

# Opportunities and Perspectives of Cloud Technology for E-Government

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## Abstract

The paper studies the use of cloud technology in e-government. The usage methods and service opportunities of cloud technology in e-government are offered; usage opportunities and perspectives of e-government services are analyzed for more efficient use.

**Keywords:** cloud technology, e-government, e-services, computing and memory resources, distributed systems, cloud services.

## 1. Introduction

Recently, multiple companies and users take advantage of a wide range of e-government services. This requires sustainable development of e-government basing on modern technologies. On the other hand, the cost of computer and network equipments used by the organizations to expand their network infrastructure, and the expenses spent in order to keep the efficiency of this structure are rising regularly. In this regard, the giant companies carry out extensive research to cut these costs by using existing resources, and search for new solutions to meet the requirements. The analysis of conducted studies shows, that for the maximum use of the network resources cloud technology should be used. This technology ensures efficient use of network resources and Internet services.

The rapid growth of e-services of e-government system caused the expansion and complexity of the information exchange between government agencies. Perfectly chosen e-government model has a profound influence on the economic and socio-political development of the country, and on the improvement of the life quality and the development of democracy.

In regard to all above mentioned facts, to manage e-government system properly, and to provide users with qualitative services appropriate models should be offered. Using the resources of data mining centers these models process a large volume of data, and offer cheap Internet services to users. Obviously, other advantages of cloud services for e-government system should not be left out. These advantages include cost reduction, service integration, and numerous usage opportunities. As the cloud services of e-government system are new it is necessary to determine the use and development of this technology in data security in order to reveal its advantages and weaknesses.

## 2. Cloud technology models and services

Cloud technology is widely used in the management of complex systems based on computer networks, and in the development of distributed computing systems. Such systems with large computational and memory resources are established on the basis of computer networks with high-speed communication channel. Using high-speed communication channels, the use of cloud system services by the users of different organizations and institutions is economically more advantageous [1].

Cloud technology enables the users and organizations to obtain large computing and memory resources, and at the same time, the users do not care about that where these resources are located. Cloud technology is distinguished by 4 types for its appointment [1,2]:

- General purpose clouds;
- Special purpose clouds;
- Collective clouds;
- Hybrid clouds.

General purpose clouds – any user or company may be subscriber of these clouds. It offers solutions of unsolvable problems in other computing systems, which are more suitable due to its price, and the development of the web sites or business systems capable of measurement features. For example; Google Apps/Docs, Microsoft Office Web.

Special purpose clouds – are developed within corporate organizations, offices and departments. Developed cloud technology is protected from unauthorized access by means of brandmauers (screens), and are not going beyond the closed internal network, and provide high level protection. An organization is capable to manage private cloud independently, or may assign this task to external executor. An infrastructure may be located either at the side of customer and remote operator, or at the side of customer or operator partially. Private clouds guarantee solution of a number of serious problems better rather than open (public) clouds. These problems are as follows:

- ✓ security;
- ✓ confidentiality of data;
- ✓ waiting time;
- ✓ comply with the requirements of state and regional regulators.

*Collective clouds* - are used for a number of organizations with common interests.

*Hybrid clouds* – is a hybrid model (public, private and collective), which includes combination of one or more clouds. It is an environment used by a number of internal and external cloud providers.

Most commonly used cloud service models are as follows [1]:

- Infrastructure-as-a-service (IaaS) – IaaS enables to carry out the rent of the infrastructure (computing and memory system). Besides virtual servers with secure computing and memory resources, these resources also include communication channels, which provide high speed access to data storage system. In short, in this level a computer infrastructure is developed for the problems solution. Available IaaS services may include Amazon S3, Amazon Elastic Computer (EC2), IBM Blue Cloud, and so on.

- Platform-as-a-service (PaaS) - PaaS is a virtual platform enabling the users to use specialized software applications (Apache, My SQL, etc.) and operating systems located in virtual servers (organized in physical servers). For example, IBM IT Factory, Google App Engine, Microsoft.NET Azure Services Platform (Windows Azu-re), Force.com and etc.

- Software-as-a-service (SaaS) – provides the software to the users. The programs used here include Microsoft "Software Services" (e-mail, video conference), Google Apps, Google Docs, and so

on. The user may send requests to the clouds through the network channels without downloading resident portion of the necessary software applications to user's computer. Software applications function on the server providing SaaS service and send the calculation results to the user. Thus, the user does not receive the software, and only uses it when it is necessary and pays accordingly.

