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A Review on Synchronization of Hybrid Platform Mobile Data to Cloud

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***Abstract*—** Today's consumers are highly reliant on their mobile applications. If apps don't work, users won't use them -- it's that simple. Mobile Computing is a technology that allows transmission of data, voice and video via a computer or any other wireless enabled device without having to be connected to a fixed physical link. The cloud data can be used by any device running over cross platform such as windows, IOS, Android etc. Mobile phone is widely used in today's life. The term smartphone is the multipurpose device and it is mostly used for making phone call and writing text messages. But mobile is also have some limitations in the area of battery life, thermal heating and computational capabilities. It could be said that cloud computing is just another buzzword, a way to sell already existing technology. This paper give a brief introduction about different perspective of mobile cloud computing.

Keywords-*.Hybrid Cloud Computing, Cloud Data Synchronization, Smartphone, mobile phone, cloud computing*

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I. INTRODUCTION

Mobile devices with any operating system or platform such as Android, IOS or windows can be backed by scalable machine intelligence (SMI) in the cloud is the defining computing paradigm of our time. Modern tools require special consideration for the challenges developers face on mobile: serverless capabilities, a cloud-first data model capable of persisting data even when the device is offline, low-latency access to media anywhere in the world, and real-time data synchronization across all mobile platforms. Cloud Platform gives developers comprehensive solutions with a focus on ease of use and speed – all without having to manage infrastructure.

Figure 1. Various Cloud available Options

Mobile Cloud Computing (MCC) is the composition of cloud computing, mobile computing and wireless networks to bring rich computational resources to mobile users, network operators, as well as cloud computing providers.[1][2] The ultimate goal of MCC is to enable execution of rich mobile applications on a plenty of mobile devices, with a rich user experience.[3] MCC provides business opportunities for mobile network operators as well as cloud providers.[4] More comprehensively, MCC can be defined as "a rich mobile computing technology that leverages unified flexible resources of varied clouds and network technologies toward unrestricted functionality, storage, and mobility to serve a multitude of mobile devices anywhere, anytime through the channel of Ethernet or Internet regardless of heterogeneous environments and platforms based on the pay-as-you-use principle."[5]

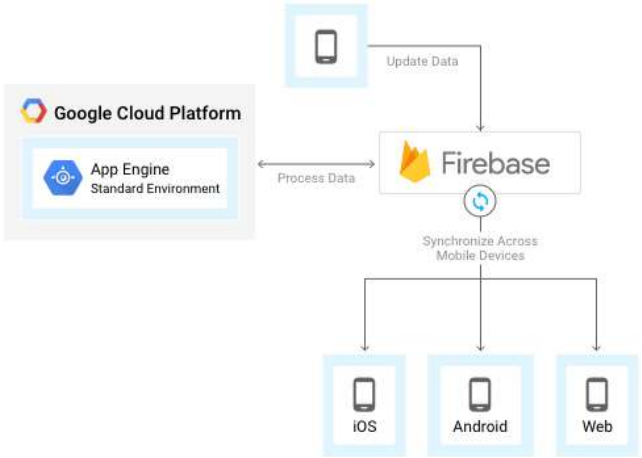

Figure 2. Basic Cloud Storage Functionality and Synchronization

To avoid reliance on the network, providers of databases and cloud services have started to add synchronization and offline capabilities to their mobile offerings. Solutions like Couchbase's Couchbase Mobile, Microsoft's Azure Mobile Services, Amazon's Cognito, and Google's Firebase offer the all-important sync that enables apps to work both online and offline.

For example Firebase Anywhere is a database-oriented rapid development tool that allows developers and designers to create

Web and hybrid mobile apps that work offline. It allows less-experienced developers to create sophisticated apps with a combination of configurable components, visual design tools, code-generation "genies," and a small amount of coding in Xbasic or JavaScript.

