Security Threats and Different Challenges of Mobile Cloud Computing

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Abstract: **Mobile devices are becoming an essential part of our daily life due to most efficient and effective communication tools without time and space boundation. Everyone has a mobile, tablet, tablet with calling facility i.e. Fablet. Cloud Computing (CC) has been widely recognized as the next generation's computing infrastructure with the rapid growth of mobile applications and the support of Cloud Computing for a variety of services, the Mobile Cloud Computing (MCC) is introduced as an integration of Cloud Computing into the Mobile Environment. Mobile Cloud Computing is gaining stream. MCC is referred to as the infrastructure where both the data storage and the data processing happen outside the mobile device. In MCC environment, Cloud Computing, Mobile Computing and Application face several challenges like Mobile Computation Offloading, Seamless Connectivity, Vendor/Data Lock-in, Long WAN Latency, Live VM (Virtual Machine) migration issues, Low Bandwidth, Energy-Efficient Transmissions and Trust-Security and Privacy Issues. In this paper, I have discussed about several challenges and issues related to the Mobile Cloud Computing. This paper gives information about Mobile Cloud Computing Application, Security and Issues.**

Keywords: **Bandwidth, Cloud Computing, Energy Efficient transmission, Mobile Cloud Computing, Offloading, Security, Virtual Machine.**

I. INTRODUCTION

The acceptance and availability of mobile devices such as Smartphone, Tablet, Fablet, which are offering best communication as well as information services, are creating dependency as such that no one can think a moment without them. Mobile Cloud Computing (MCC) [1] is defined as an infrastructure where storing of data and processing of data occurs not in the mobile device. Mobile Cloud Applications transfer the data computation and storing from the mobile devices to the cloud, bringing applications and mobile computing to not only the Smartphone users but a huge number of mobile subscribers. Mobile Cloud Computing (MCC) provides mobile users with data storage and processing services in clouds, without worrying to have a powerful device configuration such as CPU speed, memory capacity, battery life-time, etc., as all the resource intensive computing [2] can be performed in the cloud.

Due to the capability to compute advance computing and faster connectivity with respect to ordinary mobile phones, Smartphones are in the top of the invention list. The global revenue of mobile networks has reached $1,200 billion in the year 2012[3]. The size of the mobile cloud market in consumer and enterprise is raised to reach over $45 billion by 2016[4].Mobile Cloud Computing (MCC) can be defined as "the availability of cloud computing services in a mobile ecosystem. This incorporates many elements, including consumer, enterprise, femtocells, transcoding, end-to-end security, home gateways, and mobile broadband-enabled services." There are different smartphones with different features, but the devices can be categorized by operating systems. The most-used mobile operating systems are the Research in Motion (RIM) BlackBerry operating system, the Windows™ Mobile® operating system, Nokia's Symbian platform, and UNIX® variations such as Google Android and Apple iOS [5].From a simple perspective, mobile cloud computing can be thought of as an infrastructure where storing of data and processing of data occurs not in the mobile device, enabling new types of applications such as context-aware mobile social networks. MCC can be simply divided into mobile computing and cloud computing. The mobile devices can be laptops, PDA, smartphones and so on, which connect with a base station or a hotspot by a radio link such as 3G, Wi-Fi or GPRS. Although the client is changed from PCs or fixed machines to mobile devices, the main concept is still cloud computing. Mobile users send service requests to the cloud through a web browser or desktop application. Providing cloud services in mobile environment creates some challenges and problems. Mobile computing faces obstacles related to the performance [6] (e.g., battery life, storage, and bandwidth), environment (e.g., heterogeneity, scalability, and availability), and security [7][8] (e.g., reliability and privacy). Mobile devices cannot handle complex applications due to some limitation of resources. To access mobile cloud computing applications mobile device should be in online but it is not possible for all time. So, offline solution of the device needs to be studied as well. In order to understand the challenges and issues, this paper is organized as follows: Section I gives an introduction, Section II details the architecture and merits-demerits of MCC, Section III represents challenges, Section IV gives an idea of present work, and the conclusions are drawn in Section V.

II. ARCHITECTURE OF MOBILE CLOUD COMPUTING

The mobile cloud computing architecture fig.1 is composed from the components: mobile users, mobile operators, internet service providers and cloud service providers. Mobile devices generally mobile phones, tablet, fablet communicate with the mobile networks with the help of Base station (BS) [9], Access Point (AP) and/or Satellite [10]. There are also different applications of Mobile Cloud Computing (MCC) by using the cloud services without using network provider, directly through the Internet. Mobile users send service requests to the cloud through a Web Browser or desktop application. Mobile devices are connected to the mobile networks via base station which function is to establish and control air interface i.e. the connection and functional interfaces between the networks and mobile devices. Mobile user's information such as ID, location, etc. and requests are processed by the central processors which are connected to servers providing mobile network services. Here, the services like authentication, authorization and accounting (AAA) [11] can be provided to the users based on Home Agent (HA) and subscriber's data stored in databases. The mobile network operator delivers the mobile clients requests to the cloud through the internet.

