ABSTRACT

E-Government (e-gov) contributes to social development by easing access to governmental services. However, the deployment of an e-gov IT infrastructure, though relatively affordable, is still out of reach in most African rural communities. Cloud computing is emerging as a new paradigm that provides computing as a utility, and requires minimum investment in terms of IT infrastructure. Thus, it presents a promising opportunity for boosting e-gov services and reducing the digital-divide in developing countries, especially in Africa. In this paper, we present the different aspects related to deploying e-gov services into the cloud. We basically represent the most suitable deployment model, and delineate a roadmap for deploying a prototypical private cloud that can initially offer e-gov services to community areas (e.g., rural communities), and then grow on towards spreading over whole countries, or even the whole continent. As a proof of concept, we present the deployment of a prototypical embryonic e-Gov service, deployed on a private academia cloud that has been deployed in Morocco.

Categories and Subject Descriptors
H.4.2 [Information Systems Application]: Type of Systems

General Terms
Design, Experimentation

Keywords
E-Gov Services; Digital Divide; Cloud Computing; Deployment Models

1. INTRODUCTION

The deployment of e-gov services requires a minimum IT infrastructure, in terms of hardware (e.g., servers), software (e.g., databases), and maintenance (e.g., engineers). Even though this is largely affordable in most countries, it still constitutes a strong barrier to overcome in most developing countries. In this context, cloud computing emerges as the ideal to overcome the barrier of IT infrastructure and allow for a wider spreading of e-gov services in developing countries, especially in Africa.

Cloud computing is emerging as a new paradigm based on providing computing as a utility (e.g., gas and water), and requires minimal IT infrastructure. E-gov services can be entirely hosted in the cloud, which can be either a private or a public one (or even hybrid), and the clients (e.g., governmental institutions) will have optimal assurance about the full maintenance of the application as well as its availability. Clients are not concerned about setting the relevant IT infrastructure, or about recruiting the needed potential skills (e.g., engineers) to run and maintain it.

In this paper, we shed further light on the subtleties of deploying e-gov services in the cloud. We present the pros and cons, and demonstrate feasibility via a real-world case where “obtaining birth certificates” is deployed as an e-gov service using both a private and a public cloud. The deployed application strongly proves the concept and promotes a wider spread of e-gov services in isolated areas, especially in African rural communities. Besides, we present a roadmap for the deployment of prototypical private clouds, in developing countries, that will cope with the expected increased demand on cloud services, especially e-gov services.

2. E-GOV SERVICE ON THE CLOUD: REDUCING THE DIGITAL DIVIDE

Most developing countries suffer from the digital divide. According to the Cambridge Online Dictionary, the digital divide can be defined as “the problem that exists because some groups of people have the opportunity and knowledge to use computer technology and some do not” [1].

2.1 Digital Divide and the Cloud

E-gov can play a major role in reducing the digital divide in developing countries. If most governmental services (e.g., birth certificates, tax forms, administrative procedures, etc) are provided to citizens via IT, the citizens will be encouraged, and biased, to further use IT in their daily lives, hence contributing to reducing the digital divide. For instance, in rural areas (e.g., in Africa), citizens need to travel even tens miles to get their birth certificates generated. With the advance of mobile computing, which gained a strong spread in Africa, citizens can instead generate the certificates in a couple of minutes, e.g., by requesting the service via a mobile phone application. In such situations, the citizen will be more than eager to use e-gov services, get acquainted to use IT, and thus contributing to digital divide reduction.

Besides, cloud computing can contribute to reducing the digital divide by lowering the deployment costs for e-gov services, and thus will promoting a wide spread of e-gov services even in poor countries where the investment budgets are very limited.
2.2 Main Pros
When deploying e-gov services in the cloud, a (large) set of (rural) communities can use the same sole application. In other words, reusability is a key in here since the same application interface will be deployed for all concerned communities, e.g., communities in a particular geographical region of a country. This goes along with the business agility feature of the cloud, which mainly implies the ability to dynamically request further compute resources based on the real-time need, thus highly promoting efficiency regarding compute resources usage.

