

Context-aware preferences for Internet services?

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Abstract. Modern services change their behaviour based on the preferences of the customer. The preferences of people depend on different contexts from their physical location to their current role. Therefore the context has to be taken into account when service is personalised. This paper describes how customer preferences acquiring is affected when context is also taken into account. Different methods used for personal information acquiring by Internet services are analysed from the context-aware preference point of view.

Keywords: personalisation, personal preferences, identity management, context awareness, privacy

1 Introduction

Due the evolution of the communication technologies and access devices the way we use Internet today has changed from the days when Tim Berners-Lee, along with his colleagues, developed World Wide Web in CERN. Back in the 90's, Internet services were used from fixed location with a desktop computer that had a decent monitor. Browsing the service content was done by a mouse and a keyboard was used for inputting data. The convergence of tele- and datacommunication networks allowed an access to the services via new types of devices. At the same time new types of services and service access emerged.

Today the access to services may be done via variety of devices using different types of access methods and communication paradigms (Figure 1). This variety provides new challenges for service providers. Service providing cannot rely that customer have big screen, reliable and fast connection and proper equipment to input data effectively. In order to provide good use experience for the customer, the service have to be adapted for the user hardware capabilities. These capabilities can be acquired in the form of User Agent Profile defined by 3GPP. Furthermore, solutions to the challenges provided by different hardware used on Internet services is researched in W3C Device independence workgroup [1]. The hardware capabilities is not the only challenge that have emerged. With the new small terminals the user's are not fixed to a certain location for service access and use. The addition of Wi-Fi capabilities to mobile phones allows the use of free regional wireless networks [2] instead of rather expensive cellular technology such as GPRS.

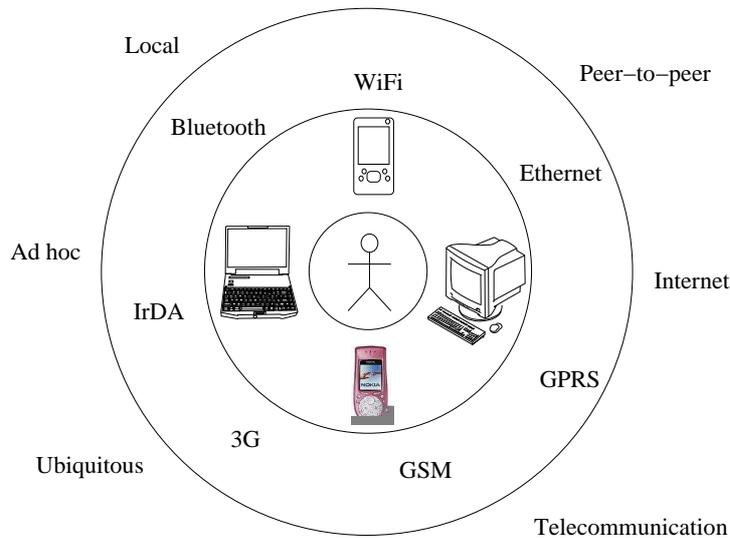


Fig. 1. Heterogeneous service access and use

Due to these new challenges and possibilities the personalisation of services for customers is becoming more important. Mobile customers are less willing to browse through several pages in order to find the information or product they are looking for. Effective personalisation will also provide better customer satisfaction and thus increase the customer's loyalty towards the service [3,4]. In order to conduct the personalisation of the service, the service requires information about the customer's preferences. These preferences can be acquired from the customer by asking them for example during registration to the service. Another possibility used for example by amazon.com is to monitor the behaviour of customers during their service use and gather data that can be used to personalise the service.

When the services are used through mobile devices, the context of where the customer is, may change more than when using the desktop computer at home. For example, the location of desktop computer user will never change during the service use while mobile phone user may move from the street full of sunlight down into the darkness of the subway station. These changes may affect to the preferences the customer has i.e. the preference has dependency on some context information. For example, in the direct sunlight user prefers light background with dark letters while in the darkness the background is preferred to be dark and letters light. The preferences may also be dependant on several context. For example, the preferred type of lunch is different when customer is having lunch in short lunch break at work than it is on vacation in some exotic location. Several dependencies for personal preferences have been identified in [5].

