A Survey on Mobile Cloud Computing

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***Abstract*—** Mobile applications are growing explosively with cloud computing concept. Mobile Cloud Computing is a new technology for mobile services. It integrates the cloud computing into mobile environment to overcome some obstacles related to performance, environment and security. This paper gives survey of Mobile Cloud Computing with respect to its definition, architecture and applications.

Keywords - Cloud Computing; SaaS; PaaS; IaaS; Mobile Cloud Computing; Mobile agent; Portability; Interoperability;

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I. INTRODUCTION

Cloud Computing enables convenient, on-demand network access to a shared pool of configurable computing resources (such as networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. There are three basic models of cloud service Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

Infrastructure as a service (IaaS): In the most basic cloud-service model, providers of IaaS offer computers - physical or (more often) virtual machines and other resources. IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw (block) and file-based storage, firewalls, load balancers, IP addresses, Virtual Local area network (VLANs), and software bundles. IaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide area connectivity, customers can use either the Internet or carrier cloud (dedicated virtual private networks).

Platform as a service (PaaS): In the PaaS models, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.

Software as a service (SaaS): Users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee.

Mobile Cloud Computing: Mobile Cloud Computing at its simplest refers to an infrastructure where both the data storage and the data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and mobile computing to not just smartphone users but a much broader range of mobile subscribers.

II. LITERATURE REVIEW

Problems in cloud computing are analyzed and uses open cloud computing federation which incorporates multiple CCSP'S (cloud computing service provider's) to provide a uniform resource interface. A new mechanism called MABOCCF (Mobile Agent Based Cloud Computing Federation) is proposed by Zehua et. al.[1] which combines mobile agent with Cloud Computing to construct a cloud computing federation mechanism. This is used in MABOCCF to ensure better compatibility. Chetan et. al. [2] propose Cloud Computing techniques for storage and processing of data on mobile devices. This paper addresses the issues and possible solutions related to Mobile Cloud Computing. It also describes the open source project for mobile cloud platforms called OPENMOBSTER and the services needed by mobile cloud client and server. To ensure security in mobile cloud platform, the paper proposes a new model of security where detection services can be moved to cloud. This architecture consists of three components such as Host agent (runs on each device and watches out the file activities on the system), Network Service (analyses the files sent by the host agent), and Caching (is a local, private and global shared cache). It also describes the limitations of the proposed model such as disconnected operation and privacy. Pragya et. al.[4] address essential characteristics, service, and deployment models of cloud. This paper discusses few challenges and solutions of it related to implementation of Mobile Cloud Computing. A method is proposed by categorizing Mobile Cloud Computing in to two broad categories GPMCC [General Purpose Cloud computing] and ASMCC [Application Specific Cloud computing].It also presents an overview on open research issues such as Energy efficiency, Security, Better Service and Task division. Esseradi et. al. [15] discuss about the current mobile cloud computing development and research challenges. The mobile devices are facing many challenges in their resources (e.g., battery life, storage, and bandwidth) and communications (e.g., mobility, privacy of data and security). The value and originality of cloud computing comes from packaging and

offering resources in an economical, scalable and flexible manner that is affordable and attractive to IT customers and technology investors. A user lends resources (software, storage, server, network) as needed, uses them, get a support of real-time scalability according to service load, and pays accordingly. On the other hand, mobile devices used in the mobile environment include personnel information and enable to provide the environment that collects a variety of context-aware information. Hence, context-aware reasoning technique has been studied to provide a suitable service for user by using user context and personal profile information in mobile environment. Yi Xu et. al. [16] have made a review on mobile cloud computing, with focus on the technical challenges of Mobile Cloud Computing for multimedia applications. The paper focuses on the technical part of the enabling technologies and discusses the challenges and existing solutions from several aspects such as energy conservation. Existing prototypes of mobile media cloud systems are also reviewed.

Rajendra Prasad et. al. [3] address the way to combine Cloud Computing and mobile devices for future opportunities. The Cloud Computing Challenges such as Implications and Legal issues, Performance, Security, Privacy, Control, Bandwidth Costs and Reliability are discussed. The paper describes a general architecture of Mobile Cloud Computing. Few implications such as m-Learning, m-Commerce, m-Healthcare, m-Game, m-Banking are described. Kovachev et. al. [5] have proposed the Mobile Community Cloud Platform (MCCP) as a cloud computing system that can leverage the full potential of mobile community growth. An analysis of the core requirements of common mobile communities is provided before the design of the cloud computing architecture that supports building and evolving of mobile communities. They have proposed architecture of cloud computing to facilitate mobile data and service creation, management and sharing across mobile communities. Advanced mobile applications running on smart phones such as iPhone and Android phones will be empowered to make good use of the cloud infrastructure. At present, it is still hard to predict the success of the cloud computing to support mobile communities, only based on this conceptual and technical proposal. Guan et. al. [6] introduce the basic Mobile Cloud Computing model, describes the challenges such as network latency, Limited bandwidth, Security, Privacy etc. and also describes the conceptual model of Mobile Cloud Computing. Ronnie et. al. [10] address different security issues in Mobile Cloud Computing. The Mobile Cloud Computing divides the security into two parts, namely mobile network user's security and cloud security. This paper also mention guidelines for security and privacy in cloud computing.

