Implementation of Cloud Computing In E-Governance – A Green Revolution

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Abstract—Cloud computing is one of the most popular, exciting and emerging technologies in the area of information technology. It has gained its popularity due to three important features 1) cost-effectiveness, 2) flexibility and 3) access to vast variety of pool of resources. Cloud computing mostly works through Internet and due to recent developments in Internet; it has become one of the promising and interesting technologies to be used by various organizations, institutions for learning purposes etc. Many government organizations are now trying to adopt the cloud computing technologies and trying to render their services through clouds. To adapt to these technologies special service-oriented architecture (SOA) has to be developed than the traditional used structure.

This paper tries to describe that by implementing the cloud computing model and architecture a good e-governance strategy and framework can be developed for e-government. It also discusses about SOA, challenges of e-governance and benefits of using cloud computing in e-governance.

Keywords- Cloud computing, service-oriented architecture, e-governance, e-government, benefits.

I. INTRODUCTION

In the present era, every organization wants to reduce their expenditure for infrastructure, computing resources and various services. To fulfill their needs they are trying to adapt to new emerging technology such as cloud computing. These developments of organizations are putting a direct impact on the various government departments, their functions, and their relationships with the citizens, consumers, businesses and other governments. By implementing cloud computing model and architecture, the government can use the e-services in effective and efficient manner. E-services are delivering cost-effective services which can increase the economy and government productivity. E-governance with cloud computing offers more interactive services to citizens, automated problem resolution, manages the security, privacy and tries to reduce the budget on the actual usage of data.

II. CLOUD COMPUTING

Cloud is a metaphor for Internet and cloud computing promises to increase the velocity with which applications are deployed, increases innovation and reduces costs. Gartner [10], defines cloud computing as “a style of computing where massively scalable IT-enabled capabilities are delivered as a service to external customer using Internet technologies”. Cloud computing has a wide range of services which can be hosted in different patterns with respect to the required service needed by the organizations [1]. The main objective of the cloud computing is to provide services with shared infrastructure and resources i.e. computing can become location and device independent. Since cloud computing makes computing on-demand scalable form as additional networks, storage and computation capacity can be added when required. The following figure shows the basic cloud computing model [1].

![Basic Cloud Computing Model](image-url)

Cloud computing offers a wide number of benefits. They are:

a. Rapid scalability and deployment capabilities
b. Decreased maintenance and upgrades
c. Improved resources utilization
d. Improved economics

e. Improved collaboration capabilities

f. Ability to engage in usage-based pricing

g. Reduced information technology infrastructure

h. On-demand infrastructure and computational power

i. Improved disaster recovery capabilities

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III. E-GOVERNANCE

Governance is a way of describing the links between government and its broader environment, political, social and administration [7]. E-governance is a process of delivering the service to the external and internal users or the stakeholders for the benefits of both government and the users that they serve [6]. All the services offered by the government can be made online for the benefit of the user by e-governance model [2].

A. Application of E-Governance

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

1. Government-to-government (G2G): high degree of message is exchanged between the various departments of government to fulfill the work.

2. Government-to-enterprise (G2E): all the government controlled enterprise such as electricity and water board, telecommunication etc. should immediately respond to all the government policies.

3. Government-to-business (G2B): government interacts with various businesses in terms of policy enforcement, tenders, taxes etc.

4. Government-to-consumer (G2C): different types of services such as hospital service, land and revenue service, agricultural service etc. are offered by government to their citizens depending on the type of service required.

B. Cloud Computing Services for E-Governance

Cloud computing model consists of a good collection of computing resources such as servers, storage, networks etc. application which can be easily accessed on demand with the help of service provider. Each facility provided by the cloud computing is considered as a service. Cloud computing offers few services such as [2]:

1. Infrastructure-as-a-Service (IaaS): the capability provides to the consumer is the provision of processing, storage, networks and the other entire fundamental computing resources. The consumer does not manage or control the underlying cloud infrastructure, but has the control over operating system, storage deploy application and can possibly select the network components such as firewalls, load balancer etc.

E-governance application such as bank ATM’s service, flight booking service etc. requires 24 *7, 365 days infrastructure availability minimizing the downtime. Therefore this application needs unlimited power supply, CPU service, storage and bandwidth when using the cloud. Hence the designer of the application needs to focus on the usability rather than the scalability. Thus, the application performs better on cloud as compared to traditional architecture.

