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Cloud Computing in Smart Phone Technology

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Abstract: Cloud computing is growing computing paradigm that is innovate to deploy cost effective solutions over Internet. Using Internet as the backbone, cloud computing asserts that it is possible to provide computing as a "utility" to end users "as and when needed" basis. Mobile cloud computing (MCC) is simply cloud computing in which at least some of the devices involved are mobile. Today the majority of mobile applications do most of the data storage and processing on the mobile devices themselves and not in the cloud. Going forward cloud computing and smartphone technologies evolved into a mobile cloud, with mobile specific infrastructure, cloud storage, security and compliance, and applications among other things, equipped the latest mobile cloud based smartphone. For the past two years, the tech industry trends have revolved around cloud computing and smartphones and the two technologies are interrelated. Now a day Capital firms rapidly invest in cloud computing and smartphone companies. This paper covers features, challenges and issues of cloud computing based smartphone technology using MCC.

Keywords: Cloud Computing, Smartphones, SaaS, PaaS, IaaS, Mobile Cloud Computing (MCC).

I. INTRODUCTION

Cloud computing is typically defined as a type of computing that relies on *sharing computing resources* rather than having local servers or personal devices to handle applications. In cloud computing, the word cloud (also phrased as "the cloud") is used as a metaphor for "*the Internet*," so the phrase *cloud computing* means "a type of Internet-based computing", where different services — such as servers, storage and applications —are delivered to an organization's computers and devices through the Internet. Cloud computing is comparable to grid computing, a type of computing where unused processing cycles of all computers in a network are harnesses to solve problems too intensive for any stand-alone machine

The goal of cloud computing is to apply traditional supercomputing, or high-performance computing power, normally used by military and research facilities, to perform tens of trillions of computations per second, in consumer-oriented applications such as financial portfolios, to deliver personalized information, to provide data storage or to power large, immersive computer games. To do this, cloud computing uses networks of large groups of servers , typically running low-cost consumer PC technology, with specialized connections to spread data-processing chores across them. This shared IT infrastructure contains large pools of systems that are linked together. Often, virtualization techniques are used to maximize the power of cloud computing.

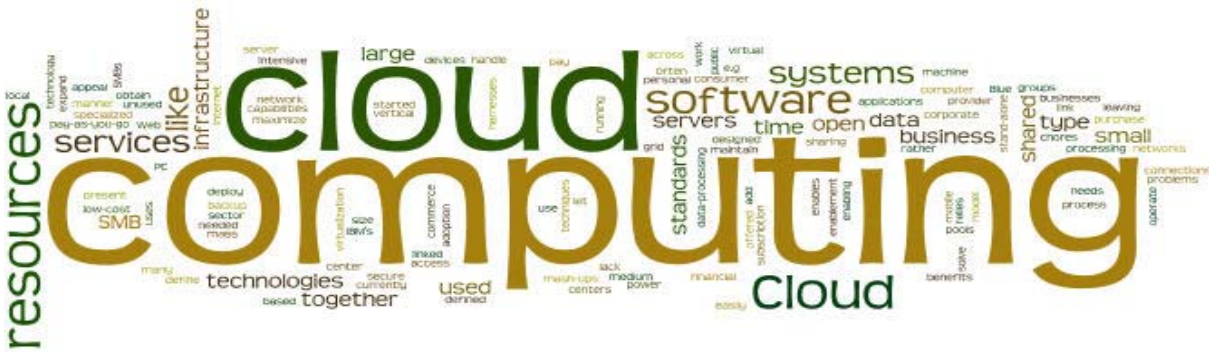

Figure 1: Cloud Computing [1]

