

# An E Governance model using cloud computing technology for Developing Countries

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**Abstract**— Information and communication technology (ICT) is an emerging era of present decade and playing a vital role for the advancement of our global society. As the popularity of ICT enabled application is increasing E-Governance has been established as a revolution not only in developed country but also in developing nations. E-Governance is a way to achieve good governance through ICT in order to have better citizen participation. The sole aim of E-Governance is to establish strong and transparent relationship between citizens, government organization and business organization so that a faith could be developed among all. This could also ensure improved services, optimized Government process and an ideal democratic environment for government operations. The cloud computing is a vibrant application development which provide solution for all E-Governance infrastructure development at lower cost and less time requirements. In this paper, the significance of cloud computing in present scenario has been described. An E-Governance model framework which utilizes the potential of cloud computing is presented. The various aspects and infrastructure requirements for typical Governance cloud has been discussed in this paper. A detail investigation about merits and demerits of the proposed solution has been done on the basis of SWOT analysis and concluding remark has been presented at the end of this paper.

**Keywords** — Information and Communication Technologies (ICT), E Governance, Cloud Computing.

## I. Introduction

Information and communication technology (ICT) is an emerging era of present decade and playing a vital role for the advancement of our global society for getting timely information and making communication faster. As the popularity of ICT enabled application is increasing, E-Governance has been established as a revolution not only in developed countries but also in developing nations. So E-Governance is the necessity of time for not only in developed countries but also developing nations. As internet reachability increases, demand of E-Governance is also increases. So, E-Governance is an essential requirement to any nation for providing better citizens participation and intergovernmental relationship. The sole aim of E-Governance is to establish strong and transparent relationship between citizens, government organization and business organization so that a faith could be developed among all. Selection of technology for E-Governance is a critical task because of ever increasing demand of cost, security; reliability and confidentiality are associated with E-Governance. The cloud computing is a

vibrant application development which provides solution for all E-Governance infrastructure development at lower cost and less time requirements.

The first part of this paper explores the e-governance concept and implementation requirements. Second part of this paper highlights the significance of the cloud computing technology in E-Governance implementation. The various aspects and infrastructure requirements for typical E-Governance cloud has been discussed and a cloud computing based E-Governance model has been presented. A **SWOT** analysis is performed to highlight advantages and drawbacks of proposed model.

## II. E GOVERNANCE

E-Governance provides an automation of all government functionalities and enhances organizational efficiency and citizen participation. [2] The effective e-governance involves e-governance requirements and components of the e-governance. These terms are explored below.

### E-Governance Requirements

E-Governance provides a way to improve government work and make easy sharing of information with the citizens. For practical implementation of E-Governance it is important to identify certain factors which are going to play key role during deployment of E-Governance.

The e-governance requirements are divided into three parts for proper investigation which is shown in fig 1:

- 1. Government to Government:** The need of government to government functionality is fully related to administration, inter government control and monitor on the government. It focuses on the inter communication between two governments and other aspects of the government to government communication.
- 2. Government to Business:** Business organizations are important for any country and contributing substantially for the development. Government also keep an eye on these organization for enforcing the policies ,standards and accountability .here it essentially required to automate government to business interaction such as tender management, contract management ,tax payments etc.
- 3. Government to Citizen:** Basically, the prime responsibility of any government is citizen service. Government to citizens interface is required to facilitate them basic emanates, proper education,

health care and a quality life. A single window government solution could help to achieve citizens satisfaction required in E-Governance. Fig 1 is representing the typical requirement of E-Governance.



Figure 1: Typical requirements of e-governance

### Components of a typical E-Governance Application

Three tier architecture for E-Governance is shown below in figure 2. The architecture consists three layers of the system. In the data storage layer, proper schema for data storage has been defined for e-governance. It provides foundation for storage for data which is coming from different processes and serves the request of the any process which demands the data. Application layer works between user layer and data layer. It facilitates the connection between user process and data layer. The upper layer or user layer has a Graphical User Interface for the user interaction with the system. In E-Governance system, a user can interact with the help of upper layer (GUI) and can get information from the system. The government officials and legislatures can update the information of the system with the help of upper layer .This architecture has following advantages in context of E-Governance [3]:

- **Heterogeneous System:** E-governance application support different platforms, different hardware and different working software. It integrates all these heterogeneous systems to fulfill the requirements of t E-Governance.
- **Modifiability:** In 3-tier architecture, responsibility of each tier is fixed. Segregation of responsibilities makes it easy to modify and code at any tier.
- **Scalability to handle many clients:** Clients communicate with the system by using application layer. This application layer provides database connections to clients. The strength of client deploying several servers on application layer.
- **Integrated Data Access:** Most of the applications use data from different sources. Application layer provide facility of managing the connection to database. Application is used to connect all these data sources. Figure 2 explains the architecture of E-Governance with three layers.