2. Platform-as-a-Service (PaaS): the capability provides to the consumer is deployment onto the cloud infrastructure. Consumer created applications using programming language and tools supported by the provider. The consumer has the control over the application they run, but does not have the control over operating system, hardware or network on which the application is running.

In traditional e-governance model, the departments have to wait until they purchase and deploy of the resources. But cloud offers a standard platform such as operating system provision, query service, database service, on-demand middleware service, workflow services. Government departments can request for the required service and they can use the resources instantly rather than waiting for purchase and deployment of resources as done in traditional methods.

3. Service-as-a-Service (SaaS): the capability provides to the consumer is to use the provider’s application running on the cloud infrastructure and access the various client’s devices through the client infrastructure such as web-server. A newly formed state or province can use the service provided by the cloud provider on request rather than purchasing all the application, hardware, software and all the other fundamental computing devices.

Various different applications can be provide as a standard service where the departments can request and manage them online. Some applications such as certificate management system,, e-policy, e-court, utility bill payments, service and help desks. Implementation of cloud in e-governance can offer excellent services within short time and can accelerate all the e-governance services, which can reduce cost effectively.
Following figure shows cloud services

- **SAAS (G2G, G2B, G2E, G2C), SLA (Service Level Agreement)**
- **PAAS (Middleware solutions, database service, backup service)**
- **IAAS (Hardware, storage, network)**

Fig 2: Cloud Services

### IV. CHALLENGES WITH TRADITIONAL ARCHITECTURE

1. **Application Life Cycle Management**: throughout the life time of an application cost effective management facility has to be provided. Replication facility is needed to make the application highly available which may cause duplication in the number of resources used by the various government departments. Numbers of advanced tools are needed to handle the complexity and sophistication in the development of software.

2. **Software Licensing and Support**: requiring license for the application and data centers is one of the major worry. Since the data centers are distributed only one license is sufficient for the application.

3. **Accountability**: in traditional infrastructure, the application doesn’t have the central accountability.

4. **Scalability**: traditional infrastructure needs to be upgraded frequently so as to meet the challenges.

5. **Modifiability**: making modification in the traditional infrastructure is very expensive and time consuming.

6. **Physical security**: all the information processing activities have to be prevented from unauthorized physical access of computing resources which includes a) threats and facility requirements b) personnel physical access control c) computer physical security.

### V. SERVICE-ORIENTED ARCHITECTURE (SOA)

The challenges faced by the e-government in traditional architecture are overcome by the improved condition of developments and solutions. One way is to have cloud computing and service-oriented architecture (SOA), which should be applied for the consumer.

Cloud computing permits the whole country to uniformly cover with e-government solutions irrespective of the diversity and provides e-service. It also reduces the cost of information technology used which is one of the major barriers in providing the e-government services.

Service-Oriented Architecture (SOA) is a paradigm of designing and developing information technology solutions which provides a service as the primary building blocks. A service is an autonomous and reusable unit of business which may be stored into a service repository which is a collection of service running in an enterprise. SOA facilitates the customer to achieve centricity i.e. the customer may receive all the required e-service in one place on the Internet independent of the provider. Customer centricity shortens customer processes which help in the improvement of the quality of human life and increase the economy efficiency. It also permits the e-service between the public and private sectors, by stimulating in the development of e-economy by compound services such as integrated service, mix service and value-based service.

SOA architecture is based on 8 main design principles [3, 8]. They are:

1. **Standardized Service Contract**: service contracts included in same service repository must conform to contract design standards.

2. **Service Loose Coupling**: it refers to connection or relationship between two things. It promotes the independence of design, evolution of logic and implementation of services.

3. **Service Abstraction**: service contract contain only essential information on services and tries to hide the underlying details of a service as much as possible. It plays important role in the positioning and design of service compositions.

4. **Service Reusability**: service contract contain only business and administrative logic and hence can be used as a reusable resource.

5. **Service Autonomy**: services are autonomous and demonstrate the high level of control over runtime environment.

6. **Service Statelessness**: services minimize usage of resources and limit itself to storing and processing state information only when it is absolutely necessary.

7. **Service Discoverability**: service is described with metadata and can be discovered and interpreted efficiently.

8. **Service Composability**: service can be freely composed into various configurations regardless of the size and complexity of the given configuration.