Taking context into account for determining user preferences will require changes in the way the personal preferences or personal information is managed. In this paper the current methods of personal information management are evaluated in Chapter 2.

Chapter 3 discusses how context-awareness can be taken into account and what kind of problems have to be solved to get to context-aware identity. Chapter 4 concludes the paper.

2 Personal information management

In order to personalise services the service has to have access on personal information. The location where the preference data is stored and how it is accessed affects also how the context data can be taken into account. The traditional way for acquiring the data is by letting user fill a registration form that asks variety of questions and the service then stores this user profile in database. However that is not the only possibility. If we look at the ways services are accessed, several possibilities can be identified. Figure 2 presents these possibilities, namely 1) registration, 2) database at network, 3) browser and 4) Mobile device based approaches.

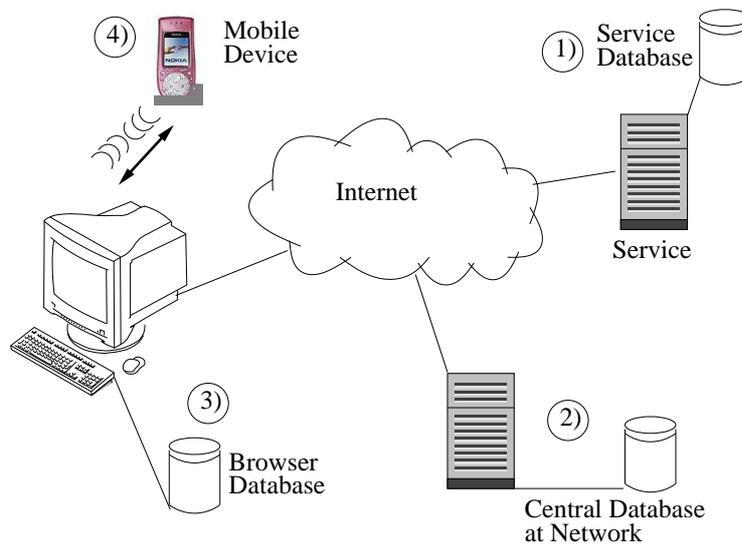


Fig. 2. Different locations for personal information

If we take a look at the registration approach. First of all users have to register for the service before they may start using it. The service stores the information about the customers, i.e. user profile, into its database for the further usage. Thus next time the user accesses the same service he doesn't have to provide the same information again. Instead, the service looks up the user profile from its database. In order to find the correct personal information from the database a user authentication is required. Besides the basic identifying information, services may request the user's preferences, follow the user's behaviour on the server and store the gathered information into appropriate

database. The stored information can then be used to personalise the service i.e. adapt the service outlook and content into more customer friendly form.

There is some drawback on this approach. As the variety of the used services grows, the places to where the user has to provide his personal information grow and the confusion about the contents of the user profiles increases. If user preferences change, the user needs to know all the places where the information is stored and update the data there. It is unlikely that the user remembers all these places thus resulting contradictory information. Another problem arises when considering the security of the personal information. When the information is stored in the service database, user has to trust that the service provider is capable of storing the information securely enough. The more services user uses, the bigger is the chance that one of them has weaknesses in their security system. To minimise the amount of databases the personal information is stored, the customer can easily decide to concentrate to only few service providers.

Second possibility is to store the personal information in a single database on the network. This database can be administrated by a trusted third party or the customer. Some of the single sign-on (SSO) approaches such as Microsoft .NET passport [6] and Liberty Alliance [7] can be used to provide a third party based solution for the personal information storage problem. However, originally .NET passport required the service provider to pay a fee to Microsoft. This meant that small service providers could not afford to adopt the passport. It is also unlikely that temporary services like conference registrations are willing to do the extra work required to join in the SSO system especially when all they need is simple registration information for one time event.

