

## E-GOVERNMENT BASED ON CLOUD ENVIRONMENT IN INDONESIA

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### ABSTRACT

*E-government is a concept that is believed to improve government services. The revolution of technology nowadays may lead to cloud computing in e-government where services as its core. From literatures, cloud environment offers many benefits than traditional infrastructure. Therefore, Indonesia as developing country with unique geographical background should be looked at this alternative. From worldwide ranking, e-government in Indonesia is considered less than satisfactory. Implementation e-government tends to ineffective and inefficient. This is because of problems that are found from traditional infrastructure such as lack of competency for human resources in ICT, lack of integration, inefficient investment of infrastructure in regions, etc. Cloud environment is expected to overcome those problems with service on demand concept on centralized infrastructure. This paper proposes initial architecture for implementing e-government based on cloud computing in Indonesia.*

*Keywords – e-government; cloud computing; architecture;*

### 1. INTRODUCTION

Developing countries are facing many challenges in implementing e-government from budgetary barriers to citizen expectations and seamless services (Lau, 2003). Government should choose the best implementing strategy so e-government can be delivered in effective and efficient way. An effective e-government system should be reliable, cost effective, ease to maintenance, satisfying other nonfunctional (Tripathi and Parihar, 2011).

Nowadays two main trends in the area of information technology influence e-government. The first trend is constant development of computer infrastructure which becomes more powerful and at the same time less expensive. The second trend is constant increase of users' skills and knowledge of operating computers. These two trends enhance possibilities of providing electronic services both in the public and the private sector (Cellary and Strykowski, 2009). Public sector should take this opportunities to provide e-government based on services.

Cloud computing is a way to achieve the goals in delivering services with less infrastructure investment. Cloud computing provides a new service consumption and delivery model inspired by Consumer Internet Services (Tripathi and Parihar, 2011). Besides, as a kind of green technology, cloud computing can raise the utilization rate of resource of data center considerably and can reduce the consumption of energy. Therefore, cloud computing is the best environment to establish the e-government (Yeh, et al, 2010).

Indonesia is a unique country. Indonesia has 33 provinces and 497 district/city spread into thousand archipelago. In governance, they use regional autonomy system where each region has rights, authority and obligation to regulate and manage the household itself in accordance with laws and regulations. The e-government system tends to walk alone and there is no integration each other.

In the other side, their current strategy in e-government tends to inefficient and ineffective with heavy infrastructure investment. For example, in implementing electronic identity card services, government choose to build infrastructure in every district / city. The budget of that project is very large but still problems come both technical and non-technical. Government should provide convenient and easy-to-access, logical groups of service, customized service to meet personal needs, and greater participation to determine what, how, and when service is provided (Fajar, et al, 2011). Indonesia should change the paradigm in implementing e-government from traditional infrastructure to cloud environment.

This paper presents initial architecture for implementing cloud environment in e-government based on analysis of current conditions in Indonesia. This architecture allows for greater information, resource sharing and promote more standardization and consolidation in the government's resources.

## 2. PREVIOUS STUDY

### 2.1. Cloud Computing

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 (NIST).

#### 2.1.1. Delivery Models

In cloud computing, there are 3 basic delivery models in cloud computing :

##### - Software as a Service (SaaS)

Cloud offers software / application as a service. Software as a Service (SaaS) makes use of a cloud computing infrastructure to deliver one application to many users, regardless of their location, rather than the traditional model of one application per desktop. It allows activities to be managed from central locations in a one-to-many model, including architecture, pricing, partnering, and management characteristics (Microsoft - SaaS).

##### - Platform as a Service (PaaS)

Cloud offers standard platforms in terms of providing different kinds of systems, middleware and integration systems (IIIT, 2010). It supports the full life cycle of designing, implementing, testing, and deploying web applications and services (Microsoft - PaaS).

##### - Infrastructure as a Service (IaaS)

IaaS provisions processing, storage, networks, and other fundamental computing resources where cloud government is able to deploy and run arbitrary software, which can include operating systems and applications (Zhang and Chen, 2010). The biggest advantage of IaaS for government is that it offers a cloud-based data center without requiring you to install new equipment or to wait for the hardware procurement process, giving you access to IT resources that otherwise might not be available (Microsoft – IaaS).

