

Context-aware Campaigns in Social Networks

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Abstract—Services have become increasingly important in today’s Web-based applications. Users can access services in an anytime, anywhere manner using a wide variety of mobile devices. Mobile services are a key driver in today’s telecommunication market, even though the potential of mobile services has not been fully exploited in existing telecommunication systems. A main driver in these markets are context-aware services to build intuitive services for mobile handsets. One success factor is to support a broad range of handsets available on the market and making the services context-aware by obtaining contextual information. Context may be derived from information obtained from the handset - most prominently location information. In this work, we present a mobile marketing platform enabling the advertisement of services in mobile markets. Advertisements and offerings need to be customized based on user preferences. We propose a recommendation approach of services based on social-network properties and human provided services. Our contributions are the *Woodapples* platform offering a set of APIs for creating mobile campaigns and an approach for managing social and service network structures in a unified manner.

Keywords-Location-based services, context awareness, data correlation, mobile handsets, collaboration, trust, human provided services

I. INTRODUCTION

In the last years, the technology world witnessed a very powerful new trend - more and more people started using their handsets when accessing the Internet. The main driving force behind this trend is the improved versatility, power and usability of mobile handsets, which in turn enabled the market to invest more in building mobile-phone-friendly web services. One new revenue stream for telecommunication operators we see in the next years is definitely Context Aware Services on Mobile Handsets, which include human interaction. To launch successful Mobile Services there is a need for a proven development framework for those services. It has to be reliable, create a community of developers that are focusing on it and, of course, it should try to cover nearly all mobile handsets on the market. The current situation, with big suppliers (Google, Apple, Nokia, RIM, etc.) developing their own frameworks and ecosystems, does not encourage interoperability, neither are they focusing on integrating human capabilities as services in their systems.

In this paper we present an environment, where humans and services comprise a collaborative system not only incidentally but for a certain time span by using mobile services. This work employs service discovery techniques in social networks, integrating and finally unifying human and mobile services, as well as trust-aspects between the actors to optimize collaborations.

The rest of the paper is organized as follows. Section 2 introduces a motivating scenario which we use to illustrate the main challenges. We present related work in Section 3, before we introduce our proposed framework in Section 4. We conclude the paper with a discussion in Section 5 and present and outlook for future work in Section 6.

II. MOTIVATING SCENARIO

The integration of humans and services into a common network structure - this approach can be referred as Service of a Friend (SOAF) [1] - fosters the creation of Web service ecosystems. Users should be able to find any person who can deliver a human provided service (HPS) [2] in a standardized, service-oriented manner. In context of Web service discovery, one can learn lessons from humans and how they search for problem solutions. Humans exploit local information and use links to other persons to ask for pointers or for information when needed. In short, humans ask their friends whether they had a similar problem and how the problem was solved. This way, humans build networks of knowledge around each other.

Unfortunately SOAF cannot be the only mechanism to achieve our vision. Immediately the question rises how one can find a friend who is currently available and willing to provide the requested service. And if there is no friend available, can we make "friends" instantaneously? How can we establish trust (as defined in [3]) between users formerly not known to each other. What kind of notification mechanisms can be employed to establish instant communication between the collaborators, when at least one of them is mobile?

In the last year, tisco [4] implemented a mobile marketing platform. The name of the framework is *Woodapples - Information people love*.

Woodapples is a platform for mobile marketing. A movie illustrating how *Woodapples* is working can be found under

[5]. The idea behind this platform is to offer an advertisement platform such as Google Ads for mobile handsets. Service providers can setup campaigns with a specific budget, a time span and a location radius. The marketing info will be then published to people within a certain location area in a specified time span if they are interested in this information.

