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MOBILE CLOUD COMPUTING APPLICATIONS FOR SMART COMPUTING - A STUDY

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ABSTRACT

Cloud computing is emerging as one of the most important branch for providing seamless applications on mobile devices. Mobile Cloud Computing integrates the cloud computing into the mobile environment and overcomes obstacles related to the performance, environment and security. Mobile Cloud Computing refers to an infrastructure where data processing and storage can happen outside the mobile device. This paper presents a brief Survey about Mobile Cloud Computing Architecture, Applications, Challenges and Solutions and Advantages.

KEYWORDS: Mobile Cloud Computing Architecture, Applications, Challenges and Solutions

INTRODUCTION

Today, the market of mobile phones is growing at a very high speed. Everyone has a mobile phone which provides the facility to move anywhere and access the data anytime. There are some limitations in mobile phones with respect to the desktop these are limited battery life, storage capacity, bandwidth etc. With the emergence of Cloud computing in mobile web mobile users can use infrastructure, platform, software provided by cloud providers on on-demand basis. Emergence of Cloud Computing with mobile devices gave birth to Mobile Cloud Computing. Mobile devices (e.g., smartphone, tablet pcs, etc) are increasingly becoming an essential part of human life as the most effective and convenient communication tools not bounded by time and place. Mobile users accumulate rich experience of various services from mobile applications (e.g., iPhone apps, Google apps, etc), which run on the devices and/or on remote servers via wireless networks. The rapid progress of mobile computing [1] becomes a powerful trend in the development of IT technology as well as commerce and industry fields. However, the mobile devices are facing many challenges in their resources(e.g., battery life, storage, and bandwidth) and communications (e.g., mobility and security) [2]. The limited resources significantly impede the improvement of service qualities. The combination of a ubiquities mobile network and cloud computing generates a new computing mode, namely Mobile Cloud Computing. As a result, mobile applications can be rapidly provisioned and released with the minimal management efforts or service provider's interactions. With the explosion of mobile applications and the support of Cloud Computing for a variety of services for mobile users.

Mobile cloud computing brings new types of services and facilities for mobile users to take full advantages of cloud computing.Various applications based on Mobile Cloud Computing, such as Google's gmail, Maps and Navigation systems for mobile, Voice Search, and some applications on an Android platform, MobileMe from Apple, LiveMesh from Microsoft and Motoblur from Motorola, have been developed and served to users.

