Adoption of Cloud Computing in e-Governance

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Abstract. Cloud is a model or architecture and a new paradigm of computing with SOA as its base architecture. Cloud Computing has evolved as a key computing platform for sharing resources that include infrastructures, software, applications, and business processes. e-Governance plays a vital role in any organization and clouds with different layers are helpful to the e-Governance services. Cloud has different services, which are integrated and reused. As e-Governance is using distributed services, which requires a lot of infrastructure. Cloud services are helpful to reduce the cost of infrastructure and software cost. This paper describes how to adopt cloud computing in e-Governance applications to reduce infrastructure, and platform cost, to increase network security, to increase scalability and quick implementation.

Keywords: e-Governance, Cloud Computing, SOA, Security, Privacy.

1 Introduction

There is an increase in the online e-Governance services provided by federal and provincial Government in India. It is a country with more than one billion people, where proper implementation of these online services faces a lot of problem in delivering efficient and cost effective services. There are some questions in our mind when we started to plan for adopting the cloud computing that starts with privacy and security. Not many people really know how it works, but they are using it in their everyday life. Many websites that we browse through everyday are set up on Amazon Web Services, which is Amazon's Cloud Services offering. Using the Internet to perform computing, though does offer us cost savings with regards to computing hardware, software, infrastructure etc, but one does need to factor in the additional requirement of high speed, always on Internet that Cloud Computing demands. Cloud Computing provides environments to enable resource sharing in terms of scalable infrastructures, middleware and application development platforms, and value added business applications in terms of services. The operation models may include pay-as go utility models, free infrastructure services with value added platform services, fee-based infrastructure services with value-added application services, or free services for vendors but sharing of revenues generated from consumers. We know that Cloud Computing as a technology is at a very nascent stage but it seems very likely that it will be the next big breakthrough technology for the Internet. If we start to focus on creating

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the infrastructure needs for a wider and more efficient e-Governance delivery system, then we should be able to harness this technology in a few years, by which time the technology would also have matured and be ready for deployment in a country like India with many diversity.

At the same time [6], Service Oriented Architecture (SOA) has been a popular framework in many application domains. The architecture of SOA allows services to be discovered, composed, and executed. Based on these technologies, services can be rapidly composed and the composite service can be deployed to achieve the desired goal. To support successful cloud computing, SOA plays a major role with ever increasing importance. All the hardware, software, and data resources can be wrapped as services in clouds. When an end-user wishes to accomplish a certain task, a composition service can be employed to discover the needed resources and compose them to provide the desired functionality and quality to the end-user. In this paper, we proposed a model for e-Revenue system in the government land revenue collection services. This model helps G2G, G2E, G2B and G2C applications to take the help of the available services on the cloud.

2 Cloud Building Blocks for e-Governance

The building blocks of cloud computing are rooted in hardware and software architecture and networking devices that enables innovative infrastructure scaling and virtualization [2]. However the next infrastructure innovations are more dynamic and carry on dynamic provisioning to manage in large cluster within the infrastructure. There are also implications for the next generation application design to make optimum use of resources and fault tolerances in an organization.

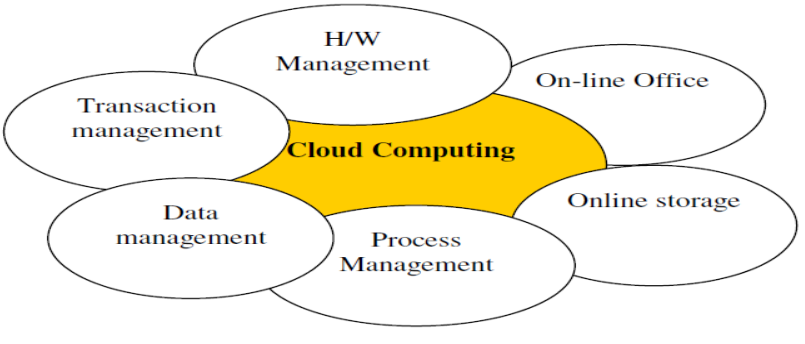

Fig. 1. Integration of services with Cloud

Cloud infrastructures have the potential to introduce good performance behaviors. While sharing a large infrastructure can average out the variability of individual workloads, it is difficult to predict the exact performance characteristics of an application at any particular time. Like any shared infrastructure, varying individual workloads can impact available CPU, Networks and I/O resources resulting in unpredictable performance behavior of the combined applications.