The standards for connecting the computer systems and the software needed to make cloud computing work are not fully defined at present time, leaving many companies to define their own cloud computing technologies. Cloud computing systems offered by companies, like IBM's "Blue Cloud" technologies for example, are based on open standards and open source software which link together computers that are used to deliver Web 2.0 capabilities like mash-ups or mobile commerce. Cloud computing as a service over the internet has three distinct characteristics that differentiate it from traditional hosting. Firstly,it is sold on demand, Secondly, typically by the minute or the hour; Lastly, it is elastic -- a user can have as much or as little of a service as they want at any given time; and the service is fully managed by the provider. It can have the flexibility:

- *Elastic resources* to scale up and down quickly and easily to meet demand
- *Pay for use* as a metered service so that pay for what is used by the consumer
- *Self Service access to all the IT resources*

The consumer needs nothing but a personal computer and Internet access. Significant innovations in virtualization and distributed computing, as well as improved access to high-speed Internet and a weak economy, have accelerated interest in cloud computing.

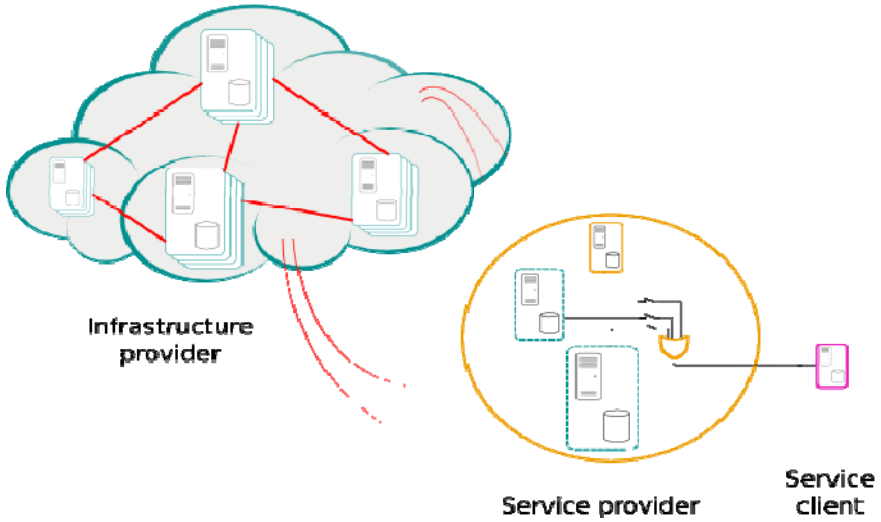

Figure 2: Cloud Computing model: Emphasizing delivery of as service [4]

II. Cloud Computing Services

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams. [3]

Framework of cloud computing: 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 application layer, platform layer and infrastructure layer.

A. Software as a Service (Saas) layer:

Cloud-based applications or *software as a service* (SaaS)—run on distant computers "in the cloud" that are owned and operated by others and that connect to users' computers via the Internet and, usually, a web browser. Advantages of its use are firstly, there is no software to purchase, install, update or maintain, which is handled by the service providers. Secondly, the user can sign up and rapidly start using cloud apps. Apps and data are accessible from any connected computer. Thirdly, no data is lost if the computer breaks, as data is in the cloud. Finally, the service is able to dynamically scale to the usage needs of the organization. In the software-as-a-service cloud model, the vendor supplies the hardware infrastructure, the software product and interacts with the user through a front-end portal. SaaS is a very broad market. Services can be anything from Web-based email to inventory control and database processing. Because the service provider hosts both the application and the data, the end user is free to use the service from anywhere.

B. Platform as a Service(PaaS) layer:

Platform-as-a-service in the cloud is defined as a set of software development tools hosted on the provider's infrastructure. Developers create applications on the provider's platform over the Internet. PaaS providers may use Application Program Interface (APIs) website portals or gateway software installed on the customer's computer. Force.com, (an outgrowth of Salesforce.com) and GoogleApps are examples of PaaS. Platform as a service provides a cloud-based environment with everything required to support the complete life cycle of building and delivering web-based (cloud) applications-without the cost and complexity of buying and managing the underlying hardware, software, provisioning and hosting. Advantages of its use are firstly, to develop applications and get to market faster. Secondly, deploy new web applications to the cloud in minutes. Thirdly, reduce complexity with middleware as a service. 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. Program developers are the major clients of the platform layer. 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 Google App Engine and Azure from Microsoft.

