VALUE CREATION ND CO-CREATION IN THE MOBILE CLOUD

Gary Fragidis[1,2] Dimitri Konstantas[2] Konstantinos Tarabanis[3] and Adamantios Koumpis[4]

[1] Technological Education Institute of Central Macedonia, Serres, Greece
[2] University of Geneva, Switzerland
[3] University of Macedonia, Thessaloniki, Greece
[4] University of Passau, Germany
garyf@teicm.gr, Dimitri.Konstantas@unige.ch, kat@uom.gr, Adamantios.Koumpis@uni-passau.de

ABSTRACT

Purpose –
This paper presents a perspective on value creation in mobile service, especially when it is provided via the cloud. The popularity of mobile devices, especially smartphones and tablets, increases the interest in mobile service. Mobile cloud computing has been developed to remove certain technological restrictions in the provision of mobile service. Taking a a user-driven and usage-oriented perspective for mobile service, the purpose of this paper is to provide a conceptual framework for service value, value creation and co-creation in the mobile cloud.

Design/Methodology/approach –
Research in mobile cloud computing emphasizes on the technological requirements and challenges. This paper extends the research scope and integrates concepts from service management in order to understand better mobile service and value creation and co-creation with it.

Findings –
The paper proposes a terminology and models for mobile service provision. Then the paper provides a conceptual framework for value creation in mobile service that combines human and technological aspects in mobile service provision.

Research limitations/implications –
The paper provides a bridge between technological, business and usage aspects of mobile service and supports the better understanding of the relevant concepts. The paper can provide insights for the analysis of mobile service provision, value creation and value co-creation in mobile service, which can lead to the development of new service and business models. Future work can investigate the practical aspects of value creation in mobile cloud, by analyzing features and measures for the roles of the actors, their activities, the use of mobile service, etc.

Originality/value –
Research in mobile cloud services from a user-centric perspective is very sparse in the literature.

Key words – Service value, value creation, mobile service, mobile cloud computing.

Paper type – Conceptual paper

INTRODUCTION

The substantial progress in mobile technologies and the wide availability of wireless Internet has driven to an increasing popularity of mobile computing devices, which have become an essential tool of people in their everyday life. Mobile devices -especially smartphones and tablets- are used today more and more to provide a variety of services ("mobile services") that go beyond communication and support a wide spectrum of human activities, including social interaction, entertainment, economic transactions, business operations, personal time management, data management, learning, healthcare and a variety of location-aware and context-aware services.

A serious obstacle in the further development and use of mobile services stems from the technological limitations of mobile devices, especially with concern to resources (battery life, storage, etc.) and capacity (processing, bandwidth, etc.). Mobile cloud computing has been developed as a solution to these problems, by marrying together mobile technologies and cloud computing to extend the benefits of cloud computing to mobile devices. Mobile cloud computing can boost the development of mobile services, as well as enable the development of entirely new types of services (Smura, Kivi and Töyli, 2009) and become the dominant model for mobile applications in the future (Fernando, Loke, and Rahayu, 2013). Huang, Xing and Wu (2013), for instance, give a perspective of the services of the future as a combination of people needs, the physical environment that surrounds people and the virtual environments with which people are involved.

Research in the area has been focused on the technological advancement of mobile cloud computing, while research on the business and user aspects is marginal in the literature (e.g. Rahimi et al., 2014, Leimeister et al., 2010). However, mobile services support people in their everyday life practices and the mobile cloud exists to empower the mobile user (Fernando, Loke, and Rahayu, 2013), for instance by extending or expanding the functionality of the user's mobile device. Without good knowledge of the usage aspects of the service, companies are prone to fail to support their customers and they are missing opportunities for the development of new service and new business models.

In this paper we provide a user-driven and usage-oriented perspective for mobile service. We introduce concepts from service management to explore the meaning of value creation, analyze the role of the user and study especially the interaction, collaboration and co-creation of value between the user -through his mobile device- with the service provider and the actors of the mobile cloud. We focus on the mobile cloud because it is developing as a new technology that promises to resolve many of the obstacles for mobile services and because the user can participate in multiple ways in the creation of value for him and for others. The purpose of this paper is to provide a framework that integrates concepts from mobile cloud computing on the one hand and service management on the other hand in order to understand better the usage and value creation in mobile services.

The paper contributes in the literature in the following ways: first, it analyzes concepts and models of mobile service provision and explains the roles and activities of the different actors; second, it integrates the human aspects of mobile service with regard to the use of the service and the creation of value with the computing operations of the mobile device and the mobile cloud for the provision of the mobile service; third, it shows that certain concepts of the service management literature, especially for the creation and co-creation of value, are relevant in mobile cloud computing; fourth, it provides a bridge between the technological, the business and use aspects of mobile services and supports the better understanding of the relevant concepts.

