

Comparison of Multi Cloud Storage Systems for Mobile Devices

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ABSTRACT

Cloud Storage is a model of online data storage where data is stored in a virtualized pool of servers hosted by third parties (CSPs) and located in different geographical locations. Cloud Storage revolutionized the way how users access their data online anywhere, anytime and using any device as tablet, mobile, laptop, etc. A lot of issues as vendor lock-in, frequent service outage, data loss and performance related issues exist in single cloud storage systems. So to evade these issues, the concept of Multi Cloud Storage introduced. There are a lot of Multi Cloud Storage Systems exists in the market for mobile devices. In this article, we are providing a comparison of four Multi Cloud Storage Systems for mobile devices Otixo, Unclouded, Cloud Fuze and Clouds and evaluate their performance on the basis of CPU usage, Battery Consumption, Time consumption and Data usage parameters of 4G network using three mobile phones Nexus 5, Moto G and Nexus 7 tablets. Finally, open research challenges and future scope are discussed.

Keywords: Cloud Storage, Multi Cloud Storage, Vendor Lock-in, Mobile Devices, Mobile Cloud Computing.

1. INTRODUCTION

Cloud storage is a data storage model in which data is stored in pools of servers those are located in multiple data centers and managed by different Cloud Service Providers [1]. All management of hardware and other resources is taken care by CSPs. It is the responsibility of CSPs to keep data available to end users and enterprises and also take care of privacy and security of data. Enterprises or end users use these services on a pay as per use basis means they will pay rent for the services. These storage services (Cloud Storage) can be accessed by a web application or mobile application via an API provided by different cloud storage providers.

1.1. Mobile cloud storage

When cloud storage is accessed through mobile devices is known as Mobile Cloud storage. A lot of services are offered by different mobile cloud storage providers include creation and managing of files, photos, movies and music. Both companies and individuals use these services. Different cloud storage provider's offers a very limited free storage space and user have to pay money for additional use. Some mobile companies give inbuilt mobile cloud storage apps with their handsets. With these apps, mobile data is synchronized with different platforms. E.g. Apple device comes with preloaded I cloud app in it and android devices come to Google Drive. Similarly, Samsung has tie-up with Drop Box and Sky Drive comes with Microsoft devices.

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1.2. Cloud Storage Services for mobile devices

Cloud storage system is a N/W of data centers those are distributed in different geographical locations and using the concept of virtualization to store data. With this availability of data is increased by redundantly storing data on different data centers. This process of storing data on the cloud is hidden to the user. There are two types of cloud storage services

- Basic cloud storage services
- Advanced cloud storage services

Basic cloud storage services: Users don't have direct access to these services; these are included in custom software's with the help of API (Application Programming Interface) in. E.g. Rack Space, Amazon S3.

Advanced cloud storage services: These services make use of basic cloud storage services for data storage. These services provide interface in the form of mobile applications or web applications to the user for data storage and management. E.g. Google Drive, One Drive, Box, Drop Box. These are some famous cloud service providers. Users can access these services either through their websites [2] or through mobile applications [3] provided by them. Figures of both methods are shown below

