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E-Governance Paradigm Using Cloud Infrastructure: Benefits and Challenges

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Abstract

Most of the companies including government organizations are running their applications in the cloud due to the rapid advancement in ICT. In recent years cloud computing is one of the most significantly achieved development in the IT industry which gives a platform to use the application in the form of services which is more scalable, reliable, high performance and relatively low cost as compared to other distributed computing infrastructure. E-Governance is one of the applications of ITC to enable and exchange the information between the G2G, G2C, G2B, G2E modality of society. So it can be seen simply as moving citizen services online, but in its broadest sense it refers to the technology-enabled transformation of government. It reduce costs, whilst promoting economic development, increasing transparency in government, improving service delivery and public administration, and facilitating the advancement of an information society. So for e-gov cloud implementation, resources for e-governance modality can be mapped to the services and deployment models. Though the e-Gov cloud deployment is a greatest challenge of ICT, but the main challenge is the security and protection to both government and the citizens. The main objective of this paper is to provide a clear idea about the e-Gov using cloud computing models and outlines the problems and requirements for understanding the e-Gov paradigm in India.

Keywords: e-Governance ;Cloud computing; Cloud computing models; e-gov using cloud infrastructure

1. An Introduction to e-Governance

E-Governance refers to the use of information and communications technologies (ICT) to improve the efficiency, effectiveness, transparency and accountability of government[1]. E-Government can be seen simply as moving citizen services online, but in its broadest sense it refers to the technology-enabled transformation of government - governments'

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best hope to reduce costs, whilst promoting economic development, increasing transparency in government, improving service delivery and public administration, and facilitating the advancement of an information society.[1][2][3] The main objectives are:

*1.1 Reducing Costs***.**

Putting services on-line substantially decreases the processing costs of many activities compared with the manual way of handling operations. Efficiency is also attained by streamlining internal processes and by enabling faster and more informed decision making.

1.2 Promoting Economic development

Technology enables governments to create positive business climates by simplifying relationships with businesses and reducing the administrative steps needed to comply with regulatory obligations. There is a direct impact on the economy, as in the case of e-procurement, which creates wider competition and more participants in the public sector marketplace.

1.3 Enhancing Transparency and Accountability

E-Government helps to increase the transparency of decision-making processes by making information accessible - publishing government debates and minutes, budgets and expenditure statements, outcomes and rationales for key decisions, and in some cases, allowing the on-line tracking of applications on the web by the public and press.

1.4 Improving Service Delivery:

government service delivery, in the traditional process, is time consuming, lacks transparency, and leads to citizen and business dissatisfaction. By putting government services online, eGovernment reduces bureaucracy and enhances the quality of services in terms of time, content and accessibility.

1.6 Improving Public Administration-

e-government administrative components, such as a computerized treasury, integrated financial management information systems, and human resource management systems, lead to greater efficiency in public administration. Features include the integration of expenditure and receipt data, control of expenditure, human resources management, intelligent audit through data analysis and the publishing of financial data.

1.7 Facilitating an e-Society

One of the main benefits of an e-Governance initiative consists of the promotion of ICT use in other sectors. The technological and management capacities required for e-Government administration encourage, in turn, the development of new training courses and modules in schools and universities trying to supply the required skills and capabilities to the market.

2. 3- Modalities Of e-Governance Facilities

2.1 Government to Citizen:

It deals with the relationship between government and citizens. G2C allows citizens to access government information and services instantly, conveniently, from everywhere, by use of multiple channels. [1]

*2.2 Government to Business***:**

It consists of e-interactions between government and the private sector. The opportunity to conduct online transactions with government reduces red tape and simplifies regulatory processes, therefore helping businesses to become more competitive. [1]

2.3 Government to Government:

Governments depend on other levels of government within the state to effectively deliver services and allocate responsibilities. In promoting citizen-centric service, a single access point to government is the ultimate goal, for which cooperation among different governmental departments and agencies is necessary. G2G facilitates the sharing of databases, resources and capabilities, enhancing the efficiency and effectiveness of processes. [1][2]