C. Infrastructure as a Service layer (Iaas):

Infrastructure as a service provides companies with computing resources including servers, networking, storage, and data centre space on a pay-per-use basis. The definition of infrastructure as a service (IaaS) is pretty simple. Cloud infrastructure including servers, storage, virtualisation and networking are given out for rent on demand- in a pay model and accesses that infrastructure over the Internet, in order to create or use applications. There is no need to invest in owning hardware. IaaS is perfect for start-up or businesses testing out a new idea. Since the infrastructure scales on demand, it's great for workloads that fluctuate rapidly. IaaS is the **fastest growing area** of cloud computing**.** Managed IaaS is suited for large enterprises running production workloads. **Common managed IaaS workloads are** analytics, big data, SAP and other enterprise applications. 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). Typically services in this layer such as Elastic Computing Cloud of Amazon.

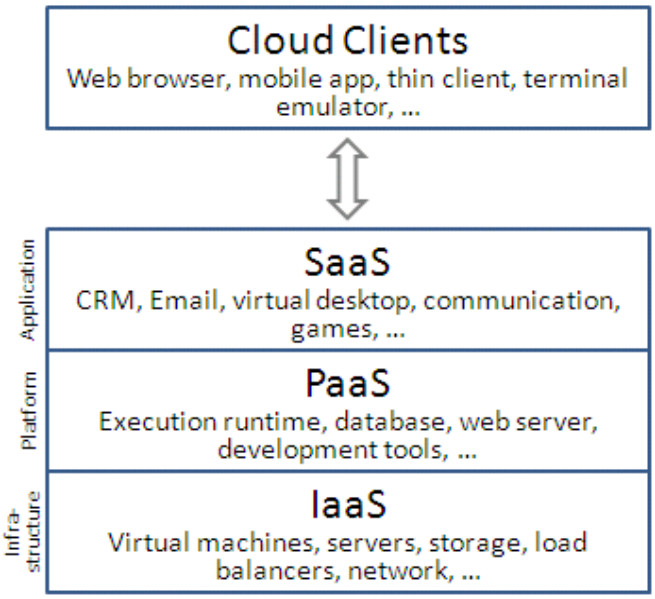

Figure 3: Computing service models [5]

Infrastructure-as-a-Service like Amazon Web Services provides the customer with virtual server instances and storage, as well as application program interfaces (APIs) that allow the customer to start, stop, access and configure their virtual servers and storage. This model allows a company to pay for only as much capacity as is needed, and bring more online as soon as required. Because this pay-for-what-you-use model resembles the way electricity, fuel and water are consumed; it's sometimes referred to as utility computing.

III. Cloud Computing Deployment Models

A cloud can be private or public. A *private cloud* is a proprietary network or a data centre that supplies hosted services to a limited number of people. A *public cloud* sells services to anyone on the Internet. (Currently, Amazon Web Services is the largest public cloud provider.) .When a service provider uses public cloud resources to create their private cloud; the result is called a *virtual private cloud*. Private or public, the goal of cloud computing is to provide easy, scalable access to computing resources and IT services.

Broadly the cloud deployed models are categorized as [2] [3]

A. Private Cloud:

A private cloud is owned and operated by a single company that controls the way virtualised resources and automated services are customised and used by various lines of business and constituent groups. Private clouds exist to take advantage of many of cloud's efficiencies, while providing more control of resources and steering clear of multi-tenancy.