The rest of the paper is organized in six sections. In section two we present an overview of mobile services provided via the mobile cloud. In section three we analyze the different perspectives on the concept of mobile service and we describe models of mobile service provision. In section four we debate on the role of the user in mobile service provision and the …

concept of value creation and co-creation in mobile services under the prism of the service management literature. In section five we develop a conceptual framework for value creation and co-creation in mobile services. The paper concludes with the discussion of the results and other key research issues.

BACKGROUND ON MOBILE SERVICES AND MOBILE CLOUD COMPUTING

Mobile services are services that can be accessed and used with the use of mobile technologies and mobile devices (such as smart phones, tablets and other wireless devices). The great advantage of mobile devices comes from their ability to support the mobility of the user. They are characterized by ubiquity, localization, improved personalization and increased convenience (Heinonen and Pura, 2006; Rowley, 2006) and, thus, they are able to provide mobile services that are different from other e-services and physical-world services (Baldauf, Dustdar and Rosenber, 2007). Mobile services are not simply alternatives to other services, but under certain circumstances (Verkasalo, 2009), they can provide new types of value (e.g. location-aware services), new ways for value configuration (e.g. real-time interaction with friends and other users who share the same context), rich experiences (e.g. context-aware services that adapt to the situation of the user) and opportunities for more added value (e.g. receiving service any time and especially at the moment it is needed).

Cloud computing refers to a new computing paradigm (Youseff, Butrico and Da Silva, 2008; Mell and Grance, 2011) that is based on the use of Internet infrastructure for the provision or sharing of computing resources (hardware and software) 'as a service', on demand and on temporary basis. Satyanarayanan (2011) describes the vision for cloud computing as "information at your fingertips anywhere, anytime". Cloud computing has been recognized as the next generation computing infrastructure (Dinh et al, 2013) and a new economic and business computing paradigm (Qi and Gani, 2012) that can offer can offer ample business opportunities (Satyanarayanan, 2011).

Mobile cloud computing has been emerged to bring the benefits of cloud computing in mobile devices (Yang et al., 2012; Dinh et al., 2013). The meaning of the mobile cloud applications is not very lucid in the literature. Yang et al. (2012) distinguish three major approaches for mobile cloud applications: a) extending the access of cloud services to mobile devices; b) enabling mobile devices to work collaboratively as cloud resource providers; c) augmenting the execution of mobile applications on portable devices using cloud resources. In the first approach, users access with their mobile devices software/ applications "as services" offered on the cloud, with all the computation and data handling being performed in the cloud. The second approach makes use of the resource at individual mobile devices to provide a virtual, ad hoc and local mobile cloud environment, without access to the Internet cloud. The third approach uses the cloud storage and processing for applications running on mobile devices.

With regard to the typical service models of cloud computing (Mell and Grance, 2011), the mobile cloud is most often considered as a SaaS model, when it is used to access software offered on the cloud, and it is considered as IaaS or PaaS model, when it is used to augment the capability of mobile devices through partial or full offloading of the computation and data storage from the mobile devices (Yang et al., 2012). Dihal et al. (2013) suggest that Mobile SaaS entails mobile services that run on local devices as "end-users services", while Mobile IaaS (and to a lesser extent Mobile PaaS) could be provided as a mobile extension of regular IaaS (PaaS).

Wan et al. (2013) describe three basic mobile cloud computing service models that are based on the role of the mobile device. In 'mobile as a service consumer' (MaaSC) -which is the most common model- the mobile device receives computing functions as single direction service from other actors that operate on the cloud. In 'mobile as a service provider' (MaaSP) the mobile device becomes the service provider of information or computing capacity through the cloud.

'Mobile as a service broker' (MaaSB) can be regarded as a special case of the MaaSP, because the mobile device provides services to other mobile devices or sensing nodes in its proximity.

In the literature we can find several examples of mobile cloud applications. Here we are interested in examples that include user's involvement and provide direct benefits to the user. Some typical examples refer to mobile crowdsourcing, collective sensing, location-aware and context-aware services, pooling mobile resources and sharing applications between mobile devices. Mobile crowdsourcing can be used in emergency situations and crisis management, like after a physical destruction or for finding a lost child (Satyanarayanan, 2011); in addition, for various social projects, like collective multimedia development (Fernando, Loke, and Rahayu, 2013). Collective sensing and location-aware services exist when a car transmits in real time information about the traffic and environmental conditions - and the car driver receives promptly a variety of additional location aware information and services (Huang, Xing and Wu, 2013). Location-aware and context-aware services exist if a task reminder application is set to be triggered by the location of the mobile user (Lin and Hung (2014) or the mobile user receives input from his social media about the activities of his friends. There are many examples related to pooling mobile resources and sharing applications between mobile devices. For instance, visitors in a museum can share applications (e.g. OCR to read text, translator, etc.) and pool together mobile resources (e.g. battery, bandwidth, roaming service, etc.) through an ad hoc network they create in order to receive mobiles services during their tour in the museum (Huerta-Canepa and Lee, 2010). Similarly, the participants in a conference can receive services that improve their travel experience and provide added value during the conference, such as exchanging and sharing information, planning common activities, etc. (O' Salivan and Grigoras, 2013). Travellers can share resources for transmitting files (e.g. e-mail) or a group of friends can play collaboratively a mobile game that runs on the mobile device of one user and is shared locally with the others (Dihal et al. 2013).