Following figure shows the design principles of SOA and its strategic benefits.
VI. E-GOVERNANCE CHALLENGES

Cloud computing have a number of advantages for government which includes – reduced cost, increased storage, higher level of automation, increased flexibility, and higher level of employee mobility. E-governance brings a good opportunity of service to all its citizens, but it faces few challenges which can be grouped as [2, 5];

a) **Technical Challenge**: security, privacy and interoperability of existing hardware and software are the key factors of any projects. A clear technical solution, transparency of procedures and possibly all independent auditing details should be given by the government before the start of the project which is a little difficult task.

b) **Economical Challenge**: economical issues which are mainly concerned with returns of investment can be achieved if the cost of implementation, maintenance and operation is kept low. Since e-governance is considered as a nationwide plan, all the implemented applications must be reused by other administrative departments.

c) **Social Challenge**: due to different varieties of languages and technical issues, majority of the people may not be ready to access e-governance features. A successful implementation of e-governance requires a re-conceptualization of the government.

VII. CLOUD COMPUTING BENEFITS IN E-GOVERNANCE

The challenges of e-governance can be resolved by cloud computing.

1. **Data Scalable**: to deal with different varieties and huge amount of data for years for e-governance database offers the lowest level of integrity, which can be overcome by cloud database. Cloud database offer a high level of data scalability without compromising on the performance.

2. **Auditing and Logging**: modification to any information of e-governance requires service which can be controlled by using information technology service by keeping the providers of service accountable. Cloud can help in analyzing huge volume of data and detecting any type of fraud. It helps by placing a good defense mechanism to ensure proper security thereby making the applications reliable and available.

3. **Replication and Migration**: same types of application are used by the different government department which incurs more budget, time and effort. Cloud architecture offers a feature to create an instance of an application which can reduce time and cost in the deployment of application and resources.

4. **Significant Cost Reduction**: by making use of cloud architecture government can reduce the capital expenditure spend on the traditional services as all the resources and applications are in the cloud.

5. **Increased Flexibility**: instead of deploying the different computing resources in government departments cloud offers on-demand facility. Using these facilities the government departments can demand the required resource or application when required.

6. **Disaster Recovery**: natural disaster such as flood, earthquakes, and internal breakdowns could cause the e-governance application to loose data and make service unavailable. Disaster recovery procedure must be placed and practiced from time to time in which the data must be switched from data center to another. Cloud virtualization technologies allows backup and restoring. It also offers the feature of replication and migration as compared to the traditional data center.

7. **Reporting and Intelligence**: the factors such as CPU, storage, networks, peak load consumption level etc. must be regularly monitored and reported for better resource
utilization, which helps in planning and minimizing the cost. Cloud offers better intelligence infrastructure as compared to traditional because of its sheer size and capabilities.

8. Service Quality: user will get reliable services for 24*7, 365 days.

9. Policy Management: e-government has to follow and implement the policies of government and data centers for routine operations. By using cloud architecture, policies with respect to security applications can be formalized and enforced in the data centers.

10. System Integration and Legacy Software: all the existing application providing the service can be integrated and deployed with all the other applications in the cloud. Since cloud is built on an SOA principles which can offer an excellent solutions for integrating the various applications.

11. Going Green: due to the large amount of power usage for air-conditioning, electronic wastes are creating a bio-hazards and pollutions in the data centers. Cloud computing helps government to go-green by centralizing all the resources and improve the resource utilization thereby reducing the pollution and making the environment green.

VIII. CONCLUSION

Cloud computing is an emerging technology in which clouds provides strong foundation of services to both public and private sectors with the help of required technology and resources. E-government needs all the fundamental computing resources to function properly, but present economy situation makes it difficult to manage all the infrastructure, technology and deployment of new resources.

Cloud computing can resolve all the difficulties faced by the e-government by providing various services. By designing the applications based on the SOA principles, cloud computing can reduce the operational cost and increase the e-government, by making information technology as e-service which is much cheaper and faster.

From above research conclusion can be drawn that by using cloud computing model better service can be obtained in less cost and enhance the government services worldwide which helps in the development of the country and the relationship with the citizens. At the global level cloud computing architecture can benefit government to reduce the redundant efforts by increasing proper resource utilization, which in turn will helps the government to reduce pollution, waste and go ‘Green’.

REFERENCES