Currently, people have to setup their preferences in order to retrieve the best possible marketing information for their needs. In future a mixture of preferences, which got entered by the customer and a data mining algorithm will refine the use case. Besides this the integration of human provided services is a key factor for Woodapples. A generic scenario of an interaction flow will typically assume an advertiser who wants to place an advertisements. The campaign should be of some exclusivity and thus narrowed to only a small range of so called experts. An expert will be somebody whose reputation is well known in the community, and preferably being a long time customer. The reason for the exclusivity could be a voucher included in the advertisement. This model is well aligned with the idea of *viral marketing* to maximize positive word-of-mouth among customers (e.g., see [6]).

The mobile marketing concept includes that basically, but not exclusively, only people, who enter the dedicated vicinity, will receive the notification. Receiving a location based advertisement will not be considered a spam message, since the person is registered for the notification service and willing to receive information concerning specific topics. If the advertisement includes a voucher, the addressee will be attracted to directly interact with the advertiser (e.g. enter the shop or restaurant, etc.) Redeemed vouchers can be recorded as success. The ratio between redeemed and not redeemed vouchers will be a measurement for the success of the campaign. The advertiser will be able to refine the client's profile if the ratio tends to one of both extremes (0 or 1). For the expert it will strengthen his reputation (increase his expertise) if he embraces the offer to interact, since this interaction clearly distinguishes him from so called "only said to be experts". If he rejects too many times, he will lose even his reputation as expert. If the expert is not able to get in contact with the advertiser currently, he might want to forward the advertisement to friends. The reason for forwarding the info could be an incentive clause in the advertisement (e.g. 10 new customers implying one meal for free).

From case to case a "newcomer" will be among the friends. Why does he get notified? The reason for that might be, that he recently dropped the wish to get in touch with this specific topic (e.g. "never ate Asian food, want to try it the first time"). In that case the forward interaction of the expert represents a recommendation to a potential new customer. Since the expert is well known for good recommendations the newcomer will take his chance. But, for some reason he declines to act alone. He invites his

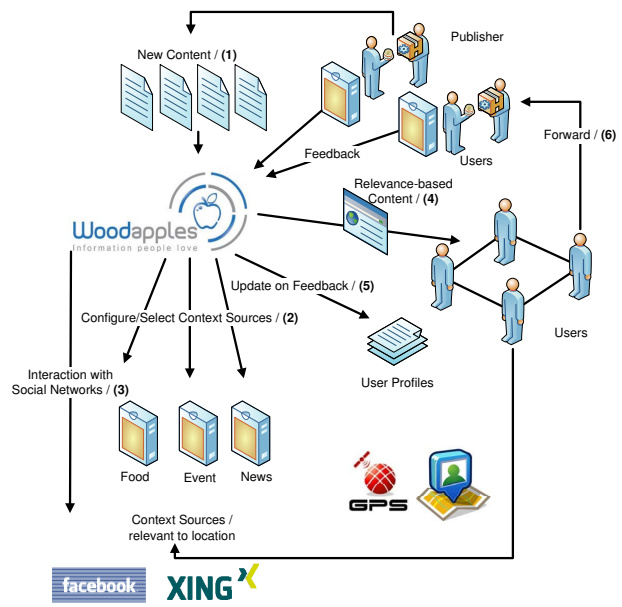


Figure 1. Woodapples - A common use case scenario

friends or even spontaneously similar minded people in the vicinity to join in (technically this includes a trick: the profile of the newcomer needs to be temporarily updated with the new interest). The message to the invited people could include a motivating comment on this event being the "very first time" ("teach me how to eat with chop sticks"). Later, the newcomer could rate the recommendation and thus updating his own profile (being interested in the topic), and indirectly the reputation of the expert.