CONCEPTS OF SERVICE PROVISION IN THE MOBILE CLOUD

Terminology for service provision in the mobile cloud

The discussion about service provision in the mobile cloud is prone to serious misunderstandings as concerns the meaning of the term 'service'. The source of misunderstandings is the multiple dimensions of the concept of service and in particular the different uses of the term in computer science and in business science Baida, Gordijn and Omelayenko, 2004; Cardoso, Voigt and Winkler, 2009). Besides, there is commercial hype and diverse ways of combining cloud computing and mobile applications (Liu et al., 2013). Yang et al. (2012) describe three approaches for mobile cloud applications. We can gather from these approaches that, from a usage point of view, mobile cloud applications can support the access of services offered in the cloud, while from a computing point of view, they can enable mobile devices to work collaboratively as cloud resource providers or augment their operations by using cloud resources.

In this section we attempt to explain and clarify the concept of service in the mobile cloud. In particular, we distinguish between mobile service for the user and computing service for the operation of the mobile device in the mobile cloud. We name the former 'mobile service' and the later 'mobile cloud service'.

A 'mobile service' is an electronic service that can be provided, accessed and used with the use of mobile technologies and mobile devices. Mobile services are used by users in commercial transactions commerce, business operations, learning, healthcare, entertainment/ multimedia, gaming, social networking and collaboration, augmented reality, searching/ querying, etc. (Dinh et al., 2013, Rahimi et al., 2014; Wang and Chen, 2014; Liu et al., 2012).

A mobile service can be the mobile version of an e-service (as the term is described in Baida, Gordijn and Omelayenko, 2004), or it can be provided only in a mobile form, such as certain kinds of location-aware and context-aware services. Likewise, a mobile service can be the mobile counterpart of a physical world service, or it can be only in mobile form. For instance, we talk for banking service when the customer goes to a branch in his neighborhood, e-banking service when the customer uses a web banking system, and mobile (m-)banking service when the customer uses a mobile banking application via his mobile phone.

Mobile service is an electronic in nature service that is produced and consumed by real world entities: business organizations (service providers) produce and provide mobile services as a part of their business functions; end-users as individuals consume mobile services in their everyday life practices (in this paper we focus on the end user and we neglect transactions between business organizations). Hence, mobile services have a real world effect. For instance, a mobile banking service can be technically produced, delivered and consumed in electronic and mobile networks, but it provokes some results that have a meaning in the real world and affect entities and situations of the real world.

Service providers can offer mobile services directly to the end user with the use of Internet and wireless technologies; or they can provide mobile service via the mobile cloud, with the use of cloud resources, cloud computing technologies and mobile technologies. In most cases, the user does not know (and perhaps does not care) about the way mobile services are transmitted and received by his mobile device. These relationships can be seen in figure 1.

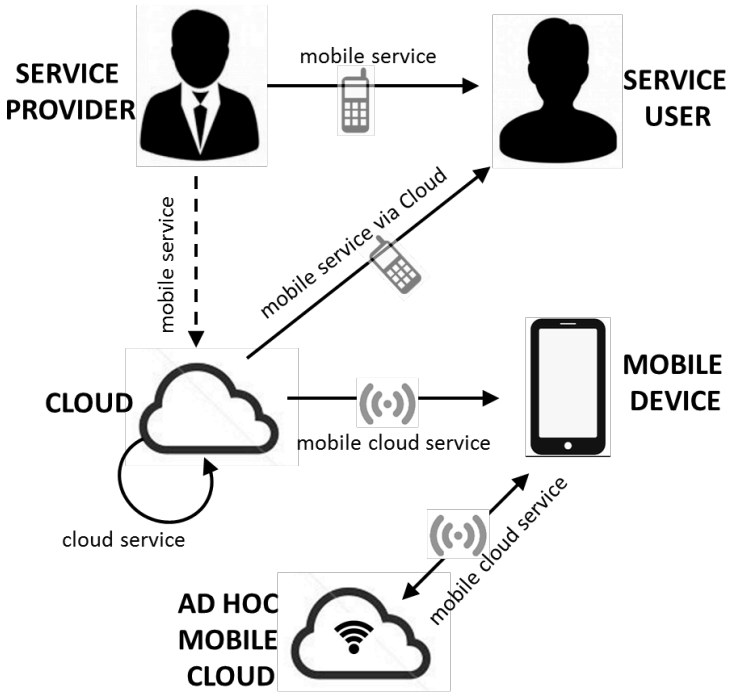

Fig. 1. Provision of mobile service and mobile cloud service

A ‘mobile cloud service’ is a computing service that is provided with the use of mobile technologies and mobile computing technologies and consumed by the mobile device of the user, as a part of its operations in order to enable and facilitate the provision of mobile services to the user or to other users. For instance, in order to provide navigation service to the user, the mobile device uses the cloud for the processing of location-aware data. Examples of mobile cloud services are related to the access, transmission and storage of data in the cloud, the outsourced execution of computing operations of the mobile device, security services, etc. Mobile cloud

services exist only in the virtual environment of the cloud and serve the augmented operations of the mobile devices.