From the figure 1, it can be concluded that a cloud is a mixing of different management services. Cloud can be categorized as public cloud and private cloud, but the service can be used for each other with in an organization and can import from others. Public cloud infrastructures by the nature are outside the enterprise must leverage wide area network which can introduce bandwidth and latency issues. In addition, many Public Cloud providers have multiple storage offerings with varying performance characteristics. Typically, write performance is typically impacted to a much larger degree than read performance, especially with non-block oriented storage. Every management system having their own infrastructure and those can be used on optimal way for better computations. To overcome many challenges, Cloud can leverage proactive scaling of resources to increase capacity in anticipation of loads.

2.1 Cloud Services

Cloud computing is the combination of various technologies that is enough to provide smooth functions. The technologies as Grid Computing, Virtualization, Distributed Systems, System engineering and Service Oriented Architecture (SOA) play an important role in cloud computing. SOA is a pattern of architecture where as cloud is an instance of architectures. Cloud computing is the ability to provide IT resources over the Internet. These resources are typically provided on a subscription basis that can be expanded or contracted as needed. Services include storage services, database services, information services, testing services, security services, and platform services. Anything that is there in the data center today can be found on the Internet and delivered as a service.

2.2 Components of e-Governance

The importance of e-Governance lies in creating a global society, which has capacity to absorb divergent value patterns to eventually form universal normative axis having thrust on humane element. Precisely, it focuses on automation, informatisation, and transformation so as to increase the pace of development. Thus the fundamental objectives are,

- To have governance which economizes,
- To have governance, which multiplies in manifold the output at same cost
- To have governance which functions faster, better and transparent.
- To have governance, which retrieves facts completely from archives to help bureaucrats to recycle them in such a way that the feed- back can be utilized for making more prudent policies.

However to understand that how e- governance can transpose government as an instrument for building up a society, based on a collaborative mixture of conventional values with scientific approach, to create a better world, it would be essential to identify various components of e- governance and their interrelationships with each other. The following components can be identified as in the figure 2.

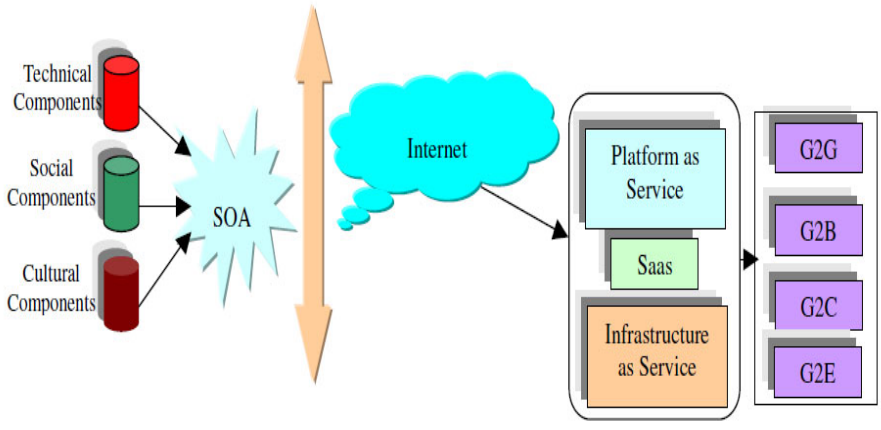

Fig. 2. Cloud computing for e-Governance

2.2.1 Technical Components with Electronic Dimension

This relates to educate people who are in the bureaucratic structure or outside its periphery regarding use of electronic means to develop better connectivity within the system. It requires use of computers (a) in developing the database, (b) in networking to facilitate the communication, (c) in creating e- knowledge workers so as to increase their potentiality.

