Mobile - Cloud Computing for Context- Aware in Real-Time Environment

Bhawana Ahlawat¹, Lokesh Kumar²

¹Department of Computer Science and Engineering, Rohtak Institute of Engineering & Management, Rohtak, INdia
²Assistant Professor, Department of CSE, Rohtak Institute of Engineering & Management, Rohtak, INdia

ABSTRACT

Together with an explosive growth of the mobile applications and emerging of cloud computing concept, mobile cloud computing (MCC) has been introduced to be a potential technology for mobile services. MCC integrates the cloud computing into the mobile environment and overcomes obstacles related to the performance (e.g., battery life, storage, and bandwidth), environment (e.g., heterogeneity, scalability, and availability), and security (e.g., reliability and privacy) discussed in mobile computing. This paper gives a survey of MCC, which helps general readers have an overview of the MCC including the definition, architecture, and applications. The issues, existing solutions and approaches are presented. In addition, the future research directions of MCC are discussed.

Keywords- Mobile cloud computing, offloading, mobile services.

I. INTRODUCTION

In recent years Cloud Computing has emerged as one of the most active research topics. Many efforts have been invested in research to propose new technologies that provide IT solutions in different modalities, i.e., IaaS, PaaS or SaaS, always based on the utility-computing business model. The goal is to allow companies (both small and large) to purchase IT services from cloud vendors on a pay-as-you-go basis, rather than owning their own IT department and infrastructures. The main benefits reside in increased business agility, IT control, cost efficiency, and productivity, as well as a reduction in the number of management resources that are required. Thus, Cloud Computing has been recognized not only as a technological innovation but also as an IT market and business innovation. For that purpose techniques and technologies have been proposed for virtualization, balancing and efficient resource usage, easy and reliable remote services consumption, and avoiding services from being tied to the specification of particular cloud vendors.

While the general consensus establishes that the larger the company adopting the cloud alternative is, the larger are the benefits provided by this paradigm, real experiences of large companies massively adopting Cloud Computing are still needed. Companies manifest their intention and willingness to move to the cloud but they are still at the stage of studying its potential and actual benefits. This could cause doubts about the real potential of Cloud Computing. However, since millions of people already consume cloud services like Dropbox, Facebook, etc., one can argue that Cloud Computing is here to stay. Although these services are small and structurally simple, the magnitude of their success is reaffirmed by their figures. As an example, in 2011 Google billed 29.3 billion Dollars, and in October 2012 Facebook reached its first billion users.

Such massive consumption of cloud services takes place in a context in which 25% of the global network traffic is generated from mobile devices. Smartphones and tablets are reaching, and even in some cases surpassing, the capabilities of laptops and desktop computers. In 2016 the network traffic generated from mobile devices is estimated to reach 50%. Such traffic is expected to be dedicated to cloud services consumption such as video streaming, email and instant messaging or social media access. So, the interest on the development of cloud computing in the context of mobility is undeniable.

There are over 21.2 million visually impaired or blind people in the United States [Pleis et al.] and many more in the world. The 2009 survey by the U.S. Department of Labor [US Bureau of Statistics, 2010] shows that at all levels of education, persons with a disability were less than half as likely to be employed than were their counterparts with no disability and 75% of the blind population in the survey were not part of the labor force. The two biggest challenges for independent living of the blind and the visually impaired as stated in [Giudice et al.] are access to printed material and safe and efficient navigation. In order to navigate safely, blind people must learn how to detect obstructions, find curbs when outside and stairs when inside buildings, interpret trace patterns,
find bus stops and know their own location [Giudice et al.]. This implies being fully aware of the context of their living and working environment. Context-aware navigation for the blind is not only safely reaching a destination, but also being able to track personal items/objects of use (such as luggage on an airport carousel), and identify/interact with acquaintances on the way or at a social gathering.