In figure 1 we can see two popular in the literature approaches of mobile cloud computing (Yang et al., 2012). In the first case the mobile device receives computing service (e.g. storage and processing) from the cloud for the augmented execution of the tasks of the mobile device. In the second case the mobile device participates in an ad hoc local mobile cloud environment (cloudlet, mCloud, etc.) that enables mobile devices to work collaboratively by pooling resources and sharing operations. In figure 1 we can see also the provision of cloud service (iterative link) as a part of the operations of the different actors of the cloud ecosystem.

Models of service provision in the mobile cloud

Based on the different types of service in the mobile cloud, we can distinguish the following models of service provision in the mobile cloud:

a) Direct mobile service provision. The service provider offers mobile service to the user directly, without the use of any cloud resources.

b) Cloud-based mobile service provision. The service provider uses cloud resources in order to offer mobile services to the user. The prevailing cloud computing model here is the SaaS. The users may not be aware that the mobile service is transmitted via the mobile cloud. This model refers to the first approach of mobile cloud computing, as describe in Yang et al. (2012).

c) Mobile cloud service provision. The mobile device receives service from the cloud in order to augment its computing capacity by executing remotely computing operations and tasks. The user is not directly involved. However, the user is aware and, in fact, decides for the use of mobile cloud services by applying the required settings and possibly paying a fee. This model refers to the third approach of mobile cloud computing in Yang et al. (2012).

d) Ad-hoc mobile cloud service provision. The mobile device participates in a local cloud (e.g. cloudlet, mCloud, etc.) that is created ad hoc with other mobile devices and cloud-based resources in proximity. The mobile device both receives and provides computing services in the ad hoc cloud; for instance, it offers computing capacity because it holds big battery resources and uses the bandwidth of an other smartphone in the ad hoc cloud, because it provides cheaper or faster Internet access. As in the previous case, the user is not directly involved, but he is aware of the participation in the ad-hoc mobile cloud. It refers to the second approach of mobile cloud computing in Yang et al. (2012).

Figure 2 summarizes the information about service models and service provision in the mobile cloud. Mobile service provision takes place directly and through the cloud; mobile cloud computing is used to facilitate mobile service provision.

