Trends and Applications of Mobile Cloud Computing

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Abstract- *Mobile cloud computing offers cloud computing services on mobile devices. Almost all the people in the world are using mobile devices for their day to day activities. Advancement of Smartphone technology and high speed mobile networks pushed most of the people to carry out their business activities on mobile devices. For this reason most of the business organizations are progressively adopting mobility. Mobile cloud computing promises to offers data storage and computing services of cloud to its users via internet. Because its advantages like mobility, improving battery life enhanced data storage, scalability, accessibility, and high performance computing services mobile cloud computing is adopted business enterprises irrespective their size. The main objective this paper is to present the review on applications, current trends and security concerns of mobile cloud computing.*

Keywords- Cloud Compourting, Mobile Cloud Computing, Trends, Mobile Cloud Computing Applications,Mobile Devices.

I. INTRODUCTION

Cloud computing is a method of storing, processing and managing the data from local computers or servers, hosted on remote servers provided by service providers through internet. It serves on-demand access of computing resources on sharing basis to computers or other devices. Its popularity increasing day by because of its resilient characteristics such as its remote based network accessibility, agility, elasticity, reliability, and location independent access of resources [32]. Cloud computing reduces the maintenance and administering cost and burden of IT infrastructure for the enterprises and let them focus on their business prospective. Mobile technology escalation from past decade allowed cloud computing offer its services for mobile users. Mobile cloud computing (MCC) is a cloud technology which is a conjunction of cloud computing and the mobile technology. Mobile cloud computing allows cloud users to access the cloud services and resources on mobile phones. Mobile cloud computing makes effective use of time and energy for execution of applications and improves the data handling capabilities of mobile devices. Cloud Computing utilizes network and capacity to provide services to customers in a pay per service manner. It processes and

stores data on the internet instead of personal computing devices, and runs the user applications on remote servers [25]. Cloud computing serves as three layer service (Fig. 1) environment one is IaaS (infrastructure as a Service) provides computing infrastructure for customers like hardware and storage etc., second one is PaaS (Platform as a Service) offers computing platforms like operating system services to customers, and the last one is Software as a Service (SaaS) runs software applications on cloud which are needed by customers.
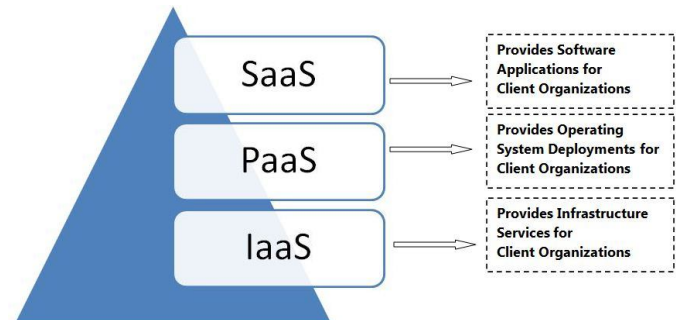

Fig. 1. Cloud Computing Service Layers.

There are four types of cloud deployment models are their public, private, hybrid and community cloud models. Public cloud allows general public to share the resources, Private cloud is dedicated to individual customers or organizations, hybrid cloud is a combination of public and private cloud models, and in community cloud model services are provided for communities. Process of running high quality applications and accessing of applications from isolated servers on mobile devices through wireless networks is called mobile computing. Mobile cloud computing is a form of cloud computing technology in which superior computing services, data and applications are stored on internet and accessed by mobile devices [2]. Mobile cloud computing discards the requirement of high and substantial device configurations since all the computing process is carried over cloud. In Mobile Cloud Computing Architecture (Fig. 2) Mobiles Devices are connected to Cloud through Internet via mobile networks. Mobile networks are acts as interface to control connections between cloud networks and mobile devices. Mobile user's requests for resource, data or service are transmitted over internet to cloud servers via mobile network to cloud servers, then the requests are processed in