Indeed, cloud computing exhibits strong business agility whereby only a “small” application (in terms of needed compute resources such as processing, memory, and permanent storage) can be deployed at the beginning, and then dynamically request further resources as needed, a fact that shows efficiency in resources usage and overcomes the actual situation where a whole infrastructure needs to be deployed regardless of the usage. These resources might remain idle most of the time if only few users are using the e-gov application, which is the common case during night-time hours for instance.

2.3 Cons
The primary concern with hosting e-gov services in the cloud pertains to data privacy. This merely stems from the fact that data needs to be hosed in the cloud, and the latter is likely to be operated by an external party which might manipulate and unveil the hosted data. To ensure data privacy, we propose adopting one of the following three basic approaches:

• Deploy the service in a private cloud instead of a public one. This is the ideal solution. Still, this necessitates the deployment of the relevant IT infrastructure, which ought to be costly. Nevertheless, it is still worth investment especially if the private cloud will be used on a large basis, e.g., a whole country or the whole continent.

• Deploy the application in a public cloud, and encrypt the data. This will partially enforce data privacy since data needs to be decrypted for access. To further reinforce the privacy, we need to identify a trustful cloud services provider, and sign relevant agreements, about data privacy, accredited in the host country.

• Deploy the application in a hybrid cloud. In such a scenario, the data part can be hosted in a relatively small private cloud, while the application and the business logic can run in a public cloud. This way, we make advantages of both using private and public clouds: The public cloud provides flexibility and maintenance in terms of running the business logic, while the private cloud provides a relatively secure repository for sensitive data, and thus promoting data privacy.

The other main concern about deploying e-gov services in the cloud is the reliance of the whole service on the availability of a full-time connection to the Internet. In other words, if the Internet connection goes off, the whole application does as well.

3. “JAMAATI” AS A PROTOTYPICAL REAL-WORLD E-GOV APPLICATION ON THE CLOUD
Jamaati is a project, deployed in Morocco, which is meant to reduce the “digital divide” to “computizing” the e-gov services at the Moroccan rural counties specifically. (Jamaati is an Arabic meaning “my (rural) community”. In fact, the digital divide is becoming a more persistent issue in the Moroccan society. According to a recent study by the Open Society Foundation (OSF) [2], the access to the computer technology and Internet is still limited to the urban zones and the educated classes in the cities (OSF 2012). Jamaati aims to tackle this issue through deploying a platform for the personnel of the Moroccan rural counties. The platform has been fully deployed on the cloud, and is accessible online [3]. Therefore, the clients of Jamaati will neither need to dedicate a special infrastructure nor trainings for employees.

Jamaati consists of two main parts: the first one is the back-office of the application. It includes the implementation of a web application for employees of the counties, in addition to the design of a database that stores data concerning citizens of each specific rural county. The whole platform is hosted in a private cloud for reasons mainly concerning the sensitivity of the personal information about the citizens. The second part, which is the front-office, targets the creation of an Android mobile application that would be used by the citizens to request a document from the rural county without having to be physically present at the county. Jamaati is deployed on a private cloud at one of Al Akhawayn University labs. For testing reasons, the platform is also deployed on the Google App Engine public cloud [4].

Jamaati was deployed using Jclouds [5], which has support for the Eucalyptus [6] cloud. Jclouds is an open source library which helps the user getting started in the cloud using his Java development skills.

Ideally, we need at least two racks of servers that will be placed in quite different geographical areas and used as a replica and main. Replication in the cloud is a prerequisite and presents challenges [7, 8]. However, in our case we used the default replication venue adopted by the underlying cloud platform, i.e., Eucalyptus.

4. CONCLUSION
In this paper, we highlighted the opportunities of migrating e-gov services to the cloud, and mainly delineated how this can reduce the digital divide in developing countries, especially in Africa.

To concretize the proposal, we suggested starting by deploying a real-world prototypic private cloud tested, and we outlined a relevant real-world implementation in Morocco.

5. ACKNOWLEDGMENTS
We thank Yassine Mahana, and Mohamed Amine Lechger, for considerable contribution in developing the Jamaati Application.

6. REFERENCES