The processing of the user requests in the Cloud system is performed as follows [1]:

- ✓ The user sends requests for service;
- ✓ Management System defines necessary resources according to the request;
- ✓ Resource distribution system identifies the necessary resources;
- ✓ After identifying the necessary resources the request is processed.

Availability of data mining centers of the state agencies and institutions, which are based on various platforms, as well as the use of multiple operating systems needs a group of engineers and web developers, and stable maintenance of these equipments, and it requires huge financial expenditures. At the same time, the data processing centers use different platforms and operating systems, and it makes their integrate difficult. Cloud technology is widely used to eliminate these problems and to provide the service of better quality to the users.

In the next part, the concept of e-government, and the problems arisen from the application of cloud computing in e-government are analyzed.

### 3. E-government system measurement

Currently, a number of countries around the world conduct research to develop the concept of "E-government". Recently, one of the factors that influence the development of democracy in the developed countries is the establishment of "e-government". Using modern information technologies "e-government" enables state agencies to provide information and e-services to all citizens living in the territory of the country, legal and physical persons, foreign citizens, and the persons without citizenship. The main goal of newly created opportunities is to reduce the "distance" between the civil servants and the citizens, to simplify and to ensure transparency of these relations. To achieve this goal, "E-government" portal, which includes e-services provided by the government agencies, is established by "single window" principle, in order to apply a wide range of e-services, to raise their number and to improve the quality, as well as to provide more convenient communication between citizens and public authorities.

Significance of "e-government" includes [3]:

- Expanding the use of new technologies in public administration, improving performed activity, and simplifying their utilization rules
- Improving the efficiency of the performance of state agencies and local units of self-governance, and perfecting the quality of offered e-services
- Optimizing e-services offered by the state agencies to the users, and simplifying their implementation procedures
- Ensuring the validity, integrity, reliability and availability of the data presented to the users via e-services
- Minimizing the time spent for data search and retrieval according to the user's request
- Providing availability of e-services in the territory of the country, regardless of the user's location.

To ensure above-mentioned e-government system, it is required to develop a new network infrastructure, which is very expensive. And it needs a long period of time. Currently, to develop above mentioned systems cloud technology is widely used, which is much cheaper and faster.

Countries around the world, especially state agencies which are in contact with the people directly, deliver their services through relevant technologies to realize daily activities. The latest technologies are very significant to reduce the time required for the development of services, and to ensure helpful and efficient services to the citizens. The system realizing the information exchange between the state agencies, between the government and the citizens, between the state and the businesses agencies is called "e-government" system. E-government system provides management processes, such as digitization of the state registration, automation of taxing, receiving the information from the public, distribution of data collection, realization of elections, high level e-services, and so on, through the use of modern information technologies, such as the Internet, local and global networks, mobile phone, and etc [4,5].

Most countries have tried to take advantage of e-government systems to achieve their objectives, some of them succeeded. According to the statistics of May 28, 2014 published by of the Waseda University (Tokyo, Japan, Institute of e-government), we can say that the United States is the most successful country for the implementation of e-government system. It is followed by Singapore, Korea, United Kingdom, Japan and etc [6]:

9 indicators used for e-government measurement are as follows [6];

- ✓ Network preparedness/infrastructure
- ✓ Management Optimization
- ✓ Online services
- ✓ National portal (e-government portal)
- ✓ Government CIO (Chief Information Officer)
- ✓ E-government promotion
- ✓ E-government participation
- ✓ Open government
- ✓ Cyber Security

Republic of Korea, Australia and Singapore rated on top respectively in the United Nations E-Government Survey 2014 [7].

