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RESEARCH ON MOBILE CLOUD COMPUTING: REVIEW, TREND AND PERSPECTIVES

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Abstract: In the past decade, due to technological advancement in wireless communications, mobile computing, and cloud computing has experienced an explosive development. Mobile cloud computing is the combination of the mobile computing and the cloud computing. Cloud computing is the trend in which resources are provided to a local client on an on-demand basis, usually by means of the internet. Mobile cloud computing (MCC) is simply cloud computing in which at least some of the devices involved are mobile. It provides mobile users with data storage and processing services on a cloud computing platform. This paper shows the key issues of cloud computing, mobile computing and the mobile cloud computing application also what are the problems are available using the mobile cloud computing.

Keywords: Cloud computing, Mobile computing, MCC computing.

I.INTRODUCTION

Cloud computing is defined as the trend in which resources are provided to a local client on an on-demand basis, usually by means of the internet. Cloud computing has grown rapidly in the past few years due to the increasing network bandwidth, mature virtualization techniques, and emerging cloud based business demands. Mobile devices will overtake PCs as the most common web access entities worldwide. Thus, the combination of a ubiquities mobile network and cloud computing generates a new computing mode, namely Mobile Cloud Computing. Mobile Cloud Computing (MCC) is a term that refers to an infrastructure where both data storage and data processing are done, outside of mobile devices from which an application is launched. Mobile devices like iPhone, Blackberry, Android are becoming popular clients to consume any Web resources, especially Web Services (WS). This paper discusses cloud computing as a currently exploring way to deliver remote mobile applications to mobile devices through internet providing a remedy to the lack of resources in mobile devices and also a new level of security is achieved by centralizing maintenance of security-critical software.

It provides mobile world a new ad hoc infrastructure where data storage and processing is performed outside the mobile device and cloud computing gets an extended feature of mobility. Mobiles are now integral part of business world and importance of mobile database is inevitable. Many mobile devices have significant constraints imposed upon them because of the importance and desirability of smaller sizes, lower weights, longer battery life and other features. Thus, cloud computing for mobile devices is a very appealing and potentially lucrative trend. The trend of the MCC system is not just aimed at providing fixed services for users in certain areas, but is especially to look forward to establishing connections among mobile users all over the world.

II.BACKGROUND

Mobile cloud computing is a new technique has been devised since 2009. In order to help us grasping better understanding of Mobile Cloud Computing, let's start from the previous techniques: Mobile Computing and Cloud Computing.

A. Cloud Computing: Cloud Computing has become a popular phrase since 2007. Cloud Computing is a general term used to describe a new class of network based computing that takes place over the Internet. Basically a step on from Utility Computing. A collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform). Using the Internet for communication and transport provides hardware, software and networking services to clients. These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface). In addition, the platform provides on demand services that are always on, anywhere, anytime and anyplace. Pay for use and as needed, elastic. Scale up and down in capacity and functionalities. The hardware and software services are available to general public, enterprises, corporations and businesses markets. the major function of a cloud computing system is storing data on the cloud servers, and uses of cache memory technology in the client to fetch the data. Those clients can be PCs, laptops, smart phones and so on. Cloud computing is a parallel and distributed computing system, which is combined by a group of virtual machines with internal links. Such systems dynamically offer computing resources from service providers to customers according to their Service level Agreement (SLA). Cloud computing is an umbrella term used to refer to Internet based development and services.

Basic cloud Characteristics: The "no-need-to-know" in terms of the underlying details of infrastructure, applications interface with the infrastructure via the APIs. The

"flexibility and elasticity" allows these systems to scale up and down at will utilizing the resources of all kinds of CPU, storage, server capacity, load balancing, and databases. The "pay as much as used and needed" type of utility computing and the "always on!, anywhere and any place" type of network-based computing. Cloud are transparent to users and applications, they can be built in multiple ways such as branded products, proprietary open source, hardware or software, or just off-the-shelf PCs. In general, they are built on clusters of PC servers and off-the-shelf components plus Open Source software combined with in-house applications and/or system software.