Characteristics of private clouds include:

- A self-service interface that controls common services, allowing IT staff to quickly provision, allocate and deliver on-demand IT resources
- Highly automated management of resource pools for everything from compute capability to storage, analytics, and middleware
- Sophisticated security and governance designed for a company's specific requirements

B. Public Cloud:

Public clouds are owned and operated by companies that use them to offer rapid access to affordable computing resources to other organisations or individuals. With public cloud services, users don't need to purchase hardware, software or supporting infrastructure, which is owned and managed by providers.

C. Hybrid Cloud:

A hybrid cloud uses a private cloud foundation combined with the strategic use of public cloud services. The reality is a private cloud can't exist in isolation from the rest of a company's IT resources and the public cloud. Most companies with private clouds will evolve to manage workloads across data centres, private clouds and public clouds—thereby creating hybrid clouds. Evolving to a hybrid cloud strategy will allow companies to keep critical line of business applications and sensitive data in a traditional data centre environment or private cloud, while also taking advantage of public cloud resources like SaaS for the latest applications and IaaS for elastic, economical virtual resources to scale. The key factor for hybrid cloud success is the ability to efficiently and securely manage the combination of public and private cloud services as a single unified computing environment which is the main capability to fully take advantage of the cloud.

IV. FEATURES AND CHALLENGES OF CLOUD COMPUTING

The features of Cloud Computing are as follows:

- *Virtualization*: The 'Cloud' can be considered as a virtual resource pool where all bottom layer hardware devices is virtualized. End users access desired resources through a browser and get data from cloud computing providers without maintaining their own data centres. Furthermore, some virtual machines (VMs) are often installed in a server in order to improve the efficiency to use resources; and such VMs support load migration when there is a server over-load.
- *Reliability, usability and extensibility*: Cloud computing provides a safe mode to store user's data while users do not worry about the issues such as software updating, leak patching, virus attacks and data loss. If failure happens on a server or VM, the cloud computing systems transfer and backup those data to other machines, and then delete those failure nodes from the systems automatically in order to make sure the whole system has normal operation.
- *Large-scale*: In order to possess the capability of supercomputing and mass storage, a cloud computing system normally consists of thousands of servers and PCs. Google Cloud Computing, for example, has already controlled 2% of all servers or about 1 million servers located in two hundred different places in the world, and will move upward to 10 million servers in the next decade.
- *Autonomy:* A cloud system is an autonomic system, which automatically configures and allocates the resources of hardware, software and storage to clients' on-demand and the management is transparent to end users.

Challenges of Cloud Computing::

First of all, cloud computing needs an improved mechanism to provide a safe and high efficiency service as the numerous invoked third-party software and infrastructures are implementing in computing. In addition, due to data centres of resource using a mass of electricity, efficient resource scheduling strategy and methods are required in order to save energy. Furthermore, as a Service Level Agreement (SLA) is established between users and service providers in cloud computing, so the performance and analysis of services are necessary to be monitored. Last but not least, simple and convenient application interfaces are indispensable for service providers in cloud computing, thus a uniform standard is required eagerly.

Cloud Computing Advantages.

One can access applications as utilities, over the Internet. Manipulate and configure the application online at any time. It does not require installing a specific piece of software to access or manipulating cloud application. Cloud Computing offers online development and deployment tools, programming runtime environment through Platform as a Service model. Cloud resources are available over the network in a manner that provides platform independent access to any type of clients. Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider. Cloud

Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection. Cloud Computing offers load balancing that makes it more reliable.

V. MOBILE CLOUD COMPUTING (MCC)

In Mobile Cloud Computing, processing is done in cloud, data is stored in cloud and the mobile devices serve as a media for display. *Mobile cloud computing (MCC)* 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 the mobile devices and into powerful and centralized computing platforms located in clouds, which are then accessed over the wireless connection based on a thin native client. Mobile devices face many resource challenges (battery life, storage, bandwidth etc.). Cloud computing offers advantages to users by allowing them to use infrastructure, platforms and software by cloud providers at low cost and elastically in an on-demand fashion. Mobile cloud computing provides mobile users with data storage and processing services in clouds, obviating the need to have a powerful device configuration (e.g. CPU speed, memory capacity etc), as all resource-intensive computing can be performed in the cloud. According to a recent study by ABI Research, more than 240 million businesses will use cloud services through mobile devices by 2015.