3. National e-Governance Plan (NEGP)

National e-Governance Plan (NeGP) has been approved by the Government of India for implementation during the years 2003-2007 to lay foundation and provide impetus to e-Governance throughout the Country. The Plan advocates definition of institutional mechanisms and core policies for managing e-governance initiatives across the Country in a cohesive manner and

entails that services, having high volume of citizen interactions, with major impact on National and Regional economies or where service-owners themselves show readiness to optimize, be targeted as Mission Mode Projects (MMPs) at various levels.[1][5]

Further, by providing appropriate weightage to quality and speed of optimization and by utilizing full potential of private sector involvement, NeGP aims at creating a citizen-centric and business-centric environment for governance. [5]However, it was observed that most States were inadequately equipped in terms of personnel and skill-sets needed to handle the host of issues involved in effective implementation of NeGP in their respective areas. State Governments needed to provide for overall direction, standardization and consistency across initiatives and at the same time, were to have resources and flexibility to drive the Plan in the best-possible manner.

4. The e-Governance Strategy In India

- Localize implementation and decision-making and deploy the core infrastructure to deliver services to the Third Tier of Governance [5]
- Manage all ICT initiatives as "capital investments" which can be evaluated in terms of pre-defined goals and measurable targets
- Make various stakeholders capable of conceptualizing, developing and managing e-Governance tools themselves
- Aim at service-oriented approach of Governance and create an integrated, modular and scalable framework to become more adaptive
- Utilize policies, structures and frameworks to bring about transparency in various government functions. [5][6] figure-1 outlines the Six pillars for achieving e-Governance framework.

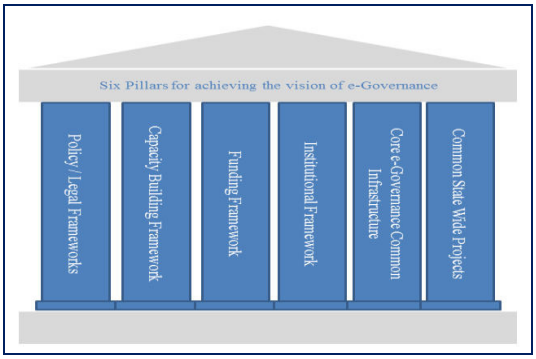


Fig-1. Six pillars for achieving e-Governance framework[1]

5. Major Implementation Challenges In India

Poor people and poor infrastructure are major challenges in countries like India. It poses a major challenge in reaping the full benefits of service provision under e- governance. The various barriers can be enumerated as follows: [5][6]

- *Poverty*:
  Accessing Internet is a costly affair for the poor who struggle for their livelihood in developing countries like India. Required infrastructure in the form of installing the necessary telephone lines needed for internet or email access is equally unaffordable in most poor countries.
- *Technical illiteracy*:
  There is general lack of technical literacy as well as literacy in countries like India.
- *Language Dominance*:
  The dominance of English on the internet constrains the access of non-English- speaking population. In the case of India, 95 percent of the population does not speak English. Due to such overwhelming dominance of English over these communication channels, computers and the internet are quite useless in Indian villages.
- *Unawareness:*

There is general lack of awareness regarding benefits of E-Governance as well as the process involved in implementing successful G-C, G-G and G-B projects.

- *Inequality:*
  Inequality in gaining access to public sector services between various sections of citizens, especially between urban and rural communities, between the educated and illiterate, and between the rich and poor.
- *Infrastructure:*
  Lack of necessary infrastructure like electricity, internet, technology and ways of communications will affect the speed which delays the implementation.
- *Impediments for the Re-Engineering process:*
  Implementation of E-Governance projects requires lots of restructuring in administrative processes, redefining of administrative procedures and formats which finds the resistance in almost all the departments at all the levels. [5]

6. An Introduction To Cloud Computing

Cloud computing is a next generation computing platform that helps the users to share the resources through communication mediums. According to National Institute of Standards and Technology (NIST) one of the most accepted definition of cloud computing is "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". European Community for Software and Software Services (ECSS) defines "cloud computing as the delivery of computational resources from a location other than your current one".[7][8][9] So in simple words cloud computing can be defined as a distributed computing environment that enables the users to access and exchange their resources (applications and data) remotely and provides services to use the remote hardware and software within a network without the knowledge of technological infrastructure . The figure-2 shown below gives a clear idea regarding the infrastructure requirements for cloud deployment.