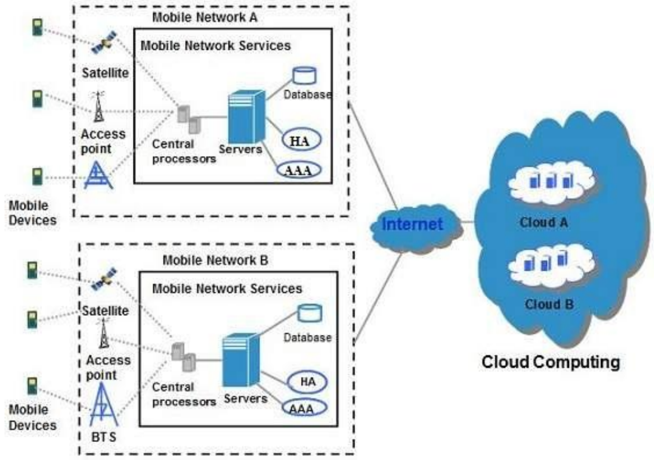

Fig 1 Architecture of Mobile Cloud [37]

In the cloud, user's requests are processed cloud controllers which to navigate to the corresponding cloud services to provide cloud users. In Mobile Cloud Computing (MCC), mobile network and cloud computing are combined together to perform optimally and provide best Quality of service (QoS) [12] to mobile users. Cloud Computing (CC) exists when tasks and data are kept on individual devices. Applications run on a remote server and then sent to the client depends on their request.

Mobile cloud computing has several advantages and disadvantages which are mentioned below.

Advantages:

- Flexibility: We can enjoyed the flexibility of mobile cloud computing which means that we can access our data from anywhere in the world, using any mobile device. It does not matter where we are, as long as we connected to the internet we can access both applications as well as data from our mobile device.
- Real time data availability: Another advantage of mobile cloud computing is that we can get access to real time data, whenever we want and wherever we want. Given that the data and applications are managed by a third party, updating our data as well as accessing it in real time is easily possible. Moreover, it can be accessed by multiple persons simultaneously.
- Multiple platforms: [13] Unlike all other applications, mobile cloud computing allows for multiple platform support such as Android, iOS, Windows, Blackberry. In other words, whatever the platform may be, we can easily access the data and applications stored in the cloud.
- No upfront costs: In most cases, cloud applications have minimal or no upfront cost. It is very much a pay-for-use service which has helped to grow adoption of the model.

Disadvantages:

- Security: [14][15] One of the major concerns with cloud computing is the security of data. Often mobile users will provide sensitive information through the network, and if not protected, can lead to major damages in the case of a security breach.
- Performance: Another major concern with mobile cloud computing is with regard to its performance. Some users feel performance is not as good as with native applications. So, checking with our service provider and understanding their track record is advisable.
- Connectivity: Internet connection is critical to mobile cloud computing. So, we should make sure that we have a good one before opting for these services.

III. CHALLENGES OF MOBILE CLOUD COMPUTING

a. Restricted Resources

Implementation of cloud computing becomes difficult in mobile devices due to limited number of resources. Mobile device has less computation power, limited battery capacity, less screen size and low quality display. Similarly, if processors are getting faster, screens are large in size and devices are equipped with more sensors, then more energy is consumed beyond the battery capacity. The battery life is drained out due to an increasing demand from users for energy hungry applications [16]. As compared to a fixed device, mobile devices in general have:

- 3 times less processing power
- 8 times less memory
- 5 times less storage capacity
- 10 times less network bandwidth

b. Low Bandwidth

Bandwidth [17] is one of the main issues in Mobile Cloud Computing (MCC) because demand of cloud is increasing due to the number of mobile and cloud users are dramatically increasing. To maintain a best Quality of Service (QoS) in MCC, the data distribution policy is important because it determines how the available bandwidth is distributed among users from different networks. When there are large amount of data transferred in a wireless network, the network delay may increased significantly and become unacceptable. Therefore, efficient wireless resource distribution policy is required to provide QoS guarantee for the transmission in cloud services.

c. Mobile Computation Offloading [18][19]

In Computer Science, computation offloading means to transfer of certain computing tasks to an external platform such as a grid, cluster or a cloud. Smart Mobile Devices have comparatively slow processors, small amount of storage and limited battery capacity. Most of applications use wireless networks whose bandwidth is comparatively lower than wired networks. Thus there is latency between the demand for complex programs and the availability of resources.