That traction will push the revenue of mobile cloud computing to $5.2 billion. Mobile cloud computing is a highly promising trend for the future of mobile computing. Smartphones are employed with rich cloud services by integrating applications that consume web services. These web services are deployed in cloud. There are several Smartphone operating systems available such as Google's Android, Apple's iOS, RIM BlackBerry, Symbian, and Windows Mobile Phone. Each of these platforms supports third-party applications that are deployed in cloud.

Architecture MCC includes four types of cloud resources: Distant mobile cloud, distant immobile cloud, Proximate mobile computing entities /Proximate immobile computing entities and Hybrid

The figure 4 shows the framework for mobile cloud computing architecture: Mobile devices are connected to the mobile networks via base stations that establish and control the connections and functional interfaces between the networks and mobile devices. Mobile users' requests and information are transmitted to the central processors that are connected to servers providing mobile network services. 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.

***Issues*:** Despite of having significant development in field of mobile computing, there still exist many issues:

A. *Emergency Efficient Transmission*: There should be a frequent transmission of information between cloud and the mobile devices.

B. *Architectural Issues*: Mobile cloud computing is required to make architectural neutral because of heterogeneous environment.

C. *Live Vm Migration*: It is challenging to migrate an application, which is resource-intensive to cloud and to execute it via Virtual Machine.

D. *Mobile Communication Congestion* Due to continuous increase demand for mobile cloud services, the workload to enable smooth communication between cloud and mobile devices has been increased.

E. *Security and Privacy*: This is one of the major issues because mobile users share their personal information over the cloud.

Mobile cloud computing has many **advantages** among the few listed below:

- Sharing information and applications without the need of complex and costly hardware and software as the business computations are run in the cloud.

- Enhanced features and functionality of mobile phones through new cloud applications.
- Ease of access and development since the access point to mobile cloud computing is through a browser and not a mobile operating system.
- Cheaper for cloud computing vendors to build mobile cloud applications because of economies of scale, i.e access to all smartphone devices, one application can be shared and accessed by many smartphone users.
- Broader reach, since mobile cloud applications can be accessed through a browser, the cloud computing applications can be reached by all mobile users not only smartphone users, as long as the mobile has access to the internet.

Some of the potential pitfalls to mobile cloud computing is the lack of internet speed and access. Also, mobile cloud computing presents challenges already inherent in PC and Notebooks such as security breaches, and viruses' attacks, and it is thus important to have identity authentication as well as controlled and secured access.

Mobile cloud computing will provide many benefits for cloud computing, mobile network operators. Among those benefits: increased reach, reduced costs, and reduced reliance on hardware and software equipments.