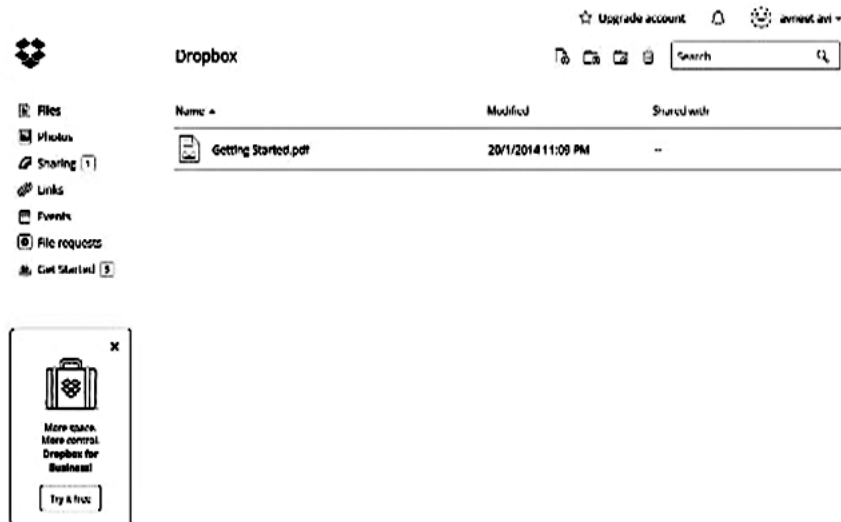


Figure 1: Website interface of DROPBOX



Figure 2: Android App interface of DROPBOX

1.3. Multi Cloud Storage

Multi-cloud is a technique in which one can use multiple cloud services on a single platform. Nowadays, the storage issues among users have raised [4]. So, the cloud computing plays a major role in this scenario. Various multi-cloud applications are available on the internet, but they are affected by various drawbacks.

The remaining of this paper is structured as follows. Section 2 outlines Background and Motivation for this work. Section 3 provides the results of analysis for Multi Cloud Storage Systems for mobile devices. Finally, in Section 4, we conclude our paper and discuss on how this research can be further explored in future.

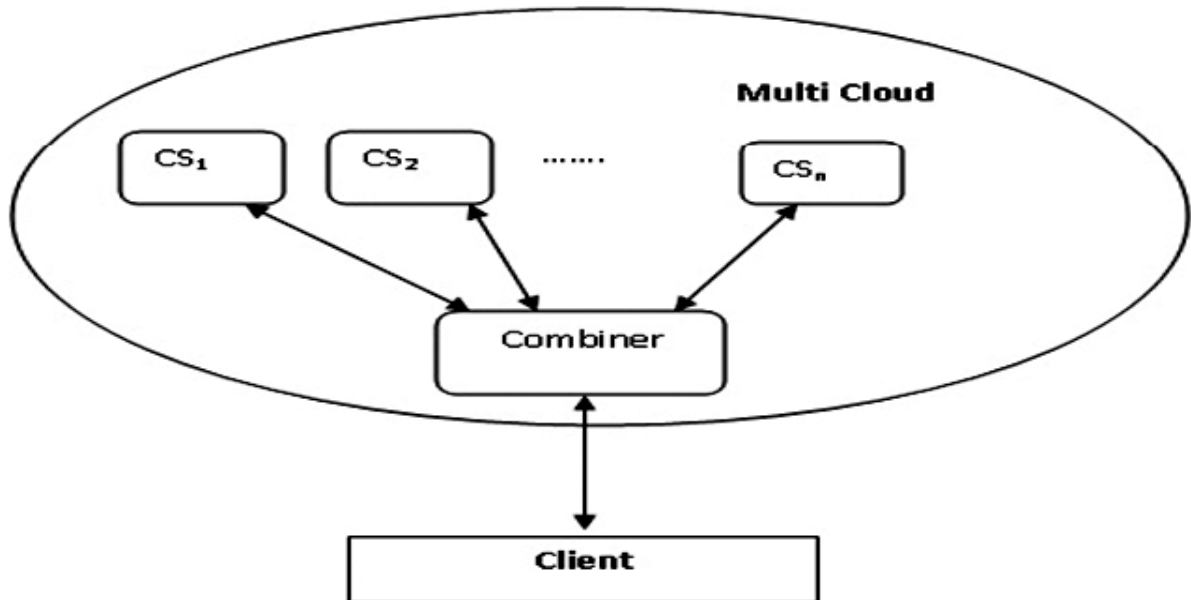


Figure 3: Multi Cloud Storage scenario

2. BACKGROUND AND MOTIVATION

In this section, we discuss issues of Multi Cloud Storage Systems for mobile devices in terms of resource consumption.