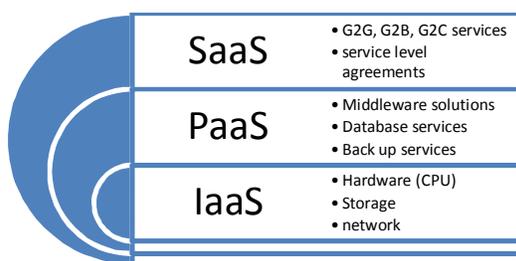


Fig. 1. Three Delivery Models in Cloud (IIIT, 2010)

#### 2.1.2. Fundamental elements

From the perspective of Rayport and Heyward (2009), it is essential for a country to have the following conditions in the cloud environment: Universal connectivity, Open access, Reliability, Interoperability and user choice, Security, Privacy, Economic value, and Sustainability (See Figure. 2). Indonesia as developing country have to prepare this elements in order to implementing cloud environment effectively.

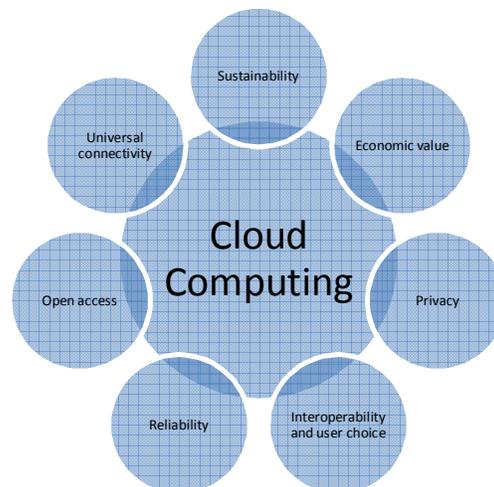


Fig. 2. Fundamental Elements in Cloud  
(Rayport and Heyward, 2009)

#### 2.1.3. Benefits

In purpose to open the government eyes why cloud environment is very essential this day. These are many cloud benefits in e-government (Tripathi and Parihar, 2011):

##### - Data scaling

Database in cloud environment has advantages in high-end scalability, that is, large scale, distributed scalability, the kind that can't be achieved simply by scaling up

##### - Auditing and logging

Using information technology, government can prevent corruption threat by keeping the providers of the services accountable. Cloud can help in analyzing huge volumes of data and detecting any fraud.

##### - Performance and Scalability

Scalability in cloud architectures is inbuilt. The performance of e-government applications can be scaled vertically by moving to a more powerful machine that can offer more memory, CPU, storage.

##### - Reporting and Intelligence

Because of its sheer size and capabilities, cloud offers better Business Intelligence infrastructure compared to traditional ones. Applications can mine huge volumes of real time and historic data to make better decisions to offer better services.

##### - Policy management

Policies and regulations related to e-government can be formalized and enforced in the data center.

##### - Systems Integration and Legacy Software

The integration of various applications can be done in cloud environment which built on SOA principles.

## 2.2. E-Government

E-government is an evolving concept and has been researched by many parties. The rapid technology advances contribute to this trend of governance in a country.

### 2.2.1. Definition

According to Abramson and Means (2001), e-Government can be defined as the electronic interaction (transaction and information exchange) between the government, the public (citizens and businesses) and employees. World Bank organization defined e-government as the government owned or operated systems of information and communication technologies that transform relations with citizens, the private sector and/or other government agencies so as to promote citizens' empowerment, improve service delivery, strengthen accountability, increase transparency, or improve government efficiency.

E-government is a concept that requires a good understanding in implementing the IT strategy of a country. E-government means different definitions for different people. From definitions above, there are main elements in e-government: users (government, business, and citizen), transformation, and electronic system/services. These elements are interrelated in achieving goals of governance.

### 2.2.2. Maturity Model

E-government is a gradual process. An e-government maturity model provides us with guidance on how to gain control of our processes for developing and maintaining eGovernment services and how to evolve toward a culture of excellence in providing and managing e-government (Windley, 2002). There are many maturity models in e-government that have been proposed by researchers. One of them is Shahkooh, Saghafi and Abdollahi maturity model (see Fig. 3)

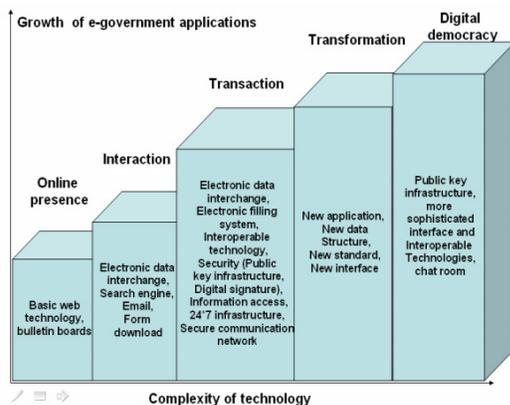


Fig. 3. Shahkooh, Saghafi, And Abdollahi Maturity Model

They have compared and synthesized 9 maturity models and proposed new one. This model consists of 5 stages:

- Online presence  
Government provides e-government as information center with basic web technology.