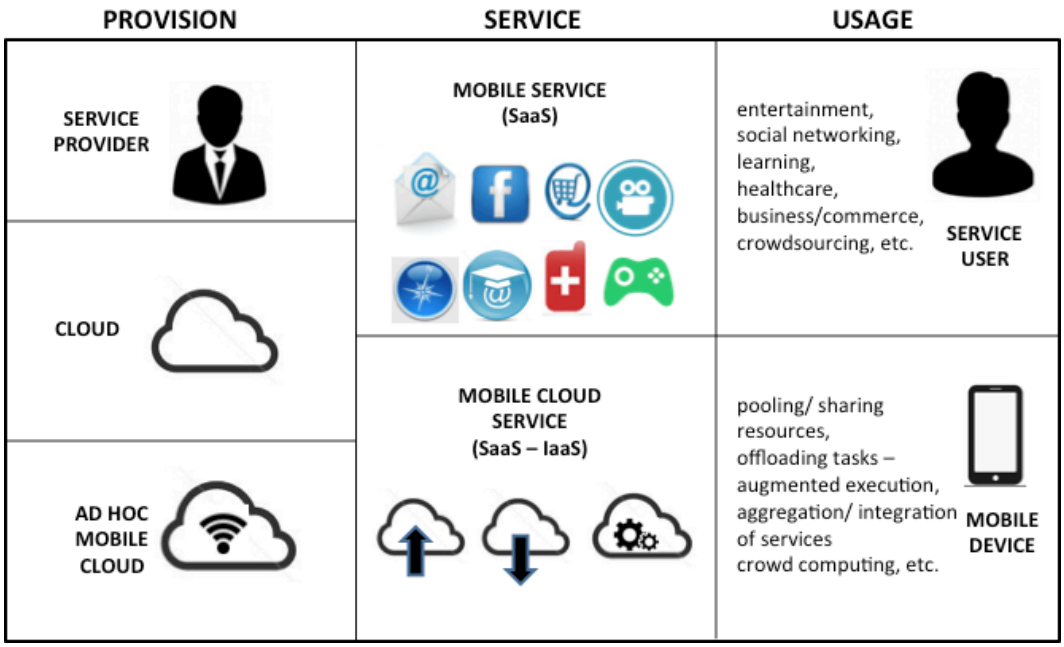

Fig. 2. Models of mobile service provision

A FRAMEWORK FOR VALUE CREATION IN THE MOBILE CLOUD

The central role of the user in mobile service

In the previous section we made the distinction between mobile service, which is consumed by the user and produces real world effects, and mobile cloud service, which is a computing service consumed by mobile cloud devices in order to enable and facilitate the provision of mobile service to the user. It is clear that it is the combination of mobile service and mobile cloud service that brings benefits and empowers the mobile user. Mobile service and mobile cloud service are supplementary. Without the mobile cloud technologies for the augmented execution of the operations of mobile devices, mobile service would be restrained and less important. And without the urgent need for mobile service, the significance of the mobile cloud diminishes.

Mobile devices function in an autonomous way in mobile cloud computing, when they interact with other devices or mobile cloud resources to receive or provide service. In addition, they have their own objectives, such as reduce energy consumption or improve the quality of connection to the Internet. However, their objectives and their operations are closely related to the provision of mobile service to the user and they must serve the needs of the user. It is difficult to see the mobile device in separation of the user, his activities and intentions. The mobile device is simply the smart and multi-functional tool that enables people receive service in a flexible way in their daily life practices, anytime and anywhere.

The combination of service concepts from the real world and the computing world introduces the idea of mobile service provision as a cyber-physical phenomenon. This idea is not new in the literature of mobile cloud computing. Huang, Xing and Wu (2013) suggest a user can be represented by a virtualized entity in the cloud, through his mobile device, an approach that can introduce a "next-generation mobile cloud computing service model" in that both physical systems and virtual systems are seamlessly integrated through virtualization technologies to provide services. The connection between a cyber-physical system (CPS) and cloud computing is envisaged also by Simmon et al. (2013), who cast the term 'Cyber-Physical Cloud Computing'

(CPCC). Moreover, research in the areas of ubiquitous computing, pervasive computing and the Internet of Things include also the user (as a human being) in the conceptualization of the cyber-physical framework. The National Institute of Standards and Technology (NIST) uses the term 'Smart Networked Systems and Societies' (SNSS) to describe the network of connected computing resources, things and humans (Simmon et al., 2013). Humans participate as an integral part of SNSS, especially through social networks, and social networking services allow people to access, store and share their real-life experiences. Conti et al. (2012) place humans at the center of the 'Converged Cyber-Physical World', as humans use several computing devices in their everyday life practices in order to interact with the virtual world. Likewise, Zhuge (2014) suggests human beings live and develop in a 'Cyber-Physical Society', which is a multi-dimensional complex of the cyberspace, the physical space and the social space. The human-centric role of mobile technologies is attributed by Sheth, Anantharam and Henson (2013) with the term 'Computing for Human Experience'. Huang, Xing and Wu (2013) suggest mobile devices have a dual character and operate in the physical world as cyber-physical system (CPS) and in a virtualized mobile cloud as cyber-virtual system (CPV).

The development of an integrated view on mobile service that combines technological and usage aspects and emphasizes on real world effects and on value creation requires inevitably to include explicitly the user in the analytical framework. The mobile device should be seen in combination to the user, who receives mobile service to perform human activities and attain personal objectives. Hence, the mobile device facilitates the provision of mobile service and intermediates and connects the physical world of the user with the virtual world of the computing operations. In sum, the mobile device can be seen as a cyber-physical system and the mobile service provision as a cyber-physical phenomenon.

Considering the mobile device as a cyber-physical system and the mobile service provision as a cyber-physical phenomenon can have important implications for value creation in mobile service and can provide new research and practical opportunities. For instance, the interlinking of cyber and physical reality enables the automatic observation and measurement of human behavior, reveals pattern of interactions between individuals, allows for the analysis, modeling and experimentation with human behaviors and supports a data-driven dynamic adaptation of systems, in response to inferences derived from user habits, preferences and routines, as they emerge (Conti et al., 2012). Understanding better the individual and how he creates value in his context and in his daily life practices, in which mobile service is naturally embedded, is a key requirement for service value, service improvement and for the development of new services and new service models.

Input from the service management literature can help understand better the concept of mobile service. Recent research in service management focuses on the role of the service consumer/ user and on the creation and co-creation of value. Service value is created by users in their everyday practices (Gronroos and Voima, 2013), or co-created with the providers (Vargo and Lusch, 2008). Service providers do not create value, but they only offer service, as a 'value proposition' and as input in the value creating process of the users. Service providers can also support and facilitate the users in their value creating processes. In the study of service systems, value co-creation is promoted also as the primary object of study in service systems and as the basic action that takes place in the interaction between service systems (Spohrer and Maglio, 2010).

