

Mobile e-Governance in Cloud

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Abstract—We are living in the era of internet and smartphones. Almost everybody in developing countries has at least one smartphone or connection to the internet through any other mobile device. So developing mobile software for the people or government is a big chance to make people life easier. The time has become a very important factor for which you cannot even pay for extra time, so making life easier for those people who do not have time is big chance not losing it. All the data that are generated from the software or services is the best match to store those data on cloud, with which we do not care about privacy and protection, availability to access them, manipulation of them and so on. In this paper, we describe how this newly emerged paradigm of cloud computing can be helpful for mobile e-Governance. Using cloud of course has a cost, but if you cannot give the same conditions that cloud gives, it is best choice to store the data on cloud. If we use cloud, you do not have to pay for all the IT staff who cares about the data, servers, databases, networks, with that money you can pay for cloud services. We start by an introduction about the cloud and e-Government, continuing with what the benefits and challenges of the e-Government and cloud are computing, the relationship of e-Government and cloud computing, mobile e-Governance in cloud and some examples of some countries that are using mobile e-Government in cloud.

Keywords—e-Government, e-Governance, Cloud Computing, Mobile, Data Storage

1 Introduction

This paper describes the role of cloud computing standards, usage of mobile and other devices which can be connected to the internet, cloud services for data storage and interaction and architectures in framing a good e-Governance strategy to realize e-Government. Governments have been slower in realizing the potential benefits of the Information Technology to provide e-services. e-services are delivering cost-effective services, which can drive the growth of the economy and government productivity.

Cloud computing provides a new service consumption and delivery model inspired by Consumer Internet Services. Cloud computing drives down costs and accelerates cost reduction benefit. Cloud is making rapid inroads. e-Governance with cloud computing offers integration management with automated problem resolution, manages security end to end, and helps budget based on actual usage of data. At a global level, Cloud architectures can benefit government to reduce duplicate efforts and increase effective utilization of resources. This in turn helps the government going green, reducing pollution and effective waste management. Since government requires a massive infrastructure it is important for government to use cloud computing on long term basis.

The paper elucidates the benefits of cloud in rolling out e-Governance services. It also describes e-Governance general requirements, while delving more into the challenges of e-Governance and listing out the benefits of cloud computing architectures. The paper lists out the cloud computing benefits as applied to rolling out e-Governance applications [2].

e-Governance makes the governance easy, convenient, efficient, transparent and accountable. e-Governance eases the flow of information among different stakeholders. e-Governance is a process of reform in the way governments work, share information, engage citizens and deliver services to external and internal clients for the benefit of both government and the clients that they serve. Governments have innumerable applications that can be automated. Government spending on IT would increase the productivity of the government and would help in decision making and policy enforcement etc. [23]. Applications in the government fall into the following broad categories:



Fig. 1. Types of e-Governance application

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 [23], in a pay-as-you-go manner. The advantages of using cloud services have been increasingly encouraging customers to adopt them [26].

2 e-Governance, benefits and challenges

Developed and developing countries will have enormous benefits with the implementation of the e-government applications. With this implementation, citizens, businesses and government sectors will benefit by having a 24/7 access into public information. According to Seifert, implementing e-government will reduce the cost and the levels of organizational processes by re-organizing operating procedures [3]. Using e-government modules, will greatly improve performance of public sectors by delivering services more efficiently for all the customers. In addition, implementing e-government will have a great impact in economic and service operations where transaction costs will be reduced, the transparency will be increased and the services will be increased for the citizens [4]. Implementation of e-government will also have those benefits:

- Customer and organizational time, effort and cost will be reduced,
- Delivery of services will be improved which will make citizens satisfied,
- Increase of citizen's knowledge on ICT,
- New businesses and opportunities will be created,
- Increase efficiency of government in processing data,
- Information sharing and discussing new ideas with other governments,
- Improving accuracy, transparency and facilitating information transforming between government and customers,
- An increased trust between citizens and government.

So, implementing e-government system, will not only save resources, effort and money but it also helps the government build better service qualities and reduce the time spent on sectors [5].

Regarding all those benefits that we can have from the implementation of e-government, however there are several challenges that will slow down the implementation of it. Challenges will be found in various categories including technical, organizational, social and financial.