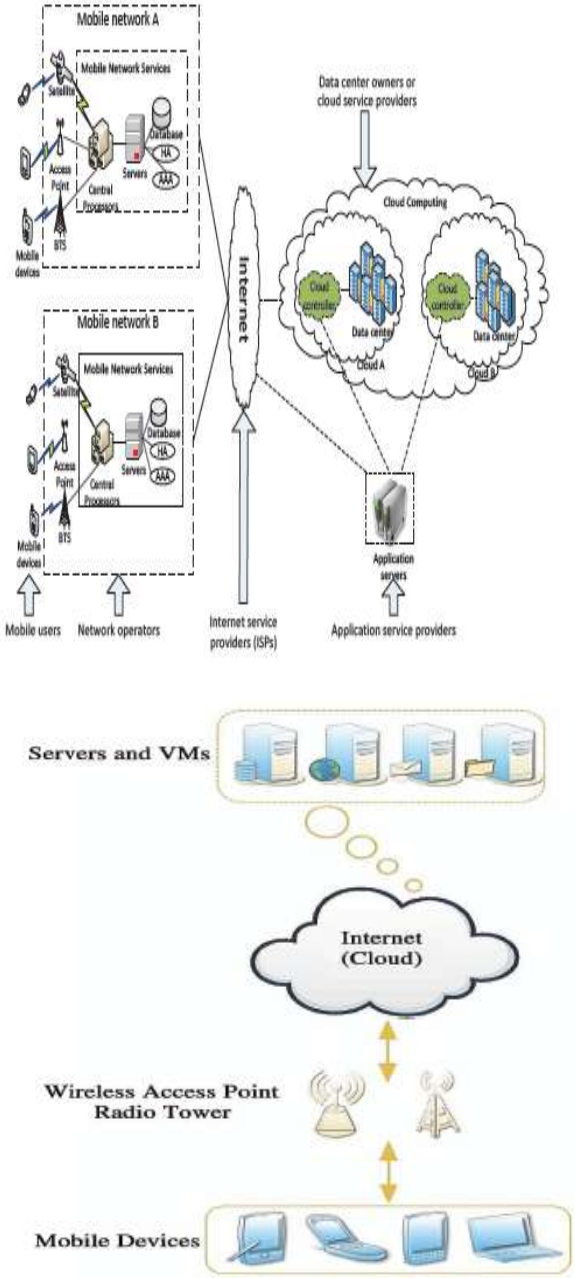

Fig 1 :Cloud Computing

ARCHITECTURE OF MOBILE CLOUD COMPUTING

The general architecture of MCC can be shown in Fig:2. In Fig.2, mobile devices are connected to the mobile networks via base stations (e.g, base transceiver station (BTS), access point, or satellite) that establish and control the connections (air links) and functional interfaces between the networks and mobile devices. Mobile users' requests and information (e.g., ID and location) are transmitted to the central processors that are connected to servers providing mobile network services. Here, mobile network operators can provide services to mobile users as AAA (for authentication, authorization, and accounting) based on the home agent (HA) and subscribers' data stored in databases. After that, the subscribers' requests are delivered to a cloud through the Internet. In the cloud, cloud controllers process the requests to provide mobile users with the corresponding cloud services. These services are developed with the concepts of utility computing, virtualization, and service-oriented architecture (e.g.,web, application, and database servers).

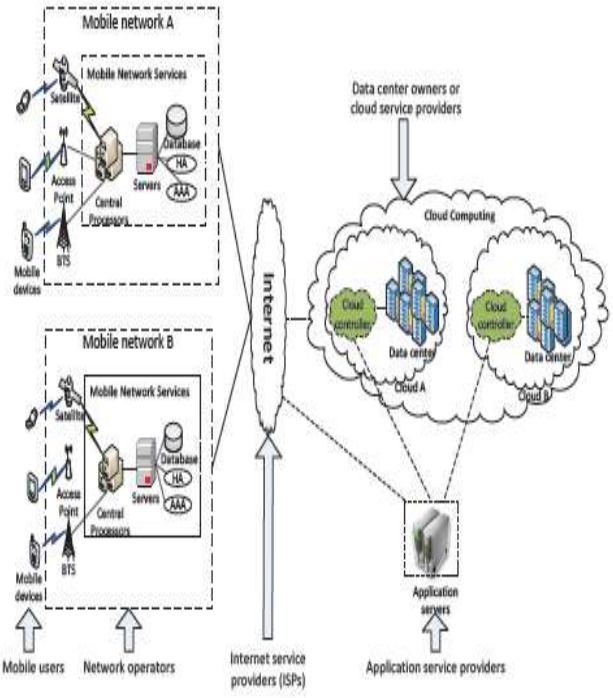

Fig 2 : Cloud Computing Architecture

APPLICATIONS OF MOBILE CLOUD COMPUTING

Today a mobile user requires a lot of services which he can perform while moving. Use of cloud computing in mobile devices can fulfill these requirements of mobile users. Now Mobile Cloud Computing is emerging day by day, there are many areas where Mobile Cloud Computing is used. Mobile Cloud Computing can be used in performing mobile accounting, mobile payment or in mobile healthcare. It can also be used to listen music anytime from anywhere. Some of the applications of MCC are described here.

A. Cloud email: Today all mobile users are using Gmail (a free email service provided by Google) on their mobile devices. This is a live example of Mobile Cloud Computing because all emails of a user are store on a server (outside the mobile phone) and all processing is performed on the cloud.