2.1. Storage Issue

Typically, different Cloud Storage providers are providing very limited free storage capacity ranging from 2GB to 10 GB [5], which is not sufficient as per the requirement of users to store large amount of data because now a days, users are having smart phones, which are having high quality HD cameras and even users are eager to capture HD (Full HD/UHD) contents, which consumes a lot of storage space and storage space available in smart phones and even free storage space provided by different CSPs is not enough. So, to avoid this issue, the concept of Multi Cloud Storage introduced. But in existing Multi Cloud Storage systems, they are just providing a single interface to user by which management of multiple cloud storage services becomes easy but in these systems, they didn't merge storage of different Multi Cloud Storage systems into a single pool. [6] proposed a Multi Cloud Storage system named Mult Cloud for mobile devices, which created a single storage pool from available free storage from each Cloud Storage provider but in this system all storage techniques as erasure coding, data splitting, data compression etc. are implemented on client side so it degraded the mobile device performance as mobile devices have limited resources. So we need a Multi Cloud Storage system for mobile devices which will provide more free storage in the form single pool means the background of data distribution on different Cloud Storage providers is abstracted from user and user will get a single view of storage.

2.2. Battery Consumption Issue

In existing Multi Cloud Storage systems, the scenario used for accessing cloud storage by mobile devices is as described in Figure 4.

In this scenario, in case of multi sync process, if a user want to upload same file to different cloud storage providers, file will be uploaded one by one on each cloud storage which will consume more battery of mobile device which is undesired as mobile device has limited resources. So we need a Multi Cloud Storage system that will consume less battery of mobile device as energy is vital part of any civilization.

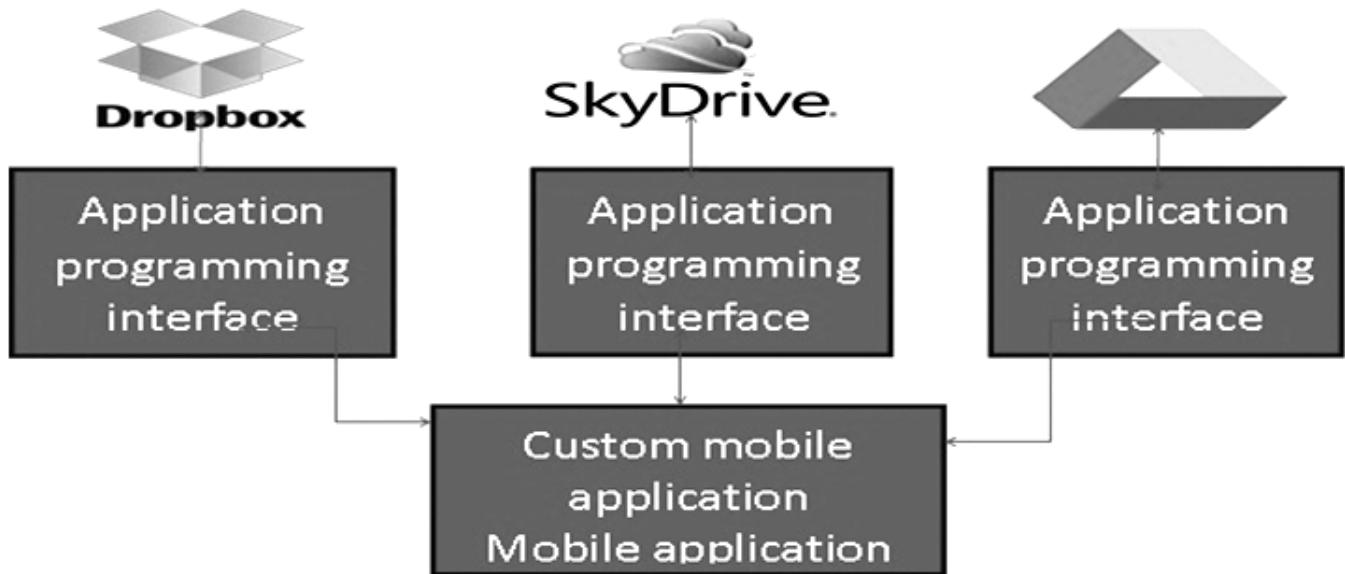


Figure 4: Scenario of accessing cloud storage service by mobile devices

2.3. Security Issue

[7], In existing Multi Cloud Storage systems for mobile devices as Otixo, Gladinet, Storage Made Easy, Joukoo, user has to enter his login credentials to these third party services, which could lead to a security and privacy issue as users credentials are with third party so users valuable data can be misused. So there is a need of Multi Cloud Storage system that will be more secure.

