government. As a result demand and load on the e-government system is increasing day by day. Therefore technology adopted for e-government should be scalable which meet growing numbers and demand of citizens. Cloud computing is considered a scalable technology because it can dynamically add extra hardware such as CPU, servers, hard drives etc to accommodate growing number of users (citizens).

V. CHALLENGES IN CLOUD COMPUTING AND E-GOVERNMENT

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 stakeholders. Trust is an act of firm belief in truth, reliability, faith, confidence, or strength of someone or something. It is a belief in the capabilities and skills of others that you think you can reasonably rely on them to care for your valuable assets [14]. Trust is playing an important role in the success of e-government system. It is

important for the success of e-government that people should have trust in the e-government system. Some of the challenges in cloud computing which can directly effecting e-government are discussed below:

A. 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. When third parties are processing important data stored at remote machines at various locations it is obvious people would be worried about the privacy of their personal data because it is a human right to secure their private and sensitive information [15].

B. 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 [14]. In cloud based e-government system data will be stored at third party data centers where we have less control over data and the cloud computing providers have complete access to sensitive data. In a situation like this the protection of intellectual property and personal information is very important.

C. 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 some times. Also the loss of data or security breach of data cannot be compensated by the cloud service providers as the data is irreplaceable.

D. Security

Cloud computing security concerns the "confidentiality, availability and integrity of data or information" [16]. Security plays an important role in establishing the trust of the users in cloud computing. If we look into cloud computing in context of e-government it is important that e-government based on cloud computing should be secure.

E. On Demand Self Service

On demand self service is one of the important characteristics of cloud computing. This characteristic is achieved through virtual environment or management interface which is accessible to all cloud service users. It is the responsibility of the cloud service provider to keep the management interface secure from the unauthorized access because the management functionality should be accessible by few authorized administrators. Access authorization is required in order to give access to authentic users through claim base access control, federated identity approaches and security assertion mark-up language.

F. Data Leakage

Data leakage also affects the trust of citizens and public sector organization in cloud based e-government system. E-government system contains sensitive data and information about users and businesses therefore security of the sensitive data is important. Data leakage can be also the main source of discouragement for the government to use cloud based e-government system.

VI. CONCLUSION

For the last two decades, e-government has attracted government around the world to itself. Today almost every country in the world has developed and implemented e-government system in some form or another 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 effectiveness and efficiency can be increased further if governments make good use of new and modern computing technologies like service oriented architecture (SOA). Cloud computing is the realization of the service oriented architecture which is the direct outcome of research in virtualization, utility computing, distributed computing, grid computing, content outsourcing and web 2.0. The performance of cloud based e-government systems is better than the traditional e-government systems. The cloud based e-government provides several benefits over the traditional e-government. Since information and applications are hosted online in cloud computing that is why they are available and accessible from anywhere and at any time. In the light of current economic situation where governments around the world are under pressure to cut extra spending and they are shrinking the ICT budget as well. In this situation cloud based e-government is a good option in which governments do not need to purchase ICT equipment. In fact they lease ICT resources and services according to their need instead of investing huge amount of money in buying equipment. In short, capital costs are replaced by operational costs for the resources used by government organizations. Trust and security are also playing an important role in the success of e-government. One of the important stakeholders of the e-government is the citizens therefore they should have trust in e-government systems. In cloud computing data is stored and processed at third party premises therefore citizens and businesses are concerned about the confidentiality and security of their sensitive data and information. Similarly data leakage can also affect the trust of citizens and businesses because in some cases the data loss can be irreplaceable. But still the cloud based e-government system is providing more benefits in the form of efficiency, scalability, flexibility and cost effectiveness as compared to traditional e-government system.

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