Enabling Personal Mobile Applications through Semantic Web Services

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1. MOTIVATION

Using Web-based services has already become an integral part of our everyday life. Semantic Web technology and the advent of universal and mobile access to Internet services will only add to the broad range of existing services on the Web and provide additional features like knowledge-based, location- or context-aware information. On the other hand, so far little work has been done to explicitly account for aspects of mobile computing in semantic service frameworks. Whereas much of the work in Semantic Web services discovery and composition concentrated on the functionalities of the services, contextual information, personal preferences and more generally personalization are more pressing challenges in the mobile computing arena. In order to manage an increasing amount of mobile services, it is essential that Semantic Web services standards explicitly support the needs of developers and users, such as the discovery and selection of services they personally need in a given situation or context.

To illustrate our requirements, in this position paper we cite one of several use cases that is based on our early work in the field of Web service selection which aims at leveraging Semantic Web Services for mobile applications. The use cases are bases on our work on MobiOnt – a semantic toolbox to explore mobile user-centered services on the Semantic Web [7]. Here the vision is to take full advantage of future complex service offerings on limited client devices and to handle the need for personalized service discovery in mobile environments.

2. A PRACTICAL USE CASE

In [7] we study the case of a future mobile Internet radio scenario. Internet radio has become increasingly popular in recent years with boosting numbers in Web radio stations and subscribers. Already today, popular Internet radio portals host thousands of live streams [5][6]. The vision of universal radio access through the World Wide Web is further accelerated through the mobile Web with wireless access to audio content from anywhere, anytime. In this context, personalized access to content is particularly important to accommodate both, varying technical as well as personal user needs and preferences.

In our testbed we have modeled Internet radio stations as Web services with varying service characteristics. Radios channels are described using MobiOnt, an Internet radio ontology (a fragment of the ontology is shown in Figure 2) that consists of concepts that describe and classify Web radio services in terms of program format, origin, audio format characteristics and a time-based classification of streamed audio content. MobiOnt is then used for preference-based service discovery. Note that our Internet radio scenario is only one of many possible applications for the MobiOnt framework.

Parts of the radio ontology are carefully exposed to the user through MobiXpl, the graphical front-end to our system. MobiXpl emulates different mobile terminals and consists of a mobile ontology browser with support for individual user views as well as an intuitive interface to user preferences. The idea is to only display selected concepts and sub-ontologies depending on the user's experience level and usage profile.

3. USER PREFERENCES AND PROFILING

While browsing the service ontology, concepts that circumscribe services with key relevance to the user can be selected and combined to user preferences. In our preference framework [4], these (partially) ordered feature sets are directly handled without the use of any explicit quality or ranking values: user preferences are introduced as a special relation with the semantics of considering some object (or class) A superior to another object (or class) B ("I like Music channels better than News stattions"). Intuitively, during service discovery such user preferences have to be understood as wishes whose satisfaction should be maximized, but cannot always be fulfilled. In that sense, preferences indicate constraints that a service should fulfill to best meet its requirements. On the other hand, even if none of the indicated preferences are met, a service match can still be possible. Subsequently, these preferences are used during the service discovery to implement cooperative service discovery.

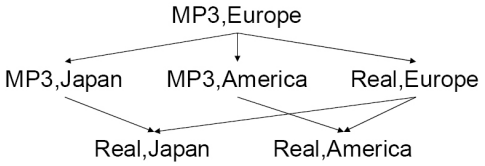

Figure 1: User-defined preference ordering.

To manage multiple user preferences complex preferences can be inductively constructed from a set of base preferences by means of preference constructors [4][7]. Figure 1 shows an example of a combined preference from the radio scenario. Here a user has indicated that she generally prefers radio programs from Europe over those from Japan or America. Still, the latter two choices are her preferred choices over any other available program. Due to the technical capabilities of her player, she also prefers MP3 encoding over Real. Furthermore, she specified that both base preferences (Program and Encoding) are equally important to her.

