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Mobile Cloud Computing: Overview and challenges

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ABSTRACT

Today is the era of Cloud Computing Technology in IT Industries. Cloud Computing is Internet-based computing, whereby shared information, resources, and software, are provided to terminals and portable devices on-demand. The rapid development of mobile technology and wireless networking and drives a strong demand for Mobile Cloud Computing (MCC). In MCC environment Cloud Computing, Mobile Computing and Networking are combined to offer cloud-based services to mobile users where the data are stored and applications are processed in a centralized computing applications located in the cloud. In this paper first, we present the overview of MCC in terms of architecture, deployment models, service models and applications of MCC. Then we outlined issues and challenges related to MCC.

Keywords— Cloud Computing, Mobile Cloud Computing, Cloud security and privacy, Cloud challenges

1. INTRODUCTION

Over the past few years, developments in the field of network-based computing and applications on demand have led to an explosive growth of application models such as cloud computing.

The increased use of mobility with Information Communication Technology (ICT) has dramatically changed the way of our lives. Mobile devices such as PDAs, tablet and smart phones became an integral part of our lifestyle. Smart phones are considered as the representative for the various mobile devices as they have been connected to the Internet with the rapidly growing of wireless network technology. Ubiquity and mobility are two major features in the next generation network which provides a range of personalized network services through numerous network terminals and modes of access. The core technology of cloud computing is centralizing computing, services, and specific applications as a utility to be sold like water, gas or electricity to users. Thus, the combination of a ubiquitous mobile network and cloud computing generates a new computing model, namely Mobile Cloud Computing.

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2. MOBILE CLOUD COMPUTING

With the development of cloud computing and Mobile devices, the term “Mobile Cloud Computing comes” into existence. What is MCC? MCC is a combination of mobile computing, cloud computing and mobile internet.

It takes away the data processing and storage from the mobile device to the remote cloud and reduces the load of the mobile device in terms of processing power and energy. After the processing has been done in the cloud server, the resulting data is sent back to the device.

Aepona [1] describes mobile cloud computing as a new paradigm for mobile applications where data processing and storage are moved from a mobile device to powerful and centralized computing platforms located in clouds over the internet. All these centralized applications are then accessed over the wireless connection based on a thin native client or web browser on mobile devices.

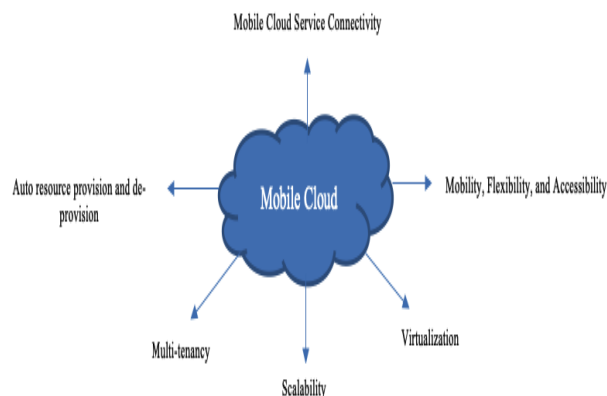


Fig. 1: Basic Features of MCC

Definition 1[2]: ‘Mobile cloud computing at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and MC to not just smartphone users but a much broader range of mobile subscribers’.

The MCC forum (<http://www.mobilecloudcomputingforum.com/>) defines MCC as: ‘Mobile cloud computing at its simplest refers to an infrastructure where both the data storage and data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and MC to not just smartphone users but a much broader range of mobile subscribers’.

3. MOBILE CLOUD COMPUTING ARCHITECTURE

The general architecture of MCC consist of components: mobile users, mobile operators, Internet Service Provider (ISP), and cloud service providers.