2.2.2 Cultural Components with Ethical Dimension

The cultural component needs to create value patterns conducive for e-Governance to operate focusing on work ethos that cannot be denied. Thus to work out the ethical framework is the key to move further by discarding obsolete set of values that come in the way of potential utilization. Thus "e" of ethical framework has to be the focal point in constructing a morality-based system.

2.2.3 Political Components

The political system is an essential aspect of governance. It holds responsibility of rationalizing various operative frameworks by enacting laws. This helps to maintain & sustain the cohesive force that is required by society to integrate its people and abide them to follow a uniform policy to fulfill their targets. This refers to the importance of "e" of enactment of laws to stop society from disintegration.

2.2.4 Social Components with Egalitarian Dimension

The fundamental duty of any government is to educe a society, which is based on the principles of equality and justice. This is possible when people will be aware of their rights & duties on the one hand, and know about the governmental policies made for them on related issues on the other, hence a vigilant society can be evolved where they can raise their voices by questioning the governmental decisions. This would help in attaining the "e" of egalitarian society with thrust on equality.

2.2.5 Physiological Components

Developing required psyche so as to facilitate formation and inculcation of right type of attitudes in the people is prerequisite for efficiency. Apart form this; readiness to connect to people, to listen to their queries, to look for solutions, to improve communicative skills etc. will be necessary elements for behavioral modifications. Hence personality adjustments must be carried out to cater to the needs of common man. This specifically relates to "e" of extension of self so as to have constructive collaborative social relationships.

All the components of the Government can be integrated by using services. Those services can be mixed and imported to the cloud by using different cloud based services such as hardware as services, software as services and service itself as services. These services can be provided as G2B, G2E and G2C for innovation and optimal performances.

2.3 Service Identification

The cloud architecture allows rapidly allocating and de-allocating massively scalable resources on a demand basis. It gives flexibility to choose multiple vendors that provide reliable and scalable business services, development environments, and infrastructure that can be leveraged out of the box and billed on a metered basis. The other benefits are scalability, high reliability, reduced costs due to operational efficiencies, and more rapid deployment of new business and reduce runtime and response time etc. The three major IT implementation in Government sector are IT facilitation in State Data Center (SDC), automation of government workflow and e-Governance projects. These three major areas required huge resources in terms of computing, networking and IT infrastructure. The process for prioritizing e-services is an iterative pattern, guided by both transaction criteria and the perceptions of stakeholders. The methodology for prioritizing the services is expected to provide an impartial view of priorities, drawing on best practices in rationalizing, phasing, and sequencing investments to capture local knowledge and initial conditions, and gather information from secondary source (authorities) to identify key services and stakeholders and the services. Following are the various categories of the services to be identified:

- Government to Citizen Services (G2C Services)
- Government to Business Services (G2B Services)
- Government to Employee services (G2E Services)
- Government-to-Government Services (G2G Services)
- Shared services
- Informational services
- Interactive services
- Transactional services
- Integrated services

Chances are good that we have a beefy enough Internet connection to make cloud computing viable. However, realize that the more to do on the cloud, the more demand will be placed on Internet connection. It's important to secure an Service Level Agreement (SLA) that meets the bandwidth requirements. This not only ensures that we are getting the desired speed, but if the ISP fails to meet those levels, there can be some sort of remediation in it.