2.4. Data Usage Issue

As we know, user need internet to access cloud storage service. If a user wants to upload/download a large size file to multiple cloud storage providers, a lot of data is wasted in this process especially in case of multi sync process. So to avoid this issue, we need a Multi Cloud Storage system, which will consume less data pack.

3. RESULTS OF ANALYSIS OF MULTI CLOUD STORAGE SYSTEMS FOR MOBILE DEVICES

In this section, we have furnished the results of comparison of four multi cloud storage systems, Otixo, Unclouded, Cloud Fuze and Clouds and evaluate their performance on the basis of CPU usage, Battery Consumption, Time consumption and Data usage parameters on 4G network using three mobile phones Nexus 5, Moto G and Nexus 7 tablet. In this, we have taken a file of size 116 MB to upload and compares the above mentioned multi cloud storage systems for parameters battery consumption, CPU usage (in minutes-seconds), Data Usage (in MB) and Time Consuming (in minutes-seconds). The specification of devices is

Table 1
Specification of Mobile Devices

	<i>Nexus 7 (Tablet Device)</i>	<i>Moto G</i>	<i>Nexus 5</i>
O. S.	Android	Android	Android
CPU	1.3 GHz	Quad Core 1.2 GHz	Quad Core 2.6 GHz
RAM	2 GB	3 GB	2 GB

3.1. Comparison for Nexus 7 Tablet

In this section, Table 2 is describing the results of four Multi Cloud Storage systems for mobile devices Otixo, Unclouded, Cloud Fuze and Clouds on Nexus 7 Tablet device .

Table 2
Comparison Table for Nexus 7 Tablet Device

<i>Name</i>	<i>Data Usage</i>	<i>C.P.U Usage</i>	<i>Battery Consumption</i>	<i>Time consumption</i>
Otixo	124 MB	5 min	2%	4 min
Unclouded	126 MB	6-40 min	1%	6 min
CloudFuze	125 MB	4-53 min	1%	10 min
Clouds	123 MB	5-20 min	2%	8 min

3.2. Results for Nexus 7 Tablet Device

This section is recitating the graphical results in Figure 5 shows Data Usage for Nexus 7, Figure 6 shows CPU Usage for Nexus 7, Figure 7 shows Battery Usage for Nexus 7 and Figure 8 shows Time Consumption