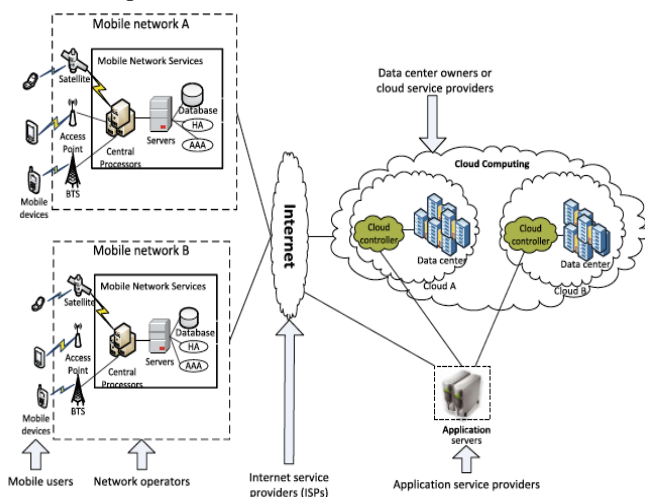


Fig. 2: Architecture of MCC

Mobile devices are connected to the mobile networks via base-stations (e.g., base transceiver station, 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 authentication, authorization, and accounting based on the home agent 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).

The mobile cloud computing architecture provides effectiveness by using the advantages of cloud computing. Four deployment models are identified for cloud architectures are:

3.1 Private Cloud

The cloud computing architecture is operated for a private organization and may be managed by the organization or a third party. It may be, exists on premise or off premise.

3.2 Public Cloud

The cloud infrastructure is made available to the general public or a large industry group. It may be owned by an organization selling cloud services.

3.3 Hybrid Cloud

The hybrid cloud architecture is a combination of two or more clouds that remain unique entities but are bound together by proprietary technology.

3.4 Community Cloud

It is used and controlled by a group of the organization for some common concerns weather managed by the third party or internally. It is a multi-tenant infrastructure shared among multiple organizations from a specific group with common computing concerns.

Similar to the Cloud Computing MCC also adopt a utility billing model to achieve low-cost services using the pay-as-you-use approach for required resources and provided services. Idly used models in MCC are listed below:

- **Mobile Network-as-a-Service (MNaaS):** MNaaS provides mobile networking infrastructures as a service [8]. The main advantages or MNaaS is its higher elastic scalability that requires a relatively low start-up cost for a network service vendor. A MNaaS example is OpenStack Networking (<http://www.openstack.org/software/openstack-networking>), which is an open-source cloud operating system. It allows users to create their own networks, control traffic, connect servers, and devices to one or more networks. OpenStack Networking is an example of MNaaS.
- **Mobile Cloud Infrastructure-as-a-Service (MIaaS):** MIaaS Provides computing and Storage resources as well as network components and devices are provisioned, managed, and returned according to on-demand mobile client requests in a pay-as-you-use model.
- **Mobile Data-as-a-Service (MDaaS):** MDaaS provides large scale databases and other storage resources and also supports data transactions, data management and data accesses. The examples of this model are Google Drive and iCloud.
- **Mobile Platform-as-a-Service (MPaaS):** MPaaS Provides mobile application development, deployment, hosting and testing tools. <https://appmobi.com> is an example of MPaaS.
- **Mobile Software-as-a-Service (MSaaS):** MSaaS provides facilities to deploy and executed the mobile application on a cloud, and mobile users will access the mobile application services through a thin mobile client based on wireless internet communications.

4. APPLICATIONS OF MOBILE CLOUD COMPUTING

In these days, a wide range of applications of Cloud Computing (CC) are used by mobile users such as cloud storage [9], cloud mobile media [10], learning and education [11], mobile social networks [12], mobile gaming [13], cloud-assisted Internet of Things (IoT) [14, 15]. These applications are developed to meet mobile user demands and mobile device capability [16]. The main goal of these applications is to provide mobile users with the access to available services on the cloud even from limited resourced mobile devices. In this section, some typical MCC applications are introduced.

4.1 Mobile commerce

Mobile commerce (m-commerce) is a business model for commerce using mobile devices. The m-commerce applications generally fulfil some tasks that require mobility (e.g., mobile

transactions and payments, mobile messaging, and mobile ticketing). The m-commerce applications can be classified into few classes including finance, advertising, and shopping. M-Commerce Applications provides the following services:

4.2 Financial services

It includes mobile banking (when customer uses their mobile devices to access their accounts and pay their bills) as well as brokerage service, in which stock quotes can be displayed and trade.

4.3 Service/retail

It provides the ability to the consumer for placing the order and pay for orders through any mobile device.

4.4 Telecommunications

Mobile has played a significant role in communication technology. It includes message transfer, voice data transfer, service requirements, bill payment and account review via mobile telecommunications.

4.5 Information service

It includes the delivery of financial news, sports figures and traffic updates with a single mobile device.

