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Survey paper on Mobile Cloud Computing

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Abstract:

Cloud computing is evolving as a new paradigm of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet. The confluence of hardware virtualization, cloud and mobile computing drives the new era of mobile cloud computing. Platforms such as android, iOS, Windows 7 erodes the power of computing platforms like Microsoft Windows and Apple Mac OS and is creating cross platform app centric environment in which end-users and in particular the consumer marketplace will drive developments in business computing. There are endless possibilities that can be brought about with the mobile cloud in the near future. This paper discusses the current state of mobile cloud computing and open challenges in mobile cloud computing.

Keywords: Mobile computing, Mobile Cloud Computing, Microsoft Azure, Mobile Communication, Amazon EC2,

Section I: Introduction

Today's mobile phone users can perform a wide range of tasks by downloading applications to their handset from online stores. These applications are called native applications specific to the mobile operating system and they use the computing power and memory contained in the device to run the application. Sophisticated applications which requires more processing power and memory is not suited to run on these devices. Hence it poses a challenge for the mobile application developers to build different versions of the same application for multiple mobile operating systems and more sophisticated applications require robust computing power and memory in the handset. Cloud computing, an evolving trend with which we can access various services over the internet, can bring unprecedented sophistication in mobile ecosystem. It can leverage the power of handsets by executing the applications on the cloud instead of locally running them on the mobile device. This give rise to the new term called mobile cloud computing. Mobile cloud applications can not only be accessed by smart phones, but they can also be accessed by low cost featured phones where the processing power and memory is restrained. The demand for resources by the mobile applications can be fulfilled by cloud platforms such as Amazon EC2, Microsoft Azure and Google AppEngine which can provide the resources that are deficit in mobile phones.

Several views exist on mobile cloud computing. From one perspective, mobile cloud computing can be defined as an architecture where the data processing and storage happens outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones into the cloud, bringing the apps and mobile computing to not just smart phone users but a much broader range of mobile subscribers. On the other way round, mobile cloud computing can be thought of as a cloud where the cloud is formed by a group of mobile devices that share their computing power to run applications on them. By this way mobile cloud computing can bring tremendous benefits to the feature phone enabled users as equivalent to the smart phone users. Mobile computing can also mean using portable devices to run stand-alone applications and/or accessing remote applications via wireless networks [5]. The paper is organized as follows: section II covers Mobile Cloud Computing [MCC] approaches in providing its services. Section III surveys the current literature and extract the current challenges facing MCC. Section IV list some research idea that can be tackled by researchers to further enhance the use of MCC.[1]

Section II:
Mobile Cloud Computing Approaches :

One approach to deploy MCC is that the applications that require extensive computation are offloaded to the computational cloud and the results are returned to the mobile device. Cloud service providers (CSPs) provide the physical and virtual areas in which such apps are run-

ning. In most cases, users are unaware of the location where such apps are executed. However, mobile users are ideally able to connect to such clouds anywhere and at any time. CSPs bring together various resources to form a cloud. Mobile users should be able to benefit from this cloud in storing large amounts of data, thereby protecting their data from virus attacks, data loss, or data leakage that can cause the data to be destroyed [2].

Other approaches for MCC considers the mobile phone itself as a resource provider to other mobile cloud computing seekers. This allows for what is known as mobile peer-to-peer communication. This can be done in combination with providing resources from stationary objects as well. The aim of this approach is to maximize connectivity by utilizing the maximum potential of the mobile phone [3].

SECTION III.

A. Recent Mobile Cloud Computing Challenges:

Considering that MCC is a relatively new technology started in 2009, there are many challenges that arose upon experimenting with the systems and after establishing several clouds led by different CSPs. Each CSP and cloud may have their own set of issues resulting from various variables, but some issues are common and seen in most clouds mobile cloud computing initiatives. Those issues are worth addressing and require further exploration.

1) A. Limited Computational Capacity and Battery Life

When it comes to battery capacity, the mobile devices are relatively limited compared to stationary devices where is a lot of space to implement stronger, long-lasting energy sources. Mobile phones have a limited computational capacity that limits many of its functions. For example, the use of location services like GPS consumes a lot of energy because it involves extensive use of sensors. Likewise, some apps that require a huge processing capacity, like image processing for video games, speech synthesis, natural language processing, augmented reality and wearable computing. Such services represent a computational challenge to application developers, because they are not able to implement applications that meet such a need. Given the fact that this limitation is dictated by the limited battery capacity and the small size of mobile devices, it is more likely for this problem to be solved using software developments than hardware ones [4].

