A SERVICE ORIENTED FRAMEWORK FOR MOBILE BUSINESS VIRTUAL COMMUNITIES

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The rise of the availability of mobile devices in the personal and professional domains leads to an increased need of middleware and organizational structures. Due to the recent improvement of the computing power of mobile devices, mobile users may now also act as service providers. We design a service-oriented architecture to introduce mobile virtual communities enabling wearable devices to be used also as service providers.

1. INTRODUCTION

The growing market of mobile devices, along with the ubiquitous availability of wireless and broadband access networks, opens a new era of market solutions. The sale of internet compatible devices is growing exponentially in recent years. For example, the sale of PDA units has reached the 17.7 million mark in 2006[1], a 25.4% increase over 2005. Also, the manufacturer *Research In Motion*, that dominates the market of PDA devices with its Blackberry line of products, announced a 76.5% jump of sales in the first quarter of 2007[2] [3]

Simultaneously, the world of sensors is experiencing dramatic changes. For example, prices of imaging sensors are falling sharply while their quality is increasing[4], and medical sensors prices also follow the same trend. As a *Research and Marketers* report noticed, "*With the (actual) price of medical sensors (…), low*

[1] http://www.m-travel.com/news/2002/02/pda_sales_incre.html
[2] http://www.rim.net/investors/pdf/2007rim_ar.pdf
[3] http://www.computing.co.uk/computing/news/2193170/blackberry-sales-double
[4] http://www.purchasing.com/article/CA6499634.htm

cost and high volume sales have become the key to remaining competitive in the disposable sensors market"[5].

Location sensors, i.e. GPS sensors, when not already embedded in mobile devices, are also available at much lower prices than only two years ago. A recent survey[6] shows a demand of mobile users to have an integrated GPS in their next mobile phone. Professional users are also fully concerned with these new tendencies. In the medical field, the use of specific external and internal non-intrusive sensors to treat patients, as well as the general use of mobile devices by healthcare providers are growing rapidly.

Putting these facts together shows that we are witnessing the development of three trends in parallel: The processing capability of mobile devices, an ever increasing ubiquitous connectivity and the widespread availability of sensors which can be interfaced to mobile devices respectively. These current trends assessed together result in the emergence of new user behaviors and a need for software products that will take full advantages of these features.

In this paper we describe our approach for mobile virtual communities (MBVC). It follows the principles of service-oriented architecture. This work extends our previous definition of virtual knowledge communities (Maret, 2008). Section 2 of the paper investigates related work on virtual organizations and communities, mobility and middleware support for web services. Section 3 describes the service-oriented features. Section 4 describes the mobile virtual communities. We have implemented the resulting architecture (community platform) to prove its feasibility. This is achieved by extending off the shelf open source community software and introducing our service oriented architecture. Some details of implementation are provided in section 4. In section 5 we present an example of MBVC based on this architecture. Finally we present some concluding comments in section 6.

2. RELATED WORKS

Current investigations on virtual communities and virtual organizations focus often on service oriented architecture. (Baglietto, 2005) presents such an architecture implemented in the case of cargo and transport business area. (Wang, 2006) defines a high level visual language (VINCA) for the description of service compositions in virtual organisations for non expert users. None of these architectures take the mobility feature into account.

Web services can be embedded on mobile devices, especially thanks to mobile middleware such as those proposed in (Pratistha, 2003), (Srirama, 2006) or (Pawar, 2007). In our work, we rely on the middleware developed by (Pawar, 2007), which was initialy implemented for mobile health purposes.

Creation of virtual organizations has to be made through a contracting step. Contracts can take into account business and/or legal issues. (Kutvonen, 2005) propose a B2B web service based middleware to set up business level contracts between the different actors. (Weigand, 2003) proposes an architecture to

[5]http://www.researchandmarkets.com/reports/365353/world_market_for_sensor_opportunities_in.pdf

[6] http://www.itnews.com.au/News/67338,gps-to-boost-mobile-phone-sales.aspx

coordinate web-service based organizations with contracts, focusing on business and legal issues.

Mobile virtual communities are introduced in (El-Morr, 2007) and (Kawash, 2007). However, interfacing mobile virtual communities with service oriented architectures for virtual organization has not been fully explored. The aim of this paper is to combine virtual communities facilities and middleware support for mobile web services. We use also contracts and negotiations tools for SOA, which lead then to the creation of mobile business virtual communities.