Fig-2 The Cloud infrastructure

7. Advantages Of Cloud Computing

- *Flexibility/Elasticity***:**
  Users can access computing resources as and when needed, without any human interaction. Capabilities can be rapidly and elastically provided in some cases automatically.[7][20][22]
- *Scalability Of Infrastructure.*
  New nodes can be added or removed from the network as can physical servers, with limited modifications to infrastructure set up and software. Cloud architecture can scale horizontally or vertically according to the user's requirements.[7][22]
- *Broad Network Access***.**
  Capabilities are available over the network and accessed through standard mechanisms that promotes by using heterogeneous platforms (like mobile phones, laptops, and PDAs).
- *Location Independence.*
  Cloud interfaces are location independent and they can be accessed by well established interfaces such as Web

services and Web browsers, so that no knowledge about exact location of the user is required. It gives a high level of abstraction to the users data.

- *Unlimited Storage.*
  Storing information in the cloud gives almost unlimited storage capacity. Hence no more need to worry about running out of storage space or increasing current storage space availability.
- *Easy Access to Information.*
  Once registered in the cloud environment any one can access the information from any location provided, there is an Internet connection.
- *Economies Of Scale And Cost Effectiveness***.**
  Cloud implementations regardless of the deployment models tend to be as large as possible in order to take advantage of economies of scale. Large cloud deployments can often be located close to cheap deployment to lower cost. It does not require upfront investment and much capital expenditure. Users may pay and use or pay for services and capacity as they need them. [22]
- *Backup and Recovery.*
  Since all the user's data is stored in the cloud, backing it up and restoring the same is relatively much easier than storing the same on a physical device. Most cloud service providers are usually competent enough to handle recovery of information. Hence this makes the entire process of backup and recovery much simpler than other traditional methods of data storage.[7]
- *Reliability*
  It improves the use of multiple sites which makes cloud computing suitable for business continuity and disaster recovery.
- *Sustainability*
  It improves resource utilization and makes the cloud environment more efficient.

8. Cloud Computing Service Models.

8.1 Infrastructure as a Service(IaaS)

Infrastructure as a Service (IaaS) is one of the three fundamental service models of cloud computing . A services of cloud computing models is shown in the figure -3. In this model the users are allocated with computing resources in order to run their applications. The computing services are provided in a virtualized environment i.e in cloud by using a communication network. The best known example of IaaS is Amazon Cloud Formation, Amazon EC2. It can be implemented by utilizing the concepts like Enterprise infrastructure, Cloud hosting, and Virtual Data Centers (VDC). Network as a service (NaaS) is a category of cloud infrastructure services where the user can use the network connectivity as a services. NaaS involves the optimization of resource allocations and resource computing in the network. VPN, and bandwidth on demand are the common example of NaaS.[14,15,16,22]

8.1.1 Advantages of IaaS.

- Resources are available on demand as and when the user requires it. That means the user will not have to worry about the Infrastructure required to run the application. so this scalable.
- In IaaS the Infrastructure the virtualized environment is set up and maintained by the cloud provider. So no investment in hardware for the users. As it saves the implementation cost and time of execution.
- The service can be accessed on demand and the client only pays for the resource or application used not for the Infrastructure
- The service can be accessed from any location 24X7 provided there is an internet connection. So IaaS is location independent.
- Physical security of user's data is the responsibility of the cloud provider. So the time required to give security to data is saved.

- The chance of system failure is less. Any case of failure will be smoothly handled by the service provider. So it is fault tolerant.