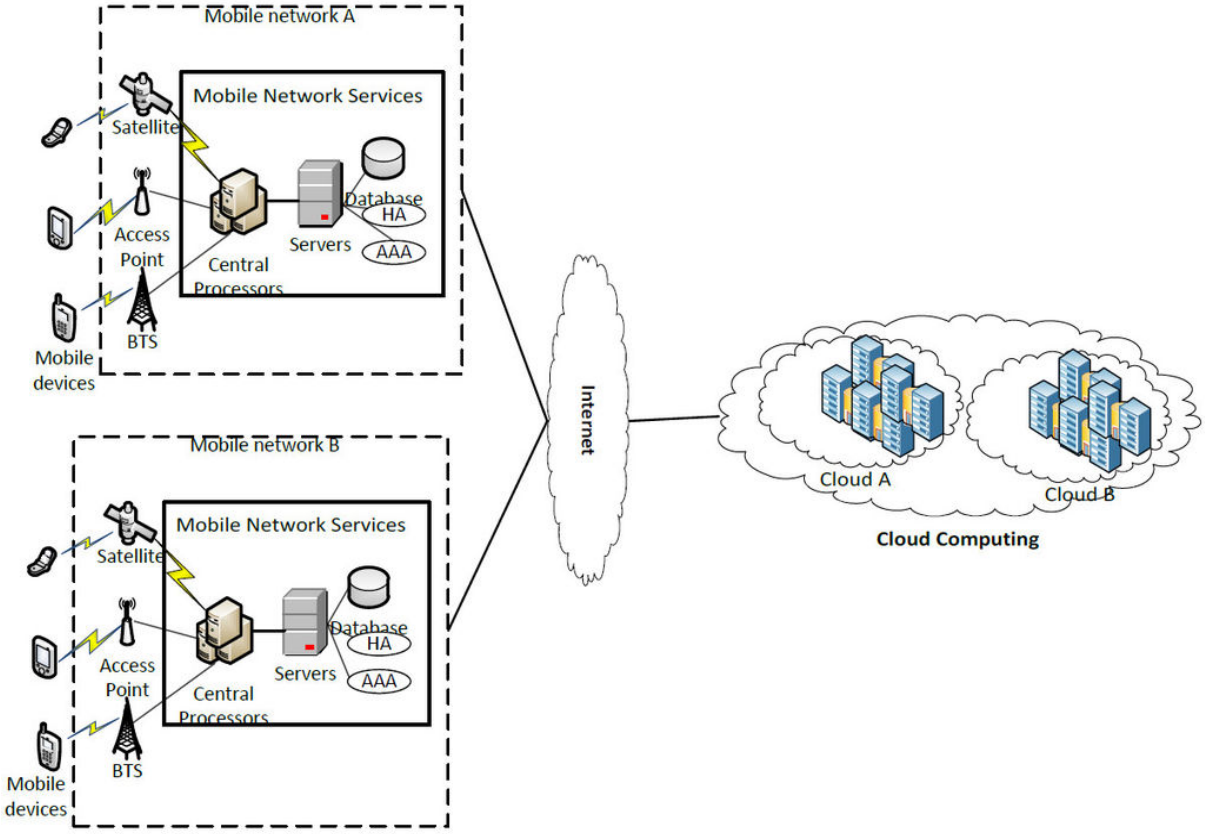

Figure 4: Mobile Cloud Architecture [7]

Challenges: In the MCC landscape, an amalgam of mobile computing, cloud computing, and communication networks (to augment smartphones) creates several complex challenges such as Mobile Computation Offloading, Seamless Connectivity, Long WAN Latency, Mobility Management, Context-Processing, Energy Constraint, Vendor/data Lock-in, Security and Privacy, Elasticity that hinder MCC success and adoption[8]

Advantages of MCC

A. *Extending Battery Lifetime*: Computation of floading migrates large computations and complex processing from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds). Remote application execution can save energy significantly. Many mobile applications take advantages from task migration and remote processing

B. *Improving data storage capacity and processing power:* MCC enables mobile users to store/access large data on the cloud. MCC helps reduce the running cost for computation intensive applications. Mobile applications are not constrained by storage capacity on the devices because their data now is stored on the cloud.

C. *Improving reliability and availability*: Keeping data and application in the clouds reduces the chance of lost on the mobile devices. MCC can be designed as a comprehensive data security model for both service providers and users: Protect copyrighted digital contents in clouds. Provide security services such as virus scanning, malicious code detection, and authentication for mobile users. With data and services in the clouds, then are always(almost) available even when the users are moving.

D. *Dynamic provisioning:* Dynamic on-demand provisioning of resources on a fine-grained, self-service basis No need for advanced reservation

E. *Scalability:* Mobile applications can be performed and scaled to meet the unpredictable user demands Service providers can easily add and expand a service

F. *Multi-tenancy*:Service providers can share the resources and costs to support a variety of applications and large no. of users.