- Interaction  
In this step, e-government allows interaction between government, business and citizen such as filling form, e-mail, etc.
- Transaction  
E-government provides transaction services such as tax payment, fine payment, electronic identity card.
- Fully integrated and transformed e-government  
Delivery of services is integrated by providing a single point of contact to constituents
- Digital democracy  
The final stage, e-government provides services for political participation in democracy such as e-voting, surveys, etc.

## 3. E-GOVERNMENT BASED ON CLOUD ENVIRONMENT

### 3.1. E-Government in Indonesia

Indonesia is a developing country with very large populations, 237.641.326 people in 2010. Furthermore, this country has a vast area that is 1,904,569 km<sup>2</sup> and spread into 17.508 archipelago. These things that make Indonesia has its own characteristics compared to other countries.

In governance, Indonesia uses sectoral-regional approach. So, it causes Indonesia has central government and local government. Governance system in local government and its relationship to central government can be seen in Fig. 4 (Moedjiono, 2005).

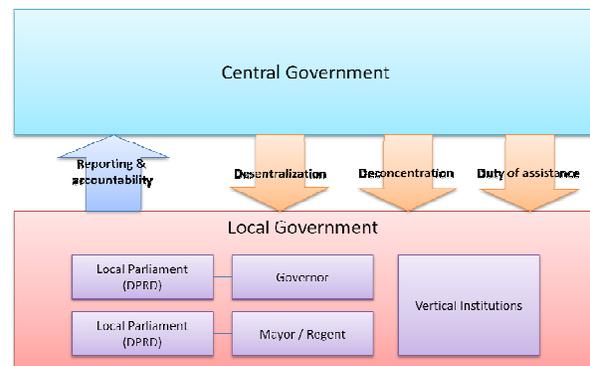


Fig. 4. Local Government and central Government

(Hermana and Silfianti, 2011)

According to Hermana and Silfianti evaluation who used data on March 2010, there were 82,9 % local government website can be accessed. From these website 45,25 % (almost 50%) are from java island. It is indicated the digital divide in Indonesia and Java island is a center of technology and modernization.

Based on content, most of these website just provide information and news. The important services like FAQ, e-procurement, site and location map are not provided in most of local government website. It showed that local government has not utilized e-government via website optimally.

Implementation e-government in Indonesia can be considered less than satisfactory. It can be seen from their position in worldwide e-government ranking in 2010. From Waseda University institute of e-government ranked Indonesia in 32th position. In United Nations study, Indonesia has experienced rank decline from 106 to 109. Finally, Intelligence Economist Unit that showed digital economy ranking assessment indicates that Indonesia in rank 65 out of 70 countries.

From Sensus and Lusa observation based on findings in literatures, there are crucial problems from implementation e-government in Indonesia. These problems are divided into several aspects : data systems, legal (policy), institutional, human, technological, leadership, and driver/demand (culture).

In data systems aspect, It's hard to do an integration because there is no standardization in platforms and databases application development.

In legal aspect, there is lack of regulation on e-government promotion. E-government is still considered a project that depends on regional leaders who are in power. In addition, Cyber crime threats requires handling of a comprehensive law.

In institutional aspect, organization structures do not support the implementation of e-government, especially in the region. A partnership that is formed is not optimum, especially in local government.

In human aspects, the capability in using ICT is considered low. Therefore, the measurable of competency readiness is needed, which measures the level of competence in a government institution. In other hand, the

users are not getting adequate training and socialization in using e-government system.

In technological aspect, many problems are found in terms of collaboration and integration of database that include the central government, regions, institutions and other relevant government agencies. ICT infrastructure has not been adequate and evenly distributed throughout Indonesia.