3. SERVICE ORIENTED ARCHITECTURE

In service oriented architecture (SOA), the different entities taking part in the system (also called actors) are either 'service providers' or 'service consumers'. This is not exclusive: actors can also be both providers and consumers. SOA aims at achieving loose coupling among interacting software agents. A service is a unit of work which can be done by a service provider to achieve desired end results, for a service consumer. Both provider and consumer are roles played by software agents on behalf of their owners[7]. In SOA, mobile devices usually play the role of service consumers. Due to the evolution of the computing power, connectivity ability and storage capacity, the role of mobile devices has to be reconsidered. Indeed, we use mobile devices also as service providers. We will now first present the architecture for SOA mobile business virtual communities and then analyze the creation process and the use of a virtual community within the SOA.

A service federation approach has been identified in (Luis M. Camarinha-Matos, 2005).The partners are service providers, they form a community of providers and the resulting organisation is a complex composition and orchestration of their services.

We propose a so-called Community Platform, which is based on relevant community software. Two types of actors are related to this platform. The first ones are actors providing services and willing to propose them for the creation of Business Virtual Communities (BVCs). They form the community of Providers. The second type of actors is composed of the end-users (or service consumers), participating to VCs, i.e. using some of the proposed services. End-users form the second community.

Combining both communities (Providers and End-users) into one platform leads to valuable advantages: The community platform considers the user profiles and actions, considering the user's rights, and then selects the most appropriate service for this user. This is clearly of interest for business applications, but it can also be implemented towards medical assistance for instance (Pawar, 2008). Since our architecture includes also mobile devices as service providers, end-users can call on these mobile services (Fig.1).

[7] http://web**service**s.xml.com/pub/a/ws/2003/09/30/soa.html

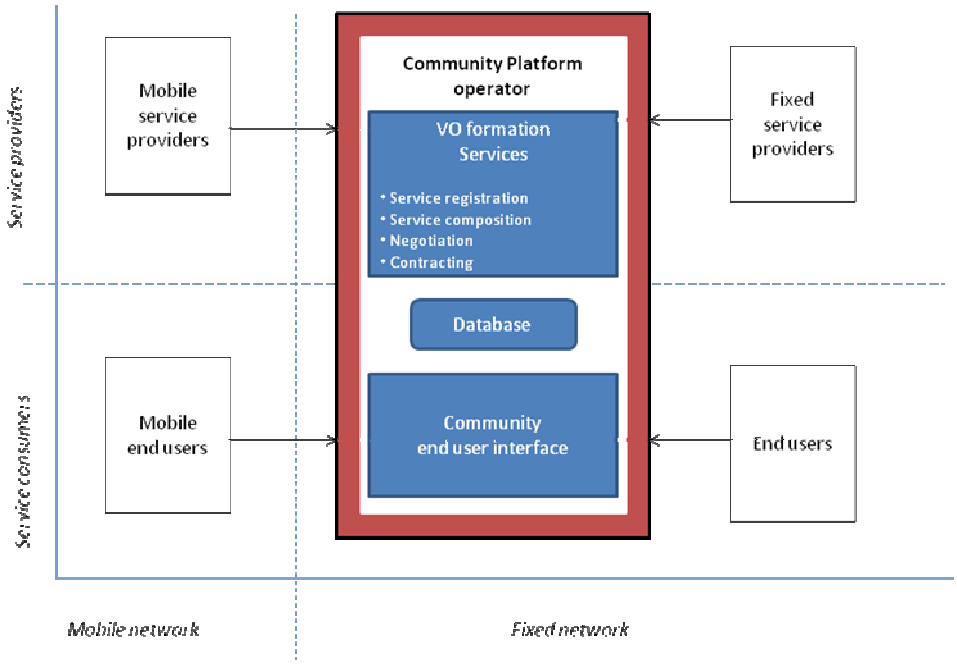


Figure 1: Fixed and mobile service providers and consumers around the community plate-form.