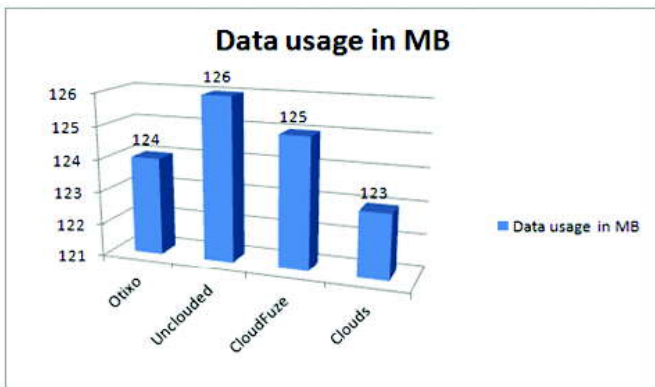


Figure 5: Data Usage for Nexus 7 Tablet Device

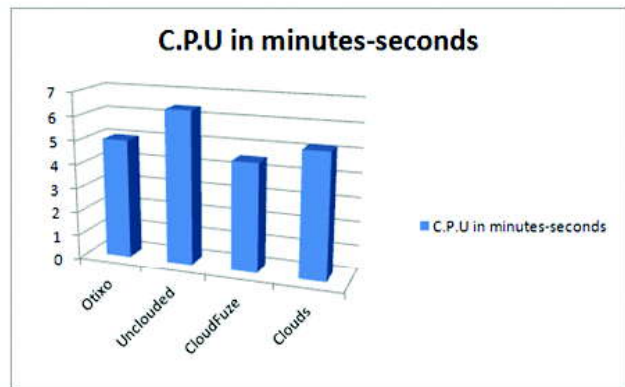


Figure 6: CPU Usage for Nexus 7 Tablet Device

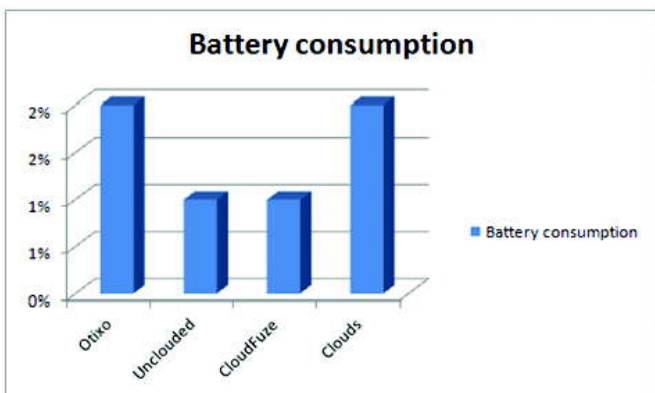


Figure 7: Battery Usage for Nexus 7 Tablet Device

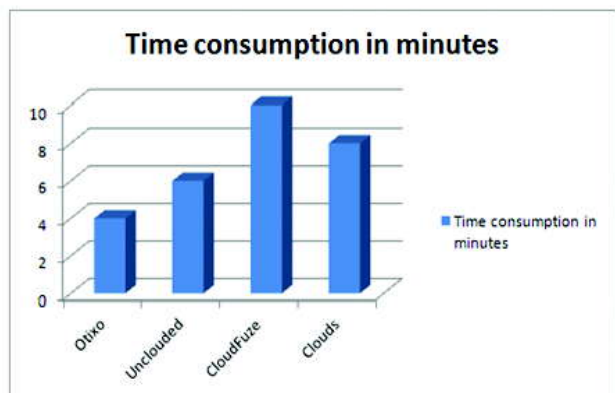


Figure 8: Time Consumption for Nexus 7 Tablet Device

for Nexus 7 for parameters Data Usage, CPU Usage, Battery Usage and Time Consumption parameters while uploading a 116 MB file on Nexus 7 Tablet device and using 4G network.

3.3. Comparison for Moto G Mobile Device

In this section, Table 3 is describing the results of four Multi Cloud Storage systems for mobile devices Otixo, Unclouded, Cloud Fuze and Clouds on Moto G device .

Table 3
Comparison Table for Moto G Mobile Device

Name	Data Usage	C.P.U Usage	Battery Consumption	Time consumption
Otixo	126 MB	12-35 min	2%	15 min
Unclouded	127 MB	14-11 min	3%	17 min
CloudFuze	127 MB	14-20 min	3%	18 min
Clouds	125 MB	16-15 min	3%	18 min

3.4. Results for Moto G Mobile Device

This section is reciting the graphical results in Figure 9 to Figure 12 for parameters Data Usage, CPU Usage, Battery Usage and Time Consumption parameters while uploading a 116 MB file on Moto G device and using 4G network.

