

Review Paper**Revolution of Mobile Cloud Computing its Role in Gaming Industry and Design Challenges: A Review****K. Sampath Kumar and D. Mahija**

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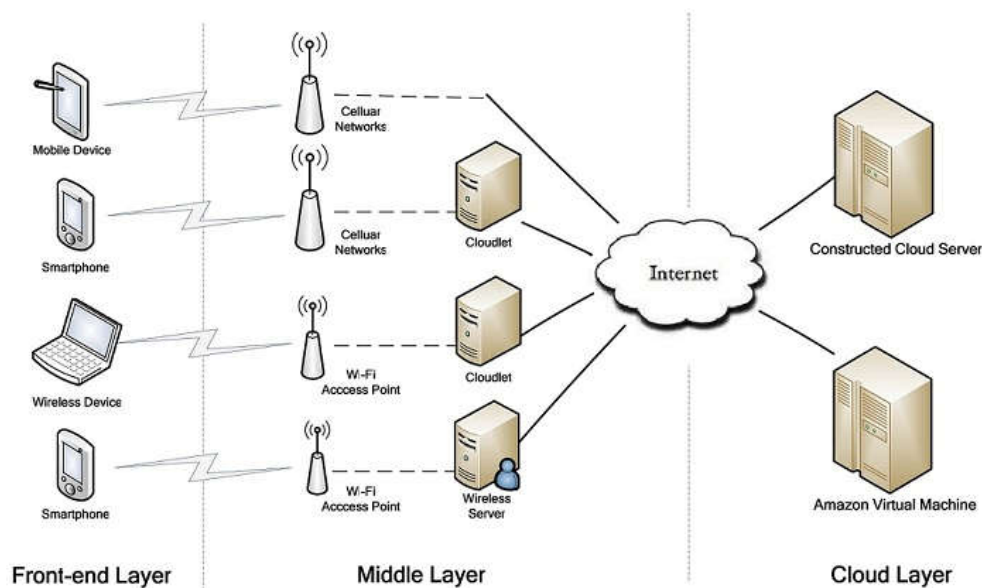
Corresponding Author:**K. Sampath Kumar**Computer Hardware,
Department of Physics,
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India.**Abstract**

A new infrastructure can be created using mobile cloud computing, a new platform which combines the mobile devices and cloud computing. Cloud performs the heavy lifting of computing-intensive tasks and storing massive amounts of data. In this new architecture, data processing and data storage happen outside of mobile devices. Cloud computing is playing a vital role in the gaming industry as it has come to a stage to help industries to grow their businesses. There are many benefits of cloud technology to the gaming industry and out of them three are more prominent. They are: increased availability and accessibility, variety of hardware and multiple game content. The main advantage of this is that game players can speedily access the games using any digital-enabled devices. They can play as many games as possible in real-time without having to acquire plenty of consoles to do this. Moreover mobile cloud computing poses challenges due to the intrinsic nature and constraints of wireless networks and devices. These challenges complicate the design of distributed processing more than fixed cloud computing. Variable reliability, less throughput, longer latency, limited energy source of mobile devices, resource poverty of mobile devices versus fixed devices are the major challenges in the design mobile cloud computing.

Key words: Mobile cloud computing, gaming industry, console, throughput, latency, energy source.

Introduction

Mobile devices face many resource challenges such as battery life, storage and bandwidth. Also, mobile cloud computing offers advantages to users by allowing them to utilize infrastructure, platforms and software by cloud providers at low cost and elastically in an on-demand fashion. It provides mobile users with data storage and processing services in the cloud, eliminating the need to have a powerful device configuration (e.g. CPU speed, memory capacity, etc), as all resource – intensive computing can be performed within the cloud. (Victor Onomza waziri, et.al, 2014, Pragnya Gupta, et.al, 2012, Suganya v, et.al, 2015, Chozha Rajan, et.al, 2015)^{1,2,3,4}

**Fig 1:** Architecture of mobile cloud computing:

MCC uses computational augmentation approaches by which resource-constraint mobile devices can utilize computational resources of varied cloud-based resources(Above Fig). In MCC, there are three layers, front-end layer, middle layer and cloud

layer, including four types of cloud-based resources, namely distant immobile clouds, proximate immobile computing entities, proximate mobile computing entities, and hybrid (combination of the other three model).

Development of cloud computing in Mobile applications

Cloud computing, a new business model for organizations itself is proving to be an emerging technology in IT world to utilize software, applications and hardware resources without any upfront investment. In near future, with the broad development in mobile applications and advancements in cloud computing, a new expansion is being expected in the form of mobile cloud computing (MCC). MCC provides a platform where mobile users make use of cloud services on mobile devices because the use of MCC minimizes the issues such as performance, compatibility, and lack of resources in mobile computing environment. Despite this advancement achieved by MCC, the users of MCC are still below expectations because of the associated risks in terms of security and privacy. These risks are playing important role by preventing the organizations to adopt MCC environment. (Abid shahzad, et.al, 2013, C. Shravanthi, et.al, 2014)^{5,6}

Cloud computing in gaming industry

There are some positive developments in the gaming industry since cloud computing is now in a stage to help businesses optimize their methods of operations. The three prominent benefits of cloud technology to the gaming industry are highlighted as follows:

- **Increased Availability and Accessibility:** Cloud computing is flexible and scalable in the area of storage capacity and it allows gaming companies to make available a series of content that are accessible to their customers as soon as they log in into their accounts. This indicates that game players do not necessarily need to bother about how they could save their games and/or protect them for regular access. This unique opportunity of getting games to play anytime of the day has reportedly increased game players' satisfaction, a condition that stands to help game companies retain habitual gamers and maximize sales and revenues over a long period of time.
- **Variety of Hardware:** Players have the liberty to use various devices to access their games with the help of cloud computing. Previously, game players solely relied on the "consoles", they are required to carry around to enjoy their games. Nowadays, all devices such as smart phones, palm-held devices, laptops, desktops and so on are applicable. As a matter of fact, game players now enjoy the rare freedom of playing their games while on-the-go.
- **Multiple Game Content:** Unlike before when a console only afforded players the opportunity of playing a single game at a time, cloud computing creates the avenues for accessing and playing multiple games at a time. This practice does not only help game companies to rake in more revenues, it also adds values to the experience of playing games. This situation of satisfaction, on the part of the players, has reportedly led to the improvement in game-maker-customer relationship and loyalty. This is a quality that is bound to translate into higher profitability for the game industry.

These three innovative contributions of cloud computing to the gaming industry are quite influential in the industry. Game-makers are now concentrating on providing interesting and long-lasting game content to their customers, instead of worrying endlessly on producing hardware or consoles that customers will find portable, easy-to-use and light. (Jack Sepple, et.al, 2013, Rajesh Bose, et.al, 2015)^{7,8}

Role of cloud computing in business

Cloud technology provides a platform for innovation and new business expansion as major game-makers like Microsoft, Nintendo and Sony are gradually migrating their game content to the cloud. This attitude does not only help the environment to be cleaner, it also simplifies the procedures of playing games. The game-makers are going to increase their sales and revenues through this improved method of game-content delivery; the customers are going to enjoy their games without worrying about the headache of carrying their consoles around nor thinking about the cost of buying many consoles in order to have access to multiple games at a time. Though, the players' personal information are required to open their accounts at the beginning of their subscriptions, the recent development in cloud computing security will help protect their identities so that they will not be subjected to identity theft, as it happened recently to some online game players. Cloud computing is indeed revolutionizing the gaming industry with the hope of transforming the processes of game access, methods of play and storage for constant access. (Neelam S Desai, 2016, Stuart Taylor, et.al, 2016)^{9,10}

Design challenges of mobile cloud computing.

Mobile cloud computing poses challenges due to the intrinsic nature and constraints of wireless networks and devices. These challenges such as variable reliability, less throughput, longer latency, limited energy source of mobile devices, etc, mainly complicate the design of distributed processing more so than fixed cloud computing.

- *Variable reliability, less throughput, longer latency:* Unlike fixed broadband where a physical link supports consistent network bandwidth, wireless connectivity is characterized by variable data rates and intermittent connectivity due to the gaps in coverage. Mobile broadband networks generally have longer network latency than fixed broadband and the dynamic nature of application throughput demands, subscriber mobility and uncontrollable factors like weather which can cause bandwidth capacity and coverage to vary.
- *Limited energy source of mobile devices:* Another fundamental challenge arises from the fact that mobile devices are generally less powerful and use batteries, whose capacity is fundamentally limiting. It is therefore important to maximize battery life through the careful partitioning of application functions across servers and devices. The display element and cellular connectivity are the two biggest contributors of energy use in a smartphone. Non-display applications would likely be well suited for mobile cloud computing, as these applications do not require display usage.

- *Resource poverty of mobile devices versus fixed devices:* The challenges presented by the resource-poor nature of mobile devices, drivers for adoption of mobile cloud computing. In an effort to offset device limitations, resources can be added to the cloud infrastructure to provide seamless user experiences for advanced applications. Although mobile technology has improved significantly over the past several years, there is a significant cost of mobility for a given cost and level of technology available. As compared to a fixed device, mobile devices in general have three times less processing power, eight times less memory, five times less storage capacity, 10 times less network bandwidth. While mobile device performance will continue to improve in absolute terms the disparity between the resource constraints of mobile and fixed devices will remain and must be accounted for in the types of application selected for mobile cloud computing.

Necessity of Mobile cloud computing

With so many new mobile devices hitting the market, billions of new users have the issue of freedom for the software on the device and freedom in the mobile cloud. The Free Software community has the opportunity to participate in the mobile cloud debate and shape this new environment. Ignoring the issues posed by the mobile cloud risks excluding a large number of digital citizens from the benefits that free software has brought to other computer users. The mobile cloud is an open territory where many vendors are already fighting to lock-in user.

By definition, mobile devices that access the Internet are performing mobile cloud computing: handsets need to borrow storage and computing power from the cloud because of their limited resources or because it makes more sense. Many of the modern devices not only can store locally the maps and calculate routes, but they rely on the cloud to get real time information about traffic conditions and plan the routes accordingly. Accessing data in the cloud from mobile devices is becoming a basic need. (Fabrizio Capobianco, 2009)¹¹

Future scope and Research in Mobile Cloud Computing

The advanced mobile cloud computing platform has not only led to an improvement in the processing of mobile applications and services but has also opened a revolutionized realm wherein mobile cloud computing can be applied to the operating systems installed in mobile devices and the operating systems as a whole can run on the cloud framework, increasing the processing speed and optimizing operations to attain efficient results. Moreover, Mobile platforms are already accessing the cloud for a lot of consumer-based services such as email, social media, online file storage and corporate communications tools. But so far, there are essentially only two players here: the individual or consumer, and the consumer cloud service. One of the biggest changes which is expected in the near future is the entry of a third player, the corporate back-end system (e.g., corporate ERP, Financials, SCM and other mission-critical systems)."

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