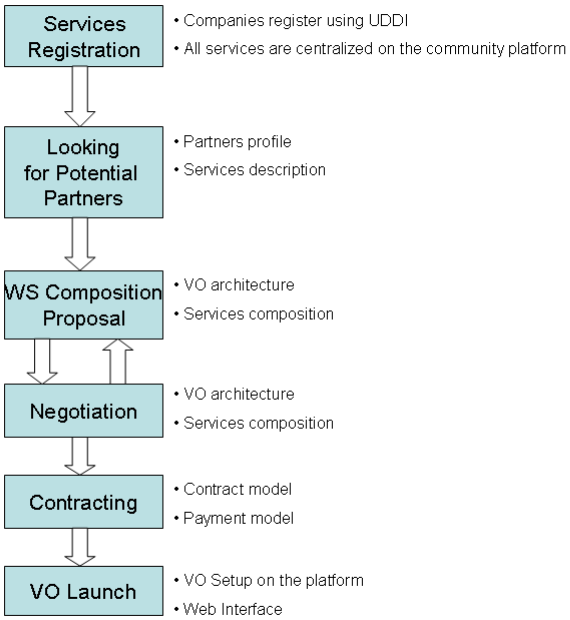
4. MOBILE VIRTUAL COMMUNITIES

4.1 Introduction

Following Kawash and Morr (2007), it can be said that Mobile Virtual Communities (MVC) that exist today are limited to allowing mobile users to receive some information or reminders and eventually to participate into discussions. Through our architecture, we can propose virtual communities that are not limited to fixed predefined services, but combine both fixed and mobile services. This opens up then a new range of applications.

4.2 Formation of MVCs

The creation of Mobile Virtual Communities within the platform follows the traditional process of service federation approach (fig. 2). It is organized by the community plate-form operator (CPO). The first step is the registration of the services on the platform. Any user can register as a service provider. The next step consists of the partners' aggregation. This is controlled by one of the partner, using profile information, history and all other data it can find. Partners finalize their engagements in the contracting step. The Virtual Organization is then published.



The community platform operator (CPO) provides the facilities to the service providers to create virtual communities within the platform. Revenue sources of the CPO are decided during the contracting step. Revenues of the CPO may be for example calculated on a percentage on transactions, or on the duration of the community or on any agreed upon procedure.

4.3 Using MVCs

The list of VO is presented on the community platform. End-users decide then to act as members of a given VO Any service provider can also act as a VC member. Members can use fixed or mobile devices, and they can participate using fixed or mobile services in sharing data and documents within the communities.

4.4 Implementation

Our implementation is absed upon an off-the-shelf open source community platform. The platform Dolphin[8] was tuned to fulfill the requirements of the Service Oriented Architecture. We select to use Web Services technologies for this implementation and we rely on the PHP-based library NuSoap[9] to interface Dolphin native PHP with Web Services. The interactions of mobile web services with the

[8] http://www.boonex.com/products/dolphin/
[9] http://sourceforge.net/projects/nusoap/

fixed network are supported by the Mobile Service Platform (van Halteren & Pawar, 2006). Thanks to this platform, mobile devices are enabled for acting as service providers.

The VC formation is not yet fully implemented, so it remains controlled by the CPO. VCs are created and they include mobile services. Users can become members of these communities; they can participate and make use of the services.

5. USE CASES

5.1 Content server within communities

User generated content is one of the growing business in the web economy. This generates a lot of traffic, composed of the content generated by user. This content production is usually not rewarded. For example the social-networking website Facebook was recently valued at 10 Billions dollars while the contents are provided for free by 40 millions users. Other examples are video sharing websites like Youtube or Dailymotion. They provide storage and sharing facilities and once again the contents are generated for free by users, although those websites generate subsequent revenue through displayed advertisements. The three previously-cited websites belongs to the top 50 most visited websites. Most of the traffic (especially videos) on those websites was generally generated using mobile devices.

Using our plate-form, providers of pictures or videos could register as content providers. The proposed service is in this case the access to pictures or videos. This service can be included into a VC concerned, for instance, by “cars” if this topic is chosen. Members of this VC can send requests to the mobile service in order to get some pictures or videos. Members can be both content consumers and content producers. The community platform may enable to guarantee that content producers are rewarded according to the traffic generated by their provided content. End-users are thus encouraged to provide original contents.