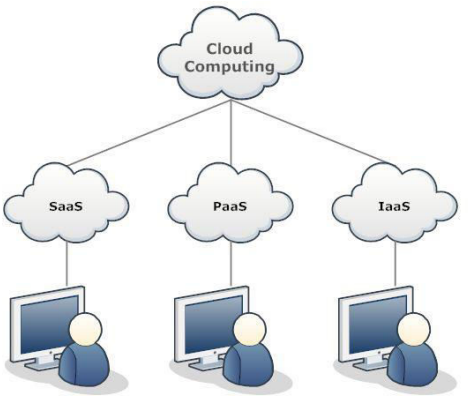


Fig-3 The layers of cloud service models

8.2 Platform as a Service(PaaS).

Platform as a Service is a category of cloud computing service model that provides the developers a platform to build and use applications and services by using a communication network. PaaS services are available in the cloud and accessed by users by using web browsers. In the PaaS model, cloud providers provides a platform which includes operating system, programming language execution environment, database, and web server. The users can use these facilities to develop their applications. The well known PaaS providers are AWS Elastic Beanstalk, Cloud Foundry, Heroku, Force.com, OrangeScape. The services are constantly updated by the service providers, with existing features upgraded and additional features added. In PaaS services the user has to pay for a subscription basis and charged just for what they use. PaaS includes Operating system, Server-side scripting environment, Database management system, Server Software, Network access ,Tools for design and development and web hosting.[22]

8.2.1 Advantages of PaaS:

- The user doesn't have to invest for physical infrastructure as it will be provided by IaaS on demand. So this gives fully mobility to focus on the development of applications.
- With PaaS services application development is simple. So anyone can develop an application with less technical knowledge by using web browser.
- User can have control over the applications that are installed within their platforms and can create a platform that suits their specific requirements. They can 'pick and choose' the features they feel as necessary.
- In PaaS applications can be changed or modified if required.
- The services are not isolated, application specific or location dependent. So users in various locations can work together provided they are connected through a communication medium.
- Security of user's data and the application is the responsibility of the cloud provider. Data security, backup and recovery are the major security issues.

8.3 Software as a Service(SaaS)

The third model is **Software as a Service** which provides a platform in which the users access the software from the cloud. The users of SaaS will not have to worried about managing the cloud infrastructure and platform on which the application is running. The software installation and operation is the responsibility of the service providers

and already available by using IaaS and PaaS.[17,18,22] This is typically end user applications delivered on demand over a network on a pay per use basis. The examples of SaaS include: google apps, MicrosoftOffice365, Onlive, GT Nexus, Marketo, and TradeCard. These applications are hosted in "the cloud" and can be used for a wide range of tasks for both individuals and organizations.

8.3.1 Advantages of SaaS.

1. No additional infrastructure or platform required to run the applications, as it provided by the service provider (IaaS and PaaS).
2. Software Applications are ready to use once the user subscribes. The user only have to pay for software not for infrastructure or platform setup.
3. With SaaS services application development is simple. So anyone can develop an application with less technical knowledge any time by using web browser.
4. Software updating is automatic i.e if any updates are available online to existing user, offered free of charges.
5. SaaS provides mobility to the user where applications can be accessed via any internet enabled device, which makes it ideal for those who use a number of different devices, such as internet enabled phones and tablets, and those who don't always use the same computer.
6. The services are not isolated, application specific or location dependent. So users in various locations can work together provided they as connected through a communication medium.
7. There are no initial setup costs is required with SaaS, as SaaS offered with other services.

9 Cloud Deployment Models

According to the usages of data and applications required by the users the cloud computing models are broadly classified in four different types called as cloud deployment models.

