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TOWARDS CONTEXT-AWARE WEB SERVICES

Bouchra Soukkarieh, Florence Sèdes
IRIT, Paul Sabatier University
118, Route de Narbonne, 31062 Toulouse, Cedex 9, France

ABSTRACT

The advancement of wireless networks and mobile computing requires advanced information systems built with context-awareness. These systems are more and more based on the usage of Web Services that are based on a system designed to support interoperable application-to-application interaction over the web. However, the classical architecture of these services does not take into account the idea of context adaptation and that is where the direction of our work is heading. In this article, we present our proposal which aims to extend the classical architecture of Web Services to a context-aware architecture in order to provide nomadic users with a list of Web Services that are adapted not only to their profile but also to their context.

KEYWORDS

Web Services, context adaptation, CSCP, CC/PP.

1. INTRODUCTION

With the emergence of new mobile technologies, ubiquitous systems and distributed systems, users need to use the same applications in varied execution contexts. Consequently, the idea of the adaptation carried out in the fixed environment becomes insufficient for mobile environments. So, researchers in this field are working to integrate the context as an essential parameter of the adaptation mechanism to take into account the new aspects of this environment. In other words, users will launch their queries in a Web-based information system, while waiting to get adapted information to their profile and their environment (preferences, device, environment, etc.).

These *Web-based Information Systems (WIS)* are more and more based on the usage of Web Services. A *Web Service (WS)* is a software system designed to support interoperable application-to-application interaction over the web. The classical architecture of WS is composed of three entities (provider, user and registry) and is based on three standards (WSDL, UDDI and SOAP). Despite the importance of context in WIS where the user isn't any more sitting at his office but is moving around different environments, WS architecture does not take into account the idea of context adaptation.

In our research works, we aim to integrate context adaptation within the classical architecture of Web Services, adding to it dedicated components that would return to nomadic users a list of Web Services that are adapted not only to the user characteristics (profile) but also to the context of his environment (localization, device, etc).

The rest of this paper is as follows: In section 2, we detail our proposal which aims to extend the classical architecture of WS to a context-aware architecture. In section 3, we expose the context profile representation using the CSCP format. In section 4, we take a rapid tour at some works in the field of context adaptation within WS. Finally, in section 5, we present the conclusion and our perspectives.

2. CONTEXT-AWARE WEB SERVICES ARCHITECTURE

Traditionally, the architecture of WS (Figure 1) is composed of three entities: the *service provider* builds the service and publishes its description in a *registry*. The *user* needs are translated into requests that are carried

- **Context Storage:** the Context manager element CM stores implicit and explicit contextual information in an XML database. This element enables to:
 - Store contextual information in databases.
 - Receive the list of WS that adapt to the user Query, from the registry and filter it according to contextual information.
 - Ask the profile of each adapted WS in the list in order to compare it with contextual information.
 - Send to the user the list of the most adapted Services to his query and to his context.
 - Check if the context of the user is changed. In this case, the CM must take these modifications into account for updating the Services that are most adapted to his context (dynamic adaptation).

B. Services profile management. In this component, SPM is responsible to:

- Extract WS profiles.
- Store these profiles in the SP database.
- Restore to the CM the services' profiles that fit the user needs.

The *service context* is expressed directly by the service provider. The *user context* is obtained in an explicit and implicit way so when the user launches his request, he can express explicitly his static characteristics and his preferences but remaining characteristics (localization, network, etc) are obtained implicitly by the context sensor as we show next.

3. CONTEXT PROFILE REPRESENTATION

Researchers in the field of the context adaptation did not yet reach a generic definition of the context concept. The most accepted definition of context is : “context is any information that can be used to characterize the situation of entities (i.e. a person, place or object) that are considered relevant to the interaction between a user and an application, including the user and the application themselves. Context is typically the location, identity and state of people, groups, computational and physical objects.” (Dey, 2000).

In order to retrieve the most relevant results with the user’s context, we should discover all context elements that influence the result. Indeed, the majority of researchers in this field classify contextual information according to their particular application. In our architecture, we base on work of (Lopez-Velasco and al, 2005) by adding parameters related to the session and to the network. Therefore, we defined four axes that aim to cover all the context parameters: the *user characteristics* which are composed of *static characteristics* (first name, last name, etc) and of *evolutive characteristics* defined by his environment (his localization, time, etc) and his preferences, the *device characteristics* (material, software), *the network characteristics* (standard, flow) and *the session characteristics* (date, hour, state, etc).

As we emphasized in the preceding paragraph, in order to provide the user with the most relevant services to his context, we must take into account not only the user context but also the services context.

To represent the contextual information, the majority of researchers, as (Lopez-Velasco and al, 2005) used the format *CC/PP (Composite Capability/Preference Profiles)* (CC/PP, 2004). CC/PP is a decomposable, uniform and extensible standard but we did not use it to represent our context because of its lack of structured functionalities. Its two leveled strict hierarchy is not appropriate to capture structures of complex profiles (Held and al, 2001).