Offloading is a technique to increase mobile capabilities by transferring computation to more resourceful computers i.e. servers. This is different from normal client-server architecture. Computation offloading is also different from grid computing where migration of process occurs from one computer to another within the same environment.

d. Seamless Connectivity

The basic difference between wired and wireless network is that the wireless network is characterized by low bandwidth and less reliable transmission. Most of mobile devices are working in heterogeneous environment which demands reliable intersystem signal handoff schemes along next generation wireless networks. Unstable wireless bandwidth, chances of signal interception, low network security is the main challenges in Seamless Connectivity. [20]

e. WAN Latency

Latency is the delay from input into a system to expected output. It varies from one system to another. WAN latency [21] itself can be an important factor in determining Internet Latency. A WAN that is busy directing other traffic will produce a delay whether a resource is being requested from a server on the LAN, another computer on that network or elsewhere on the network.

Latency has impacts on energy efficiency and interaction between cloud, mobile application by consuming excessive mobile resources and increasing transmission delays. In wireless communication, factors such as variation in bandwidth, distance from base station and throughput of different wireless technologies affect energy efficiency and usability of mobile devices.

f. Security and Privacy

Security and Privacy are challenging issues in MCC applications such as m-commerce, m-healthcare and other mobile network applications [22]. These applications are resourceful in terms of storage and computation of data. Security is needed for both clients and service providers because an unauthorized person can take advantage of confidential data. Security is most important for users who are keeping personal data into the public cloud. Any modification of data, loss of data will affect the user because there is no any other copy of those data.

On the other hand, location of any mobile user can be easily identified by GPS system which breaches the privacy of that user. The privacy is user specific that is each individual has a different perception of privacy. GPS sensor [23] measurements shared within a larger community can be used to obtain traffic congestion levels in a given city. Thus, it is important to preserve the security and privacy of an individual, but at the same time enable Mobile Crowd sensing applications. [24]

IV. RELATED WORK

Offloading in its simple terms can be defined as the mechanism of partitioning an application into offloadable and non-offloadable sections considering various parameters and then remotely executing the offloadable sections. It is one of the main features of MCC to improve battery lifetime for the mobile devices and to increase the performance of applications.

As per Khan [25] the decision for offloading is a complex process. Some factors which impact the decision are as follows:-

1. Processor Capability: - If smart phone has less powerful processor comparable to server, then offloading can happen, otherwise not.
2. Types of Connection: - Depends on the speed/type of connection, user has to decide offload or not to offload.
3. Nature of Application: - An application requiring native resources will never be fully offloaded.
4. Cloud Provider: - The cloud provider should have enough resources as required by application, otherwise user will not to get the offloading benefits.

Offloading techniques divided into two categories:-

a. Static Partitioning

It deals with dividing into partitions during the design time. Liz. et.al. [27] have defined a static partitioning scheme by considering offloading at the level of tasks. Experiments in [26] show that offloading is not effective always to save energy. If code size is small then it consumes more energy comparable to local processing. So, it is difficult to determine whether and when, which portions need to be offloaded to improve energy efficiency.

b. Dynamic Partitioning

It considers the run time parameters which play an important role in determining resource consumption. In Static partitioning, when a failure occurs, the application will be re-offloaded. But in this case only failure task will be offloaded. Also, during offloading execution, a disconnection of a mobile device is treated as a failure.

After studying Computation Offloading process and different Computation Offloading Framework such as MAUI [28], CloneCloud [29], COMET [31], THINKAIR [30], some research issues as mentioned under are identified for further study.

1. Inaccurate Code Profiling

The Code Profiler is responsible to determine what to offload. The portions of Code – method, thread and class [32] are considered as offloading candidates. Code profiling is the most important problems in offloading technology because it is difficult to find cost for the code to be offloaded. During the offloading, Code is influenced by many factors of the System. So, efficient trade- off calculation becomes complex for code offloading. [33]

2. Scalability of offloading

Mobile devices are coming in heterogeneous environment. [34] So, when offloading occurs mobile device and cloud server both should have same application. To overcome this problem virtualization technique is used but it is constrained by some factors like CPU resources and slows down the performance [35]. To complete offloading one server is needed for one user which is not possible for real scenario. So, the need for policies for code offloading systems are necessary considering both the mobile and the cloud for better energy efficiency, cost-time reduction as well as Quality of Service (QoS). [36]

V. CONCLUSION

Computational offloading has been proven feasible with latest mobile technologies (e.g. Android), mostly due to virtualization technologies and their synchronization primitives, enabling transparent migration and execution of intermediate objects. There are multiple tradeoffs between offloading and resource augmentation, and thus offloading adaptation happens by focusing on the goal of the mobile application. From an offloading perspective, I envisioned the exploration of augmented reality mobile applications, which are computationally fed by cloud, such that computational provisioning can improve the perception and responsiveness requirements that emerge from mixing the actual context with the digital device in real-time. In this article, I explore the challenges for code offloading from a systemic point of view and identify the key limitations that prevent the adoption of code offloading.I want to evaluate design strategies to overcome these limitations (limitations of existing framework) by using own code offloading framework.

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