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Mobile Computing – An Upcoming Trend

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Abstract— Mobile Cloud computing (MCC) is an upcoming trend which combines functionality of cloud computing and mobile applications. The foundation of cloud computing is the delivery of services, software and processing capacity over the internet, reducing cost, increasing storage, automating systems, decoupling of service delivery from underlying technology, and providing flexibility and mobility of information. In this paper, we explain how cloud computing differs from mobile cloud computing, workflow and basic architecture of mobile cloud computing. We will also discuss how current technologies enables mobile cloud computing possible and real life scenarios or examples will help to better understand mobile cloud computing usage. With future enhancements and better understanding of MCC we can build more powerful mobile applications.

Keywords— Mobile Cloud Computing (MCC), Mobile networks, MCC trends, MCC enabling technologies

1. INTRODUCTION

Cloud computing brings advancement in the field of information technology. Cloud computing is based on several service models such as SaaS, PaaS, Naas, DbaaS, IaaS and many more. This cloud computing approach eliminating the client server and grid computing. Now a day's all corporations are going to computerize. It is not superior idea that invest high amount of money for acquiring the servers and professional staff for maintaining this server. Instead of this, it is efficient to use cloud computing, where the companies just required to take service from the cloud service providers as per the requirement of companies. There are various companies are existing that provide cloud services. Amazon, Microsoft and Google are the companies that provide cloud services. Cloud computing is Internet ("cloud") based development and use of computer technology ("computing"). It is a style of computing in which dynamically scalable and often virtualization resources are provided as a service over the internet. One of the most fundamental services offered by cloud providers is data storage. [1]

Mobile cloud computing is the form of cloud computing in combination with mobile devices. Mobile computing relates to the emergence of new devices and interfaces. MCC include limitations of wireless bandwidth and fluctuations occur during computation. Mobile computing functions include accessing the Internet through browsers, supporting multiple software applications with a core operating system, and sending and receiving different types of data. However, the mobile devices are facing many challenges in their resources and communications. [1] The ultimate goal of MCC is to enable execution of rich mobile applications on a plethora of mobile devices, with a rich user experience. For example, big businesses and even smaller operations use specific cloud computing services to

make different processes like supply-chain management, inventory handling, customer relationships and even production more efficient. Mobile computing is taking a physical device with you. This could be a laptop or a mobile phone or some device which enables you to telework – working wherever you go because of the small size of the device you’re using. This paper describes the difference between cloud computing and mobile computing. How it differs in workflow. The advantages and disadvantages of mobile computing. Real life example of mobile cloud computing. [2]

2. LITERATURE SURVEY

Han Qi et. al. [3] discuss Mobile cloud computing(MCC) as a development and extension of mobile computing (MC) and cloud computing (CC) which has inherited high mobility and scalability. The proposed system in the paper explains the principle of MCC, characteristics, recent research work, and future research trends. Proposed system analyses the features and infrastructure of mobile cloud computing and also analyses the challenges of mobile cloud computing.

Dejan et. al. [4] discuss about the mobile communities which introduce new requirements compared to traditional online web communities. On the other hand, cloud computing is emerging as computing concept that gives the computational resources on demand and abstraction of technical details from the clients. The paper proposes Mobile Community Cloud Platform (MCCP) as a cloud computing system that can influence the full potential of mobile community growth. An analysis of the core requirements of common mobile communities is provided. The paper presents the design of cloud computing architecture that supports building and evolving of mobile communities.

Fabrizio Capobianco [5] in review paper “Five reasons to care about mobile computing”, explores the technical and market opportunities presented by the intersection of the cloud technologies and rapid advances in mobile computing for Free & Open Source Software. It discusses at least 5 reasons why mobile cloud computing is important for free and open source software, which are as follows: 1. Mobile computing is big in size 2. Mobile cloud computing is a need – form factor and other needs 3. Mobile clouds need interoperability 4. Mobile cloud largely depends on locked-down devices 5. Mobile cloud is an opportunity for free software providers.

Deepti Sahu et.al. [6] in paper titled “Cloud Computing in Mobile Applications” discusses how to implement cloud computing for mobile devices providing data storage and processing outside the device as well the techniques with the help of which mobile devices are going to access applications being offered by these clouds. Challenges related to mobile applications as interoperability, cloud application flexibility, mobile cloud convergence are overviewed. Details of challenges regarding security such as information security, privacy and confidentiality, malicious attacks, networking monitoring, compliance and enforcement, incident response are discussed.