Social barriers are related with the usability of the system by a large variety of people. All citizens of the country should have access to the system no matter the digital divide, culture, education or income.

Smith recommends that there should be public spots where people who do not have access to the internet in their homes can use those spots to access the government information. This will help avoiding the digital divide and give access to the entire citizens [10]. So by this the government can give a free wireless access point to all the country around and even the users doesn't have connection to the internet, they can access those access points and have ability to surf for those public government ser-

vices, of course this means only those government mobile applications and not the internet. This maybe can be called as state intranet, where people can access the public government services and other services the municipalities provide.

In some countries, cultural barriers are more impactful than technical barriers. Culture is difficult to study therefore it is not an easy concept to be defined. Cultural differences and individual behaviors have a significant role in the acceptance of the new technology. Swartz states that UK and Japan had difficulties implementing e-government because of the cultural differences. Therefore, the government should have more planning on this case in order the implementation to be successful one [10].

The last but not the one with the lowest impact on barriers is the financial category, which includes the lack of financial support which of course will directly impact the process of the implementation. The government should provide enough financial resources for the project including the high cost for the systems and hardware, maintenance, training and education. Reducing financial cost for the implementation might lead to project failure [11]. If we go on cloud the government will have only to pay for cloud services, which will be responsible for everything like hardware, maintenance, availability, security, privacy, etc. Of course training and educating the administrative staff and the citizens will have its own cost, because you will have to go on video beam on local TV-s how you can use those services, you will have to advertise on the different web sites, etc. so all those things have costs.

3 Cloud computing, benefits and challenges

Developed and also developing countries will have enormous benefits with 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. This cloud model is composed of five essential characteristics, three service models, and four deployment models [24].

These attributes characterize cloud computing:

- On-demand Computing Model: Governments are no longer required to own their datacenters to cover their IT needs; i.e., they can access giant pools of resources offered by providers in a way similar to accessing public utilities.
- Autonomous: Clients are unaware of the technical complexities of offered services. Some of these aspects include used technologies, physical location(s), networks, cooling structures, and number of human resources who manage the services.
- Internet-based: The name cloud originally came from the cloud shape that is widely used in the IT field to graphically represent the Internet. It means that all cloud services are hosted beyond client boundaries and delivered over the Internet.
- Easy-to-use: Cloud providers offer easy-to-use interfaces that enable clients to make use of their services. These interfaces include both GUI forms for administrators and APIs for developers as well.

- Scalable: Clients are not limited with fixed amounts of resources. Rather, they can scale up or down their usage according to fluctuating needs. This goal is accomplished through methods that allow clients to dynamically create, upload, and install their virtual machine images either by code or GUI screens.
- Inexpensive: Cloud computing gives small-and-medium-sized enterprises (SMEs) that cannot afford their own datacenters a significantly lower-cost option. This savings results from the fact that resources owned by providers are shared among several clients rather than being solely dedicated to specific client.
- Subscription-based Model: Clients subscribe to services they are interested in, and they are billed (usually at the end of the month) according to use [25]. Although cloud computing is on its way to becoming a huge success and whilst it is clear there is a lot of business value, there are reservations about using some cloud technologies, there are some of the challenges and concerns:
- Service Level Agreements: The larger the business risk the more important it will be for suppliers and customers to understand what level of services can be relied upon.

There is nothing about the cloud that makes this in principle different from any other outsourcing of services. However, this will delay many large IT shops from embracing cloud suppliers as well as be a major source of FUD by cloud opponents.

National Data Protectionism: There are significant advantages to have large data centers located near large sources of power and Internet bandwidth. However, for both social and economic reasons national governments around the world are increasingly concerned about the hosting of national data outside of their boundaries. This has led recently to legislation that restricts the retention and in some cases the flow of such information outside national boundaries.

Application Security: At present, application security beyond authorization is the responsibility of the application and this has always been an area where application developers need help and support. Client side security is improving but remains a challenge largely due to the state of browsers therefore applications need to ensure that critical security is performed outside the browser. To the extent possible all data should be encrypted using strong encryption both over the wire and while stored in databases. While it is ideal to have stateless applications, there are cases where the application needs to enforce transitions. IBM research published some interesting work using a reverse proxy to address this concern. Force.com has demonstrated that using SSL and other best practices they can meet the needs of major enterprises.