9.2 Public Cloud(External Cloud)

The most popular model of cloud computing to many users is the public cloud model. It provides cloud services in a virtualized environment accessible via Web applications or Web services through internet (Public Network). The cloud services and cloud resources are accessed from very large resource pools that are shared by all the end users as depicted in figure-4. It is owned by an organization selling cloud services.Cloud services like IaaS, PaaS and SaaS follows the public cloud model and gives Flexibility to end users for accessing these services from any internet enabled devices. [15,16,17,18,19,22]

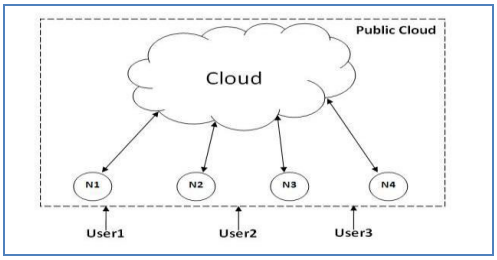


Fig -4 : Public Cloud Deployment Model

9.3 *Private Cloud*(*Internal Cloud*)

A private cloud provides a distinct and secure cloud based environment in which only the authentic users within an organization can access, as depicted in figure-5 N4 acts as a private cloud terminal. It makes the use of virtualization within the private area. It may be managed by the organization or a third party, and may exist on premise or off premise.

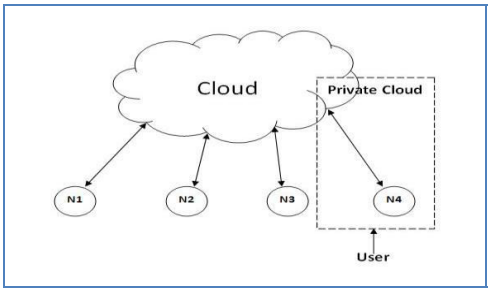


Fig -5: Private Cloud Deployment Model

9.4 Community Cloud(Grouped Cloud)

A community cloud provides a distinct and secure environment where organizations with similar requirements share a common cloud infrastructure. So it is called as generalization of a private cloud where a private cloud infrastructure is only accessible to permissible users as shown in the figure-6. It may be managed by the organizations or a third party and may exist on premise or off premise. [18,19,21]

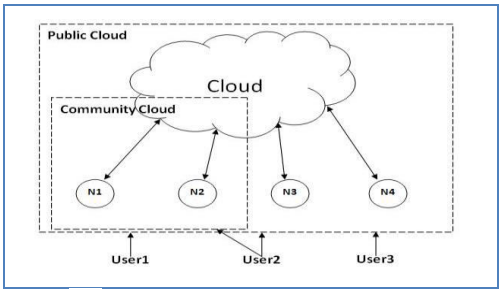


Fig -6: Community Cloud Deployment Model

9.5 Hybrid Cloud(Mixed cloud)

A hybrid cloud provides an integrated environment accessible to both private and public cloud functionalities. Therefore, an organization can maximize their efficiencies by employing public cloud services along with private cloud ensuring that all of their platforms are virtualized. Organizations who manage their private clouds first registered to a public cloud service which they then integrate into their infrastructure. The figure-7 shown below is the deployment model for hybridcloud.[19]

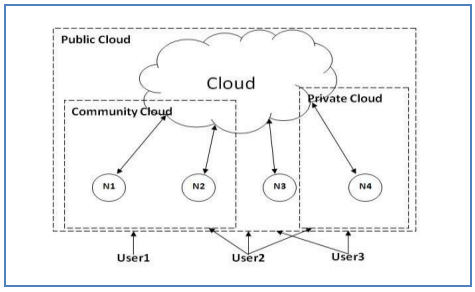
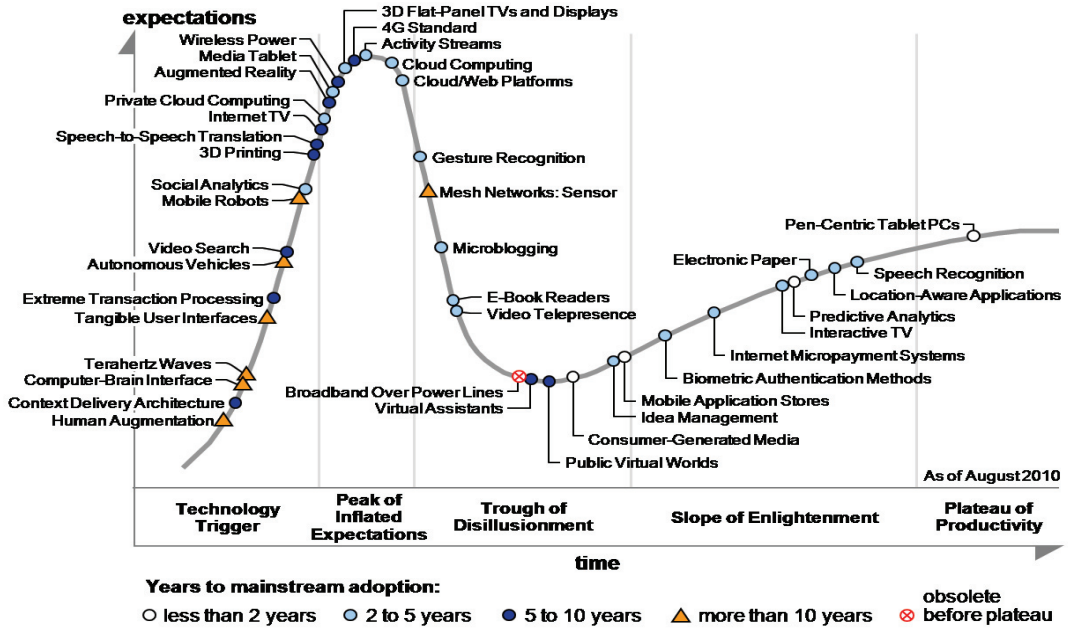