The mobile technologies, including the mobile device and the mobile cloud, are used for the transformation of resources, the development and dissemination of service and support of the users. They have some value potential (Vargo and Lusch, 2008), but value is created by the user only when the mobile service is used. If it is not used for some reason (e.g. technological restrictions, computing failures, security issues, wrong settings in the mobile devise, ignorance of user for the existence or the usage method of the service, etc.), then it creates no value at all. In addition, the same service will bring different value to different users. For instance, the value of

the mobile cloud services varies for different mobile devices, with different technical features, or for the execution of different tasks that have different computing needs.

Value is created in the context of the user. The notion of the context includes anything that characterizes the situation of the user (Abowd et al., 1999); key dimensions of the context refer to the time and location. The context is a key characteristic of mobile service and offers plenty opportunities for the development of personalized services and further service innovations (De Reuver and Haaker, 2009). Hence, besides contextual, value of mobile service is highly personalized and experiential. Mobile devices are in most cases strictly individual and, therefore, mobile services can be personalized to each user.

The mobile cloud is a complex ecosystem with a variety of actors that perform specialized functions and tasks (Rahimi et. Al, 2014; Böhm et al., 2010). Next to the mobile cloud, the user brings in his own network of service providers (e.g. mobile device sellers and manufacturers that enable receiving mobile services, other providers of services, etc.) and communities (e.g. friends on social networks who interact and send information, etc.). Hence, value is created as a result of the collaboration of the provider's and the user's networks (Vargo and Lusch, 2008). The user does not really control or even know the full extent of the collaborative network, for instance the actors and the operations in the mobile cloud. Likewise, the provider mobile service does not control or even know who else participates and contributes in the creation of value in the user's network.

Concepts for value creation and co-creation in the mobile cloud

In this section we present a conceptual framework for the creation and co-creation of value in the mobile cloud. The framework considers mobile service provision as a cyber-physical phenomenon that is enabled and facilitated by mobile devices. The proposed framework is depicted in figure 3.

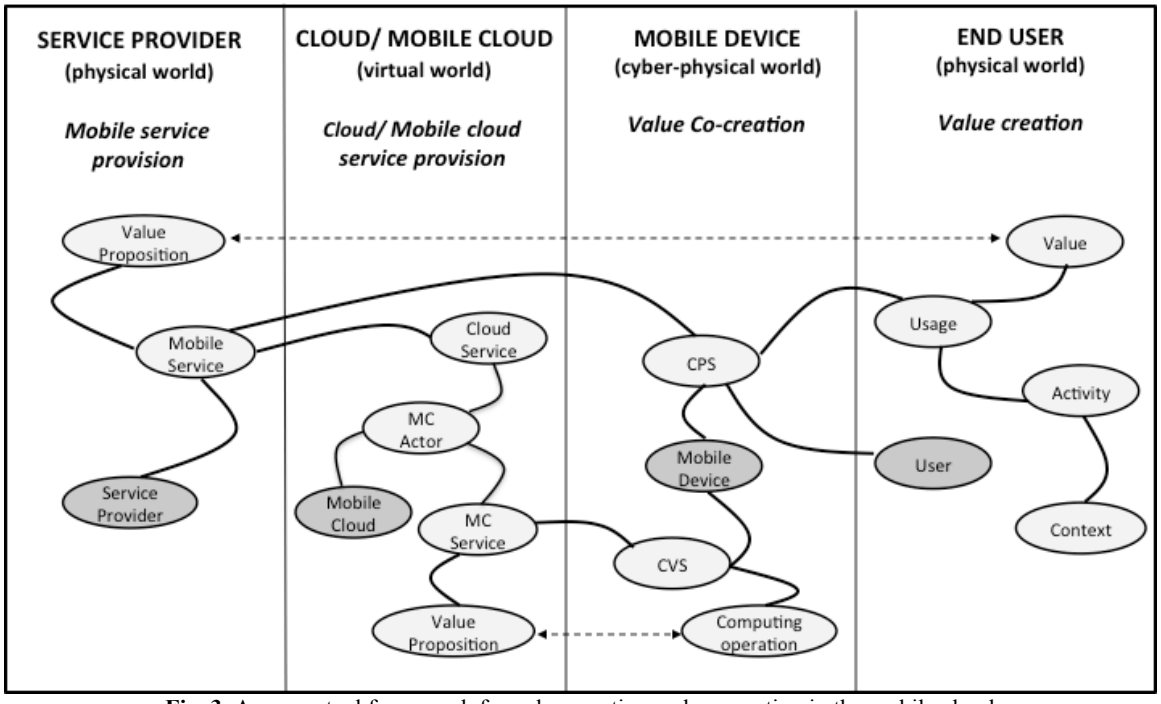

Fig. 3. A conceptual framework for value creation and co-creation in the mobile cloud

The Service Provider is the business entity that provides Mobile Service. The key activity here is the provision of Mobile Service. Mobile Service can be provided directly by the Service Provider of indirectly, though Cloud Service provided by a Cloud Actor. The Service Provider makes a Value Proposition to the User through the offer of the Mobile Service. The Value Proposition describes the potential uses and value of the Mobile Service.