Loosely Coupled Service Design: While simple in principle, it is still a challenge to design services so that applications can be loosely coupled. There is a need for more education, training and examples of good and consistent service design. Fortunately, ATOM publishing offers a model that is straightforward for many applications. The current reality is that developers using different suppliers' services need to understand different protocols and to take responsibility for orchestrated application behavior.

Occasionally Disconnected Operation: While the Internet is increasingly available everywhere, mobile applications have driven home the need to support clients that are occasionally disconnected. Client side applications must be prepared to synchronize

with the cloud when they reconnect. Google Gears allows a simple web-programming model to execute completely on the client with synchronization back to the server. MS Azure incorporates a sophisticated and flexible synchronization framework that enables applications to accommodate several different forms of file and data synchronization [26].

Cloud Computing promises substantial benefits for small, medium and large organizations. Realizing those benefits will require a focus on new application development challenges as well as the use of new programming models and practices.

4 Relationship between e-Governance and Cloud

Cloud computing is used to help the e-governments in providing the best possible services to its stockholders, citizens and businesses, and to reduce the costs by reducing repetitive operations and increase the effective use of resources in the global arena.

Cloud computing technologies have many benefits in different parts of e-government.

These benefits are discussed in the following points.

- Scalability: Cloud computing resources such as CPU, servers, hard drives can be purchased automatically in any quantity and at any time to fit growing number of users.
- Availability and Accessibility: cloud computing applications and information are hosted online therefore this creates high availability functions and citizens can use e-government applications at any time and from anywhere [2].
- Cost Saving: cloud computing systems do not need to be purchased and to install the ICT equipment's and software on their own building.
- Backup and Recovery: Since all the data is stored in the cloud, backup and restore are done much simpler than in traditional way.
- Unlimited Storage: Storing information in the cloud gives users almost unlimited storage capacity.
- Green technology: Cloud computing is relatively good in energy consumption and provides eco-system through virtual services [12] [13].
- Due to cloud computing benefits as mentioned above, many countries have launched E-governance services using cloud computing. Although cloud computing offers a lot of advantages to E-government, several issues and challenges need to be targeted or to be met when applying cloud computing [13].

The main issues and challenges for adopting cloud computing for the e-Government are:

- Security and privacy: Security requirements must be fulfilled on several layers, when the implementation of cloud computing includes advanced security technologies [14].

- Data protection and compliance: some data protection regulations do not allow the storage of sensitive data in other countries, which is basically not accomplished by most cloud service providers.
- Interoperability and data portability: There is a lack of standards when using and implementing cloud-computing services. Users should be able to change between cloud service providers with a minimum of risk and cost, so governments may need to adopt open standards policies for the cloud. Many governments decide to use ICT systems that consistent to open standards in order to save the cost.
- Identity and access management: As cloud, computing services rely completely on the availability and speed of the Internet as a carrier between consumer and service provider, speed and availability will be an issue.
- Auditing: Cloud providers currently do not offer detailed auditing possibilities where the auditing becomes essential in situations where compliance must be verified for specific regulations or policies. Several technical challenges like Data scaling, auditing and logging, rolling out new Instances, replication and migration, disaster recovery, policy management, system integration and legacy software, obsolete technologies and migration to new technologies.

5 Mobile e-Governance in Cloud

5.1 Mobile Government benefits

Mobility makes government more accessible, affordable, agile, collaborative, and convenient. Governments in many states are driving productivity internally in order to increase the effectiveness of their services externally. The case for mobile government is driven by the popularity of mobile use, opportunities to improve service delivery, improved transparency through increased access to information, and new products and services that can be co-created with citizens. Accessing the work-related applications and information on the go stimulate the productivity of employees. In a survey that is conducted from Forrester Consulting, 76 percent cited increased employee responsiveness and decision-making speed as observed benefits of accessing the mobile application for work purpose. Mobile related increases are so much visible in another report where the usage of mobile application (see figure 2) in governmental institutions from the employees had resulted in \$25 billion in salary and pension savings. Usage of mobile technology stimulates civil servants to perform their jobs more effectively. Mobile technology creates targeted decision making opportunities. It makes these abilities available to a much larger set of users for delivering public services, using mobile devices to keep employees and customers better informed in real time. Belgian Railways has standardized its processes and information across the organization on an e-government platform, with expected savings of \$30 million per year. Around 2.5 million documents were added to the system, which now provides to citizens a platform for fast, accurate information access with the confidence that information accessed is the single source of truth [16].