The UN survey uses the following 3 indicators for the e-government measurement [7]:

- OSI—Online Service Index
- TII—Telecommunication Infrastructure Index
- HCI—Human Capital Index

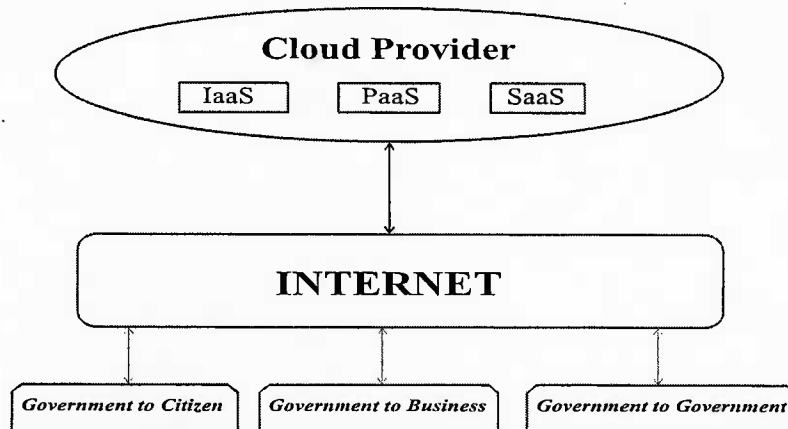
All above-mentioned indicators show the delivery of advanced e-services to the people and organizations through e-government, improved access to information, more efficient management, and improved interaction with the people.

In this section, the essence of e-government system was discussed, and now, let's review the efficient use cloud technologies for this system.

#### **4. Advantages of the use of cloud technologies in e-government**

The advantage of e-government is ensuring the services to the users in a short period of time. The government may use the advantages of cloud technology to eliminate some communication diversity of the citizens, especially in remote areas. Cloud technologies may also be used to enhance cooperation

between the different domestic organizations, to overcome the lack of data, and to monitor the efficiency of the state strategies. Distribution of cloud technology between the central administration and organizations leads to reduction of infrastructure costs. The transparency of government activities can be achieved with the use of cloud technology, as well. In this sector, cloud technology has a huge potential, and it is useful not only for the government, but also for millions of people. In the e-government system, mainly 3 types of cloud technology service (IaaS, PaaS, SaaS) are widely used (Figure 1).



**Figure 1. Cloud services in E-government**

Applying cloud technologies in E-government system will help to realize the following implementations in better quality:

- The improvement and development of public services;
- Data access and establishment of the interaction with the appropriate organizations, expansion of opportunities for citizens;
- Achieving more transparent and accountable government;
- The development of public e-services;
- Providing higher level data security.

Addressing decision making issues, e-government system provides improved management of cloud services automatically. Furthermore, it reduces the cost needed for the real use of information. Cloud technology structure can assist the government to reduce repetitive operations, and may increase the possibility of more efficient use of resources in the global arena. At present, the companies and small businesses take advantage from cloud technology basing on the payment model for the widely used services [8]. The most important problems in e-government system are divided into 3 groups, i.e. social, economic and political [9]. These challenges restrict the area of activity for politicians to use new technologies effectively. Cloud technology services are alternative tools to solve these problems. Cloud database requires orders and high productivity. This service includes a wide range of records, which is a key requirement of the government. In order to detect corruption at the government institutions, the cloud technology is able to provide information about the audit on user activity, to access to registration and to deliver the information. This can help to develop a mechanism for enhancing the security of the government. The service is for the development of reliable programs with

more options. Cloud technology provides the tools and technologies that simplify and facilitate the operations, as well. Cloud technology enables to save costs in the public sector. Amount of savings by transferring the government programs into private or public clouds, is estimated between 50-70% [10].

In e-government, it is very difficult to decide which kind of cloud technology should be adopted. The private and collective cloud models are capable to have more control over the security and confidentiality in accordance with legal regulations, therefore, it is recommended to public sector [11]. Consequently, the private cloud model is less expensive, and so, its application in e-government should not be refused [12]. Processing insignificant data of e-government programs can easily be transferred to the private cloud. Hybrid cloud is a mixture of few cloud models. Hybrid cloud may also be used in e-government, however, the sorting of the data is required, as the confidential information is not stored at private cloud. Nevertheless, before transferring government services into clouds, there will be need to conduct comprehensive comparative analysis to clarify whether security and data protection will be achieved for ordinary and existing e-government services [13; 14]

Adoption of cloud technology in e-government is not just a future plan; this process has already been realized. Cloud technology has been adopted or planned to be adopted in public sector, particularly, in European countries and cities [14]. European countries mainly use private and the collective model of cloud technology in e-government system [12]. Let's review some countries, which use cloud technology in e-government system establishment:

The studies of cloud technologies in Spain show that, there still exist certain restrictions in the adoption of cloud technology. The reasons for this are data integration, privacy and legal issues. Unlike the local authorities, the central administration has no enough driving force to adopt cloud technology. Compared to the central administration, the local authorities have more financial restrictions, and therefore, cloud technology is very supportive to save costs. The most widely used model in Spain is private cloud (approximately 58%), which is followed by public cloud (approximately 31%) and hybrid cloud (approximately 11%). Private Cloud is dominating as it provides a high level of security and privacy policies [15].