G. *Ease of Integration*: Multiple services from different providers can be integrated easily through the cloud and the Internet to meet the users' demands.

MCC Applications includes

A. *Mobile Commerce*: M-commerce allows business models for commerce using mobile devices. Examples: Mobile financial, mobile advertising, mobile shopping… M-commerce applications face various challenges (low bandwidth, high complexity of devices, security) Integrated with cloud can help address these issues Example: Combining 3G and cloud to increase data processing speed and security level.

B. *Mobile Learning:* M-learning combines e-learning and mobility Traditional m-learning has limitations on high cost of devices/network, low transmission rate, limited educational resources Cloud-based m-learning can solve these limitations Enhanced communication quality between students and teachers Help learners access remote learning resources A natural environment for collaborative learning

C. *Mobile Healthcare*: M-healthcare is to minimize the limitations of traditional medical treatment (eg. Small storage, security/privacy, medical errors …) M-healthcare provides mobile users with convenient access to resources(eg. medical records) M-healthcare offers hospitals and healthcare organizations a variety of on-demand services on clouds Examples: Comprehensive health monitoring services Intelligent emergency management system Health-aware mobile devices (detect pulse-rate, blood pressure, level of alcohol etc) Pervasive access to healthcare information Pervasive lifestyle incentive management (to manage healthcare expenses)

D. *Mobile Gaming:* M-game is a high potential market generating revenues for service providers. Can completely off load game engine requiring large computing resource (e.g., graphic rendering) to the server in the cloud. Offloading can also save energy and increase game playing time (eg. MAUI allows fine-grained energy-aware offloading of mobile codes to a cloud) .Rendering adaptation technique can dynamically adjust the game rendering parameters based on communication constraints and gamers' demands

E. *Assistive technologies*: Pedestrian crossing guide for blind and visually-impaired Mobile currency reader for blind and visually impaired Lecture transcription for hearing impaired students

F. *Other applications*: Sharing photos/videos Keyword-based, voice-based, tag-based searching Monitoring a house, smart home systems

Research Issues and Elements of MMC

Although significant research and development in MCC is available in the literature, efforts in the following domains is still lacking [9] [10]

- *Architectural issues***:** Reference architecture for heterogeneous MCC environment is a crucial requirement for unleashing the power of mobile computing towards unrestricted ubiquitous computing.
- *Energy-efficient transmission***:** MCC requires frequent transmissions between cloud platform and mobile devices, due to the stochastic nature of wireless networks, the transmission protocol should be carefully designed.[11] [12]
- *Context-awareness* **issues:** Context-aware and socially-aware computing are inseparable traits of contemporary handheld computers. To achieve the vision of mobile computing among heterogeneous converged networks and computing devices, designing resource-efficient environment-aware applications is an essential need.
- *Live VM migration* **issues:** Executing resource-intensive mobile application via Virtual Machine (VM) migration-based application offloading involves encapsulation of application in VM instance and migrating it to the cloud, which is a challenging task due to additional overhead of deploying and managing VM on mobile devices.
- *Mobile communication congestion issues***:** Mobile data traffic is tremendously hiking by ever increasing mobile user demands for exploiting cloud resources which impact on mobile network operators and demand future efforts to enable smooth communication between mobile and cloud endpoints.
- *Trust, security, and privacy issues:* Trust is an essential factor for the success of the burgeoning MCC paradigm.

Characteristics of MCC

- *User Centric*: Data in the cloud belongs to users and can share.
- *Task Centric*: Focus is shifted from what it can do to what is need to get done More information are obtained from the parallel computers running simultaneously.
- *Intelligent*: Datamining and analysis are very much needed as large dataset are stored on the computer in cloud system
- *Programmable*: Cloud's computers must be under the supervision of IT experts so that tasks performed in cloud system can automate the redistribution and data can be locally shared
- *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.
- *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.
- *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.
- *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.
- *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.