B. Mobile commerce: Mobile commerce (m commerce) applications can be mobile shopping, finance, accounting, advertising etc. All these require mobility like mobile transactions, payments, mobile ticketing etc. Using mobile commerce on mobile devices has to face a lot of challenges (like low network bandwidth, security etc) but the emergence of Cloud Computing to mobile reduces these challenges. In [3] a 3G platform based on cloud computing is proposed which has advantages of both 3G and cloud computing.

C. Cloud music: Providing facility of "Music Anywhere" to customers on their mobile device is an example where Mobile cloud computing is used.

D. Mobile healthcare: The emergence of telecommunication in medical field makes the diagnosis and treatment of people easy. Now monitoring the health of patient and to provide him treatment on time is possible. This also has some issues related to physical storage, privacy of user data, security etc. But with help of cloud computing these issues are reduced now. Mobile healthcare provides various services on on-demand basis to hospitals. [4] Proposes Healthcloud, which is a prototype implementation of mobile healthcare based on cloud computing and mobile client running Android Operating System[5].

E. Mobile gaming: Mobile Cloud Computing provides the facility of game playing on mobile devices to mobile users. Mobile gaming requires large computing resources but with help of Mobile Cloud Computing all computations are performed on clouds so mobile devices do not need to have these high computing resources (example graphic rendering). The concept of offloading is used in mobile gaming.

F. Mobile learning: Mobile learning (m-learning) provides the facility to learn anything from anywhere. It is combination of both e-learning and mobility. M-learning also has some challenges in terms of high cost of devices and network, low storage capacity, low network transmission rate. The use of cloud computing in m-learning has solved these challenges. Like now all data storage and processing is happened on the cloud so it provides learners a number of services at low cost, at faster processing speed on on-demand basis.

G. Voice-based searching: User can search anything without typing it through speech recognition. [6] Introduces AT & T speech mashup model that combine web service with cloud computing environment to fulfill the speech recognition demand of users.

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 [20]. 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.

1) Limitations of mobile devices: While discussing mobile devices in cloud the first thing is resource-constrain. Though smart phones 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 smart phones 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. Normally, smart phone needs to be charged everyday as dialing calls, sending messages, surfing the Internet, community accessing, and other internet applications. According to past development trends, the increased mobile computing ability and rapid development of screen technology will lead to more and more complicated applications deployed in smartphones. If the battery technology cannot be improved in a short time, then how to effectively save battery power in smartphone is a major issue we meet today.The processing capacity, storage, battery time, and communication of those smartphones will be improved consistently with the development of mobile computing. However, such enormous

variations will persist as one of major challenges in mobile cloud computing.

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. Some other issues such as dynamic changing of application throughput, mobility of users, and even weather will lead to changes in bandwidth and network overlay. Therefore, the handover delay in mobile network is higher than in wired network.

3) Division of application services: In mobile cloud computing environment, due to the issue of limited resources, some applications of compute-intensive and data-intensive cannot be deployed in mobile devices, or they may consume massive energy resources. Therefore, we have to divide the applications and use the capacity of cloud computing to achieve those purposes, which is: the core computing task is processed by cloud, and those mobile devices are responsible for some simple tasks only. In this processing, the major issues affecting performance of mobile cloud computing are: data processing in data centre and mobile device, network handover delay, and data delivery time. For a given standard, providing a quality guaranteed cloud service should consider the following facts: optimal division of application between cloud and mobile device, interaction between low-latency and code offload, high-bandwidth between cloud and mobile device for high speed data transmission, user-oriented cloud application performance, self-adaptation mechanism of mobile cloud computing, and optimal consumption and overhead of mobile devices and cloud servers. The following strategies can be used to response to the challenges:

1. Upgrade bandwidth for wireless connection, make the web content more suitable for mobile network using regional data centres.
2. Deploy the application processing node at the 'edge' of cloud in order to reduce data delivery time.
3. Duplicate mobile devices to cloud using virtualization and image technologies, to process Data-Intensive Computing (DIC) and Energy-Intensive Computing, such as virus scanning in mobile devices.
4. Dynamically optimize application push in cloud and the division with mobile terminals.