Fig - 7: Hybrid Cloud Deployment Model

10 Gartner Hype Cycle For Cloud Computing And E-Governance Adoption Using Cloud Services

It identifies various aspects of cloud computing and which state of adoption they are in at present and expected timeframe for main stream adoption. E.g., while ‘cloud advertising’ is closer to the plateau of productivity than ‘virtualisation’, the former has

two to five years for mainstream adoption while the latter has less than two years. This essentially means that the market penetration of 'virtualisation' is higher, while even though the maturity of technology and business model of 'cloud advertising' is higher, its market penetration is lower. As deprecate in figure-8(a) :. In Gartner hype cycle for e-Governance adoption using



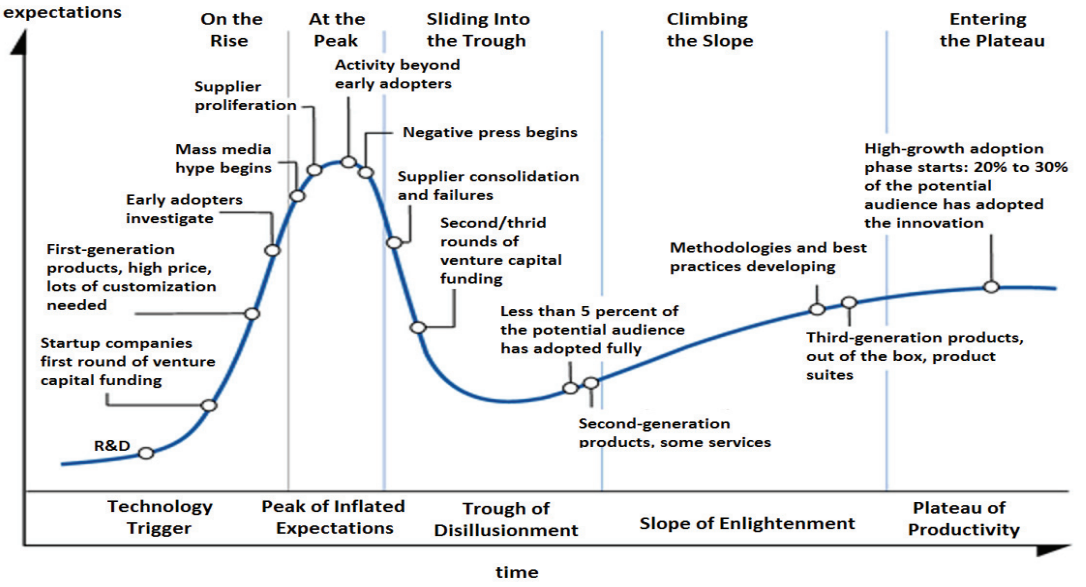
cloud services in figure-8(b) ,outlines the importance of e-gov cloud and its visibility and readiness over time.[22]