3. WORKFLOW OF MOBILE CLOUD COMPUTING

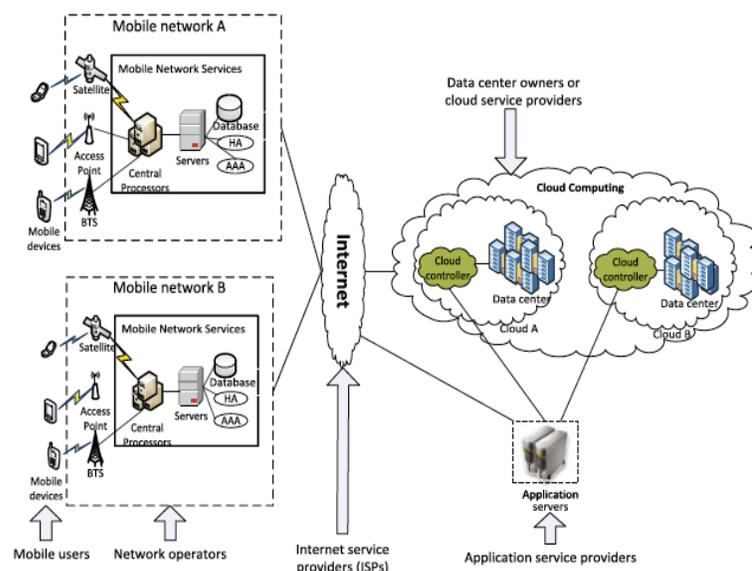


Fig 1: Architecture of Mobile Cloud Computing [11]

Architecture of mobile cloud computing consist of mobile devices, mobile networks, network operator, central processor, servers, databases, internet service provider, data centers.

Mobile devices like mobiles, laptops communicate with the mobile network with the help of base stations, access points, satellite. The information that is transmitted is operated on central processing unit, servers, databases which contain information related to the computation on mobile network provider side. Mobile network provider provides the essential services like AAA means authentication, authorization, accounting based on the information stored in databases. Authentication, authorization, and accounting (AAA) is a term for a framework for intelligently controlling access to computer resources, enforcing policies, auditing usage, and providing the information necessary to bill for services. After that network operator request to the cloud through the internet. Cloud service provider process the request to provide the services to subscriber. MCC provide effectiveness and clearness by using advantages of cloud computing.

4. REAL LIFE SCENARIOS

We are using mobile cloud computing in our daily life, but most of the times end user is unknown of its actual working. Let us discuss day-to-day life's few examples.

1. Email on the go - Email communication now plays a central role in most of our busy lives. That's fine if we don't go out much but if we travel a lot, this may cause problems. Unless we carry a mobile Wi-Fi-enabled laptop with us everywhere we go or use push email on our cell phone, having an email client sitting on our computer at home means that while out and about we risk spending time outside of the communication loop. This is one area where the cloud finds its most frequent and useful application. [9]

Online email has been offered by all the big names (such as Microsoft, Yahoo and of course Google) for a number of years and we have tried a lot of different services. Wherever in the world we have found ourselves, our emails have (almost) always been made available to us. The easiest and most convenient for us is Google Mail, although each has its pros and cons. [9]

Of course, using webmail makes us a slave to an internet connection. The first thing we do when we find ourselves in a new or unfamiliar location is to try and locate an internet café or public library to launch our secure portable browser and check your emails. Privacy concerns are never far from the surface either, especially when stories of passwords to private accounts being leaked online hit the headlines. How much of our life have you given away during email exchanges? And then there's the issue of possible data loss, which nicely leads onto the next incarnation of cloud computing. [9]

2. No need of local data storage - Data stored on our home or business computer suffers from many of the same restrictions as email and, as with email, the cloud offers a solution. Storing our MP3's, video, photos and documents online instead of at home gives us the freedom to access them wherever we can find the means to get online. [9]