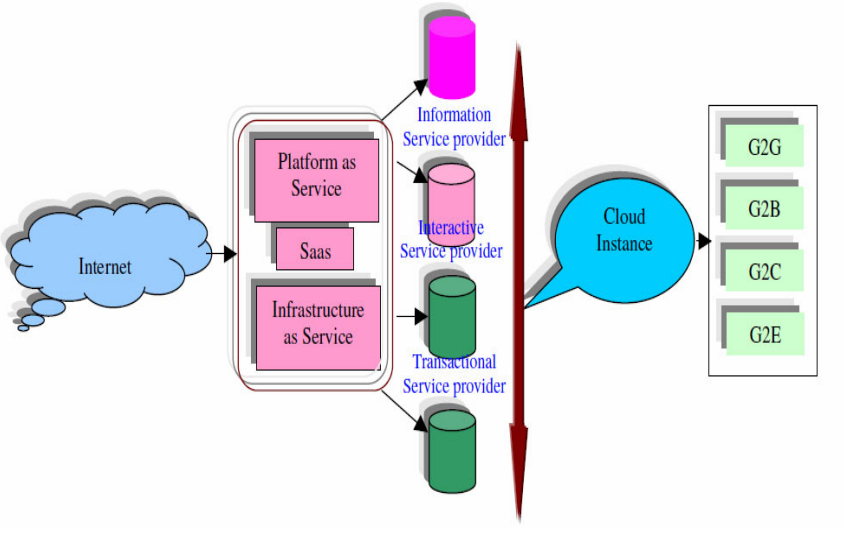

Fig. 3. Service Interaction for e-Governance

When formulating the cloud infrastructure, we should consider the issue of reliability and uptime and ask to the service provider to configure the computing infrastructure for redundancy and fail over. In LAN, redundancy used to mean that another server or two were added to the data center in case there was a problem. These days with virtualization, redundancy might mean a virtual server being cloned onto the same device, or all the virtual servers of one machine being cloned onto a second physical server.

3 Case Study

This case study is designed for a Revenue Division based on revenue collection system. Indian is divided into different provinces, which are divided into different districts. Taking eight to ten near by districts a division is formed. A district is having number of tahasils and the Tahasildar heads it. A Tahasil is having a number of Revenue Circles where the Revenue Inspector(RI) collects different revenue from the public as per the Government rules and regulations. The Revenue Inspector is a flexible person and collects the revenue from door to door and also observes many activities of his area.

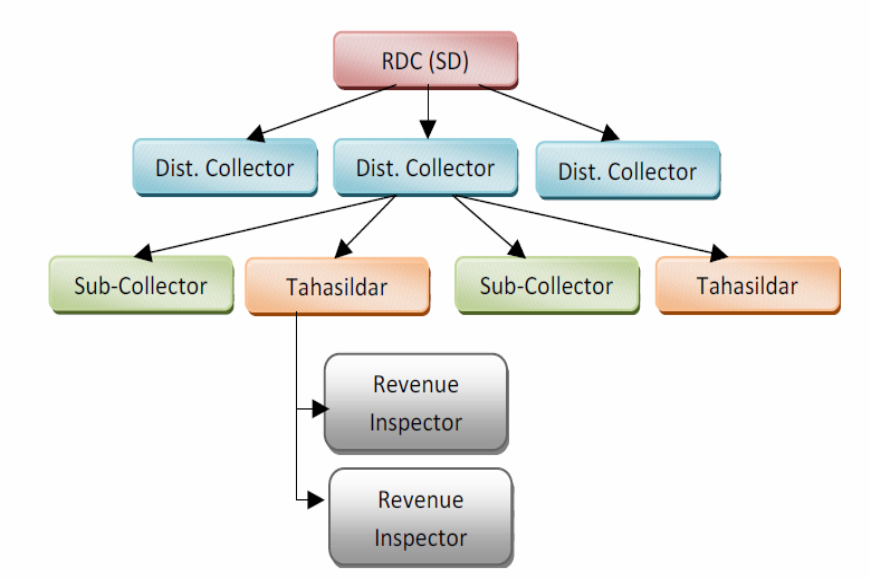

Fig. 4. Hierarchical structure of Officers in a Revenue Division

The revenue is collected from different purposes like house tax, water tax, land tax etc. as well as he also collects different number of cases and project information, which is implemented by the government. So, RI plays an important role that monitors on different projects implementation by the Govt. on his area/ circle. Revenue Inspector collects the information from his RI circle and report to the Tahasildar.