Assuming we have users which created an account at Woodapples and were downloading the mobile application to their mobile phones a common use case in Woodapples can be described as follows (see numbers in Figure 1):

- 1) A new vegetarian restaurant has opened in down-town Vienna. It wants to attract people from the surrounding area and offers a limited special menu only available for those contacted via Woodapples. In Figure 1 the vegi restaurant is indicated as a publisher that adds content to the Woodapples platform. The content consists of a teaser, a short text describing the offer, a URL to the menuplan, a voucher code. Besides this the publisher has to specify the location and the radius where he wants the message to be published, a timeframe and a budget he wants to spend for the campaign. The campaign is paid on a per click basis. Besides he can add tags, such as "Vegetarian Food" to the campaign. This information is relevant to the context and preference sources, which get updated and monitored constantly.
- 2) Internally, Woodapples constantly monitors and re-configures the context and preference sources that

provide the core data to determine the relevance of an individual context element for a particular user. One key element to the context source is location. An information is just indicated as relevant if it is setup for a special location and location radius. To monitor the location of the users and connect the context sources to their profiles the Woodapples application on the mobile phone sends back the location information with a polling mechanism.

- 3) As Woodapples is aware of the context, it knows about all involved system elements, i.e., the set of current content for delivery, the online user base, granularity of their preferences, and available context sensors. Bob, one of the content consumers, has subscribed to food related information. Bob likes to dine out, but doesn't really have any preferences for a certain cuisine. the only thing Bob was setting up so far is a preference in his user profile that he likes vegetarian food. Woodapples is aware of interactions between users. For doing so it can select between various social networking platforms, selecting the ones that deliver the best information for the current user base. Coupling social structure with location, Woodapples becomes aware that Bob and his girlfriend are within the same area. She is a vegetarian.
- 4) Subsequently, Woodapples sends out the content about the new restaurant to both of them - reasoning that they would like to have lunch together. The information that the advertisement got sent out to both of them is stored internally for reporting issues.
- 5) Furthermore Bob and his girlfriend have the possibility to rank the advertisement by using a "I like it" and "I don't like it" button. This information is subsequently used to refine the user profile.
- 6) Woodapples also offers the possibility to forward messages to other users and friends. They also have the possibility to rank the service. Finally, Bob displays the personalized code for special offer at the vegetarian restaurant and gets the special offer of the restaurant.

III. RELATED WORK

The future Internet of Services aims at enriching the existing Internet with Services. In a future Internet of Services, information is dynamically provided by all kind of data intense services. By following this vision, a set of challenges such as the integration of social aspects (e.g., trust [3]) arises. These challenges has been partially addressed with in the past with the creation of social networks (e.g., Facebook, Xing, Twitter), the end user driven creation of applications on the Internet (mashups [7], or situational applications [8]). In this context, Kleinberg [9] observed that social and technical networks converge. These hybrid networks, consisting of user generated content, like folksonomies, provide a vast source of information that is able to classify

arbitrary content (e.g., del.icio.us). Existing technologies, like FOAF [10] provide the technical foundation to link persons in social networks in a machine readable form.

These developments have a profound impact on the way businesses are conducted. As discussed in [11], crowdsourcing can be applied to businesses. Companies can benefit of these emerging network structures With regard to (Web) services by the integration of humans and services into common networks. However, with the existing infrastructure, this endeavor proves to be difficult to achieve. One of the main reasons is that, there is usually little support to integrate humans and services into networks to benefit from social connections within such network structures. To address the challenge of the human/service integration, we base our work on the concept of Human-Provided Services (HPS)[2] and utilize the SOAF framework [1] for the representation of human services relations.

In social network structures context-awareness is of central importance and has been the focus of many research efforts. Most of the available toolkits focus on gathering, aggregating and providing context information. [12] present a framework for developing mobile, context-aware applications. Within their framework Communication, happens only in one direction. In our approach we have the possibility to build a two way communication between the backend and the mobile handset, therefore offering a flexible way building new mobile services. Costa et al. [13] designed a platform for mobile context-aware applications. Context information is shared by subscribing to this platform using the WASP Subscription Language. Their framework as such offers a very big flexibility in how to build and setup mobile services, but lacks of information how to correlate contextual data. In our approach correlation of contextual data is a built in concept. The Solar middleware by [14] provides a platform for context aware mobile applications consisting of one star and several planet nodes. Client applications need not collect, aggregate, or process context themselves but subscribe to context changes at the central star. The approach of subscribing to context changes at any provider, which in our case will be the backend of the Woodapples environment, is an idea we might introduce as well in our framework.