Cloud Computing Layers: Cloud computing systems actually can be considered as a collection of different services, thus the framework of cloud computing is divided into three layers, which are infrastructure layer, platform layer, and application layer.

a) **Infrastructure layer:** It includes resources of computing and storage. In the bottom layer of the framework, physical devices and hardware, such as servers and storages are virtualized as a resource pool to provide computing storage and network services users, in order to install operation system (OS) and operate software application. Thus it is denoted as Infrastructure as a Service (IaaS).

b) **Platform layer:** This layer is considered as a core layer in the cloud computing system, which includes the environment of parallel programming design, distributed storage and management system for structured mass data, distributed file system for mass data, and other system management tools for cloud computing. All platform resources such as program testing, running and maintaining are provided by the platform directly but not to end users. Thus, this type of services in a platform layer is called Platform as a Service (PaaS). The typical services are Microsoft Google App Engine, Mosso, Force.com, Engine Yard, Face book, Heroku, AWS.

c) **Application layer:** This layer provides some simple software and applications, as well as costumer interfaces to end users. This type of services in the application layer as Software as a Service (SaaS). Users use client software or a browser to call services from providers through the Internet.

Software as a Service (SaaS): SaaS is a model of software deployment where an application is hosted as a service provided to customers across the Internet. Saas alleviates the burden of software maintenance/support. But users relinquish control over software versions and requirements. Terms that are used in this sphere include Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

Features: The features of Cloud Computing are as follows:

a) Virtualization: The 'Cloud' can be considered as a virtual resource pool where all bottom layer hardware devices is virtualized. VM technology allows multiple virtual machines to run on a single physical machine.

Virtual workspaces: An abstraction of an execution environment that can be made dynamically available to authorized clients by using well-defined protocols .Resource quota (e.g. CPU, memory share). Software configuration (e.g. O/S, provided services).

b) Purpose and benefits: Cloud computing enables companies and applications, which are system infrastructure dependent, to be infrastructure-less. By using the Cloud infrastructure on "pay as used and on demand", all of us can save in capital and operational investment! Clients can put their data on the platform instead of on their own desktop PCs and/or on their own servers. They can put their applications on the cloud and use the servers within the cloud to do processing and data manipulations etc.

c) Concerns: Performance, reliability, and SLAs, Control of data, and service parameters, Application features and choices, Interaction between Cloud providers, No standard API – mix of SOAP and REST! Privacy, security, compliance, trust.

d) Cloud-Sourcing: Using high-scale/low-cost providers, Any time/place access via web browser, Rapid scalability; incremental cost and load sharing, Can forget need to focus on local IT.

e) Cloud Storage: Several large Web companies are now exploiting the fact that they have data storage capacity that can be hired out to others. Allows data stored remotely to be temporarily cached on desktop computers, mobile phones or other Internet-linked devices. Amazon's Elastic Compute Cloud (EC2) and Simple Storage Solution (S3) are well known examples.

3) Challenges: Use of cloud computing means dependence on others and that could possibly limit flexibility and innovation. The others are likely become the bigger Internet companies like Google and IBM, who may monopolise the market. Some argue that this use of supercomputers is a return to the time of mainframe computing that the PC was a reaction against. Security could prove to be a big issue. It is still unclear how safe out-sourced data is and when using these services ownership of data is not always clear. There are also issues relating to policy and access. If your data is stored abroad whose policy do you adhere to? What happens if the remote server goes down? How will you then access files? There have been cases of users being locked out of accounts and losing access to data.

4) Advantages: Lower computer costs, improved performance, reduced software costs, Instant software updates, improved document format compatibility, unlimited storage capacity, increased data reliability, Universal document access, Latest version availability, Device independence.

B. Mobile Computing

Mobility has become a very popular word and rapidly increasing part in today's computing area. Users with portable computers still have network connections while they move. An incredible growth has appeared in the development of mobile devices such as, Smart phone, PDA, GPS Navigation and laptops with a variety of mobile

computing, networking and security technologies. Mobile Computing is using a computer (of one kind or another) while on the move. Mobile Computing is when a (work) process is moved from a normal fixed position to a more dynamic position. Mobile Computing is when a work process is carried out somewhere where it was not previously possible. Mobile Computing is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere. Mobile computing is based on a collection of three major concepts: hardware, software and communication. The concepts of hardware can be considered as mobile devices, such as Smart phone and laptop, or their mobile components. Software of mobile computing is the numerous mobile applications in the devices, such as the mobile browser, anti-virus software and games. The communication issue includes the infrastructure of mobile networks, protocols and data delivery in their use. They must be transparent to end users.