Fig-8(a):Gartner hype cycle for cloud computing 2012

Fig-8(b)Gartner hype cycle for e-Governance adoption using cloud services**.**

11 Cloud Based e-Governance System

So for e-gov cloud infrastructures, application and data usages of e-governance modality can be mapped to the three different service models such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) and can also be deployed in the form of Public cloud, Private cloud, Hybrid cloud and Community cloud. It gives a



platform to use the applications(G2G,G2C,G2B,G2E) in the form of services which is more scalable, reliable, high performance and relatively low cost as compared to other implementation of e-governance services. The figure-10 represents the e-governance modality services with cloud Infrastructure.[6][22][23] table-1 and table -2 represents the egov challenges and cloud benefits including the resource analysis.

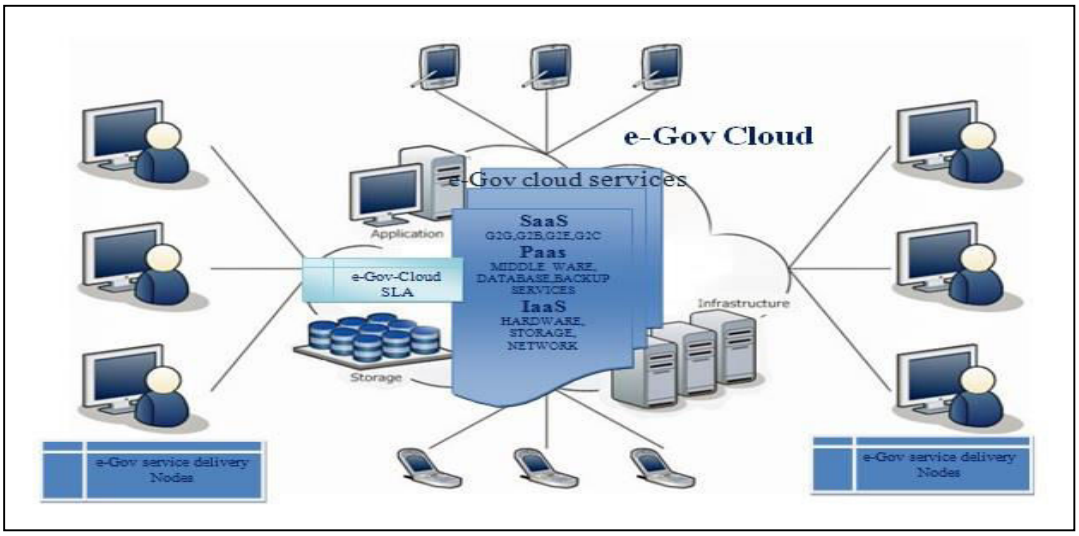


Fig-9:e-gov cloud using cloud infrastructure

Table-1. E-Gov challenges and cloud benefits

Slno	e-Gov challenges	Cloud benefits
1.	Reducing Costs	Deploying the e-gov services in cloud substantially decreases the processing costs of many activities compared with the manual way of handling operations. Efficiency is also attained by streamlining internal processes and by enabling faster and more informed decision making.[22]
2.	Promoting Economic development	Cloud implementations regardless of the deployment models tend to be as large as possible in order to take advantage of economies of scale. Large cloud deployments can often be located close to cheap deployment to lower cost. It does not require upfront investment and much capital expenditure. It improves resource utilization and makes the service delivery more efficient. .[22]
3.	Enhancing Transparency and Accountability	Users in cloud environment can access computing resources as and when needed, without any human interaction. Capabilities can be rapidly and elastically provided in some cases automatically. It improves the use of multiple sites which makes cloud computing suitable for business continuity and disaster recovery. .[22]
4.	Improving Service Delivery	New nodes can be added or removed from the network as can physical servers, with limited modifications to infrastructure set up and software. Cloud architecture can scale horizontally or vertically according to the user's requirements. Capabilities are available over the network and accessed through standard mechanisms that promotes by using heterogeneous platforms (like mobile phones, laptops, and PDAs). .[22]