In leadership aspect, the main issue is there is a lack of political leadership and continuity of e-government program. Therefore, there is a need of special education (certification) for regional leaders in understanding e-government and ICT development.

In driver/demand (culture), some paradigm shift in government bring cultural changes. There are still bad cultures are found which cause negative impacts in ICT utilization, such as corruption, collusion, nepotism, unwillingness to share, etc.

From the problems that are found above, Indonesia should change the paradigm of e-government implementation. One of ways is building cloud environment which can provides services for users with information technology resources via network. Cloud environment offers many benefits and overcome some of those problems. Benefits in data scaling, performance & scalability, reporting & intelligence and system integration can be used for solution in data sytems and technological problems. Auditing and logging benefit can solve the culture problems such as corruption. In legal aspects, policy and regulation can be formalized in data center.

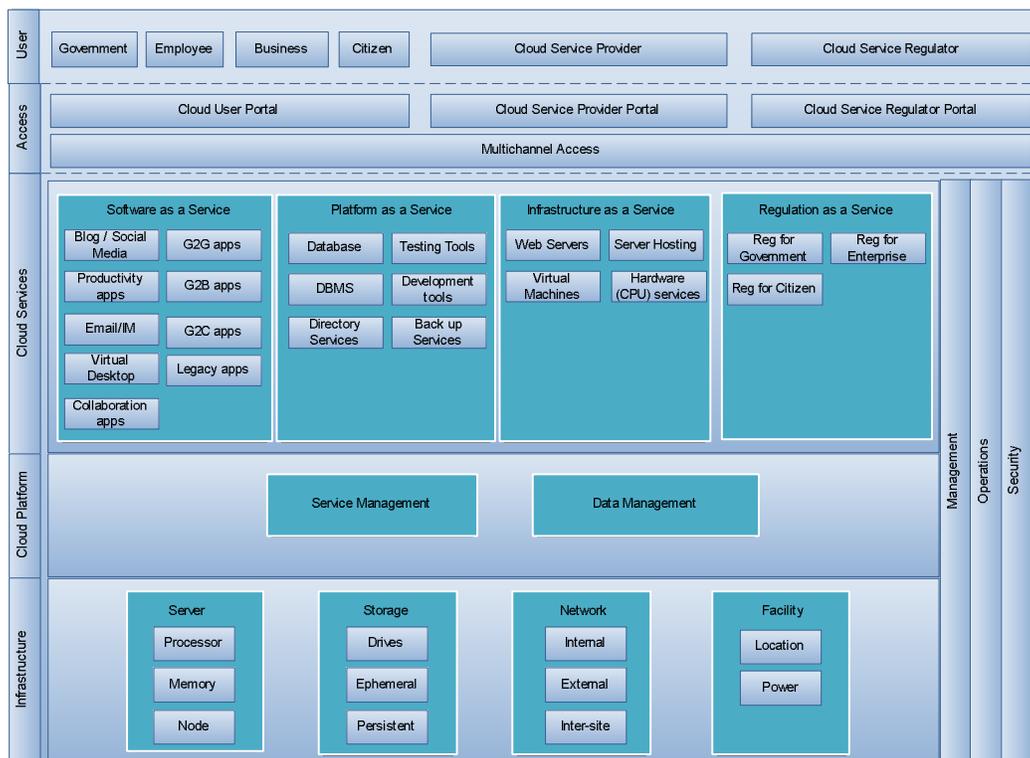


Fig. 5. Architecture of E-Government Based on Cloud Environment

### 3.2. Architecture

Based on analysis of e-government in Indonesia earlier, we proposes cloud architecture that inspired by IBM Cloud Computing Architecture and Zhang and Chen. This architecture have three main layers (See Figure 5) :

#### 3.2.1. Infrastructure / Physical Layer

Physical layer is base layer which represents all physical elements / hardware needed on cloud service provider, including server, storage, network, and facility.

#### 3.2.2. Cloud Platform Layer

This layer consist of two platforms that manage cloud services to users. Service management includes service provisioning, monitoring, service automation, change management, virtualization management. The other platform is data management which includes security, authentication, auditing, and certification compliance. These two platforms functionality is accessible via portals and APIs. In this layer, cloud service provider is responsible to provide platforms that needed for cloud services.

#### 3.2.3. Cloud Services Layer

This layer is the outermost layer that interact with users. There are four service delivery models in this layer :

- Software as a Service (SaaS)

This service model offers provider's applications that can be accessed by users on cloud environment. The applications are blog / social media, productivity apps, email, virtual desktop, collaboration apps, G2G apps, G2B apps, G2C apps, legacy apps.