Sometime the Tahasildar finalize the information and the pending cases are informed to his higher authority like sub-collector or Collector of the District. Collector is the District Magistrate of the District who takes many important decisions for the Citizens. He conducts the revenue meeting with the presence of all the Tahasildar of the district and other officers every month to monitor the collection of revenue and settlement of revenue cases. He instructs and give target to the subordinates for better collection and other activities. Similarly, the Collector of the district sends the information in the form of report to the concern Revenue Divisional Commissioner (RDC) for further information to the state Government. At the District level there is a District Data Center (DDC) for processing of different data from different levels and from different projects of the Government, the DDC plays very important role, which is monitored by the Collector.

In the above figure-4, the Revenue Divisional Commissioner (RDC) checks the information at any time for necessary implementation of Government projects. Sub-Collectors help and encourage and monitor the activities of the Tahasildar and report to the Collector of the district.

3.1 Proposed Architecture

In this architecture, all the persons that are from Revenue Inspector to higher officers Tahasildar, Collectors and Revenue divisional Commissioner (RDC) and public can

access the data in different formats. The Revenue Inspectors have a computer system with Internet connection for entering the data. The Revenue Inspector always play important role as he gathers the data from his/her own revenue circle and enter it by using their own interface. An interface is a predefined web page or program that is common to all the Revenue Inspectors, and other Officers. The interface is web based which can be accessed any where by using Internet connection. It is easy for the Revenue Inspector to access the interface anywhere from the locations. The data can be analyzed by the higher authority, in this case the Tahasildar checks the data entered by the Revenue Inspectors for further computations as shown in figure – 5 and sent to the District Office for the Collector approval. The District Data Center collects the data from different Tahasildar of the district for necessary processing and again the data in the form of reports send to the Revenue Divisional Commissioner (RDC) for review purposes and for governmental activities as well as for future planning and developments.

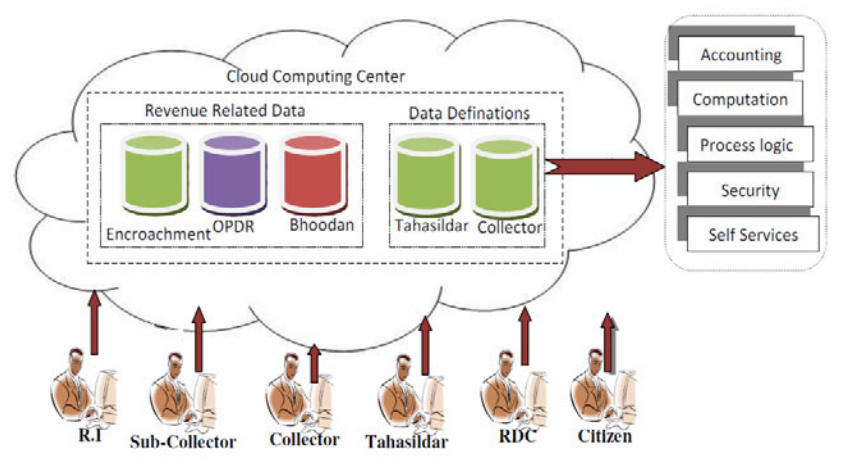

Fig. 5. Cloud based Model for e-Revenue

So, it can be concluded that the Government activities are depending on the data of lower level that is data collected from the Revenue Inspectors. Process logic has been designed by different officers for different level. Process logic is a logic or procedure, which follows different official rules and regulation. These rules and regulations are converted into different logic, which are designed by the technical personal from the Government or Revenue department. There are different process logics sometime designed by the Tahasildar as well as at District Data Center by the District Collector. Data can be process according to the Data definitions. Here there are different services for storing the data, which is collected by the RIs like encroachment, OPDR, Bhoodan, Certificate Cases etc. All the data are stored in a common place having different servers for fast processing. But different Officers at their end can access the data without using any additional hardware as well as software. They have only one system that may be thin client for accessing through Internet. Here, we are giving importance on infrastructure as service that includes servers, storage space, network