In Liberty architecture service and identity providers form circles of trust in which the participants transfer information about the user. The creation of a circle of trust requires negotiations between the participating partners. Like in .NET passport this is unsuitable for one time services provided by small service providers. In these approaches the user has to trust to the third party and that the third party uses secure methods when handling the user's sensitive data. Also the trusted party has to be same party for both user and service provider. If there are several third parties providing similar personal profiles, the service provider has to have contract with most of them, in order to not exclude any users. Obviously, information stored on third party servers, is available only when a connection can be formed between the service provider and the servers. Thus the use of service relies not only on the reliability of the network between customer and service but also the network between service and the third party. This problem is graver in the countries that have poor international Internet connections. Finally, the third party service may change the way it functions and the terms of use. For example Microsoft has stated that they will cease to offer passport functionality outside their own services. In Microsoft and Liberty approaches the user has no control over his/her profile, which is a serious drawback.

Other centralised approaches have been proposed. Koch proposes IDRepository that allows users to own their own profiles [8]. At the same time this approach supports complex user profile attributes. In Wireless World Research Forums (WWRF) book of visions Bettstetter et al. suggested user controlled personal profile server [9]. More detailed solution was described by Thai et al. [10]. Their Integrated Personal Mobility

Architecture relied on the customer's home network as a location to store personal information. Compared to the third party approaches the user controlled database is easier for service providers since they don't have to have contracts with different third parties. The data is available for services when the profile server is up and running. Security conscious user will turn the service on only when needed, thus increasing security.

The third obvious location for the personal information storage is at the user end. New web browsers have the capability to store some information for the user. Thus, the information is stored in the place, from where it is easiest to use and update. There exist two approaches that can be used to determine what information will be filled in an empty form. In the first approach the stored information depends on the web page. The browser remembers what the user has typed into the form fields, when the form was filled before. In the second approach the web page supports the browser's personal information scheme, so that the browser itself can determine what information is given in what field [11]. Although the web browsers will enhance this personal information storage functionality rapidly, it does not help the mobile or nomadic users. Mobile and nomadic users typically access the services from several different terminals at different places.

Final possible location is to store the data at user's mobile device. Mobile Electronic personality (ME) [12] is one such solution, where the data can be requested via Bluetooth connection by the desktop computer using a browser plug-in [13]. Similar approach is defined by the EU funded Simplicity project [14] that concentrates on the use of services through different terminals and devices. In order to provide seamless usage of services in different devices Simplicity project proposes the use of so called Simplicity device to store the user profile. Although several possibilities for the storage are given they conclude that the SIM + smart phone combination is not very far from the ideal storage and processing device.

3 Context and personal information

Taking the context into account when deciding the customer preferences will require some changes on existing personal information management systems. Let's see how a context aware preferences can be used. At first let's assume that context dependent personal information is already stored at some database based on the approaches defined in previous chapter. When the customer connects to the service, the service connects to a database to get the personal information. In order to select correct piece of information the customer context has to be determined. The context is then delivered either to the service or to the database holding the personal information. If context data is delivered to the database, then the database can handle the proper mapping i.e. when service requests customer's favourite drink, it gets the proper response based on the current context of the customer. If the service is given the context data, then service needs to fetch all the preference data and do the context mapping itself. Of course the service can just relay the context data to the database for handling.

Some of the context data can be thought to be private and thus customer may be unwilling to disclose it to foreigners. The idea that the service they frequently use, can

gather a database about the changes of their context may sound intrusion to privacy. For example the service may follow the locations from where service is used at which time via the context information. Thus from privacy point of view the service based databases are risk to privacy. With third party approaches the risk is even higher, since the third party gets the context data whenever the users uses any personalised service.

In the mobile device based approach the context data the context data is not transmitted anywhere but is handled locally at the customer's mobile device. The service receives just the preference data that is correct for the given situation. The actual context information remains secret. With this approach it is also possible to use context data to affect on privacy settings in different situations. For example customer may allow restaurant to receive his identity on work hours to gain lunch bonuses, but on his free time he wants to remain anonymous[15].