True, we will undoubtedly be putting our life 'out there' and with that comes all the security and privacy baggage that also plague webmail. Most, if not all, online storage facilities have safeguards in place to ensure that we, can get to our files – but even so. We all risk losing important files, memories and such like if we suffer from hard drive failure and storing such things away from a temperamental computer system no doubt seems like an ideal solution but where do we turn if the unthinkable happens and our chosen cloud filing cabinet suffers data loss or suddenly closes down? Examples of online storage services include Humyo, ZumoDrive, Microsoft's SkyDrive, S3 from Amazon, amongst others. Many offer both free and paid for storage and backup solutions. [9]

3. Are we collaborator? - On occasion we may find ourselves in need of the opinion of our peers. Downloading files onto flash memory, emailing documents to friends or family or colleagues or sending submissions by snail mail is so last century. Last year Google launched a service that allowed groups of people to work on the same document, idea or proposal in real time or whenever convenient to each participant. Using Google Wave we can create a document and then invite others to comment, amend, offer opinion, or otherwise join in with the creation of the final draft. [9]

Similar to instant messaging but offering much more scope it can take a project that might have taken weeks or even months to complete using other methods and potentially see it through to completion in mere minutes or hours.

Google is not alone in producing online collaboration tools but it is the only one we have used ourselves. Other examples include Spicebird, Mikogo, Stixy and Vyew to name but a few. [9]

4. Working in a Virtual Office - Yet again Google's online suite of office applications is probably the best known but by no means the only solution on offer. Rather than having a system and space hogging suite of applications like a word processor, a spreadsheet creator and a presentation or publishing platform sitting on our computer, we could opt to work online instead. Accessibility, potential for collaboration and perhaps even online storage are just some of the benefits of satisfying our office suite needs by working online. Examples of online suites on offer include Ajax13, Think Free and Microsoft's Office Live. [9]

5. Need extra processing power? - For the dedicated cloud enthusiast, something like Amazon's EC2 virtual computing environment might be the answer to all your needs. Rather than purchasing servers, software, network equipment and so on, users would buy into a fully outsourced set of online services instead. [9]

Most cloud environments on offer can customize the kind of service provided to exactly suit the needs of the user. If we need more processing power from time to time, a cloud-based infrastructure, being scalable, negates the need for up-front investment in client-owned resources. [9]

Other service providers include the open source Abi Cloud, Elastic hosts and NASA's Nebula platform. [9]

5. ADVANTAGES AND DISADVANTAGES OF MCC

There are several advantages of using cloud computing for mobile devices:

Flexibility: One of the major and important advantage of mobile computing is that there is no matter where are you in the world, you can access data anywhere. There is no any limitation on accessing the data as long as you are connected with the internet. You can also access data from your mobile. [10]

Real time data availability: You can access the real time data wherever you are and at any time. Given data and applications that you are accessing is managed by the third party or owner of that particular site. The updating and accessing of the data in real time is very easy. This data can also access by multiple users at a time simultaneously. This is very helpful application of mobile computing.

Multiple platforms: Mobile computing allow to access multiple platforms at a time, and this is not like the traditional applications. Whatever the platform it may be you can access data and application stored on the cloud [10]. We can switch to multiple platforms while using the mobile devices.

Security: Although cloud service providers implement the best security standards and industry certifications, storing data and important files on external service providers always opens up risks. Using cloud-powered technologies means you need to provide your service provider with access to important business data. For some instance multiple users are hosted on same server hence there are chances of hacking. The hacker might try to divide the data of user and store it on to the same sight. Here there are less chances of such type of problems.

No upfront costs: In most cases, cloud applications have minimal upfront cost. It is very much a pay-for-use service which has helped to grow adoption of the model, especially for SMBs. Without hefty fees for licensing and upgrades, the cost of adoption is less of a barrier when cash flow is an issue. [10]

As there are advantages of mobile computing, there exists some cons or disadvantages also:

Performance: The major concern about the mobile cloud computing is that some user thinks that the application is not providing good performance. The native applications are better than these applications. So check first with your service provider and understand the track of application and their way of working. [10]

Security: The second concern about the mobile computing is the security of the data. mobile users provide sensitive information through the network and if that network is not safe and protected for sharing the information then there is a concern about the security of data. [10]

Connectivity: Internet connection in mobile computing is critical. Hence before using the services you must check the connection. [10]

6. ENABLING TECHNOLOGIES FOR MOBILE CLOUD COMPUTING

The enabling technologies helps for the growth of mobile computing. Here we will discuss some technologies that will impact on the advancement of mobile computing.

