International Journal of Adaptive, Resilient and Autonomic Systems
Volume 7 • Issue 1 • January-June 2016

A Mobile Cloud Middleware to Support Mobility and Cloud Interoperability

Khadija Akherfi, Technical University of Munich, Munich, Germany
Hamid Harroud, Al Akhawayn University in Ifrane, Ifrane, Morocco
Michael Gerndt, Technical University of Munich, Munich, Germany

ABSTRACT

With the recent advances in cloud computing and the improvement in the capabilities of mobile devices in terms of speed, storage, and computing power, Mobile Cloud Computing (MCC) is emerging as one of important branches of cloud computing. MCC is an extension of cloud computing with the support of mobility. In this paper, the authors first present the specific concerns and key challenges in mobile cloud computing. They then discuss the different approaches to tackle the main issues in MCC that have been introduced so far, and finally focus on describing the proposed overall architecture of a middleware that will contribute to providing mobile users data storage and processing services based on their mobile devices capabilities, availability, and usage. A prototype of the middleware is developed and three scenarios are described to demonstrate how the middleware performs in adapting the provision of cloud web services by transforming SOAP messages to REST and XML format to JSON, in optimizing the results by extracting relevant information, and in improving the availability by caching. Initial analysis shows that the mobile cloud middleware improves the quality of service for mobiles, and provides lightweight responses for mobile cloud services.

KEYWORDS

Adaptation, Cloud Computing, Middleware, Mobile Cloud Computing

1. INTRODUCTION

Although the accelerating progress that mobile device hardware and mobile networks know, mobile devices will always be less secure, resource-limited, with unstable connectivity. Resource limitation is the main obstacle for many applications (Satyanarayanan, Bahl, Caceres, & Davies, 2009). Thus, computation on mobile devices will always involve and require cooperation. The mobile cloud computing offers a suitable platform for such cooperation. The MCC is a combination of several components which are cloud computing, wireless communication infrastructure, portable computing devices, location-based services, mobile Web (Patel, 2013). This new model allows users to a remote access to unrestricted computing power and unlimited storage space and this makes mobile devices considered as entry points and interface of cloud online services.

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.

Mobile Cloud Computing is providing many benefits for cloud computing and network operators, such as reduced dependence on hardware and software equipment, and increased reach. Mobile cloud computing has many advantages among the few listed below (Tantow, 2011; McKinley, Samimi, Shapiro, & Tang, 2006):

DOI: 10.4018/IJARAS.2016010103

- Possibility of sharing information and applications without the need of costly hardware and software;
- Enhanced features and functionalities of mobile devices through new cloud applications;
- Ease of access and development since the access point to mobile cloud computing is through a browser;
- Extending battery lifetime for mobile devices;
- Improved data storage capacity and processing power.

As shown in Table 1, cloud computing brings many advantages to mobile computing, in terms of processing, storage, power and networking, while the mobility brings the personalization and the context awareness features.

This paper proposes a mobile cloud middleware architecture that contributes to tackling limitations related to mobility. The middleware also contributes to facilitating cloud interoperability.

A general scenario of mobile cloud usage can be described as follows. A mobile user, connected to a mobile network through a mobile device, sends information and requests to a server provider in the cloud through the middleware. Cloud controllers execute mobile users' requests. The middleware gets back the results and provides them to mobile users depending on their availability, connectivity, and device capabilities. The middleware will be located between the cloud provider and the mobile client. This is because we want our system to interact with different Web Services (WS) providers and to allow the interoperability between the different clouds. In other words, provide the mobile clients with the requested WSs from any cloud providers. Another reason is the connectivity; in case there is no connection between the provider and the middleware, the system still can provide the client with the needed responses thanks to caching, this applies when the response for the request in hand is in the cache.

The paper is organized as follows. Section 2 highlights the main issues and ongoing research related to mobile cloud computing. Section 3 presents our proposed mobile cloud middleware main components and architecture. Section 4 describes a prototype scenario that illustrates how the middleware contributes in solving some of the previously introduced issues, namely adaptation and cloud interoperability. In section 5 we summarize and point to future work.

2. ISSUES AND APPROACHES IN MOBILE CLOUDS

Today, and thanks to the big improvements that the mobile technologies know mobile devices have provided better services to customers and become a source of information. Several researchers have identified the fundamental challenges in mobile computing (Lee, Niyato, Dinh, &Wang, 2011; Expert Group Report, 2010; Gupta, 2008). In fact, mobile computing environments are characterized by frequent changes in operating conditions and several resources constraints forms such as memory

Table 1. Mobile vs cloud computing

	Mobile	Cloud
Processor	Small	Unlimited
Storage	Small	Unlimited
Network	Variable	Constant
Power	Limited Battery	Unlimited
Personal	Very	Not At All
Sensors	Yes	None