Cloud computing is a hot topic in various media, and it is stated that it has the potential to transform large parts of the IT industry (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica & Zaharia, 2009). Others claim that it is only a buzzword and that the technology has been around for years, for example in the form of grid computing and computing as a utility (Reese, 2009; Rittinghouse & Ransome, 2010). It is said to be just another attempt to market and pack existing technology in a new way (Krishnan, 2010). There is also a lot of confusion on what the term actually means or includes (Rittinghouse & Ransome, 2010; Armbrust et al, 2009) which is not surprising when the term covers a remarkably wide area. However, the critique is mainly directed towards to the term itself and many claims that the idea of cloud computing is here to stay, that there is great potential in the technology (Chow, Golle, Jakobsson, Masuoka, Molina, Shi & Staddon, 2009; Krishnan, 2010; Reese 2009; Rittinghouse & Ransome, 2010).

The mobile phone is the new personal computer (Allen, Graupera & Lundrigan, 2010) and its functionality is continually increasing (Carroll & Heiser, 2010). Mobile phones are increasingly used for web browsing, email and multimedia, to mention a few areas (Nurminen, 2010). However, the portability and small size of the device has its limitations when it comes, for example, to battery life (Miettinen & Nurminen, 2010; Othman & Hailes, 1998; Palmer, Kemp, Kielmann & Bal, 2009) and computational performance. Cloud computing has been suggested to improve mobile phones in various ways, but two common areas are battery life extension and computational offloading (Kumar & Lu, 2010) [9].

II. How To Choose A Database For Your Mobile Apps

Data synchronization and offline capabilities are key to successful mobile apps. Follow these guidelines to selecting a provider:

1. Self-provisioning of resources and elasticity. Cloud computing users are able to, without human assistance, acquire any amount of computing capabilities. For example, network storage, processing capabilities or software, which are available anytime and anywhere.
2. Pay-per-use. Costs of cloud computing services are based on usage. For example, an hourly or monthly rate, traffic load or numbers of users.
3. On demand availability. Cloud services are always accessible, platform independent and are commonly accessed through a web browser or web service API.
4. Scalability. Computation resources are perceived to be unlimited in the sense of matching any resource demands that the user have. For example, bandwidth, computational abilities or storage space. The cloud services should instantly be able to adapt to the demanded usage.
5. Resource pooling. Data and resources are divided on a vast amount of servers that usually are spread geographically; the resources needed are then directed based on the computational need of the service.[6]

III. LITERATURE SURVEY

Miettinen & Nurminen explains that energy efficiency is a fundamental consideration for mobile phones and argues that cloud computing has the potential to save energy through offloading (Miettinen & Nurminen, 2010). The energy cost of the computation must however be greater than the communication transfer cost to the cloud. Another interesting remark is that energy consumption is greater if the data sent is divided into smaller bits than by sending the same data in one large chunk. Miettinen & Nurminen presents a remarkably basic but straightforward formula, Ecloud < Elocal, which states that the energy consumption to send the task to the cloud must be smaller than the local consumption on the mobile phone, for offloading to be beneficial. They have also investigated the difference between 3G and WLAN connections where they state that the 3G connection uses more mobile phone energy the further away from the base station it is and that it takes longer time for the 3G connection to transfer data, in comparison to the WLAN connection, due to the lower bandwidth. To receive data is also less power consuming than to send it. In conclusion, Miettinen & Nurminen state that there are times when cloud offloading can be beneficial but that there is a lot of factors to consider and that cloud offloading can have other advantages like saving and sharing data across multiple platforms.

Palmer et al. has also investigated the importance of mobile phones in collaboration with cloud computing. The computational power of the mobile phone is stated to be the chief limitation of the mobile phone. This constraint makes it desirable to offload computational tasks to the cloud where the resources are "unlimited". But there are also problems related to the connection between the mobile phone and the cloud in forms of latency, connection interruption and network provider costs that needs to be considered (Palmer et al., 2009).

Carroll & Heiser investigated which parts of mobile phones are consuming most energy by measuring the different parts of a mobile phone while it was operating. The result shows that data transmission, phone calls and the display are the parts that

use most energy. To send and receive data from the cloud is therefore a very energy-consuming task in comparison to other mobile phone related functions (Carroll & Heiser, 2010).