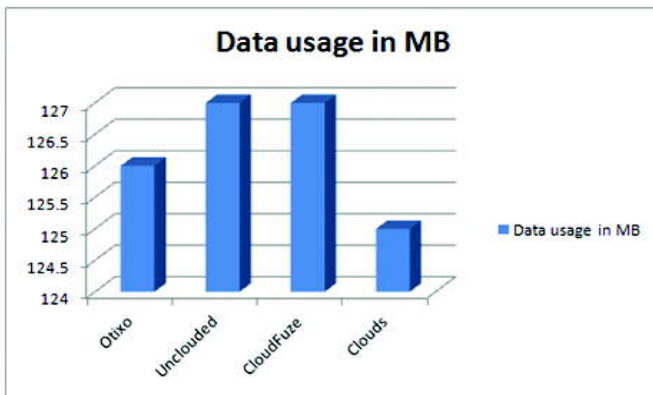


Figure 9: Data Usage for Moto G Device

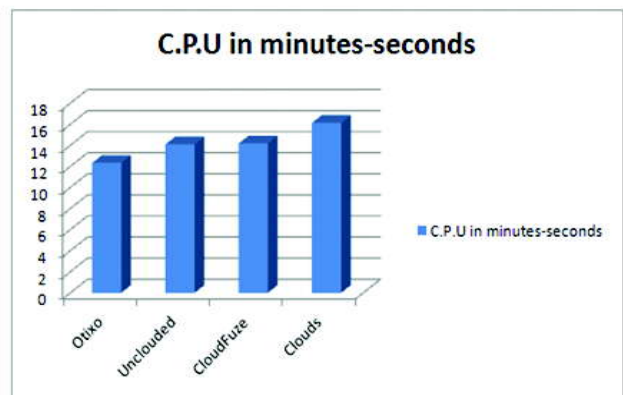


Figure 10: CPU Usage for Moto G Device

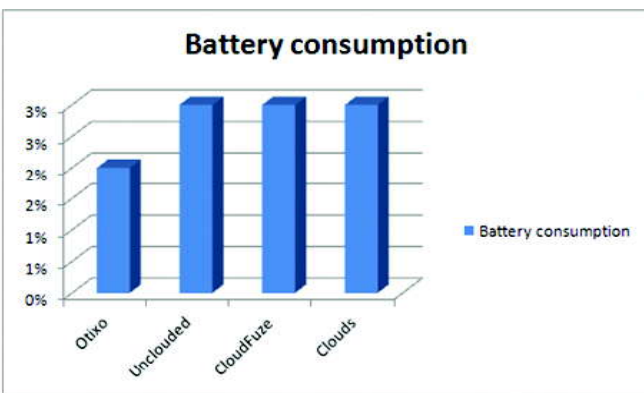


Figure 11: Battery Usage for Moto G Device

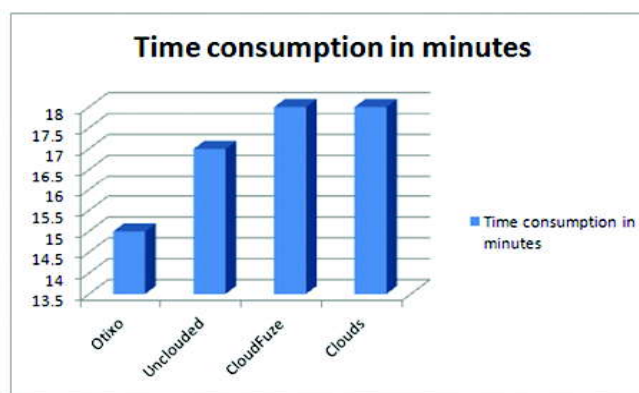


Figure 12: Time Consumption for Moto G Device

3.5. Comparison for Nexus 5 Mobile Device

In this section, Table 4 is describing the results of four Multi Cloud Storage systems for mobile devices Otixo, Unclouded, Cloud Fuze and Clouds on Nexus 5 mobile device.

Table 4
Comparison Table for Nexus 5 Mobile Device

Name	Data Usage	C.P.U Usage	Battery Consumption	Time consumption
Otixo	126 MB	12-45 min	2%	16 min
Unclouded	126 MB	15-41 min	3%	18 min
CloudFuze	128 MB	13-25 min	2%	14 min
Clouds	122 MB	13-50 min	2%	14 min

3.6. Results for Nexus 5 Mobile Device

This section is recitating the graphical results in Figure 13 to Figure 16 for parameters Data Usage, CPU Usage, Battery Usage and Time Consumption parameters while uploading a 116 MB file on Nexus 5 mobile device and using 4G network.