Independent navigation is becoming a bigger challenge for the blind with the advances in technology, products of which such as hybrid cars (aka quiet cars), make it more difficult to rely on other senses, such as hearing, for safety [Emerson et al.]. Hence, while technology is improving the lives of the general public, it is a cause for people with disabilities to fall behind and even puts their lives at risk. Most navigation aids utilizing high technology have high price tags (a few thousand dollars), making them unavoidable. The difficulty of independent navigation in the increasingly complex urban world and the lack of adorable navigation technology cause isolation of the blind and visually impaired. Blind people, not being able to drive vehicles, are the ones in greatest need for accessible transportation services. However, as stated by Kwan et al. [2008], in many cities, people with disabilities are seldom seen using the street or public Transportation due to insouciant accessibility. This situation has not changed significantly despite requirements of compliance with special accessibility rules in buildings and facilities vehicles (e.g. Announcing major stops in public transportation vehicles) such as those stated in the Americans with Disabilities Act Accessibility Guidelines [US Access Board]. As reported by the World Health Organization, more than 82% of the visually impaired population in the world is age 50 or older [World Health Organization] and this population forms a group with a diverse range of abilities [Gregor et al.]. This diversity makes it difficult to develop a single navigation device usable by everyone. Devices requiring an involved training process are especially not appropriate for elderly people with decreasing learning capabilities. In this paper, we propose a context-rich, open, accessible and extensible navigation system for the blind and visually impaired, bringing the quality of the navigation experience to higher standards. We propose the use of currently available infrastructure to develop an easy to use, portable, adorable device that provides extensibility to accommodate new services to help in high quality navigation as they become available.

The initial ideas regarding ubiquitous computing and visible computing came from the research of Mark Weiser. Weiser (1991) identified location and communication as two vitally important issues to create technological solutions so unobtrusive that they weave themselves into the fabric of our everyday lives and, by this, facilitate the birth and growth of location and context-aware computing. “Recognizing that every situation has its own given context of information and events, this context will vary depending on the situation we are in, and the tasks we are about to perform” (Dourish, 2004). Several researchers have taken up the challenge of defining context and they all agree upon its value as a source of information. Generally speaking, context is often defined either to be time, location or action (Dey and Abowd, 1999; Dey, 2001; Schilit et al., 1994). The use of context in the design of applications is a possible solution to avoid vagueness and misinterpretation, if used correctly.

Accordingly, developers and researchers see that the context is one important factor when designing new applications that open interesting possibilities for tailoring of applications for use in homes, at workplaces, on travel etc. One approach of merging the worlds of research and business is the one that is formed in context-aware computing. Dey and Abowd (1999) state that if we understand context fully in a given environment and setting, we would then be able to better choose what context aware behaviours to sustain in applications. This could lead to more realistic applications and thereby applications more meaningful to the users. Edwards (2005) also exemplified this in his approach when he used context information in a layered fashion to build an adaptive application, and argued that context is a major part of our daily life and computing with support for sharing and using contextual information (context-aware computing) would improve the user interaction. When viewing people rather than systems as consumers of information a new infrastructure is needed. With this in mind, one ought to develop more intelligent business applications tailored to the customer needs. Context-aware information combined with a broader and deeper use of context sources such as sensors, environment information, indoor sensors and adaptive application behaviour can be factors for creating richer and better applications. Thereby, make the system immediately take better advantage of the information retrieved and pursue the ideal of providing tailored and timely information to mobile information users everywhere. Context awareness as a valued source of information is also recognized by the Gartner Group (2011c) which predicts that by 2015, companies will generate 50% of their web sales through social presence and mobile applications. They further point at the development of context-aware applications together with mobile-based capabilities as a major step towards this goal.
II. ARCHITECTURE OF MOBILE CLOUD COMPUTING

Mobile devices are connected to the mobile networks via base stations (e.g., base transceiver station (BTS), access point, or satellite) that establish and control the connections (air links) and functional interfaces between the networks and mobile devices. Mobile users’ requests and information (e.g., ID and location) are transmitted to the central processors that are connected to servers providing mobile network services. Here, mobile network operators can provide services to mobile users as AAA (for authentication, authorization, and accounting) based on the home agent (HA) and subscribers’ data stored in databases. After that, 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.

III. ISSUES AND APPROACHES OF MCC

MCC has many advantages for mobile users and service providers. However, because of the integration of two different fields, i.e., cloud computing and mobile networks, MCC has to face many technical challenges. This section lists several research issues in MCC, which are related to the mobile communication and cloud computing. Then, the available solutions to address these issues are reviewed.