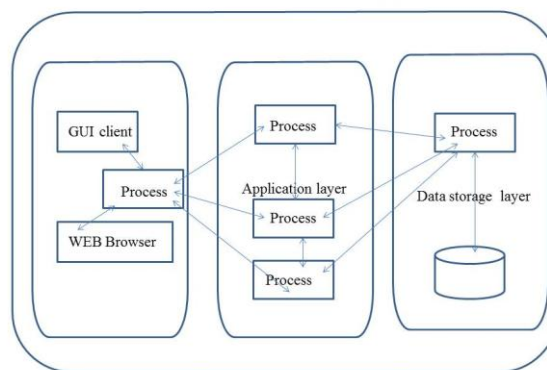


Figure 2: Typical architecture for an E-Governance application

### III. CLOUD COMPUTING

Cloud computing is upcoming area with three main features namely service availability, pay as per services, scalable feature [4]. It is based on service oriented architecture and the model could be categorized as follows:

- Public Cloud** – it is a type of cloud where third party will provide services to client via internet. Each user will have its access mechanism provided by the third party. Public cloud is a cost effective method to provide services.
- Private Cloud** – private cloud has many benefits over public cloud depending upon the service required. In addition in private cloud data and processes are managed by organization itself. It provides better and controlled infrastructure for security.
- Community Cloud** – Community cloud provides services to a community within organization. Members of community can access data on community cloud. Communities are formed by grouping of people with shared interest.
- Hybrid Cloud** –it is a combination of private, public and community cloud. It has maximum functionalities as compared to all cloud and non critical information is handled by public cloud while critical information and processing is done on organization controlled private cloud. Figure 3 illustrates the different layers of cloud computing for E-Governance.

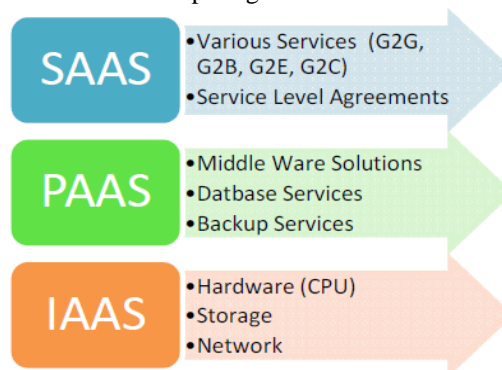


Figure 3: Layers of cloud computing for e-governance

It is important to note that cloud works on service oriented architecture and modular in nature. It can be easily integrated with other systems. Cloud architecture is based on three types of abstraction layer and each layer has its own set of services and responsibilities indicated in subsequent sections: [5].

**Infrastructure as a Service (IaaS):** It provides infrastructure as a service including hardware and networks/storage requirements for data centers. For E-Governance applications common infrastructural requirement are 24x7 availability, uninterrupted power supply to data centers, proper bandwidth allocation. In the proposed model the main focus of application designer should be on usability and functionalities of E-Governance system.

**Platform as a Service (PaaS):** Cloud provides different type of platforms as a service such as OS provisioning, middleware support services, database support services and workflow management. In e-governance with cloud advantages departments can get resources whenever they need them as compared to traditional methods.

**Software as a Service (SaaS):** It provides all application requirement for success full implementation of E-Governance. For example, Suppose an E-Governance plan decides to extend their area at district level Than no software is required to purchase at district level but cloud provider will provide required software along with additional standards services such as employee management system, district management solutions; call center service etc. in this manner cloud can provide best solution as per requirement, Hence cloud reduces cost of E-Governance.

**Cloud Vision for E-Governance:**

This section performs a selection of elements for the cloud which is useful for implementing the cloud based E-Governance.

- **Internet over Cloud:** Most of services on internet are dependent on cloud 70% of the internet users are also using cloud in various applications.
- **Distributed Data Centers:** Individual information systems are vulnerable to risks such as outside attacks, intruders, environmental risks etc. Distributed data centers provide protection from these types of threats [5]. Distributed data centers facilitate the E-Governance application usage and management by providing support for communication and real time platform. Data is distributed among different centers so single ownership on data is eliminated and it provides more security to information related to citizens.
- **Data Center Operation:** Main aim of Data center operations is to facilitate availability and continuity of services. Cloud computing uses cost effective hardware for setting data centers and the same data center can be shared in various E-Governance application. Use of same hardware setup is used for various e-government applications. It increases the resource utilization and provides scalability to the E-Governance system. On the basis of resource consumption

future plan could be built for e-governance applications. The key features of data center are shown in figure 4.