IV. A FRAMEWORK FOR CONTEXT-AWARE SOCIAL CAMPAIGNS

Figure 2 shows the overview of the framework, which is divided into three layers: *Woodapples Portal Layer*, *Woodapples Core Layer*, and the SOAF Layer.

A. *Woodapples Portal Layer*

The Woodapples Portal give Content Subscriber the possibility to open an account for Woodapples. In addition an application for the mobile phone, or a plugin for a browser is available as a download for the subscriber.

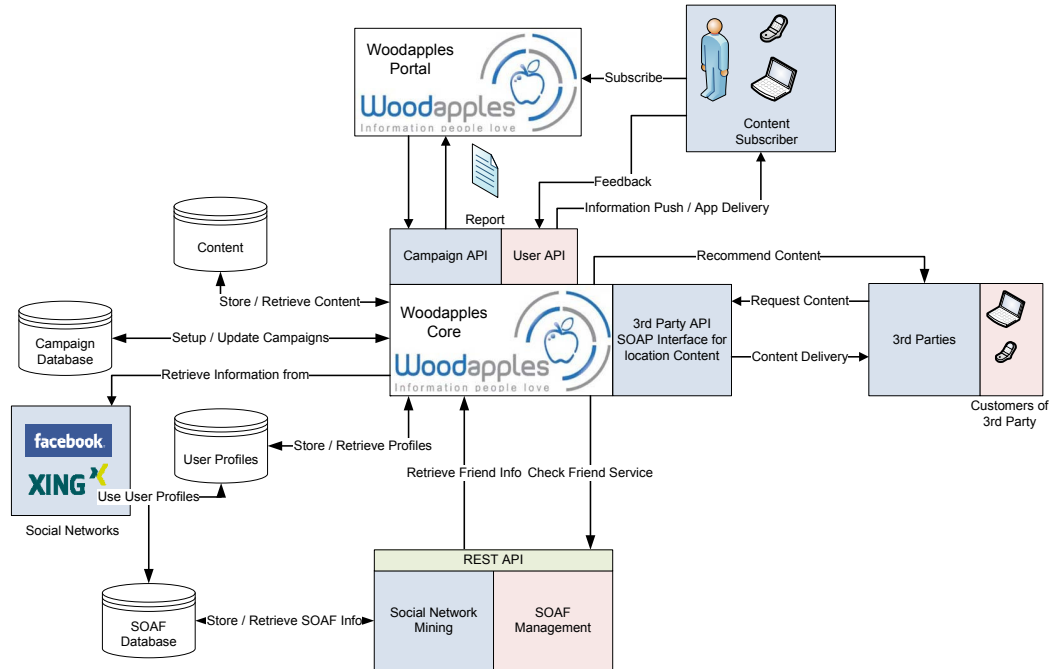


Figure 2. Framework Overview

- *Setup*: Once the account is set up the customer will be asked for special interests, such as Sports, News, Lifestyle, etc. Besides this the residential location, sex and age is stored. Furthermore it is possible for the user to add accounts from social Networks.
- *Information Push / App Delivery*: If the account is setup and the mobile application is installed the user will get information (Content) to his special interestests if one or more context variables fit to his profile. Up to now the context location is the main context variable Woodapples is taking care of. If a customer reaches a special location area where information to his special interests are available then the information will be pushed to the mobile application.
- *Feedback*: The user also has the possibility to rate the content and give feedback, which is implemented with a simple "I like" and "I dont like" feedback mechanism. This information is in addition used to update the users profile.
- *Campaign API*: The Woodapples Portal can also be used by media agencies to book campaigns for a special location area. A booking can look like this: "Deliver 100 ads to the location of xy, within the radius of 100m. The campaign has a budget of 50 EUR and should run on the 24th of December from 10:00 - 11:00". Besides this the agency has to deliver the content of the campaign, which is mainly a picture, a teaser, a description and a URL. This information is stored in the Content Database and is connected to Context

Variables, which is in this case location.