equipments, different software and databases. The infrastructure is provided in the form of virtual environment. As all the users access through Internet connectivity, that the speed and efficiency is quite important.

4 Benefits

There are many benefits on adopting the Cloud computing services in the e-Government are as follows.

4.1 Cost

Cloud computing as an architectural solution, is typically less expensive while considering in terms of the hardware, software, and human resources that have to maintain the systems. Since cloud providers use a pay-as-go or an on-demand model, there is a reasonable usage fee, typically based on time, units of storage, or other means of monetizing their clouds. Cost is the core benefit of cloud computing, since we pay as per our requirement and on processing of data.

4.2 Network

Cloud computing architecture can be represented in the Internet. The ability for a cloud service to be combined with other cloud services, making a custom service that is even more powerful than the sum of any of its parts, is a real benefit of cloud computing. Internet connection should be fast, broad for accessing and communication of data.

4.3 Performance

Cloud can be better performance as we all are concentrating on a particular system. That is its hardware, software etc for providing data. We can access by using Internet but only one system can provide data having process logic for others. Hence, the system should be strong for high performance.

4.4 Expandability

There is no need of additional hardware and software's from organizational point of view. We can expand the resources for processing the data with in an instance by using the existing resources.

4.5 Speed of Implementation

As we are not purchasing any hardware, installing operating systems, or getting permission to take a portion of a data center. We just sign up, in most cases, and then access to the cloud resources. But, for processing the data depends on the Internet and its speed for transporting.

4.6 Green Computing

Cloud computing is good for the environment as we are using very less amount of hardware resources and software. As and when required to process the data that is processed on the server and gives the result. So, it requires very less power consumption and requires fewer infrastructures.

4.7 Portability

The ability of users to access the data and tools they need anywhere they can connect to the Internet.

4.8 Simpler Device

Since both their data and the software they use are in the Cloud, users don't need a powerful computer to use it. A cell phone, a PDA, a personal video recorder, an online game console, their cars, even sensors built into their clothing could be their interface.

5 Government's Role on Adoption of Cloud

The pace of development and deployment of the Cloud will depend on many different factors, including quick maturity of basic technology, standardization of computer resources and telecommunications, cost-effective, compelling applications are developed, and quick potential users acceptation and adopt this new way of purchasing computing resources [11].

Government policy can influence each of these factors. And there are other ways in which governments can accelerate or hinder the growth of the Cloud. Just as the pace of development of the Internet has varied by country and industry, the pace of development of the Cloud will vary widely. Governments can play a critical role in shaping the Cloud. They can foster widespread agreement on standards, not only for the basic networking and Cloud communication protocols, but also for service-level management and interaction. By using the power of the purse in their IT procurement policies, governments can pressure companies to find consensus on the key Cloud standards. Governments need to access how existing law and regulations in a wide range of areas will affect the development of the Cloud. They must both "future-proof" existing law and ensure that new policy decisions do not limit the potential of this revolutionary new approach to computing.

The Cloud will be a fundamental infrastructure for the economy, national security, and society in general. A natural reaction would be to demand uniformly high quality and to regulate a number of features and services that use it. But without a lot more experience, we simply do not know enough about what the right set of underlying services will be, what are appropriate differences in price and quality of services, what techniques will be best for providing reliable service, and where the best engineering tradeoffs will be. Governments can add value by encouraging experimentation and new services. The Cloud is an upcoming technology that challenges existing business models, institutions, and regulatory paradigms. As a result, there is likely to be resistance from many different quarters to the widespread deployment of Cloud

technologies. Governments must be willing to challenge and change existing policies that could be used to hinder the growth of the Cloud. Simply trying to adapt existing regulations to the Cloud might allow entrenched interests to significantly delay the investment and effort needed for widespread use of Cloud computing. Because Cloud computing is a fundamentally different approach to computing and communications, governments should consider fundamentally new approaches to telecommunications and information policy.