There are three main optimization approaches in MCC, which are focusing on the limitations of mobile devices, quality of communication, and division of applications services. *Firstly*, using virtualization and image technology can address it effectively, and immigrate task from terminal to cloud is also a good way to achieve better results. *Secondly*, as the quality of communication in wired network is better than in wireless network, so reducing the proportion of data delivery in wireless environment is an effective way to improve the quality. In addition, upgrading bandwidth is envisaged to be a simple way to increase performance but it incurs additional cost to users. Deploying an effective elastic application division mechanism is deemed to be the best solution to guarantee the application service in MCC; its complicated, but promising high impact results.

Features and Challenges of Mobile Computing

When smartphones combine with cloud computing, the result is the fulfilment of Bill Gates' 1990 prediction that technology would eventually put the world's information at peoples' fingertips- which is Technology's Dream Combo. Mobile cloud computing is gaining stream. According to the latest study from Juniper Research, the number of mobile cloud computing subscribers is expected to grow rapidly in the next five years. Cloud-based mobile market will generate annual revenue of $9.5 billion in 2014 from $400 million in 2009, at an average annual increase of 88%.This phenomenal growth is driven by new web standard HTML5, increased mobile broadband coverage and the need for always-on collaborative services for the enterprise.[6]

Google's Gmail and Google Voice for iPhone are just two of the well-known mobile cloud apps. Mobile cloud computing is referred to as the infrastructure where both the data storage and the data processing happen outside of the mobile device. From a consumer's point-of-view, a cloud-based mobile application is similar to an app purchased or downloaded from a mobile application store like iTunes, where the processing power is driven not from the handheld device, but from the cloud. When launched from the iPhone homescreen, the apps perform like any other app on the iPhone.

Challenges:

Compared with the traditional wired network, mobile computing network may face various problems and challenges in different aspects, such as signal disturbance, security, hand-off delay, limited power, low computing ability, and so on. due to the wireless environment and numerous mobile nodes. In addition, the Quality of Service (QoS) in mobile computing network is much easier to be affected by the landforms, weather and buildings.

VI. CONCLUSION

Mobile cloud computing (MCC), as a development an extension of mobile computing (MC) and cloud computing (CC), has inherited the high mobility and scalability. By combination of *cloud computing and smartphones (mobile computing and wireless networks*), uncountable benefits are obtained by increasing the area of communication by combining different cellular communication as well as Internet communication technologies. It enhances the cumulative properties of both. These two technologies influence the whole world and as time lapses it is impossible to differentiate between people on the basis of language. Communication becomes much simple, better and fast globally. There is huge save in money and knowledge banks are ready to provide the processed Knowledge Database to everyone without barrier. Education and latest communication technologies are easily available. Smartphones provide portable use of IT - Entertainment Uses: games, music (mp3 player), books (e-book), and digital television broadcast - Social Uses: phone call, text message, wireless internet (access to e-mail, social networking websites) - Organization Uses: calendar, finance manager, address book, storage for data. Mobile technology is key to keeping in touch in the modern world. Text messaging Smart Phones aren't only used for communication, but for organizing schedules, jotting down notes, playing music, games, checking the weather, and other applications. Cell Phones "revolutionized long distance calling", make it much more inexpensive for long distance communication. Cell phone logs have also been helpful in court cases where they can be used as evidence. Mobile technology and smart phones play a major role in everyday life, and their importance is expected to continue, and even increase in the future.

VII. Scope and Future

Security is a basic concern in the system because end user is using the infrastructure of service provider. Considering the latest challenges of data corruption, data stealing, data threatening all the advanced measures need to be adopted. The measures require the latest firewall facility, latest version, antivirus, malware protection features, updating latest patches, opening only required communication ports and preventive measures so that end user trusts on the service provider for data security. One way is to develop the application for this system which might be light and user friendly or develop the more easy and advanced ways for communication with the applications of mobile cloud computing. In this way cloud oriented smartphone computing is reliable and trust worthy.

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