A. Issues in Mobile Communication Side

1) Low Bandwidth: Bandwidth is one of the big issues in MCC since the radio resource for wireless networks is much scarcer as compared with the traditional wired networks.

Proposes a solution to share the limited bandwidth among mobile users who are located in the same area (e.g., a workplace, a station, and a stadium) and involved in the same content (e.g., a video file). The authors model the interaction among the users as a coalitional game. For example, the users form a coalition where each member is responsible for a part of video files (e.g., sounds, images, and captions) and transmits/exchanges it to other coalition members. This results in the improvement of the video quality. However, the proposed solution is only applied in the case when the users in a certain area are interested in the same contents. Also, it does not consider a distribution policy (e.g., who receives how much and which part of contents) which leads to a lack of fairness about each user’s contribution to a coalition. [64] considers the data distribution policy which determines when and how much portions of available bandwidth are shared among users from which networks (e.g., WiFi and WiMAX). It collects user profiles (e.g., calling profile, signal strength profile, and power profile) periodically and creates decision tables by using Markov Decision Process (MDP) algorithm. Based on the
tables, the users decide whether or not to help other users download some contents that they cannot receive by themselves due to the bandwidth limitation, and how much it should help (e.g., 10% of contents). The authors build a framework, named RACE (Resource-Aware Collaborative Execution), on the cloud to take advantages of the computing resources for maintaining the user profiles. This approach is suitable for users who share the limited bandwidth, to balance the trade-off between benefits of the assistance and energy costs.

2) Availability: Service availability becomes more important issue in MCC than that in the cloud computing with wired networks. Mobile users may not be able to connect to the cloud to obtain service due to traffic congestion, network failures, and the out-of-signal. After detecting nearby nodes that are in a stable mode, the target provider for the application is changed. In this way, instead of having a link directly to the cloud, mobile user can connect to the cloud through neighboring nodes in an ad hoc manner. However, it does not consider the mobility, capability of devices, and privacy of neighboring nodes. tries to overcome the drawbacks. In particular, proposes a WiFi based multi-hop networking system called MoNet and a distributed content sharing protocol for the situation without any infrastructure. Unlike, this solution considers moving nodes in the user’s vicinity. Each node periodically broadcasts control messages to inform other nodes of its status (e.g., connectivity and setting parameters) and local content updates. According to the messages, each node maintains a neighboring node list and a content list and estimates role levels of other nodes based on the disk space, bandwidth, and power supply. Then, the nodes with the shortest hop length path and the highest role level are selected as the intermediate nodes to receive contents. Besides, the authors also consider security issues for mobile clients when they share information by using account key (to authenticate and encrypt the private content), friend key (to secure channel between two friends), and content key (to protect an access control). Two applications are introduced, i.e., WiFace and WiMarket that are two co-located social networking. This approach is much more efficient than the current social networking systems, especially in the event of disconnection.

3) Heterogeneity: MCC will be used in the highly heterogeneous networks in terms of wireless network interfaces. Different mobile nodes access to the cloud through different radio access technologies such as WCDMA, GPRS, WiMAX, CDMA2000, and WLAN. As a result, an issue of how to handle the wireless connectivity while satisfying MCC’s requirements arises (e.g., always-on connectivity, on-demand scalability of wireless connectivity, and the energy efficiency of mobile devices). [67] proposes an architecture to provide an intelligent network access strategy for mobile users to meet the application requirements. This architecture is built based on a concept of Intelligent Radio Network Access. IRNA is an effective model to deal with the dynamics and heterogeneity of available access networks.

To apply IRNA in MCC environment, the authors propose a context management architecture (CMA) with the purpose to acquire, manage, and distribute a context information.

IV. Conclusion

This paper has described an architecture for context-aware computing consisting of device agents, user agents, and an active map service. Each of these services is based on a dynamic environment model that is well suited for communicating changing values to hosts over wireless links. The architecture compliments work done on the PARCTAB system, which, along with a number of context-aware applications, is presented as a demonstration of these concepts.

REFERENCES