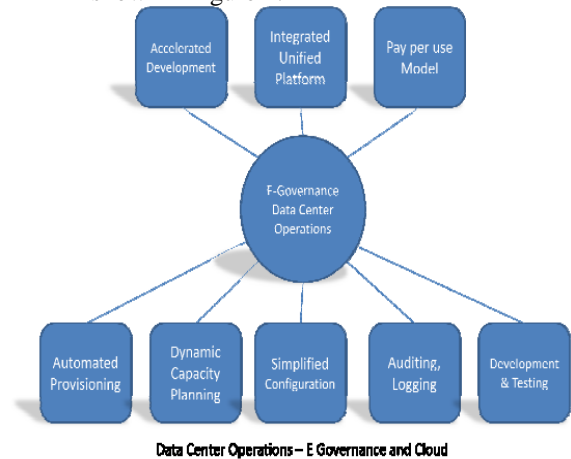


Fig 4: Data center operation for e-governance and cloud computing

**IV. INDIAN E- GOVERNANCE CLOUD STRATEGY:**

The proposed E- Governmental cloud provides a complete infrastructure for the implementation of government services including administrative and regulatory and social welfare [6]. Each cloud model has its own benefits and level of assurance for implementing the e-governance in India. The cloud strategy for e-governance in India is based on dedicated cloud for their specific services designed for E-Governance. The figure 5 indicates the presence of dedicated clouds with their specific tasks:

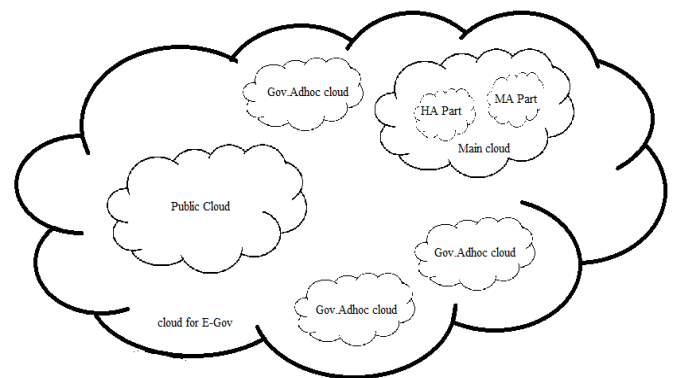


Fig 5: Cloud computing model for e-governance with high, medium and low assurance

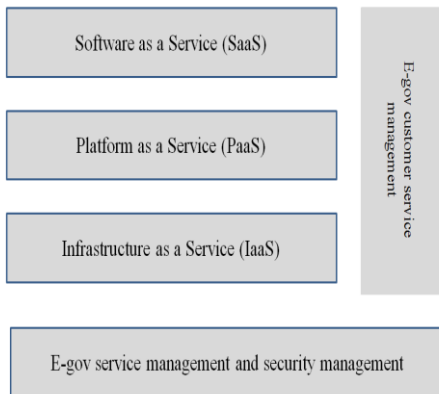
The above mentioned cloud model offers the low cost computing resources which are suitable for implementation of E-Governance. Here in the figure, the cloud structure for E-Governance is divided into high assurance and medium assurance parts. This is because whole e-governance requirement cannot meet with the public cloud. These two categories of cloud are different in security and other requirements required. There is also some agency cloud exists in the E-Governance so that required interoperability between Governmental cloud and agency government cloud could be

maintained as per standards. These standards will provide efficient and scalable cloud computing for governmental cloud .This also provides different level of security as well as other governmental requirements [7].

The three categories of cloud such as high assurance and medium assurance parts are described as follows:

- **High Assurance part** –Here, a physically devoted computing resources group is dedicated for governance. These resources are only used by government to provide its high assurance requirements.
- **Medium Assurance part** – A resource pool for cloud computing which will be collectively used by non-government cloud users .It provide a lower cost of resources for cloud computing. There is also a security control in the hands of the government.
- **Basic Assurance part** – this is a computing resource group of cloud computing based on public cloud offerings.

The figure 6 presenting layered implementation of Cloud computing model for E-Governance in India.



**Fig 6:** layered implementation of Cloud computing model for e-Gov in India

The configuration of layers for E-Governance is shown in below table 1.