The User (end user) is the human entity that consumes Mobile Service through the use of a Mobile Device. The basic activity of the User is the Usage of Mobile Services, which takes place as a part of the daily Activities of the User in the Context of his life. Value is created by the User as an outcome of the meaningful Usage of Mobile Service.

The Cloud/ Mobile Cloud refers to the general idea and infrastructure of the cloud and the mobile cloud and correspond to the technological layer of the relevant architectures. It is a middle layer between the User and the Service Provider and facilitates the provision of Mobile Service to the User. The key activity here is the provision of Cloud Service and Mobile Cloud Service. Cloud Service supports the provision of Mobile Service. Mobile Cloud Service supports the virtualization of the operations of the Mobile Device in the Mobile Cloud. The MC Actor is a network/ infrastructure/ platform provider of cloud resources as Cloud Service or Mobile Cloud (MC) Service. Value Proposition (of MC Service) refers to the potential use and value of MC Service and it is a key selection criterion for MC Service.

The Mobile Device serves as the interface of the User in order to receive Mobile Service and participate in the Mobile Cloud. It is a middle layer that refers to: a) the interaction of the User with the Service Provider or the Mobile Cloud through the Mobile Device (as Cyber-Physical System) in order to receive Mobile Service, and b) the computing operations of the Mobile Device (as Cyber-Virtual System) in order to interact with other MC Actors and receive or offer MC Service. The key activity is the co-creation of value, as a result of the interaction of the User with the Service Provider - and possibly other Users of Mobile Service. The Mobile Device is necessary in this interaction and Mobile Service cannot be used without the intermediation and the supportive operation of the Mobile Device. Of course value creation by the User is continued, when the Mobile Service is used in the personal activities of the User.

Mobile Cloud Service is based on the dynamic pooling, sharing and composition of resources and it can be even more interactive and collaborative than Cloud Service. For instance, while in cloud computing the client regularly receives services only, in the mobile cloud the client usually both receives and provides services. In certain cases, such as in mobile crowdsourcing, value is always co-created as a result of the active participation and contribution of a large number of users.

CONCLUSION

Mobile devices -especially smartphones and tablets- are used today more and more to provide a variety of mobile services. In this paper we analyzed the concept of service in mobile environments and distinguished between ‘mobile service’ on the one hand as an electronic service that is provided through mobile devices and with the use of mobile technologies, and ‘mobile cloud service’ on the other hand as computing service for the improved performance of the mobile device through the virtualization of its operations in the mobile cloud. Based on this distinction and on the relationship between mobile service and mobile cloud service, we described the mobile device as a cyber-physical system and the mobile service provision as a cyber-physical phenomenon. We ended with a conceptual framework for mobile service provision and value creation and co-creation in the mobile cloud.

This paper integrates concepts from mobile cloud computing and service management and provides a user-driven and usage-oriented perspective for mobile service that explains mobile service provision, value creation and value co-creation. The paper integrates the human aspects of

mobile service for the use and the creation of value with the computing operations for the provision of the mobile service and shows that certain concepts of the service management literature, especially for the creation and co-creation of value, are relevant in mobile cloud computing.

The conceptual framework provides some key concepts for the analysis and the better understanding of the usage of mobile service by the user. Understanding better the individual and how he creates value in his context and in his daily life practices, in which mobile service is naturally embedded, is a key requirement for service value, service improvement and for the development of new services and new service models.

ACKNOWLEDGEMENTS

This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: ARCHIMEDES III: Investing in Knowledge Society.

REFERENCES

Abowd, G. D., Dey, A. K., Brown, P. J., Davies, N., Smith, M., & Steggles, P. (1999). Towards a better understanding of context and context-awareness. *Handheld and ubiquitous computing*. Springer Berlin Heidelberg, pp. 304-307.

Baida, Z., Gordijn, J., & Omelayenko, B. (2004). A shared service terminology for online service provisioning. *ACM 6th international conference on Electronic commerce*, pp. 1-10

Baldauf M., Dustdar S., Rosenberg F. (2007). A survey on context-aware systems. *International Journal of Ad Hoc and Ubiquitous Computing*, Vol.2, No 4, pp.263-277.

Böhm, M., Koleva, G., Leimeister, S., Riedl, C., & Krcmar, H. (2010). Towards a generic value network for cloud computing. *Economics of Grids, Clouds, Systems, and Services*. Springer Berlin Heidelberg, pp. 129-140.

Cardoso, J., Voigt, K., & Winkler, M. (2009). Service engineering for the internet of services. *Enterprise Information Systems, Lecture Notes in Business Information Processing* (LNBIP). Springer Berlin Heidelberg, pp. 15-27.