4. COOPERATIVE SERVICE DISCOVERY

User preferences constructed during preference building define a service request that ultimately needs to be mapped to the underlying service ontology. MobiOnt therefore implements a flexible service discovery algorithm that can be extended through

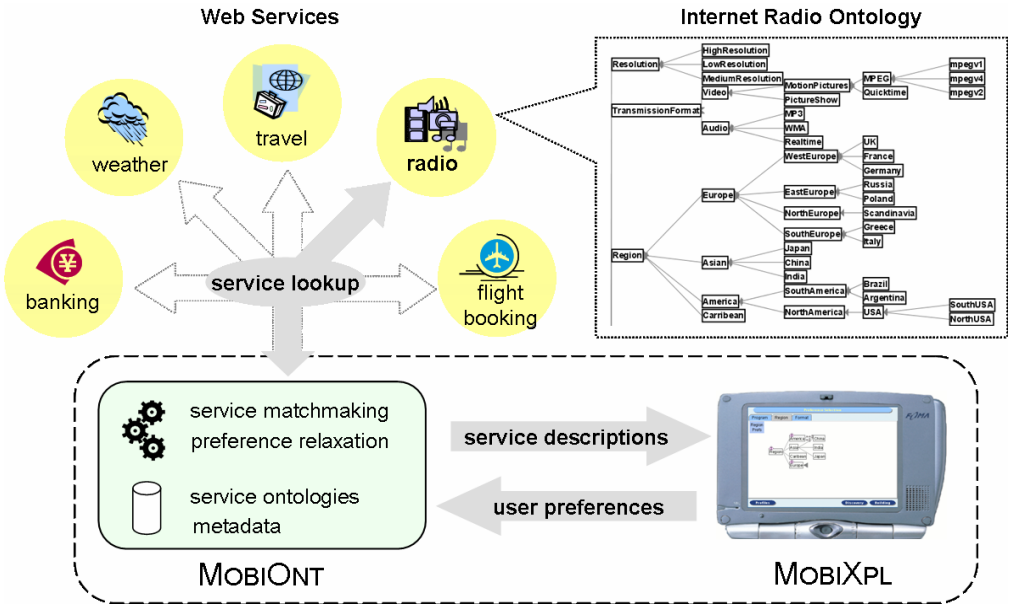

Figure 2: MobiOnt / MobiXpl – A testbed for mobile semantic-based services.

different discovery strategies. The goal of service discovery is to retrieve those service instances from the ontology that represent the best matches to given preferences.

The proposed and implemented preference-based service matching is performed along the lines of the determined preference order to implement cooperative behavior: if the search for a perfectly matching radio station fails, the initial query is gradually relaxed along the path of the (complex) preferences until a next-best match can be found. Thus, if in our example from above during service discovery no match could be found in European programs in MP3 encoding, the next discovery step consists of trying to match radio stations that broadcast Japanese or American programs in MP3 or European programs in Real. If neither of these two second-best choices is available, any other program is matched. Further implementation and application aspects as well as selective ontology browsing and preference building and mapping are further explored in [1][2][7].

5. CONCLUSION

The vision of a mobile Web in which the computing environment will be composed of various devices that are carried by different users as they go through their daily routine might soon become a reality. On the other hand, our experience shows that, to make this vision a reality, we need to combine the service-oriented approaches as put forwards by the Web services community, and methods from the Semantic Web. Only this way it can become possible to provision different services and information sources in machine understandable and truly intelligent ways. Semantic Web services provide a natural technology to make this vision a reality.

Even though the capabilities of today's Web-based services are still relatively simple, their sophistication and diversification will grow with the improvement of wireless networks, bandwidths, and client device capabilities. Consequently, finding the adequate services will become a more and more demanding problem for the individual user. We advocate that making an informed choice of the right service will essentially include matching the individual user's preferences and dislikes against the services offered in a given situation or context and have introduced the concept of user-centered Web service discovery [1] and selection [2] (extended in [3]). Based on this work, basic yet very intuitive user preferences can be defined, accumulated and taken into account during service provisioning.

To make Semantic Web services a viable technology for the marketplace, there is a need to achieve agreed standards. DoCoMo is already a member of W3C and is willing to participate in a working group that would lead to the standardization of Semantic Web services.

6. REFERENCES

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