Yang, Ou, & Chen has also acknowledged the limitations of mobile devices and argues that the miniature size and portability makes it hard to run applications that require a lot of computational power (Yang, Ou & Chen, 2008). Users want to run the applications that they use on more powerful computers on their mobile phones. Therefore Yang et al. suggests that cloud offloading could be a possible solution. They conducted an experiment where they use a text translate application. The application reads text through a mobile phone camera and translates it into German language. They compared the results of performing the translation task locally on the mobile phone and by offloading it on computers that represented the cloud. The result showed that it is beneficial to offload the task. Yang et al. also raises some important questions about the privacy related to offloading. When performing the translation task the image of the text is sent to a computer that the user does not control, which means that they no longer possess the control over the data and that third-party members could access it. Another interesting point is an offloading decision engine, as part of the application, that determines if it is suitable to offload a task or not. If the conditions are favorable, for example with a good mobile phone connection, it might be beneficial to offload the task to the cloud. However if the conditions are not beneficial then the application rather executes the task locally on the mobile phone.

Kumar & Lu has also investigated the energy constraint of mobile phones and argue that many applications are to computation intensive to be run on mobile phones. Cloud offloading is dependent on the wireless bandwidth capacity, the amount of computation and the amount of data that need to be transmitted. Kumar & Lu points out that the material that needs to be processed seldomly is considered. For example, if an application transforms an image the image itself needs to be uploaded to the cloud server before the processing can take place, and depending on the image size it can add up to quite an amount of data that needs to be 7 transmitted. There are also several challenges in using the cloud in mobile phone applications. Privacy and security issues needs to be considered when data are sent to servers managed by other people or companies. Reliability is another issue; the cloud servers must always be accessible for the application to work. If the servers are down for maintenance, the applications relying on it will not function. Finally, "real-time data" or latency is addressed. For example, in a GPS navigation application the information must be updated frequently. When using the cloud to conduct data transformation there will be some latency while sending the data back and forth from the mobile device. If the latency is great enough the information will already be obsolete when reaching the mobile device. These are some issues with cloud computing which needs to be considered (Kumar & Lu, 2010).

IV. CHALLENGES AND SOLUTIONS

The main objective of mobile cloud computing is to provide a convenient and rapid method for users to access and receive data from the cloud, such convenient and rapid method means accessing cloud computing resources effectively by using mobile devices. The major challenge of mobile cloud computing comes from the characters of mobile devices and wireless networks, as well as their own restriction and limitation, and such challenge makes application designing, programming and deploying on mobile and distributed devices more complicated than on the fixed cloud devices [7]. In mobile cloud computing environment, the limitations of mobile devices, quality of wireless communication, types of application, and support from cloud computing to mobile are all important factors that affect assessing from cloud computing. Table 2 gives an overview of proposed challenges and some solutions about mobile cloud computing [8].

1) **Limitations of mobile devices:** While discussing mobile devices in cloud the first thing is resource-constrain. Though smartphones have been improved obviously in various aspects such as capability of CPU and memory, storage, size of screen, wireless communication, sensing technology, and operation systems, still have serious limitations such as limited computing capability and energy resource, to deploy complicated applications. By contrast with PCs and Laptops in a given condition, these smartphones like iPhone 4S, Android serials, Windows Mobile serials decrease 3 times in processing capacity, 8 times in memory, 5 to 10 times in storage capacity and 10 times in network bandwidth [8].

2) **Quality of communication:** In contrast with wired network uses physical connection to ensure bandwidth consistency, the data transfer rate in mobile cloud computing environment is constantly changing and the connection is discontinuous due to the existing clearance in network overlay. Furthermore, data centre in large enterprise and resource in Internet service provider normally is far away to end users, especially to mobile device users. In wireless network, the network latency delay may 200 ms in 'last mile' but only 50 ms in traditional wired network [8].

V. CONCLUSION

Today's best apps blend client and cloud into a single platform, creating highly responsive experiences for users backed by powerful computing resources remotely. Cloud Platform helps you strike this balance easily for your mobile backend, where non-interactive tasks get offloaded to Cloud Platform, resulting in improved battery life on mobile, lower bandwidth usage, and a snappy client experience on mobile.

Mobile hybrid cloud computing (MHCC) at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device.

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