- Platform as a Service (PaaS)

PaaS offers standard platform that can be used for providing systems which supported by cloud provider. These platforms are development tools, testing tools, database, DBMS, directory services.

- Infrastructure as a Service (IaaS)

IaaS provides services in computer infrastructure. In this case are server, storage, network and facility.

- Regulation as a Service (RaaS)

RaaS offers standard regulation and policy in government. Users can get certificate and agreement from this services after completed the requirements. For example, business license for a company. This services consist of three categories based on the users : regulation for government institution, regulation for enterprise, regulation for citizen. Furthermore, this services can be used to measure maturity level (technology readiness) of institutions/enterprise/citizen in e-government.

In this architecture, there are 3 stakeholder that plays main role in cloud environment. Each stakeholder have different portal in cloud systems.

#### 1. Users

E-government involves three essentials users which are government, business/enterprise, and citizen. So there are three relationships that must be provided in cloud environment: Government to Government (G2G), Government to Business (G2B), and Government to Citizen (G2C).

#### 2. Regulator

Regulator manages other stakeholders so the cloud environment can available as expected with regulations. In this case, the regulator is government institution who responsible for IT strategy in a country.

#### 3. Provider

Provider is a third party that provides all elements that needed for building cloud environment for e-government. They responsible for operate, manage, and maintain all services and system in cloud.

In order to satisfy users, we use multichannel-access so the services in cloud e-government system can be accessed widely from one portal (gate) by various digital communication devices (Aji, et al, 2011)

### 3.3. Deployment

In deployment plan, we use hybrid cloud to provide cloud environment in e-government. A hybrid cloud is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application. The reason is to accomodate three e-government relationships (G2G, G2B, G2C) that have different characteristics so the system is deployed by composition of private and public cloud. In G2G and G2C relationships where data and information are very confidential for each stakeholders then private cloud is recommended. In cloud services to citizen, public cloud deployment is put forward for easy and open access in every circumstances. This all cloud services are provided and maintained by cloud service provider. The illustration can be seen in Fig. 6.

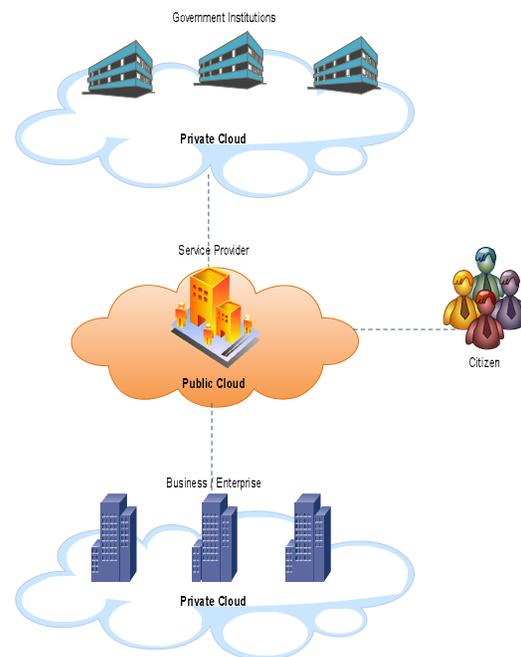


Fig. 6. Deployment of E-Government Based on Cloud Environment

#### 4. CONCLUSION AND FUTURE WORKS

Indonesia as developing country still face many problems in implementing e-government and can be considered less than satisfactory. This is shown from position worldwide e-government ranking. E-government in Indonesia tends to inefficient and ineffective. The heavy investment approach in each regions cause inefficiency in budget. Furthermore, human resources in government institutions are considered low, especially capability in using ICT. In order to improve it, there is a need to change the paradigm in providing e-government services in Indonesia.

Nowadays, the revolution of technology may lead to cloud computing in e-government. Cloud environment offers many benefits than traditional infrastructure. This paper proposes initial architecture for implementing e-government based on cloud computing in Indonesia. This architecture allows for greater information, resource sharing and promote more standardization in the government's resources. In deployment plan, the hybrid cloud approach is recommended based on the characteristics of e-government relationships in Indonesia.

In the future work, we will conduct experiments based on this cloud architecture in e-government of Indonesia.

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