Use of mobile: Enable anywhere/anytime connectivity. Bring computer communications to areas without pre-existing infrastructure, Enable mobility, Enable new applications, An exciting new research area.

Mobile objects: A mobile object is some code that carries a state, Lives in a host, that visits places, which is let in when trusted and barred when untrusted and will refuse to go to untrustworthy places

Application:

- For Estate Agents
- In courts
- In companies
- Stock Information Collection/Control
- Credit Card Verification
- Taxi/Truck Dispatch
- Electronic Mail/Paging.

Features: the features of mobile computing are as follows:
a) Mobility: Mobile nodes in mobile computing network can establish connection with others, even fixed nodes in wired network through Mobile Support Station (MSS) during their moving.
b) Diversity of network conditions: Normally the networks using by mobile nodes are not unique, such networks can be a wired network with high-bandwidth, or a wireless Wide Area Network (WWAN) with low-bandwidth, or even in status of disconnected.
c) Frequent disconnection and consistency: As the limitation of battery power, charge of wireless communication, network conditions and so on, mobile nodes will not always keep the connection, but disconnect and consistent with the wireless network passively or actively.
d) Dis-symmetrical network communication: Servers and access points and other MSS enable a strong send/receive ability, while such ability in mobile nodes is quite weak comparatively. Thus, the communication bandwidth and overhead between downlink and uplink are discrepancy.
e) Low reliability: Due to signals is susceptible to interference and snooping, a mobile computing network system has to be considered from terminals, networks, database platforms, as well as applications development to address the security issue.
Challenges: Compared with the traditional wired network, mobile computing network may face various problems and challenges in different aspects, such as Disconnection, Low bandwidth, High bandwidth variability, Low power and resources, Security risks, Wide variety terminals and devices with different capabilities, Device attributes, Fit more functionality into single, smaller device.
Future of Mobile Computing:

- Use of Artificial Intelligence
- Integrated Circuitry -Compact Size
- Increases in Computer Processor speeds.

III. MOBILE CLOUD COMPUTING

Mobile cloud computing is integration of cloud computing into mobile environment. The basic idea is to use cloud for complex computations or just as storage to extend mobile capability. Advantages like paying only for the infrastructure, scalability of applications, reductions in cost by getting rid of servers are achieved. The main aim of mobile cloud computing is to give a service to users to share data with others over cloud. There are many cloud providers available where users can store their data. Most of these can be accessed through PC and need an account to store data. Our system enables users to store their data from cell phone onto cloud and also share it with their friends. Also, user's data can be compromised by the cloud provider. So, user's cannot trust the cloud provider fully. We aim to encrypt user's file before uploading them to the cloud hence providing security. Mobile cloud computing can be simply divided into cloud computing and mobile computing. Those mobile devices can be laptops, PDA, smart phones, and so on. Which connects with a hotspot or base station by 3G, WIFI, or GPRS.

Architecture:

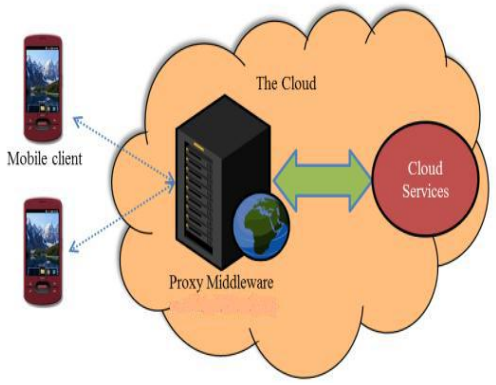

Fig. 1: Architecture of Mobile Cloud Computing

The mobile device establishes a socket connection with the proxy server (middleware). The mobile device then sends

the file to the server over this socket connection. The server then encrypts the file and sends it to the cloud provider. Server also sends an acknowledgement back to the client along with the URL to access the file. The user can share this URL with others so as to share the file with his/her friends.

Services: The cloud provider used is Amazon S3. S3 provides API to create and manage "buckets" on its cloud. These buckets can be used to identify each user. Access control can be managed for these buckets using S3 API's. Server maintains a database of users so as to identify each user with his/her allocated buffer and provide only access to his/her bucket.

Cloud Provider: Cloud computing is a form of outsourcing, and you need a high level of trust in the entities you'll be partnering with. It may seem daunting at first to realize that your application depends on the trustworthiness of your cloud providers, but this is not really anything new today, even if you're not using the cloud, you rely on and trust Network service providers, software vendors , service providers.