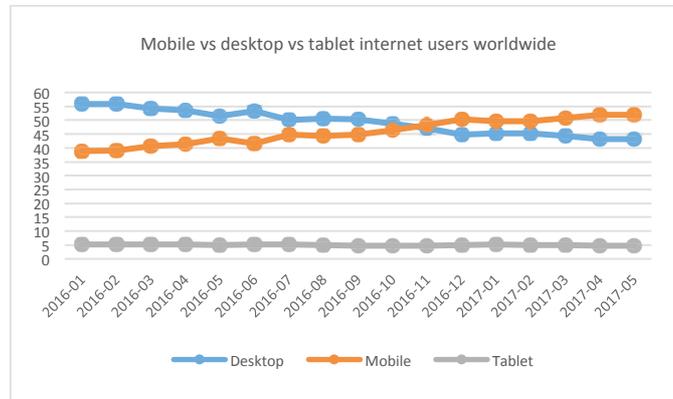


Fig. 2. Mobile vs desktop vs tablet internet users worldwide

Another benefit of using Mobile e-Government by providing the services through the cloud is that cloud solutions are cheaper than other computing models; zero maintenance cost is involved since the service provider is responsible for the availability of services and clients are free from maintenance and management problems of the resource machines, so that organizations do not need to pay or look to the internal IT solutions [16].

Applications related to E-Government represent the customer-facing component of e-government. These applications are called Smart Process Applications (SPA) and are designed to support business activities that are people intensive. Deliver in the cloud environment; SPAs give mobile users the ability to access processes from their mobile devices. Also SPAs enable the launch of integrated service apps in order to support workers in the field. Government caseworkers often manage hundreds of clients and they spend a lot of their time visiting the clients. Mobility supports remote offices and work, which increases productivity and efficiency in the field. Response times are increased on the project cycle, travel costs, and equipment expenses are reduced. With mobile case management, public servants can create cases quickly, track progress, and build-in features like camera and Global Positioning System (GPS) to support the process. The case related information is centralized and secured on an e-government system. Costs are reduced when caseworkers are more responsive and the information is accurate [16].

Access of the information by citizens is required in order to build a transparent government. With the usage of geospatial technologies and location data, government can deliver information across many channels, and accessible at any time in any place. Mobile technology increases opportunities for civil engagement. All these services that are provided into a mobile interface are provided by the cloud infrastructure in backend. Cloud infrastructure gives mobile services high availability, scalability and fast response time to the citizens and government employees [16].

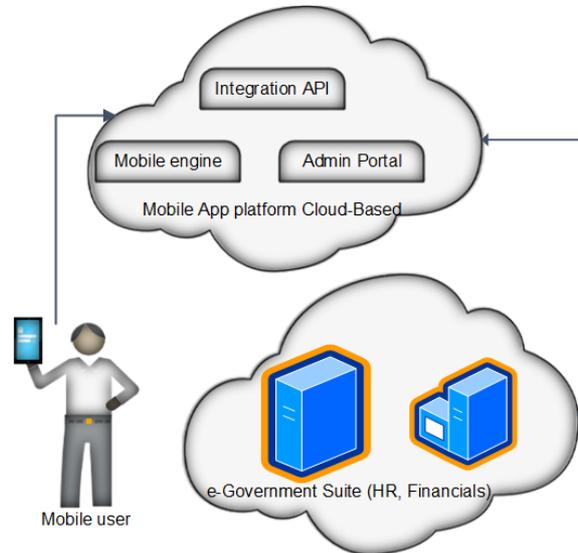


Fig. 3. Architecture of e-Government Mobile services in Cloud

5.2 Public e-Government in mobile cloud platform

In e-Government solutions, many applications are developed through the partnership with the private sector. A new engagement model is to include government partnership with citizens to co-create a product. This is made possible by foundations as Open Government and Crowdsourcing. Using this foundations citizens can access datasets that are made available by governments to develop applications and improve the lives of citizens in multitude ways [16].