Jaifu et. al. [13] present that earlier client-server based on mobile service models are not able to meet the increasing demands from mobile users in terms of user experience, services diversity, security and privacy. A brief review of Mobile Cloud Computing is provided with respect to the basic concept and canonical applications (eg. mobile video streaming, mobile online gaming). A new human-centric mobile cloud computing service model is proposed.

This article also reviews the existing work on mobile video streaming and mobile online gaming. Alizadeh et. al. [14] have presented a descriptive study on the key concepts, infrastructure and challenges of mobile cloud computing and also their advantages and drawbacks hindering the advancement of this technology in terms of privacy and security issues. In the mobile cloud environment, data and application are store in cloud servers that raise the security issues for the users of mobile computing and this issue is a key barrier in the development of the cloud computing applications. Vijay et. al. [21] propose an architecture where several services are hosted on the cloud by many cloud customers. The paper also proposes a novel trust enhanced security model for cloud which overcomes th challenges with the current Trusted Platform Module [TPM] based attestation techniques to efficiently deal with the attacks in the cloud.

Anton Panhelainen [11] address that cloud computing service provider requires keys for protecting investment on application. It requires portability and interoperability for application and services. The paper addresses probability using write once run anywhere (WORA) principle and also explains migration for portability and interoperability between clouds. Abolfazli et. al. [12] addresses encouragement for hosting services on nearby mobiles using Market Oriented Mobile Cloud Computing [MOMCC] architecture, which minimizes WAN latency and builds business opportunity. The architecture MOMCC is suitable for computing tasks since host shares computing resources. Data intensive task are less addressed in this architecture. Quigfeng et. al. [17] has predicted that the mobile area will take on a boom with the advent of this new concept. Due to the inherent characteristics of mobile environment, challenges like mobility, heterogeneity and low band-width, the advancement is hindered. This paper also introduces a new concept and an abstraction derived from mobile agent-Universal Mobile Service Cell to shield the unequivalence of heterogeneous distributed systems between mobile devices and the cloud. Andreas Klein et. al. [18] discusses about intelligent access schemes to have always-on connectivity and high quality mobile access. These schemes focus on the specific information such as users location, context requested services etc.

NKosi et. al. [19] have discussed the research areas in IP multimedia system protocol management, service activation and support of mobile cloud computing APIs for societal services such as mobile health and banking. Furthermore, the paper discusses on standards and a framework to extend the capacity, reliability and life of mobile devices through a common service provider and network operator platform. This will allow people with even low cost mobile phones to have access to advanced services. The transitional execution and performance of hosted mobile cloud services will require more research and testing, to look at which part of an application needs to be performed natively in the mobile device or the cloud. Synchronization of processes to make sure that a security protection and access to services is completed correctly. Finally, a test of the services management system for a proposed mobile health service with cloud support is demonstrated. Okkyung et. al. [20] propose a more practical solution to the problem, using "parallel process" technology to deal with large volume of big data more efficiently. Taking further from the proposal, they designed and implemented a mobile cloud computing model, which utilizes distributed computing framework based open sources, like Hadoop, in an attempt to improve the efficiency of business processing in a

mobile cloud computing environment. Rahman et. al. [22] focus about green computing and energy saving. This paper presents the research scope and classifies issues in energy saving in mobile clouds. It reviews the existing research results and techniques, and examines their strengths and weaknesses. Finally, the paper offers observations, and identifies the open issues and needs for future research.

Hamza et. al. [7] discuss discovery of web services based on cloud computing using mobile agents. It gives the general architecture of discovery system which includes Web Interface Port, Cloud Computing Port, Mobile Agents Port, and Operation Mode. Ramaswamy et. al. [8] give an introduction about cloud computing and the different types of models in cloud computing. The paper proposes a mobile agent based approach which gains the trust of both the customer and service provider. In this approach, the trustworthy customer and Cloud Service Provider are identified and malicious attaches are removed out of cloud. Cloud Broker controls and monitors and there by ensures trust. Rabia et. al. [9] addresses the two major cloud computing issues such as portability and Interoperability. The proposed architecture addresses the two issues with association of most emerging technologies such as agents and XMPP protocol.

III. CONCLUSION

Mobile Cloud Computing combines both mobile computing and cloud computing and provides optimal service to the user and the service provider. A recent study by ABI Research, a New York-based firm says the more than 240 million business applications will use cloud services through mobile devices by 2015 and this will push the revenue of mobile cloud computing to $5.2 billion. This paper gives an overview of mobile cloud computing in which its definitions, architecture, and advantages have been presented. The applications supported by mobile cloud computing including mobile commerce, mobile learning, and mobile healthcare have been discussed which clearly show the applicability of the mobile cloud computing to a wide range of mobile services.

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