Transparency: You will only be able to assess the sufficiency of cloud provider security practices if the cloud provider is willing to disclose its security practices to you. If your provider treats security practices as a confidential or business proprietary thing, and won't disclose their security practices to you, you'll have a hard time assessing the sufficiency of their security practices. Unfortunately, you may need to consider using a different provider. So it is essential that the data needs to be secured before putting it on cloud. Our system aims at providing this security by encrypting the data before uploading it to the cloud.

Security: Encryption is achieved using Amazon S3's API for client side encryption. In this, a private encryption key is used for encryption which is not shared with Amazon. This encryption is done on the proxy server and the key is shared with the user. User will have to communicate the key to anyone with whom the file is to be shared.

Data delivery: Due to the feature of resource-constrains, mobile devices have potential challenges in cloud accessing, consistent accessing, data transmission, and so on. Such challenges can be solved using special application (service) and middle-ware(provide a platform for all mobile cloud computing systems).

Task division: Researchers divide tasks (applications) from mobile devices into multiple sub-tasks and deliver some of them to run in cloud, which is a good solution to the resource limited mobile devices. However, we do not have an optimal strategy or algorithm on how to divide these tasks, which one should be processed by cloud and which one by devices.

Better service: The original purpose of mobile cloud computing is providing PC-liked services to mobile terminals. However, as the existing different features between mobile devices and PCs, we cannot directly transplant the services from PCs' platform to mobile devices. Therefore, further research should try to identify the method on how to provide suitable and friendly interactive services for mobile devices.

Components: We partition the Mobile Cloud system into different types of components including computing, storage, administrative, and networking.

Computing Component: The computing component is the entity that provides computing resources, i.e., cloud hosts. A cloud system can provide logically separate resources upon the virtualization layer. Usually, Cloud resources in one domain are grouped into a resource pool that always has at least one physical node known as the master node. Other physical nodes that join existing pools are described as in slave nodes. Only the master node exposes an administration interface and forwards commands to individual slaves as necessary.

Storage Component: Storage cumulates all resource images and users' data. Resource is prepared by cloning resource templates that are stored in the storage repository. We choose to establish a remote storage repository, Network File System (NFS), to manage the storage of resources in our cloud system. An NFS storage server is connected to the computing server via a switch that greatly increases the scalability of storage.

Challenges	Solutions
Limitations of mobile devices	Virtualization and Image, Task migration
Quality of communication	Bandwidth upgrading, Data delivery time reducing
Division of applications services	Elastic application division mechanism

Table I: Challenges and Solutions of Mobile Cloud Computing

Administrative Component: Dedicated physical servers are for administrating resources and monitoring network traffic within and across domains. There is also a set of internal functional servers serving various administrative purposes such as web service, DHCP, DNS, authentication service, DB service, and VPN. Networking Component: there are four networks in each cluster. Incoming and outgoing traffic switches isolate control traffic (i.e., resource access, OS update, and package download) coming into or going out of the MobiCloud Gateway. The data network switch is a managed switch with supper for VLAN that enables VMs from different physical servers to reside in the same virtual domain.

Scope for Future Work: Providing a better interface to view shared files. Synchronizing our app with PC to allow easy sharing of data. Providing better authentication and allow group access to shared accounts. Extending our app so that it can be used on multiplatform such a iOS, Blackberry

OS. In Mobile Cloud Computing both the data storage and the data processing happen outside of the mobile device i.e. when we combined concept of cloud computing in mobile environment. In MCC scenario all the computing power and data storage move into the mobile cloud. MCC will not provide benefits only to the smart phone users but for will help a broader range of mobile subscriber. With MCC mobile phone user will get benefit in number of ways and help them to ran there business application without large amount of capital investment in infrastructure and services.

Related Work: Data Value provides user's with service to share their data securely over cloud. But it is currently only for computers. Data Guard is another work going on which shares and protects user's data. It preserves data confidentiality and integrity using a middleware technology. It also provides disaster recovery and high availability.

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.

IV.CONCLUSION

In this day to day changing technology environment, demands of the users also changes. Users demands quality service at anytime and anywhere with speed and accuracy. In this paper author discussed various issues including current problems and challenges and solution. Mobile cloud computing is one of mobile technology trends in the future. Computing technology is undergoing important transitions and the changes are creating serious data security, privacy and management challenges.

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