- *Report*: With this information Woodapples will generate a campaign for the agencies and will deliver the information to people, who are interested in this information. Agencies then have the possibility to retrieve a report that shows them how the campaign was evolving.

B. Woodapples Core Layer

Woodapples Core takes care of storing and retrieving the Content, Campaign Management, retrieving information of Social Networks and 3rd Party Content Delivery.

- *Store Retrieve Content*: If a campaign is setup content, which is delivered for the campaign is stored within the Content Database, together with Context Information, such as Location, or Customer Base. The Customer Base indicates which group of customers should get the information pushed to the mobile application.
- *Setup / Update Campaigns*: Information for campaigns is stored in the campaign database. The main information here is the campaign owner, the Customer Base, the Budget, Location and Time of the Campaign.
- *Store / Retrieve User Profiles*: Woodapples is continuously updating profiles based on user feedback or on user input via the Woodapples Portal. This information is needed to deliver the right content to the right user base.
- *3rd Party Interface*: Via this Interface any other operators can reuse Woodapples for their needs. Via the API the 3rd is asking for content, which fits to a set of

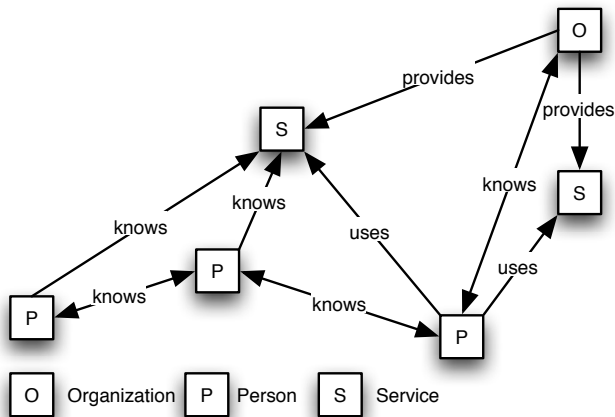


Figure 3. Overview of a SOAF network structure

context variables. Example: A 3rd party needs information for a special location. It then delivers Woodapples the Geo Coordinates of the location and a radius. Furthermore it asks for special content indicating Sport. The answer would be all information connected to Sports, which includes for every information a picture, a teaser, a description and a URL. This information can be then delivered to users of the 3rd Party. In this case the User Profiles of Woodapples are not touched.

- *Content Recommendation:* In this case the 3rd Party is informed about content, which could be from interest for him. Example: Assuming a 3rd Party is constantly retrieving content for Sport and News. If Woodapples indicates that people who are interested in Sport and News are usually also interested in e.g. Lifestyle then Woodapples would inform the 3rd Party about Lifestyle Infos. The indication if Sport, News and Lifestyle has a strong connection is done via the User Profiles of Woodapples.
- *SOAF Check:* With the SOAF Check Woodapples has the possibility to use the capabilities of the SOAF Interface, which is described in the next subsection.

