# Integration of Cloud Services for Improving NFC

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***Abstract*— Near field Communication (NFC) is a technology that provides contactless data transfer between devices. However it poses limitations of storage and security. To overcome these limitations we propose a cloud based solution which comes with the added benefit of centralized management of data. In this paper, we utilize cloud's Platform as a service (PaaS) to achieve scalability, accessibility, manageability and improved system performance. We have mainly focused upon the transfer of data between devices using NFC and migrating it to the cloud which helps in improving the overall efficiency.**

***Keywords—NFC; Cloud computing;Platform as a service (PaaS); MySQL; Cloud Storage***

## I. INTRODUCTION

The word cloud [5] is analogous to the "internet". Cloud computing refers to the technology that enables on-demand self -service, broad network access and measured service (pay-per-use) to a wide pool of configurable computing resources with minimal management effort and service provider interaction.

Cloud computing offers the following basic service models:

### *A. Infrastructure as a Service (IaaS)*

IaaS is the most basic service model in which resources such as machines (physical or virtual) are provided to the users. The operating systems as well as the applications reside on the cloud.

### *B. Platform as a Service (PaaS)*

PaaS is a service model of cloud computing that provides services such as storage, server and network for provisioning user applications. It provides a development platform for hosting applications that are running or have been completed.

It allows users to pay for only the resources that they need and use and consume only those resources that meet their requirements. In addition, services are updated constantly and customer support is provided. The biggest advantage of PaaS is minimal investment in physical infrastructure. Other benefits of PaaS are:

- Data security
- Flexibility
- Simplicity of use

### *C. Software as a Service (SaaS)*

SaaS can be described as service where customers are provided access to applications over the internet. These services can be accessed by any device which is connected to the internet.

Benefits of SaaS include:

- Scalability with updates available on demand
- Minimal cost of setup
- No additional hardware costs
- Customization of software

NFC (Near field communication) is a technology that enables contactless transfer of information between devices. NFC has a wide range of applications like payment gateways, ticketing applications and data transfer between devices. Cloud technology can be used to remove storage and performance constraints of the current NFC technology. One of the companies that pioneer in the collaborative use of NFC and Cloud technology is Fujitsu. Currently, cloud based NFC payments are also done in Austria using the PayBox service [3].

NFC [2] poses a few concerns such as security and integration with businesses. A major risk involving NFC is the device using the technology can be hacked. NFC enabled devices can contain sensitive information like card details which need to be protected. Since NFC does not require any authentication, a mechanism is required to make it more secure.

In this paper, we focus on the limitations of current NFC technology and how cloud computing can be used to overcome these.

## II. DESIGN

### *A. Data transfer between devices using NFC*

- NFC enabled devices can exchange data through the use of inbuilt applications such as Android Beam (in the case of Android devices).
- This data is stored locally on the device's database or a locally connected data store.
- The main drawback of this system is that it imposes storage constraints as the devices do not have unlimited storage space.
- The issue of storage can be solved by moving the data to cloud where the resources can be provisioned as and when required.
- The main advantages of using this technique are secure storage and scalability without the need of additional hardware.

- Another benefit is that data when transferred to the cloud [4] can be centrally managed.
- It would also provide location transparency

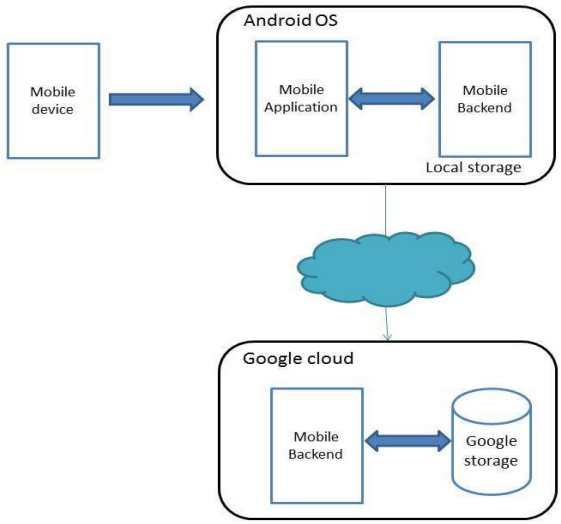


Fig. 1. Steps of migration of data to Cloud storage (Google Cloud)

### B. *NFC tags*

- For payment and ticketing applications, pre-programmed NFC tags are used.
- Users can bring their devices in contact with these tags to access the relevant applications.
- To enable consolidation, faster access and reliable transactions, the business logic can be housed on the cloud instead of on the tags themselves.
- The tags would just provide a means to access the application, the user interface for which will be placed on the user's device.
- Cloud computing would provide more security in the case of payments and would also allow users to rapidly access the applications as long as they are connected to the internet.
- This approach would be particularly useful in the design of a Smart City[1].

## III. IMPLEMENTATION

In this paper we implement a cloud based solution with an NFC integrated application which highlights the functionalities of Cloud, namely: Centralization of data, Security and Storage. Initially, the data resides on the NFC enabled device. However, with our approach, this data is migrated onto a Cloud, thus allowing better manageability.

### A. *Android Emulator*

The data to be stored is presented to the local storage through the application running on an Android emulator. The Android emulator is a virtual device running on your machine which replicates the features of a mobile device (software and hardware) except for making actual phone calls.

### B. *Local Storage*

The database is stored locally using the XAMPP server which is a server package integrated with Apache, MySQL, PHP and Perl. The database is created using SQL queries in the MySQL database and are configured with PHP files which help to create, update, read and delete data.