5.	Facilitating an e-Society	Once registered in the cloud environment any one can access the information from any location provided, there is an Internet connection. For deployment storing information in the cloud gives almost unlimited storage capacity. Hence no more need to worry about running out of storage space or increasing current storage space availability. .[22]
6.	Improving Public Administration	E-government administrative components, such as a computerized treasury, integrated financial management information systems, and human resource management systems, lead to greater efficiency in public administration. Features include the integration of expenditure and receipt data, control of expenditure, human resources management, intelligent audit through data analysis and the publishing of financial data. All the above functionalities can be managed by the faster and more informed decision making capabilities provided by CSP.[22]
7.	Reducing Costs	Deploying the e-gov services in cloud substantially decreases the processing costs of many activities compared with the manual way of handling operations. Efficiency is also attained by streamlining internal processes and by enabling faster and more informed decision making.[22]

Table-2. Resource analysis using cloud infrastructure

Slno	Parameters	e-Gov Deployment	e-Gov Deployment Using Cloud
1.	Access	Via web	Via web
2.	virtualization	N/A	Essential
3.	Switching cost	High	High ,due to incompatibilities
4.	Ease of use	Difficult	Easy
5.	Business model	Web based	Pricing (based on rent rate)
6.	Application development	Via web	In the cloud
7.	Control	Distributed	Centralised/distributed
8.	Openness	High	low
9.	Service level agreements	Optional	Essential
10.	Production Server Hardware	Essential	Provided by CSP
11.	Web servers	Essential	Provided by CSP
12.	Application servers	Essential	Provided by CSP
13.	Database servers	Essential	Provided by CSP
14.	Production Server Operating Software	Essential	Provided by CSP
15.	Development Server Hardware	Essential	Provided by CSP
16.	Backup server	Essential	Provided by CSP
17.	Laptops and desktops	Essential	Provided by CSP
18.	Development servers	Essential	Provided by CSP

19.	Development Server Operating Software	Essential	Provided by CSP
20.	Network Hardware	Essential	Virtualised infrastructure by CSP
21.	Routers	Essential	Provided by CSP
22.	Switches	Essential	Provided by CSP
23.	Load-balancing systems	Essential	Provided by CSP
24.	Firewalls	Essential	Provided by CSP
25.	Backup system	Essential	Provided by CSP
26.	Other security expenses	Essential	Provided by CSP
27.	Transmission/Bandwidth Charges	High	Vary (based on rent rate)
28.	Facilities/Equipment	High	Vary (based on rent rate)
29.	Man power required	More	Less
30.	Business staff (requirements development)	More	Less
31.	Technical staff (planning and engineering)	More	Less
32.	External contractors/consultants	Required	Optional
33.	Capital	High	Vary (based on rent rate)
34.	Depreciation of server hardware.	Essential	Provided by CSP
35.	Depreciation of network hardware	Essential	Provided by CSP
36.	Hardware maintenance	Essential	Provided by CSP
37.	Hardware upgrades	Essential	Provided by CSP
38.	Software maintenance	Essential	Provided by CSP
39.	Software upgrades	Essential	Provided by CSP
40.	Bandwidth/transmission charges	Essential	Provided by CSP
41.	Post-launch hosting expenses	Essential	Provided by CSP

12 Conclusion

This paper explains about the better e-governance services than can be available to the users if the services are available through cloud infrastructure. It gives a platform to use the application in the form of services which is more scalable, reliable, high performance and relatively low cost as compared to other distributed computing infrastructures. As e-Governance is the application of ITC to enable and exchange the information between the G2G,G2C,G2B,G2E modality of society. Though the e-Gov cloud deployment is a greatest challenge of ICT, but

the main challenge is the security and protection to both government and the citizens. The main objective of this paper is to provide a clear idea about the e-Gov using cloud computing models and outlines the problems and requirements for understanding the e-Gov paradigm in India.

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