The Cloud is inherently global, policy solutions must be cross-jurisdictional, because the Cloud is a many-to-many medium and it is not always easy to determine who's responsible for what. And also the Cloud technology and Cloud applications are evolving so quickly, government policy must be flexible and adaptable. Because the challenges are so great and the opportunities so widespread, it is imperative that policymakers and the technologists developing the Cloud start now to look for innovative technical and policy solutions.

6 Conclusion

Cloud computing has the potential to change how organizations manage IT and transform the economics of hardware and software at the same time. On-demand services and Software-as-a-Service (SaaS) solutions have become the preferred mechanisms for e-governance applications to better leverage the power of cloud computing. For any government department, the transition to the cloud is a major decision. Concerns like data control, management, accessibility and security hold the departments back from switching to the cloud. Before implementing cloud any department should first identify and prioritize IT issues and challenges within itself; next the benefits of cloud computing should be mapped against these IT issues. From the point of view of each government agency or department, creating a cloud migration strategy may be of importance. This may call for inter-departmental collaboration to identify the solutions, which are easier to transition and create necessary volumes to realize cost benefits. This could be done by the nodal information technology agencies at the apex. The proposed system can work efficiently by using cloud computing and provides information to the citizens without any further investment. So, a citizen can access the information as it is their right and Government can get good result for implementation of new projects and plans. Sometime, citizens can suggest and give feedbacks to the Government directly or indirectly for better nation building. This type of computing is open for the people, by the people and to the people.

References

[1] Mohammad, A.F.: An Achievable Service-Oriented Architecture – ASOA. In: Third Asia International Conference on Modeling & Simulation (2009)

[2] Velte, A.T., Velte, T.J., Elsenpeter, R.: Cloud Computing: A Practical Approach. McHill Publication

[3] Linthicum, D.S.: Cloud Computing and SOA Convergence in Your Enterprise A Step-by-Step Guide. Addison–Wesely, Reading

[4] Zhang, L.-J., Zhou, Q.: CCOA: Cloud Computing Open Architecture. In: IEEE International Conference on Web Services (2009)

[5] Sannella, M.J.: Constraint Satisfaction and Debugging for Interactive User Interfaces. Ph.D. Thesis, University of Washington, Seattle, WA (1994)
[6] Sahoo, M.: IT Innovations: Evaluate, Strategize, and Invest. In: IT Pro. IEEE Computer Society, Los Alamitos (November/December 2009)
[7] Pokharel, M., Yoon, Y.H., Park, J.S.: Cloud Computing in System Architecture. IEEE, Los Alamitos, 978-1-4244-5273-6/09
[8] Chuob, S., Pokharel, M., Park, J.S.: The Future Data Center for E-Govemance
[9] Stantchev, V.: Performance Evaluation of Cloud Computing Offerings. In: Third International Conference on Advanced Engineering Computing and Applications in Sciences (2009)
[10] Cellary, W., Strykowski, S.: E-Government Based on Cloud Computing and Service-Oriented Architecture
[11] Hao, W., Yen, I.-L., Thuraisingham, B.: Dynamic Service and Data Migration in the Clouds. In: 33rd Annual IEEE International Computer Software and Applications Conference (2009)
[12] http://www2.epfl.ch/webdav/site/mir/shared/import/migration/zwahr_pista04.pdf
[13] http://www.lasalle.edu/~mccoey/inl664/readingmaterials-homework/p471-peristeras.pdf