**Table 1:** configuration of layers of e-Governance

Layer of cloud	Configuration of layers for e-governance
Infrastructure as a Service (IaaS):	<ul style="list-style-type: none"> <li>• Server hosting</li> <li>• Internet access</li> <li>• LAN/WAN</li> <li>• DNS</li> <li>• Web servers</li> <li>• Storage</li> <li>• Data management</li> <li>• Computing hardware</li> </ul>
Platform as a Service (PaaS):	<ul style="list-style-type: none"> <li>• Knowledge management</li> <li>• Data mart</li> <li>• Content management</li> <li>• Instrument and testing</li> </ul>
Software as a Service (SaaS):	<ul style="list-style-type: none"> <li>• Web applications</li> <li>• Meta data management</li> <li>• Portal services</li> <li>• Enterprise services</li> <li>• Workflow</li> <li>• Human management</li> <li>• Human resource</li> <li>• Groupware</li> <li>• Collaboration</li> <li>• Digital asset management</li> <li>• Digital signature</li> <li>• Communication</li> </ul>

Government will provide citizens services and other facilities like customer relationship, web management and business support through its government cloud. In this way, the government cloud is also responsible for standardization of the services [8]. This cloud model will provide a cost saving cloud computing structure for the e-governance [9]. These services are given below which will be implemented in the cloud computing model for perfect e-governance which is shown in fig 6. The other services required for customers and other e-governance management aspects are shown in the table 2 below:

**Table 2:** other e-governance management aspect and its services

Other service	Configuration of services
Customer services	<ul style="list-style-type: none"> <li>• Personalization</li> <li>• Customer assistance</li> <li>• Reporting tools</li> <li>• Online help</li> </ul>
E-govt. service management and security management	<ul style="list-style-type: none"> <li>• Call centers</li> <li>• Billing and accounting</li> <li>• Quality of service management</li> <li>• Backups</li> <li>• ID authentication</li> <li>• Firewall and network security</li> <li>• Intrusion prevention</li> <li>• Cryptography</li> <li>• Virus protection</li> </ul>

## V. SWOT ANALYSIS OF PROPOSED MODEL OF E-GOVERNANCE

**SWOT** study focuses on four main points: Strength, Weakness, Opportunity and Threat analysis of e-governance application. Nowadays internet is an integral part of our life [10] [11]. Government also applies these methods to handle their operations and communicate with their citizens for making public confidence for them. Cloud computing provides a cost effective method to implement e-governance applications for any developing country. The SWOT analysis of this model is done below:

### **Strength:**

E-government projects utilize capabilities of internet technologies which are very advanced these days. Mobile telephony provides a way for providing services on mobile phones. Ability of cloud computing to scale up services at any instance gives strength to e-governance application. Cloud offers the ability to handle time related computing. Suppose an organization handles homogenous load throughout year but in specific month they need more resources. In this situation cloud computing provides solution by providing more resources. Cloud reduces the maintenance cost, infrastructure cost and energy consumption. Maintenance cost mainly due to technology up gradation. Time to time up gradation of server configuration, with proper security mechanism and data management comes under maintenance phase. Cloud computing provide full control over access mechanism. It provides different access mechanism for different type of users.

### **Weakness:**

The major problem of implementing e-governance application is low level of literacy and shortage of skilled

employee for development of e-government projects. E-governance applications have no usefulness in low level areas such as daily use applications because of bandwidth shortage. Organizations worried about losing physical control over data and information. Cloud service providers are also unable to give information about data servers and location data to the client. It creates a situation of confusion in the mind of clients. Cloud providers continuously try to resolve these issues. But due to this weakness, large organizations do not rely on cloud-based systems for critical applications.

**Opportunities:**

The main part of providing e-governance services is to provide hardware setup at low cost. Availability of e-governance in rural areas is achieved by providing services on cheap mobile phones. Mobile technology can be used to provide services at government level. Media can play an important role in spreading awareness about e-government services. Public-private partnership will also be useful in e-gov application.

Developing countries can use the information and communication technologies with the cloud computing and could allow the business organizations and citizens to benefit from these technologies.

**Threats:**

Some basic threats in cloud e-governance are associated with increasing manpower cost, increment in the broadband cost and no reachability of internet. Without support of legislators, cloud e-governance cannot be implemented. There is also a regional language factor in the success of the cloud e-governance. A major threat is associated with the security of the cloud-based governmental data which may be hacked. PPP model may make impact on the partnership with the private sector so it may be a threat to the private sector. There is a big threat from the entrenched incumbents. There are some threats from the lack of standards in cloud technology. So it may create a problem in the implementation of the e-governance with the help of the cloud computing. Basically, cloud computing-based e-governance is most interoperable so there should be enough support from the legislators.

**VI. CONCLUSIONS**

Cloud provides a better way to offer services to clients related to different regions. Cloud follows service-oriented architecture and provides low-cost hardware/software resources. E-governance could use both service-oriented architecture and cloud architecture and can provide services to citizens and governments at low operating cost. In this paper, a novel cloud computing-based E-Governance model has been presented. A SWOT analysis is also performed to highlight the strengths and challenges of the proposed model. The paper also suggests a three-tier cloud architecture especially for the Indian scenario which could transform the nation into an information society.

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