ADVANTAGES OF MOBILE CLOUD COMPUTING

Cloud computing is known to be a promising solution for mobile computing due to many reasons (e.g.,mobility, communication, and portability [7]). In the following, we describe how the cloud can be used to overcome obstacles in mobile computing, thereby pointing out advantages of Mobile Cloud Computing.

1) Extending battery lifetime: Battery is one of the main concerns for mobile devices. Several solutions have been proposed to enhance the CPU performance [8], [9] and to manage the disk and screen in an intelligent manner [10], [11] to reduce power consumption. However, these solutions require changes in the structure of mobile devices, or they require a new hardware that results in an increase of cost and may not be feasible for all mobile devices. Computation offloading technique is proposed with the objective to migrate the large computations and complex processing from resource-limited devices (i.e.,mobile devices) to resourceful machines (i.e., servers in clouds). This avoids taking a long application execution time on mobile devices which results in large amount of power consumption.[12] and [13] evaluate the effectiveness of offloading techniques through several experiments. The results demonstrate that the remote application execution can save energy significantly. Especially, [12] evaluates large-scale numerical computations and shows that up to 45% of energy consumption can be reduced for large matrix calculation. In addition, many mobile applications take advantages from task migration and remote processing. For example, offloading a compiler optimization for image processing [14] can reduce 41% for energy consumption of a mobile device. Also, using memory arithmetic unit and interface (MAUI) to migrate mobile game components [15] to servers in the cloud can save 27% of energy consumption for computer games and 45% for the chess game.

2) Improving data storage capacity and processing power: Storage capacity is also a constraint formobile devices. MCC is developed to enable mobile users to store/access the large data on the cloud through wireless networks. First example is the Amazon Simple Storage Service (Amazon S3) [16] which supports file storage service. Another example is Image Exchange which utilizes the large storage space in clouds for mobile users [17]. This mobile photo sharing service enables mobile users to

upload images to the clouds immediately after capturing. Users may access all images from any devices. With cloud, the users can save considerable amount of energy and storage space on their mobile devices since all images are sent and processed on the clouds. Facebook is the most successful social network application today, and it is also a typical example of using cloud in sharing images.MCC also helps reducing the running cost for compute-intensive applications that take long time and large amount of energy when performed on the limited-resource devices. Cloud computing can efficiently support various tasks for data warehousing, managing and synchronizing multiple documents online. Mobile applications also are not constrained by storage capacity on the devices because their data now is stored on the cloud.

3) Improving reliability: Storing data or running applications on clouds is an effective way to improve the reliability since the data and application are stored and backed up on a number of computers. This reduces the chance of data and application lost on the mobile devices. In addition, MCC can be designed as a comprehensive data security model for both service providers and users. For example, the cloud can be used to protect copyrighted digital contents (e.g., video, clip, and music) from being abused and unauthorized distribution [18]. Also, the cloud can remotely provide to mobile users with security services such as virus scanning, malicious code detection, and authentication [19]. Also, such cloud-based security services can make efficient use of the collected record from different users to improve the effectiveness of the services.

CONCLUSION

Mobile Computing is the most emerging and well accepted technology with fast growth. Mobile Cloud Computing is one of the mobile technology trends in the future since it combines the benefits of both mobile computing and Cloud Computing, thereby providing optimal services for mobile users. In this paper , we discussed about the applications supported by Mobile Cloud Computing including mobile commerce, mobile learning and mobile healthcare have been discussed which clearly show the applicability of the mobile cloud computing to a wide range of mobile services.Thus, the challenges and solutions, advantages of mobile cloud Computing have been discussed.

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