Conti, M., Das, S. K., Bisdikian, C., Kumar, M., Ni, L. M., Passarella, A., ... & Zambonelli, F. (2012). Looking ahead in pervasive computing: Challenges and opportunities in the era of cyber–physical convergence. *Pervasive and Mobile Computing*, 8(1), pp. 2-21.

De Reuver, M., & Haaker, T. (2009). Designing viable business models for context-aware mobile services. *Telematics and Informatics*, 26(3), pp. 240-248.

Dihal, S., Bouwman, H., de Reuver, M., Warnier, M., & Carlsson, C. (2013). Mobile cloud computing: state of the art and outlook. *info*, 15(1), pp. 4-16.

Dinh, H. T., Lee, C., Niyato, D., & Wang, P. (2013). A survey of mobile cloud computing: architecture, applications, and approaches. *Wireless communications and mobile computing*, 13(18), pp. 1587-1611.

Fernando, N., Loke, S. W., & Rahayu, W. (2013). Mobile cloud computing: A survey. *Future Generation Computer Systems*, 29(1), pp. 84-106.

Grönroos, C., & Voima, P. (2013). Critical service logic: making sense of value creation and co-creation. *Journal of the Academy of Marketing Science*, 41(2), pp. 133-150.

Heinonen, K., Pura, M. (2006). Classifying Mobile Services. *Sprouts: Working Papers on Information Systems*, 6(42) http://sprouts.aisnet.org/6-42

Huang, D., Xing, T., & Wu, H. (2013). Mobile cloud computing service models: a user-centric approach. *Network IEEE*, 27(5), pp. 6-11.

Huerta-Canepa, G., & Lee, D. (2010). A virtual cloud computing provider for mobile devices. *1st ACM Workshop on Mobile Cloud Computing & Services: Social Networks and Beyond*.

Leimeister, S., Riedl, C., Böhm, M., Krcmar, H. (2010). The Business Perspective of Cloud Computing: Actors, Roles, and Value Networks. *18th European Conference on Information Systems (ECIS)*.

Lin, C. Y., & Hung, M. T. (2014). A location-based personal task reminder for mobile users. *Personal and ubiquitous computing*, 18(2), pp. 303-314.

Mell, P., Grance, T. (2011). *The NIST definition of cloud computing.*

Qi, H., & Gani, A. (2012). Research on mobile cloud computing: Review, trend and perspectives. *Digital Information and Communication Technology and it's Applications (DICTAP),* pp. 195-202.

Rahimi, M. R., Ren, J., Liu, C. H., Vasilakos, A. V., & Venkatasubramanian, N. (2014). Mobile cloud computing: A survey, state of art and future directions. *Mobile Networks and Applications*, 19(2), pp. 133-143.

Rowley J. (2006). An analysis of the e-service literature: towards a research agenda. *Internet Research*, Vol. 16 No. 3, pp. 339-359 (2006).

Satyanarayanan, M. (2011). Mobile computing: the next decade. *ACM SIGMOBILE/ Mobile Computing and Communications Review*, 15(2), pp. 2-10.

Sheth, A., Anantharam, P., & Henson, C. (2013). Physical-cyber-social computing: An early 21st century approach. *IEEE Intelligent Systems*, 28(1), pp. 78-82.

Simmon, Eric, Kyoung-Sook Kim, Eswaran Subrahmanian, Ryong Lee, Frederic de Vaulx, Yohei Murakami, Koji Zettsu, and Ram D. Sriram. (2013) *A vision of cyber-physical cloud computing for smart networked systems. NIST*.

Smura, T., Kivi, A., & Töyli, J. (2009). A framework for analysing the usage of mobile services. *info,* 11(4), pp. 53-67.

Spohrer, J.,& Maglio, P. P. (2010). Toward a Science of Service Systems Value and Symbols. *Handbook of Service Science. Service Science: Research and Innovations in the Service Economy*, Springer, pp. 157-194.

Vargo, S. L., Lusch, R. F. (2008). Service-dominant logic: continuing the evolution. *Journal of the Academy of Marketing Science*, 36(1), pp. 1-10.

Verkasalo H. (2009). Contextual patterns in mobile service usage. *Pers Ubiquit Comput* 13(5), pp. 331–342.

Wan, J., Liu, Z., Zhou, K., & Lu, R. (2013, July). Mobile cloud computing: application scenarios and service models. *IEEE Wireless Communications and Mobile Computing Conference*, pp. 644-648.

Wang, Y., Chen, R., & Wang, D. C. (2014). A Survey of Mobile Cloud Computing Applications: Perspectives and Challenges. *Wireless Personal Communications,* pp. 1-17.

Youseff, L., Butrico M., and da Silva D., (2008). Toward a unified ontology of cloud computing. *Proceedings of the Grid Computing Environments Workshop*, pp. 1–10.

Zhuge, H. (2014). Cyber-Physical Society—The science and engineering for future society. *Future Generation Computer Systems*, 32, pp. 180-186.