4.6 File hosting and storage

It is an internet hosting service specifically designed to host user files. It allows users to upload files that could be accessed over the internet after a user name and password or another authentication is provided. Typically, the services allow HTTP access, and sometimes FTP access. Related services are content-displaying hosting services (i.e. video and image), virtual storage, and remote backup. Microsoft One Drive, Dropbox, and Google Drive are a few popular file-hosting and storage services provided by Mobile applications.

4.7 Geo location and positioning

Geolocation is the identification or estimation of the real-world geographic location of an object. In its simplest form geolocation, involves the generation of a set of geographic coordinates (latitude and longitude) and is closely related to the use of positioning systems, but its usefulness is enhanced by the use of these coordinates to determine a meaningful location, such as a street address. Google Maps and Apple Maps are the most popular example of Mobile Geo-Location and Positioning MCC applications.

4.8 Mobile gaming

Mobile game (m-game) is a potential market generating revenues for service providers. A-game can completely offload game engine requiring large computing resource to the server in the cloud, and gamers only interact with the screen interface on their devices. Games powered by MCC support multiplayer. Spaceteam and PUBG are the most popular example of Mobile games Powered by MCC.

4.9 Other applications

M-Learning, Healthcare, and Social Networking.

5. ADVANTAGES OF MOBILE CLOUD COMPUTING

MCC is a combination of mobile computing and Cloud Computing. MCC inherits advantages of Cloud for mobile services.

5.1 Dynamic provisioning

Dynamic provisioning of resources is a flexible way for service providers and mobile users to run their various applications

without an advanced reservation of resources. Without storing data in mobile devices, it is stored in the cloud and can be accessed dynamically.

5.2 Scalability

The deployment of mobile applications can be performed and scaled to meet the unpredictable user demands due to flexible resource provisioning. Service providers can easily add and expand an application and service without or with a little constraint on resource usage.

5.3 Multitenancy

Internet Service providers i.e. network operator or data centre owner can share the resources and costs to provide a variety of applications and for a large number of users.

5.4 Ease of integration

Multiple services from different service providers can be integrated easily through the cloud and Internet to meet user demand.

6. CHALLENGES OF MOBILE CLOUD COMPUTING

6.1 Low Bandwidth Problem

In MCC network Bandwidth is one of the important things as the radio resource for wireless networks are transmitted over networks according to the amount of bandwidth is present for transferring the content in the network. Since mobile network resource is much smaller compared with the traditional network's bandwidth is one of the major important issues in a mobile cloud environment.

6.2 Security and Privacy in the Cloud

In mobile cloud computing security and privacy has become the biggest concern. When establishing a remote cloud base infrastructure certainly any organization will give away private data and information which might be sensitive and confidential. The cloud service provider has full control over the management of data and also responsible for protecting data from unauthorized access and leakage.

6.3 Vendor Lock-In

One of the major disadvantages of mobile cloud computing is the implicit dependency on the internet service provider. It is really painful and cumbersome if one user wants to switch from one provider to some other provider as he has to transfer a large number of data from the previous provider to the new one. This is another main reason why have to carefully and thoroughly contemplate in all options when picking a vendor.

6.4 Virtualization Techniques

In MCC, cloud services are based on visualization techniques. In the cloud end, an image of the virtual machine (VM) of the mobile device is pre-installed and the tasks of the mobile device are offloaded to the VM for processing. This offloading of tasks creates several threats to security including security challenges within the VMs, unauthorized access, VM to VM attack, communication security challenges within the virtualized environment, security challenges within the hypervisors and challenges to the confidentiality of data.

6.5 Limited Control

Since all the applications and services run on remote or third-party virtual environments, users have limited control over the whole function and execution of the hardware and software.

7. CONCLUSION

Mobile cloud computing is an emerging and fast-growing field of cloud computing. The aim of this technology is to use services whether storage, software, or applications on the cloud by mobile devices. Though still now it is on the early stage of development, in future mobile cloud computing could become the major model for mobile application. This paper has provided an overview of mobile cloud computing in which its definitions, architecture, deployment and service models advantages and challenges for MCC have been presented. However, although this research field is still unexplored in depth, many challenges are still under research. Hence, lastly, some areas such as Mobile devices, application partitioning, offloading, data integrity, service transformation, security and privacy represent open issues which identify future research directions in this field.

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