2) B. Connectivity

Maintaining connectivity across different connection mechanisms used is a challenge for MCC. In case of 3G/4G connectivity, there is an increased data cost and latency. As users move, there is variability in signal strength that disrupts ongoing processes. This could be due to variability in location signal reception or the present of blind spots that have no connectivity at all. Accordingly, development of systems that overcome such problems is necessary for MCC to manifest its promising potential [3]. By nature, mobile devices have limited network bandwidth, compared to wired networks. The Quality of Signal (QoS) delivered to the user is affected by non-proportionate delay in execution of the applications, the dismissal of always-on connectivity, and the excess utilization of limited mobile resources. Not only does this limitation in resources affect signal, but it also takes its toll on the processes of applications [4].

C. Data Security and Privacy Issues

One of the major issues facing MCC is data security. Parasad and Gyani[l l] focused on some security concerns related to MCC including loss of physical security, handling of encryption and decryption keys, security and auditing issues of virtual machines, less norms for data integrity, and services platform incompatibility from various vendors. Further, when offloading data to the cloud, there is concern about data safety and privacy. The offloading process places the data of the user at risk of data breach and invasion of personal information. [6] There is also the concern about intended violations, which are seen as a specific person hacking a particular device for the sake of sabotaging or stealing important information. Although different from hackers who violate the data of random users, such premeditated attacks could even be more harmful and have a negative impact of user's privacy [3]. Moreover, a flaw in the encryption algorithm on the CSP's part can result in unauthorized access to one's information. Any user can access sensitive information when security fails to protect the data of the victim user [12]. Social media and online payment seem to be the most vulnerable resources for hacking since it carries important and crucial data for users and users seem to be less careful when sharing information especially with social media [1]. Another issue with lack of security is piracy. When pirated material is distributed among mobile networks, they have a much wider exposure to unwanted users than they do in other devices. An encryption and decryption procedure can restrict access to such material by providing keys prevent unauthorized access to digital materials [3].

D. The Role of Malware in Security

The wide array of mobile applications used by mobile phones to access other mobile devices is an attractive medium for malware creators.[7] The issue is no longer caused by unauthorized users accessing unauthorized data. Rather, it is happening because people are agreeing on installing malware on mobile devices that can transfer and leak personal data to malware creators.

E. Latency

The standard architecture of mobile cloud involves three elements: Mobile client, Transmission channel and Cloud. This basic structure involves latency as the request is sent to the cloud and back to the mobile device upon completion.[8] Further, Part of the accessibility issue originates from the added security layers to prevent unauthorized access to data.

F. Heterogeneity

Heterogeneity in MCC is the existence of various types of hardware, architectures, infrastructure, and technologies of mobile devices, clouds, and wireless networks.[9] MCC is used in a heterogeneous environment ranging from different interfaces on the wireless network different nodes in the mobile device, and different wireless technologies such as WiMAX, GPRS, WLAN, CDMA2000 and WCDMA. Heterogeneity could cause MCC to fail to fulfill its proposed benefits as being efficient in energy use of mobile devices, always being connected, and scalability of on-demand wireless connection.

G. User Interface Issues

Mobile device sizes are relatively small. This means that most apps rely on interfaces that have few static elements, such as scroll bars, palettes, and pop-up menus and icons. Another drawback is the reduced typing speed due to lack of screen size. Such interfaces are considered easy-to-use, but further development is required to design easy interfaces without static elements. Another issue is that the tasks performed on mobile phones are assumed to be different from regular desktop tasks.[10] Mobile devices are assumed to be used for viewing data and less data entry, contrary to desktop computers. Accordingly, user interface designers keep that point in mind when designing software .

SECTION IV.

Future Research Perspectives

Finally, research directions pertaining to the burgeoning field of MCC opened new research and innovation opportunities. Developing security measures and establishing a neutral environment where technology heterogeneity is neutralized seamlessly are the most prominent issues that demand researchers' attention. The following are some research idea that can by tackled by researchers to enhance MCC potential:

Here are a few research ideas that could resolve some of the issues seen in MCC today:

- Develop security measures that are compatible with the low-energy status of mobile phones
- Examine ways to decrease cost of application elasticity
- Create cloudlets with minimum energy requirement and increased computing power
- Maximize computational capacity of mobile devices to overcome the current limited capacity that restricts development of high-demand applications.
- Apply a theoretical framework to a real-life situation to double-check that proposed solutions to problems are achieved by the methods expected
- Design UI with less static elements for mobile devices.

SECTION V.

Conclusion

Mobile cloud computing is a relatively new field with challenges arising every day. It has become popular because it combines the advantages of both mobile computing and cloud computing. However, because of the nature of mobile devices, MCC encounters several challenges that could hinder its claimed benefits. Example of the challenges limited computational capacity and battery life, data security and privacy issues heterogeneity of MCC technology, connectivity issues, lack of a unified user mobile user interface, and lack of interoperability. This research paper list current MCC challenges and offer solutions as proposed by recent research.

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