cloud and the results are sends back to the mobile devices [1]. The main concept behind mobile cloud computing is to change the processing of high performance applications on mobile devices and produce effective business outcomes with promising user experiences. With mobile cloud computing, storage and computing capabilities are carried on cloud platforms from mobile devices and, delivers processing and software services, reduces costs of storage and processing [4]. With the advent of Smartphones, the popularity of Mobile cloud computing is increasing day by day. Moreover because of its various advantage and characteristics like reliability, scalability, flexibility, network access and independent nature of location, most of the business enterprises are moving towards mobile cloud computing.
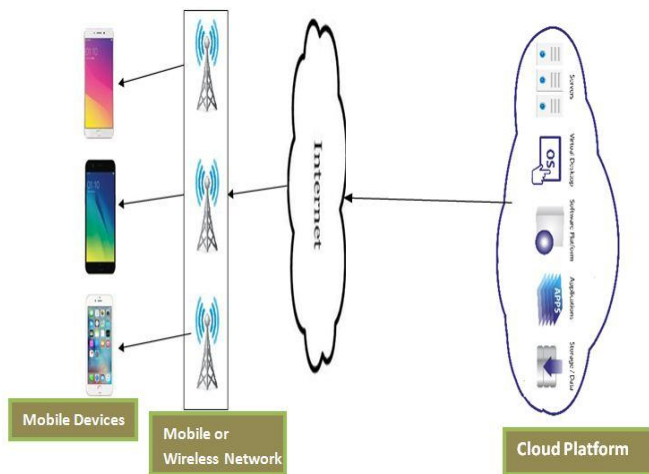

Fig. 2. Mobile Cloud Computing Architecture.

Mobile cloud computing also provides requirement of employment and its fast paced progression leads to need for employment in services like mobile application development, hardware, and outsourcing areas[35]. Although this technology has advantage of its diversified applications, still there are issues in several fields such as hardware configurations according process high end applications, connectivity and network issues, limited computing power, limited battery, limited storage, and efficient employees to develop required cloud based applications. Reason for that it is still a new technology to some countries. Following sections of this paper discusses applications of mobile cloud computing, its current trends and future predictions.

II. APPLICATIONS OF MOIBILE CLOUD COMPUTING

The major applications of mobile cloud computing includes commerce, education, health, banking, gaming and other business oriented applications[2][7][4]. These applications helped the mobile cloud market's growth and progression. Below mentioned are the few of examples mobile cloud computing.

A. Mobile commerce (m-commerce)

Explosive growth of Smartphones has been moved the e-commerce business to mobile devices. In mobile commerce or m-commerce the process of trading goods, products and services are being done on mobile devices. Applications for this model are designed so that they can easily carry out the much needed mobility tasks like mobile payments, messages and mobile ticketing[2][4]. Popularity of m-commerce is increasing rapidly because of mobility and user friendly commerce and online banking applications. However there are certain issues faced by m-commerce applications like security, low network bandwidth, configuration and connectivity issues[14]. To overcome from these issues m-commerce applications amalgamated with cloud computing technology for better security, efficient data processing speed and commerce transactions.

B. Mobile Education or m-learning

Mobile education is from of e-learning or electronic learning technology that is carried out on mobile devices. M-learning offers advantage that one can continue the learning process at anytime and anywhere. The main concept behind m-learning is to prioritize the learner's interactions with the mobile technology. Nowadays Wide use of mobile applications for constituting education assistance became integral part of education. M-learning applications have various limitations such as need for high cost mobile devices, low network speeds, connectivity issues, and data charges and less availability of resources. Migrating of mobile learning applications towards cloud technology will solve these issues. Moving m-learning to cloud will have the advantage of huge storage capabilities, high performance processing abilities and increased battery life. It also enables students for getting access of educational resources remotely, at the same time teachers can assess the knowledge levels at timely manner.

C. Mobile Banking or m-banking

M-Banking is currently widely used technology for various banking services and transactions with help of various banking applications and smartphone evolution. User can avail banking services at any situation and at any place through SMS, mobile internet, and with banking applications.

D. Mobile Healthcare or m-healthcare

Drawbacks with conventional medical treatments like security and privacy, medical errors etc., can be overcome mobile cloud computing technology. M-healthcare helps patients to access appropriate help form resources and also offers several on-demand services to medical organizations. There are many applications that mobile cloud computing can offer in health care field such as time based monitoring of patient conditions and sending reports to organizations, managing and coordinating emergency situations, health monitoring mobile devices and applications for tracking diabetics level, pulse-rates, blood pleasures and fat content etc., users can their medical reports, health related information at anytime anywhere.