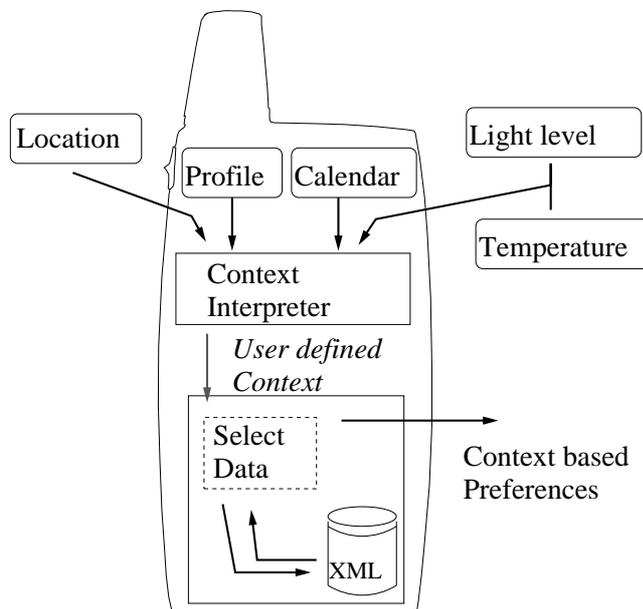


Fig. 3. From several context to user defined context

Another question is, how to describe the context. Let's think about seemingly simple context like location. While location at first sounds like unambiguous piece of data, it can be defined in variety of ways. GPS provides exact coordinates for location, while from preference point of view it might be more interesting to know whether the user location is in shopping mall or on the street [16]. In order to get proper piece of data from the database for the given context, the context provider and context user has to use notation that they both understand. The user should also be able to understand the context for which the preference is defined for. Unified identifiers for different kind of contexts can help the interoperability. On the other hand user's might come up for

their own contexts. On some mobile phones it is possible for users to define different profiles, such as meeting, home, or work profile, that affect on how the phone behaves. These profiles can be one source for context and an example of user definable context. The user definable context are easy to understand by the user and thus defining the preferences for these contexts is more direct.

```
<?xml version="1.0" encoding="UTF-8"?>
<Personality xmlns="http://www.lut.fi/%7Epjappine/ME"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.lut.fi/%7Epjappine/ME
  ME-context.xsd">
  <Lunch>Pizza</Lunch>
  <Lunch context="vacation">Shrimps</Lunch>
  <Lunchtime>1pm</Lunchtime>
  <Lunchtime context="work" >11:30</Lunchtime>
  <Sports>Hockey</Sports>
</Personality>
```

Fig. 4. Simple context-aware preferences XML file

The user definable contexts can also take input from outside e.g. time. In order to map the context information gained from different sensors to the contexts defined by user, an interpreter is required(Figure 3). The context interpreter has to have specific rules how to combine the different context data into a single context. The result from the context interpreter can be used to find the proper piece of data from the preference database or XML file like in Figure 4.

Another problem arises when there are several context dependencies for certain data. For example a person might prefer fast food for lunch when at work. On the other hand same person might prefer local food, when visiting another country. The question is, what is the preference when the user is visiting another country on a work trip? Should new context named “work abroad” be created. This can lead of forming huge amount of contexts and cause confusion for the user. Context interpreter and user defined contexts can help on this problem by reducing the amount of possible context.

4 Conclusions

The personal preferences depend from the context the person is. To provide accurate personalisation the context where customer is should be taken into account. Current personal information management systems require changes in order to support such an approach.

The main issue on supporting context-aware preferences is to find way for matching the preference data with current context. Multiple context sources adds complexity to the whole system. Providing context data to service may easily intrude the privacy of user. Thus services should not get the raw context data but rather just the preference data that has been processed with the context in mind. That reduces the amount of suitable personal information management approaches. Finally defining the preferences in different context may be tiresome task for the user and thus simple interfaces for up keeping the data is required.

The context information itself may be sensitive and thus should be protected to ensure user's privacy. However context awareness can help user to manage different types of identities and handle security differently on different situation. Before these advantages can be accomplished a lot more research is required.

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