4G: 4G network is now easily accessible to the users which will help you to solve the problems of latency and bandwidth. Examples: Samsung introduced the Yes Buzz 4G cloud phone, there is no need to put sim card inside phone though you can save contacts and synchronise on internet. Also in February 2011 Motorola introduced Atrix model, with fingerprint reader for unlocking the phone. It also fits in docks which connect keyboard with mouse. Converting phone into laptop. It shows how we will be using phones in future. [10]

HTML5 and CSS: For mobile web application HTML5. HTML is a hypertext mark up language which is also called as language for document publishing, it provides a means of publishing web pages including headings, text, tables, lists, photos. Enhancement and improvement that HTML5 introduces specifies the need for web application support. It allows offline support of documents which makes local storage possible. It also adds graphics, canvas for images texts, video features and video without plugins. It also provides the geo location API. [7]

HTML5 and CSS both are not fully developed yet, developers are still working on new features such as apple safari, google chrome also the sample websites CNN.com. Hybrid application framework like phone gap, QuickConnect , RhoMobile, Titanium implements HTML5. These applications and frameworks are helping to enable Cross platform development for mobile devices. [7]

Hypervisor: Another technology for cross platform application is hypervisor also called embedded hypervisor. Hypervisor allow to run any application on any platform that is on any mobile phone without any specific architecture.

Mobile platform require hypervisor to be built in. A wider range of hypervisor are present on Motorola Atrix hence it can run wider range of applications other than inbuilt applications. This is one of the easily acceptable technology. [7]

Cloudlets: Cloudlets is related to the latency in mobile cloud computers. Cloudlets is a small device that can also present in coffee shop. Wi-Fi hotspots and other local devices can be equipped with local processing and storage. When needed the device can download the data of user from nearby location hence latency get reduced. When finished the data can be returned to the centralised location. The process repeats for individual user. [7]

Web 4.0 - The term of Internet of Things is Web 4.0 and sometimes, the Symbiotic Web. One writer describes the phenomenon as the migration of online functionality to real-world objects, as in the example of being able to run a Google search of your home to find the TV remote control. The existence of this phenomenon is not so much an enabling technology as it is a driving technology for mobile cloud computing. [7]

7. TRENDS THAT IMPACT FUTURE OF CLOUD COMPUTING

Mobile Cloud is one of the hottest trends in cloud computing that is expected to play an important role in the future.

1. Mobile is used to access data presentation, spreadsheet, documentation, paper presentation. [8]
2. Phone network providers take lot of efforts on developing mobile cloud as good option. [8]
3. By moving app from the PC to tablets enterprises are taking too much efforts on mobile cloud services and computation. In this way tablets are connected to supplement the PC's. [8]
4. Consumers are now buying more from mobile commerce and also buying things from their online mobile wallets. This is enabled by mobile cloud infrastructure and computation. [8]
5. By putting their applications on mobile their robustness is not increased. People drop their phones anywhere hence there is probability of data loss. Due to this to store data on cloud than on mobile has become necessary. [8]
6. Now a day the social Medias are becoming daily need, convenient and popular among consumers and in case of business it has become a common place to share data on social media. [8]

The flexibility demanded by the mobile workforce is one of the key reasons cloud computing is on the rise. The anytime, anywhere access the data on cloud without any hurdles. Directly or indirectly most of the businesses are and will use SaaS applications for their business via mobile. So Mobile cloud computing is going to be an integrated part of the business economy. [8]

8. CONCLUSIONS

The advancement in cloud computing and mobile technology will provide new ways for mobile cloud computing to develop new approaches in its use. Juniper Report notes that the key to mobile's future depends upon processing power of the cloud itself. Thus with the help of cloud computing, cloud-based Mobile apps can scale beyond the capabilities of any smart phone. The cost of computing and sharing information and applications is reduced without the need of complex and costly hardware and software. Mobile phones features and functionality are now enhanced through new cloud applications.

In this way, we discussed the evolution of mobile cloud computing, as well how mobile cloud computing differs from traditional cloud computing. The real life scenarios where mobile cloud computing is beneficial are seen. The enabling technologies for MCC are discussed which makes it practically possible. Also, we over-viewed views on mobile cloud computing through literature survey, benefits and trends that impact MCC. In the coming future, the market of mobile cloud computing will expand and become more equal playing fields.

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