In type one crowdsourcing, government agencies can use online communities as a way to extend their abilities, relying on communities to bring new information that can be used in efficient way that leads to a better decision and resource allocation. As an example of application that is used as a crowdsourcing, solution is See Click Fix. Through this platform, users can report non-emergency issues that arise in their neighborhood. Such non-emergency issues are clogged storm drains in streets, downed traffic lights and stop signs, graffiti etc. Citizens report these problems through the mobile applications, where city governments subscribe to track these emerging issues. Government agencies responsible for these types of problems use this information to better allocate resources in order to address this issues [16].

Nowadays many countries are using e-governance and the data storage in the cloud, such as Estonia, Singapore, USA, UK, Japan, Thailand, etc.

6 e-Governance in cloud - Good examples

6.1 Estonia

Government of Estonia ratified concept of Estonian government cloud and data embassies. The government cloud ensures digital continuity of Estonia, increases quality of e-services and mitigates various IT security risks. Additionally, implementing cloud technology in public sector supports innovation and development of Estonian information society. Data embassies are defined as a data center in an allied foreign country that stores data of critical government information systems and mirrors of critical service applications. Therefore, data embassies help to ensure Estonian digital and data continuity.

6.2 Singapore

The Singapore Government acknowledges that each model of cloud computing provides its own level of assurance and benefits. As such, strategy of the cloud for Singapore Government is to leverage the proper cloud for the proper need by adopting a multi-prong approach to cloud computing as follows [15]:

- Leverage commercially - available public cloud offerings for proper needs so as to benefit from lower cost of computing resources.
- Implement a private government cloud (G-Cloud) for whole-of-government use where security and governance requirements cannot be met by public clouds.
- Enable interoperability between G-Cloud and agency Clouds through a set of internal G-Cloud standards.

The Singapore Government Cloud or G-Cloud is the next generation whole-of-government infrastructure. It provides efficient, scalable and resilient resources for cloud computing and it is designed to meet different levels of security and governance requirements [15]:

- High Assurance Zone – a physically dedicated computing resource pool which is used by Government to serve its high assurance needs.
- Medium Assurance Zone – a computing resource pool which is shared with non-government cloud users to lower cost of computing resources for Government.
- Basic Assurance Zone – a computing resource pool which is shared with public cloud users.

To further aggregate the whole-of-government demand to minimize the cost of Government, the Government identified and provided common services, such as business analytics, customer relationship management and web content management, software as a service and platform as a service offering on G-Cloud. New central services like government web service exchange and gateways to authentication and payment services has been added at the next phase of G-cloud. G-Cloud enables

standardization, and sharing of computing resources and applications at the whole-of-government level, thereby generating cost savings to the Government.

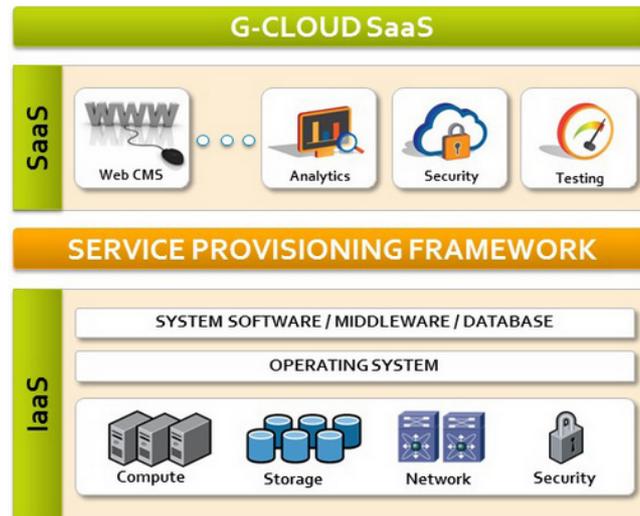


Fig. 4. G-Cloud of Singapore [15]

6.3 USA

The official web portal of the United States government (www.usa.gov) is one of the busiest website portals in the world as it receives approximately 342,000 visits daily [16]. It is the best site to visit when U.S.A government services are required. It is designed to aid the citizens of U.S.A to interact with the government departments efficiently. However, users frequently suffered long delays and downtimes during high traffic periods, such as voting seasons, monthly unemployment statistics release days, and natural disasters. In order to overcome this problem, U.S.A government decided to develop new IT hardware devices, which stays Idle most of the time when there is no high demand to access the web portal. It also uses more power and requires additional security features such as multifactor authentication and physical on-site security at the data center building. The time required to upgrade this site was up to nine months. The General Services Administration (GSA) was paying about two million American dollars for software licenses and hardware upgrades in addition to 350,000 US dollars for staff costs each year.