E. GPS and Sensor applications

Data across local-area or peer-to-peer networks can be shared at fast rate between groups of mobile devices that are near to each other and it is cost-effective. Mobile devices are manufactured with sensors like light sensor, accelerometer, GPS sensors, so that they can track phone locations and readings.

F. Mobile Gaming

In mobile gaming technology combined with cloud computing, game users can interact with game interface and cloud providers offloads the game in high performance cloud servers. M-gaming is effective money spinner for cloud service providers.

On top above applications mobile cloud computing can have advantages of extending the data storage, improving processing speed, battery life and reliability.

III. TRENDS IN MOIBILE CLOUD COMPUTING

Since the demand for services like software, hardware and IT outsourcing in increasing rapidly, by the end of year 2020 the market value of mobile cloud computing is expected to reach $191 billion[34]. According to [Timur Mirzoev, Amy Coleman, Robin Wacha-Bessert], the cloud computing will became significant driver for growth of new employment and services delivery. Most of the business enterprises are migrating towards mobile cloud services to make use of its advantages. Since some organizations need to travel abroad to meet their clients, in some organizations works are carried out by other branch offices, and to associate with employees of the organization from different geographical locations, business processing is turned out to be mobile in current days. In recent study conducted by Microsoft's trend report "Why Businesses are Moving to the

Cloud", states that nearly 50% of companies are using mobile devices for their regular business activities. Report further stated that small and medium size business enterprises are transforming their business towards cloud, over big large scale enterprises. By the end of 2020, 78% of small and medium size business enterprises use cloud services and they also estimated that this market will grow from 43 billion dollars to 55 billion dollars in US alone at end of year 2018. The report further said 95% of organizations abide the use of laptops, and 88% of organizations have smartphone support and 78% have supports tablets to carry out their business related activities [Fig. 3]. Recent Forrester's survey stated that "in future there will be more than half of users adopt the mobile technology and to keep up this situation enterprises must use cloud services". Security is the most primary and crucial issue of cloud computing since vast amount of data is migrated to cloud. Widespread cloud utilization leads to putting sensitive data risk to a greater extent. In [26], Prof. Mamta Sharma and Prachi Bhopi mentioned that organizations in mobile industry are trying hard to produce best and utmost security solutions for user's data on mobile devices. They also said the in future demand for EMM (Enterprise Mobile Management) will be increased among business organizations. There should be focus on huge amount of data added to cloud and new methods to handle that data. Past few years saw new types of data breaches and security attacks (like botnets, ransomeware) etc. on cloud and on mobile devices using technology advancements. So in future there are some security concerns that must be looked after since hackers will use more advanced techniques to attack. In [38] Bob Violino mentioned few issues to look after that causes security problems for cloud organizations. Data breaches will become main targets since data breaches can happen with mediocre security principles of an organizations, software limitations, and human errors. Poor Identity Access Management and Credential management will lead to unauthorized access of companies or user's sensitive data. This situation likely to cause severe damage for the enterprise and users. Since cloud service providers uses application programming interfaces (APIs) and user interfaces (UIs) for better user experiences, the security of activity performed over these are depends upon security levels APIs. And also multi-tenant cloud systems that provide access to shared storage and resource services can target for attacks by stealing the data of opponent organization's data. A new type account hijacking attack occurs on cloud if hackers gain access to user credentials. By doing this attackers can damage, manipulate, redirect customers to illicit websites or they can serve false results to customer queries. User's information stored on cloud can be lost permanently because of security attacks, physical disasters, or accidental deletion by service providers. Absence of adequate and strong monitoring services also makes the cloud vulnerable. Cloud deployments

with poor security practices and illicit user sign ups and free service trials can cause malicious attacks. There will more chance of denial o service (DoS) attacks.
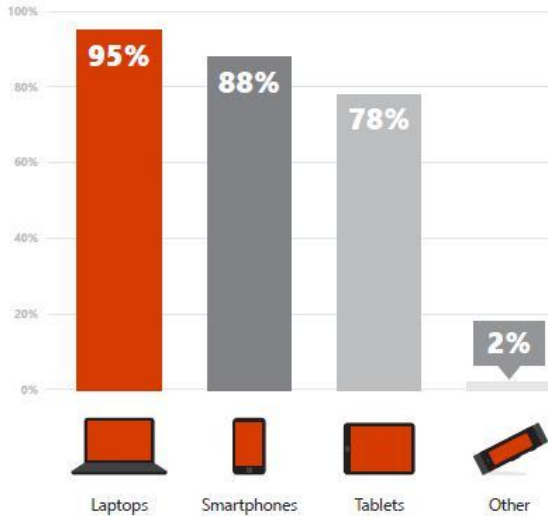