The process of transferring data is facilitated by the use of JSON (JavaScript Object Notation) objects which is a data-interchange format consisting of attribute-value pairs. This notation helps humans to read and write and machines to parse and generate.

### C. *MySQL*

The local storage consists of a MySQL database which is created through PHP files. MySQL allows easier creation and management of tables in the database. Updates can be performed easily as well. The main motive behind using MySQL is that the database can then be directly migrated to the cloud using the Google Cloud Storage technology.

### D. *Google storage*

Google cloud storage provides a basis for the data to be stored over the internet. The data that is incoming through the android app and stored locally on the MySQL database is migrated on to this storage. It is a pay per use facility and you are charged only for the amount of storage used by you. This also facilitates centralized storage of data and can be accessed from any device with an internet connection. A prerequisite for using Google cloud storage is that you must create a project along with an instance of the project. The instance is used to keep a track on the usage and billing.

### E. *Cloud SQL*

Cloud SQL, which is a service provided by Google, helps in performing the migration of the database from local storage to the cloud. The import and export of data is done by creating google buckets which transfer this data into storage. The tool used to create buckets is 'gsutil' which has a set of predefined commands. These commands help in concatenating objects, copying files and objects, setting access permissions, removing buckets and objects etc.

## IV. RESULTS

In our approach, we have considered an application for an inventory which keeps a track of available products and allows addition of new stock. The use of NFC technology eliminates the need for manual data entries and allows easy database access to the inventory manager.

### A. *User Interface*

The user interface for adding new products is illustrated in figure 2.

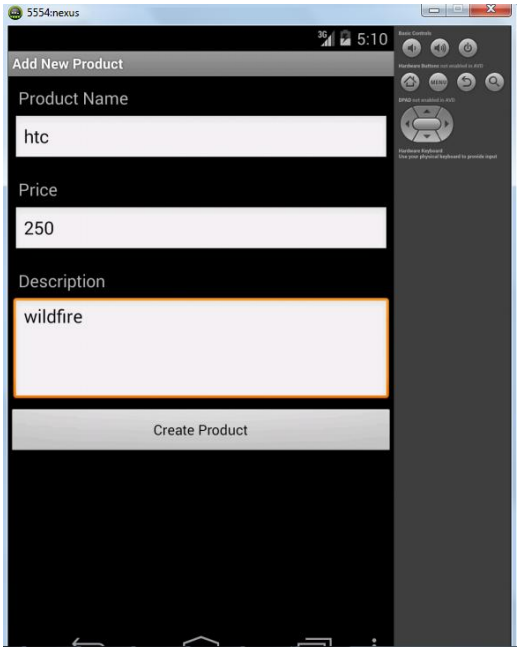


Fig. 2. Adding new entries in the database

### B. *Local Storage*

The data coming in through NFC is stored on the device locally on the MySQL database which is shown in figure 3.

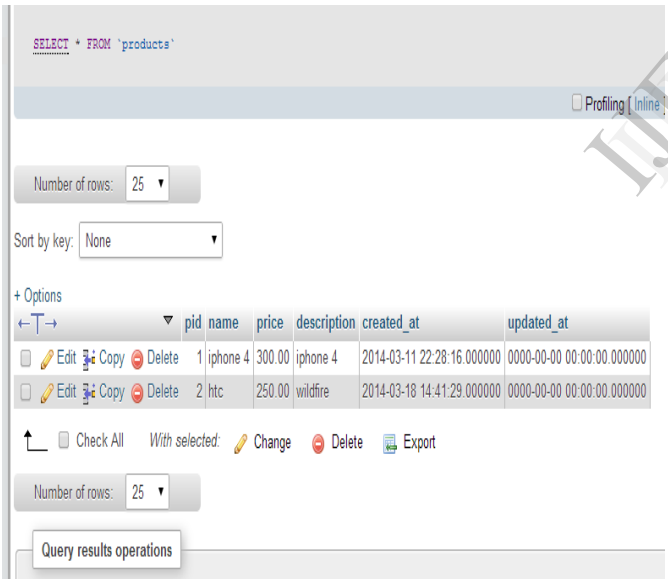


Fig. 3: Local storage in MySQL server

### C. *Cloud Storage*

The local database is now migrated to the cloud storage provided by Google thus ensuring better security and centralized management of data.


Fig 4. Data directly migrated to the cloud(Google storage)

## V. CONCLUSION

The use of Cloud storage increases the number of potential applications that could be used with NFC technology. The main limitations of NFC are security and storage, both of which are solved with the use of Cloud computing. Cloud computing provides the added benefits of centralized storage, location and device independence, scalability and manageability. Another benefit of using Cloud technology is that you only pay for the resources used.

This technique can be incorporated in various applications such as; checkout counters for super markets, ticketing portals at theatres, railway stations etc. For checkout counters, cloud improves the security by having an additional authentication step thus improving the integrity of the system. For different ticketing applications a common interface could be used to access the applications residing on the cloud. Thus cloud computing helps improve the overall user experience and reduces the complexities of these applications.

A useful application of NFC is data transfer between devices. Data such as images, videos, audio files etc. can be exchanged between NFC enabled devices. Since, NFC does not require pairing of devices it is less secure as compared to Bluetooth. Our approach overcomes this limitation as the data is stored on the cloud and only genuine users have access to it. Another constraint of the existing system is the storage limitation of devices. Cloud provides high storage capacity and easy scalability which help in overcoming the storage issue.



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