In 2011, the United Kingdom adopted a strategy in connection with the use of cloud technology in the establishment of e-government system. The main objectives of the G-cloud were to reduce ICT costs of the government, to optimize the use of the data center structure, and to increase the flexibility of the government sector [16]. In fact, the establishment of the G-cloud is an iterative process.

The official web portal of the US government ([www.usa.gov](http://www.usa.gov)) is one of the world's most widely used internet sites, so that, it is visited 342,000 times a day. It is the most perfect e-service site in the US. This site, which is in better contact with government departments, is designed to assist the US citizens. Thus, the users often complain about long delays and interruptions at the site due to the high density of the users during the elections and natural disasters. To overcome this problem, the US government, decided to install new IT equipments to update the system infrastructure when there is no high demand for access to the internet portals. More than nine months are required to update the site with traditional technology. Each year, 2,350,000 USD is required for the management of overall services, software and hardware update.

Update Cloud technology was proposed to reduce costs and increase the efficiency of the portal [17, 18].

Update of the portal with new technology provided the following advantages:

- Flexibility of cloud technology service platform:
- Minimum transition time

- Additional security capacity

Transition to the cloud technology resulted with the reduction in costs (more than 90%), improvement of facilities, the system flexibility, and fully automated process. Thus, the system receives the user requests in real time, and allows users to get information from other websites. Updating the site with cloud technology solutions takes only a day, while this was nine months before [19]. Hence, the cost allocated to [www.usa.gov](http://www.usa.gov) was reduced by 650,000 USD a year.

Opportunities obtained by the application of cloud computing service in e-government are as follows [20].

- ✓ Increasing the quality of services;
- ✓ Reducing the cost;
- ✓ Saving time, accessing the programs and data easily;
- ✓ Integration and better communication between the organizations;
- ✓ Removing geographical restrictions, hardware and software restrictions;
- ✓ User growth.

Thus, the cloud technology is the best solution to manage e-government. This solution reduces the costs, and increases the efficiency and user convenience. Moreover, the benefits such as data storage in the government, acceleration of the processes and cloud convenience must be taken into account, because these benefits meet the requirements of e-government implementation. Nevertheless the main problem is likely the difficulty of the use of the cloud. And in this regard, the laws and service level agreements are available, as the legislations of various countries differ. The data stored in clouds can be used anywhere in the world. This, in its turn, may contradict the laws regarding the confidentiality protection of the information of the citizens of some countries [20]. For example: According to the existing legislation in the countries of the European Union, certain types of professional data can not be transferred out of the EU. In this regard, Amazon and other companies have developed specific requirements for the storage and use of data of the citizens in the EU [1]. As the government rents cloud service provider in another country, it must adopt not only of the country's legislation, but also the legislation on the data transfer of the country. Thus, to use the services provided by the service providers available for all the countries all over the world, new legislations and regulations on the data transfer between the countries shall be developed. Many countries already understand that being controlled by foreign governments their traffic will cause national security problems. To prevent this, the specialists propose either to develop cloud system controlled by some other governments in agreed form, or to develop own cloud system controlled by each country. In this regard, some developed countries and developing countries are developing e-government projects separately. Developing countries, which collaborate and benefiting from each other's experience, are recommended to establish a committee to investigate programs and cloud service intensity in e-government, and to adopt the law on the data transfer.

## 5. Conclusion

The article analyzes the prospects and the possibilities of the use of cloud technology to promote the efficiency of e-government management, to improve service quality, and to reduce costs. It is noted that cloud technology service is the best alternative to the benefits, such as flexibility, cost efficiency, service integration, appropriate security and reliability, and its use in e-government. At the same time, cloud technology, which is less expensive, is recommended to be used in the development of e-government system.

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