Fig. 3. Types of Mobile Devices supported on Enterprise Networks

Offloading of high performance computing services from mobile devices to cloud enables mobiles devices to perform as regular computers used for processing, prevails over the limitations of mobile devices, and decreases the battery utilization while enhancing the performance. There will be need for manufacturing of new kind of mobile devices that are cable of performing cloud tasks with rise and expansion of mobile cloud computing, and also create employment in manufacturing sector. In [10] [Prof.M.R.Joshi] stated that at current scenario, the demand for cloud computing is increasing rapidly because of its diversified advantages such as cost-effectiveness, availability highly capable networks, data storage, hardware virtualization which leads to reduces burden of maintaining infrastructure. He further stated that the current trends in cloud computing is open source cloud computing in which different enterprises are formed open standards that deliver powerful clod services with help of its unique features to meet requirements of clients. Mobile cloud competing is one emerging trends cloud technologies, which runs high end mobile applications on mobile devices while promising rich user experience. With advent of high speed mobile networks such as 4G and especially 5G networks and high end Smartphones, mobile devices are now meeting the much needed requirements for running cloud computing tasks on mobile devices. In future mobile cloud computing applications will have strong influence on our social and business activities. With these tendencies competitiveness among service provider will be increased that results in more efficient and productive services.

As stated by survey conducted by Mobile World Live in annual industry survey report 2017 [37], this year mobile industry is expected to see great transformation, with NFV (network functions virtualization) and SDN (Software Defined Networking), and will emerge as adaptable and more feasible technology from performance perspective. The survey further said that with advancement high speed 5G networks, mobile devices will be able to handle the cloud technology network-as-a-service. The reports also stated that virtualization and 5G networks will become highly software and business oriented technologies more than ever. But there will be few challenges exist with technological advancements. Most of enterprises are feeling that cost is major barrier when migrating to 5G. Although industry transforming towards NFV and SDN, almost half of organizations which are participated in survey thinks that they not sure about virtualization reduce the cost. The report said that exhaustive IT infrastructure replacement is required to cope with the new technologies. In [39], it is said that majority of enterprises are looking towards IoT and Big data technologies. IoT has been progressed as a promising technology since previous few years. By the year 2020 the mobile devices that are connected will raise to 50 billion. The devices produce huge scalable data from attached sensors to be processed. It is a big challenge for mobile devices to analyze this big data and produce desired results. Expeditious growth of computing devices drives the explosion of huge data which is big challenge for cloud computing since they are equipped with centralized servers. Sending of the data produced by mobile devices to cloud servers and after processing and analysis of that data by remote data centres and sending back to mobile devices is huge challenge when dealing with huge amount of data. So there would be huge network traffic burden on centralized servers with data generated by IoT devices. The solution for this issue would be use decentralized cloud serves in which each computing device will be acts as a server. Mobile devices can process data independently, communicate with other devices directly and can share the resources with other mobile devices to reduce the difficulty of cloud computing resources. This paradigm gives speedy results, and more scalability and more efficiency. This decentralized technology is privatized and reduces central trust entities and is cost effective since it uses cloud computing resources that are not used often on mobile devices. Mobility in business processing became more popular these days[36].

IV. CONCLUSION

Mobile Cloud computing is an emerging trend from past few years and will grow much more because of its mobility and cloud services stake. Nowadays almost each and every person has Smartphone and mobile devices can be used

for various day-to-day and business activities. This situation will impact the demand for mobile cloud computing. Because of its agile, time and location independent access, its popularity is growing exceptionally. With advent of 5G network and IoT technologies Mobile Cloud computing has became crucial part business environment. With polarity there comes security concerns' to look after. Keeping this point of view, his paper reviewed the importance, applications and various security issues of mobile cloud computing. Further this paper also primarily focused current and future trends in mobile cloud computing.

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