Vivek Kundra has suggested a better approach; United States first federal Chief Information Officer (CIO) to migrate to the clouds was selected for the following considerations [16]. The outcome of migration to the cloud resulted in reducing cost (up to 90%), improved capabilities, system flexibility and complete process automation. Thus, customer requests are handled in real time and allowed users to access data to integrate with other websites. Cloud-based solution made upgrades to the site takes only a single day, which previously took nine months to accomplish. Thus, the availa-

bility of the website increased up to 99.99 % with almost zero downtime monthly. The allocated budget to www.usa.gov reduced to only 650.000 American dollars per year.

6.4 United Kingdom (UK)

The UK government has made the creation of the “Cloud” which is a government-wide cloud-computing network, a strategic priority [18]. The Digital Britain Report, issued jointly in June 2009 by the Department for Business Innovation & Skills and the Department for Culture, Media and Sport, calls for the UK government to take the lead in a wide-ranging digital strategy for the country.

An important aspect of the Digital Britain strategy is to improve IT use in government and allow for more services to online migration. To support this action, the UK’s IT procurement efforts focused on enabling the government to become a leading force in the use of cloud computing. The report states that: “The Government’s impact on the digital economy goes way beyond its role as policy maker. In delivering public services, as a large customer of ICT products and services and as the owner of data systems, the public sector has enormous influence on the market. In many areas, such as education, health and defense, Government can use its position as the leading procurer of services, to drive up standards (in some cases to set standards) and to provide an investment framework for research and development” [17]. The Digital Britain team from both cabinet offices has an official forum, where interested parties can learn more about the plan.

6.5 Japan

In Japan, the national government has taken a major cloud computing initiative, dubbed the “Kasumigaseki Cloud”. This initiative sought developing a private cloud environment that hosts all of the Japanese government’s computing. The Kasumigaseki Cloud provides greater information and resource sharing and promote more standardization and consolidation in the IT resources of government. By consolidating all governmental IT under a single cloud infrastructure, the Japanese government believes it will see not just reduced costs and operational benefits, but more “green,” environmentally friendly IT operations. The Kasumigaseki Cloud was part of the Digital Japan Creation Project. This represents a governmental effort aimed at using IT investments (valued at just under 100 trillion yen) to help spur economic recovery by creating several hundred thousand new IT jobs in the next few years and doubling the size of Japan’s IT market by 2020 [19][18].

6.6 Thailand

In Japan, the national government has taken a major cloud computing initiative, dubbed the “Kasumigaseki Cloud”. This initiative sought developing a private cloud environment.

7 Conclusion

We discussed about the cloud and e-Government, we saw many advantages that cloud has, and we have seen the advantages of the e-Government. We can conclude that using e-Government there are so many easy ways for society to find what they want and what they need at any time and wherever they are. The government of course should publish all the services that think the people should access for they need. Today many people are accessing the internet through the mobile devices or any other portable smart device, so they can reach the e-government services in a fast way and at any time they need. So all the services will be adopted for mobile devices and it will have a simple interface in order to be very easy to use for society.

Using cloud of course all the data should be called and transmitted through web services. The services should be developed separated from the system, so the system will call those services and find the data for CRUD operations. By using services in the future for any application that government develops in an easy way they can call the services and all the data where they store on the cloud.

We discussed about the advantages that Cloud has, some of them: we do not care for data protection and privacy, we do not care about the data backup, we do not care about the availability of accessing data, etc. But there are also some disadvantages, as we think there exist a group of people that manages the cloud, those people of course has all the data in plain text, and one day they can publish all those data, they can also sell those data to a person or a country, for abuse with those data. They can also manipulate with data, they can modify the data without knowing the client. One of the way we think it will be a little bit safe is to send those data encrypted, so no one can read them or decrypt, in this way the data are more protected from those people who want to abuse with them. However, while encrypting and decrypting data it takes a little bit time, so this is the cost in time.

The future work we think it is the privacy of the data on the cloud, it should be a little bit more secure storing the data on the cloud.

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