The design of this VC encompassing mobile services matches our platform architecture. It consists of i) the basic VC features ii) the content provider service and iii) the billing service. Notice that the billing service is part of the platform because it is shared by all VCs. Others services can be added to the VC, such as the file storage service, the video encoding service, context advertisement service. Providers can be companies specializing in either fixed or mobile services or in both of them.

This business model enabled by our architecture is a win-win situation insofar as the users will join this video hosting community instead of a competing one Indeed we believe that they will be attracted by the possibility to earn money through their generated content. High quality contents are also encouraged and this is also valuable for all: end-user, content providers, service providers and plate-form manager.

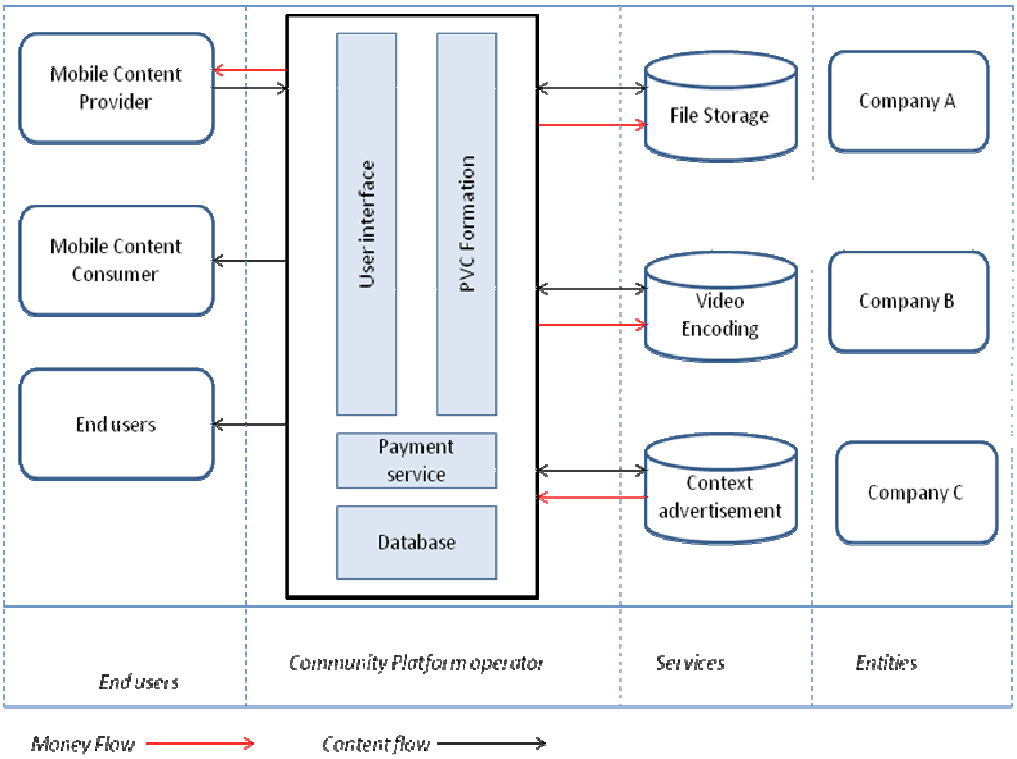


Figure 3: Use-case "Video sharing"

5.2 Decision making support within communities

Employees of a company form a community which is centered on its activity. Knowledge management into companies is a strategic issue, especially when decisions must be taken with limited time and incomplete knowledge.

Models and implementations of decision making processes have been proposed in several trivial or complex forms. (Yang 2007) gives an example of a service to make decision with uncertain knowledge based on Bayesian networks.

Let us imagine a company's employee loading a decision making process as a service on her/his mobile device. Once this device is recognized within the company's community on the community platform, the service (decision making process) can be declared and then be used as a mobile service.

6. CONCLUSION

In this paper we introduce mobile business communities based on a service-oriented architecture. We design an architecture centered upon the community platform operator. This platform supports the creation of virtual communities based on a service federation approach. Relying on an adequate middleware we integrate mobile devices as services providers and include them as active resources shared

within virtual communities. We outline the architecture and our first use case that considers mobile service provider in a service federation approach organization. Future works will concentrate on the creation process of communities providing composed services and interfaces to create easily web based business community using mashups[10] editors.

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