C. SOAF Layer

The SOAF layer of or proposed framework addresses issues concerned with network structures and in particular the integration of humans and services in a common network structure. As discussed in the motivating scenario, we need to be able to find experts and use their services (e.g., recommendations) in certain contexts. Figure 3 provides an conceptual overview of the SOAF network structure. As shown in the figure, SOAF network members have different types of relations and these need to be modeled differently. For instance, a person knows a service (e.g., a restaurant recommender service) which is provided a company or directly offered by a person (e.g., a restaurant critic). The

traversal of such linked structures is important in the context of mobile campaigning in order to reach as many as network members as possible. Our main concept is to build on existing FOAF [10] network structures and to extend the FOAF data model with service related information to include (human provided) services. In our approach, we added additional concepts to the main FOAF data model with regard to the requirements of services. In particular, we extend the relation mechanisms of FOAF to specialize the relation between services and persons in a network structure. In FOAF, persons are represented by a dedicated class Person that inherits from the class Agent. Likewise, in SOAF, we include a

- Service class to represent services that inherits from Agent,
- uses relation which extends the knows relation with additional information
- provides relation that defines the connection type between service providers and services, and
- a dedicated Connection class (inherits from Agent) that specifies the connection between services, persons and organizations).

Listing 1 illustrates how we represent service related information SOAF networks. In data model, we include a basic set of information that defines the capabilities service and offer information about the endpoint of the service, the interface description or version information.

```
<soaf:Service>
  <foaf:name>Restaurant Critic</foaf:name>
  <soaf:endpoint>×/soaf:endpoint>
  <soaf:description>Ask LeChuck for good restaurants</..>
  <soaf:interface rdf:resource="..." />
  <soaf:active>true</soaf:active>
  <soaf:version>1.0</soaf:version>
</soaf:Service>
```

Listing 1. SOAF service class example snippet

V. DISCUSSION

Context awareness and integration of humans as a service is a key feature within Woodapples. The main use case where it will be used is mobile marketing. We understand mobile marketing as a concept where people get valuable information, they really want to have. To make this happen a profiling has to be done, so that the platform can deliver the right information at the right time in the right location. For Woodapples context awareness is a key element. Up to now location is the main context channel which is used, even if the mobile application of Woodapples is implemented to get any context information that can be from interest for the use case.

From the business perspective, Woodapples can be seen as a new way to deal with mobile marketing. Up to now mobile marketing is usually connected to ideas such as SMS or MMS marketing, where the information is often seen as spam from the user perspective. The business of mobile

marketing is expected to grow in the next years, mainly in the field of location based services, that can be easily connected with marketing information.

Analysts at Gartner expect location to become a mainstream mobile application within two to five years. They see the market growing from 16m users in 2007, to 43.2m in 2008 and 300m by 2011 (Palmer, 2008). To launch successful location based services there is a need for a proven development framework for those services. It has to be reliable, create a community of developers that are focusing on it and, of course, it should try to cover nearly all mobile handsets on the market. The current situation, with global players (Google, Apple, Nokia, RIM, etc.) developing their own frameworks and ecosystems, does not encourage interoperability. Location information is nothing else then contextual information that can be retrieved from the mobile handset and can be used to build special services for the user. Besides location, there is a lot of other contextual information that is interesting to obtain, such as battery level of the handset, weather forecast for a special location, etc. All this information correlated can be used to build new mobile services for the handsets with a very high flexibility.

VI. CONCLUSION AND OUTLOOK

Building context aware mobile services is a massive upcoming market. Location Based Services as an example of context aware mobile services are a key driver of today's telecom business and is growing rapidly. Nevertheless, building context aware mobile services nowadays is hard, as the underlying mobile handset technology varies from one model to another. Besides this location based services nowadays focus on delivering information that is connected to a location, regardless if the information is valuable for the customer or not.

In this paper, we presented a framework that tries to solve this problem. The core of the framework offers the possibility to determine which information is really needed by a person who uses services on top of the framework. Furthermore it integrates human provided services into the architecture. The framework has been partly implemented within the product Woodapples, a platform for mobile marketing, which was nominated for the *2009 MMA Global Mobile Marketing Award* [15]. The goal of the platform is to offer new mobile services, where people are just getting information if it fits to their interests, or if the information was forwarded or used by a friend. In the next incarnation of the platform we will integrate the presented concepts in the Woodapples platform and implement a working prototype that addresses social aspects of campaigning.

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