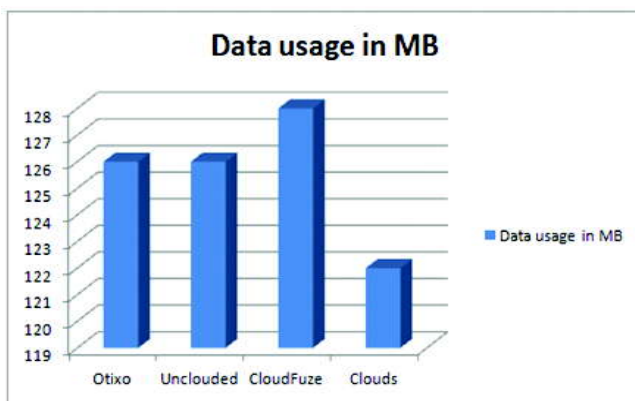


Figure 13: Data Usage for Nexus 5 Device

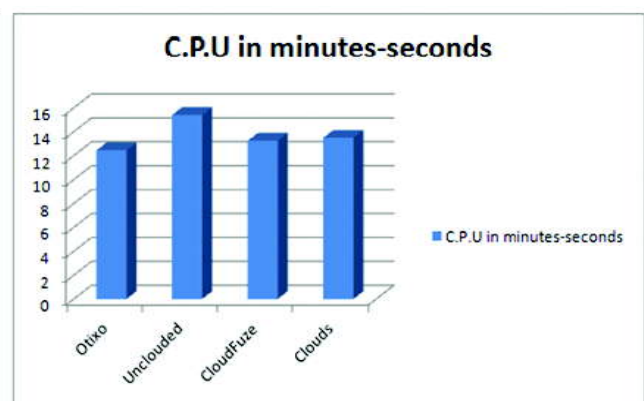


Figure 14: CPU Usage for Nexus 5 Device

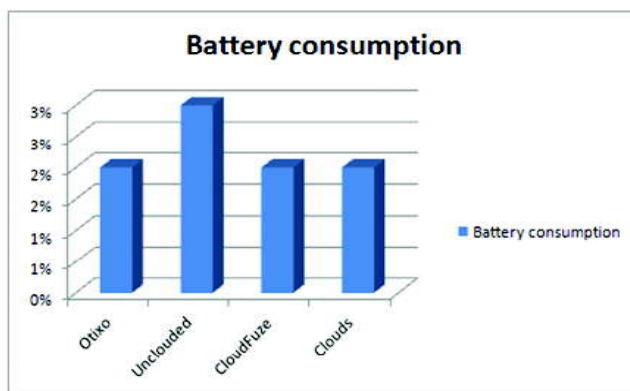


Figure 15: Battery Usage for Nexus 5 Device

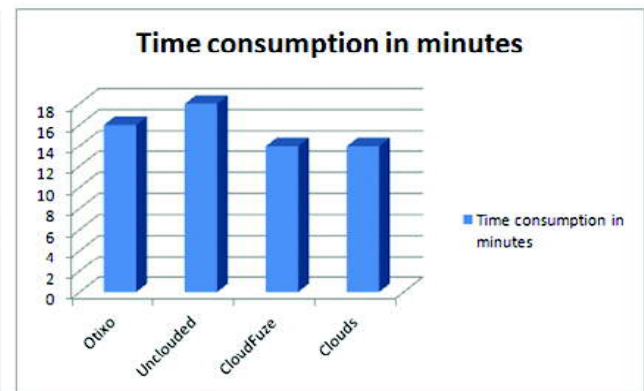


Figure 16: Time Consumption for Nexus 5 Device

4. DISCUSSION

From previous analysis of three smart phone devices, It is very much clear that device with high configuration as CPU, Battery etc. is consuming less resources as compared to device with lower configuration. If we will take only one smart phone device to compare multi cloud storage system for mobile devices, it is clearly observed that if one multi cloud storage system is consuming less battery, at the same time, it is

consuming more other resources as CPU, Data etc. So in future, an efficient multi cloud system is required for mobile devices which will consume less resources as CPU, Data, Battery and Time.

5. CONCLUSION AND FUTURE SCOPE

From above comparison of four Multi Cloud Storage Systems for mobile devices, it may be concluded that if one Multi Cloud Storage System is consuming less battery, at the same time it is consuming more other resources as CPU, Data etc. So, it is clear from above comparison that an efficient Multi cloud Storage System is required for resource constrained mobile devices, which will devour less resources of mobile devices and give better results.

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