We use the *CSCP (Comprehensive Structured Context Profiles)* format to overcome the structure deficits of CC/PP. CSCP provide a multileveled structure which allows the representation of all the types of contextual information.

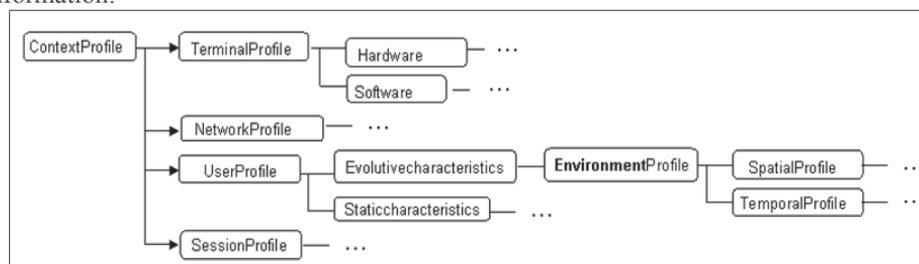


Figure 3. Structure of the context profile

The representation of the user and services context is demonstrated in figure 3. According to this format, our context profile is composed of a user profile, a session profile, a terminal profile and a network profile.

Figure 4 presents an example of a service required by a user. This one wishes that the service sheds in English and be able to adapt itself to his mobile device.

```

< ?xml version= "1.0" ?>
<rdf :RDF
xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:cscp="http://context-aware.org/CSCP/CS CPPProfileSyntax#"
...>
<ContextProfile rdf:ID=Context>
<device>
<dev :DeviceProfile>
<dev :Hardware>
<dev :memory>9216</dev :memory> <dev :ScreenWidth>320</dev :ScreenWidth> <dev :ScreenHeight>200</dev :ScreenHeight>
</dev :Hardware>
<dev :Software>
<dev :Name>EP OC</dev :Name> <dev :Version>2.0</dev :Version> <dev :Vendor>Symbain</dev :Vendor>
</dev :Software>
</dev :DeviceProfile>
</device>
<User>
<use :UserProfile>
<use :CharStatic> ... <Ause :CharStatic>
<use :CharDynamic>
<use :Preference> <use :Langu>English</use :Langu <Ause :Preference>
<Ause :CharDynamic>
</use :UserProfile>
</User>
<Session>...</Session>
<Network>...</Network>
</ContextProfile >
</rdf:RDF>

```

Figure.4. Example of CSCP profile in XML Format

In order to find a list of services adapted to the user context, we will carry out a “matching” process between the user context and the service context by comparing attributes of their metadata. The list of Web Services turned to the user will be ordered according to the degree of similarity calculated in the matching where the Service Web adapted at the head of the list is the most adapted to the user request.

4. RELATED WORKS

In this section, we take a look at some research works interested in the possibilities of applying the context adaptation on WS.

(Chari and al, 2005, 2006) are interested in the impact of the context on a medical application. A platform (SECAS) was developed in order to adapt the application to various context components: data, services and presentation.

(Pashtan and al, 2004) present an information system for tourism (CATIS) which enables the adaptation of mobile devices in terms of content and presentation. The application takes into account the user preferences, his localization and the type of his terminal. Then, calculates the user’s speed and direction using his preceding location.

A platform was presented in (Keidl and all, 2004), which facilitates the development and the deployment of adaptable Web Services to context. This platform enables the adaptation to mobile devices concerning the user location.

In this work, each researcher use contextual information according to his particular application where different types of adaptation can be highlighted:

- Adaptation to mobile devices and to the location of users is treated in the three study works.
- Adaptation to users which is taken into consideration in the three study works. However, (Pashtan and al, 2004) takes into account user preferences who are related to a precise term (such as the type of the kitchen, the type of the hotel.).
- Adaptation to the network which isn’t treated in these study works.

- The context of the session which was not mentioned in the previous works. Every context is associated a session, while a session could be associated several contexts. The session, therefore, is regarded as a principal element in the context.

In our work, we present a context model which takes into account all the conditions which can take part in the adaptation process in a mobile environment (user profile, device, network, session, localization, etc.).

We note too that existing works on adapted Web Services are *pre-programmed services* that aim to answer in an adequate way to particular users needs (such their personal characteristics or material constraints of the device used). None of these works deliver to the user *a list of adapted services* to his context. It is in this direction that our work is heading.

5. CONCLUSION

In this article, we have discussed how to extend the classical architecture of Web Services by adding special components that aim at delivering a list of adapted Web Services to user preferences and contexts. The advantages of this integration are numerous: it increases the usability, accessibility and interoperability of the system. Then, we have detailed the representation of context profile metadata using CSCP that is employed to represent, store and process the contextual information.

In the continuation of our works, we aim firstly to specify the algorithm which will help us to match between the two contexts (user and services). Then, we plan to implement our architecture that integrates the context in the classical architecture of Web Services in order to provide a platform for nomadic users that would return a list of the most relevant services to their context. Finally, our research works aim to provide a generic platform that is not restricted to a particular domain.

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