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Abstract

Situation Dependent Services are services that significantly depend on the user's situation. Considering the individual needs such services are regarded to be more beneficial to the customer than non-individual services. For the development of Situation Dependent Services it is necessary to better understand the measurable aspects of a user's situation that are relevant for customizing a service. From this point of view the paper examines the term "situation" in more detail and summarizes the relevant aspects for mobile and internet services in a framework. By now, the framework helps to classify the level of situation dependency of a service and provides an overview of major technologies that are applicable. In the future, it is intended to expand the framework to provide a methodical help for the development and improvement of Situation Dependent Services.

Introduction

Situation Dependent Services (SDS) are services that significantly depend on the customer's situation and his individual needs. They are especially relevant for internet and mobile services. For instance the mobile operators in Europe made huge investments in the UMTS licenses and infrastructure. Therefore the mobile operators are forced to support profitable services to gain a return on their investments. On the internet the competition between different service providers lead to the development and improvement of services that better enhance the fulfillment of the demands and expectations of their customers and even legitimate rising prices.

Table 1. Chances and Risks of Situation Dependent Services

	To Service Provider	To Customer (User)
Chances	– Competitive Services – New Business Models – New Marketing Methods – Positive Image	– Individualized Services – Better Comfort & Faster Navigation – Efficient Search for Services – Effective use of infrastructure
Risks	– High Start Investment – Possible Malfunction – Little Experience – Legal and Security Concerns	– Wrong Adaptations – Bad Performance – Protection of Privacy – „Transparent Individual“

The value of SDS is expected to benefit the customers as well as the service providers. A comparison of chances and risks of SDS helps to identify relevant factors. Table 1 compares the chances and the risks of Situation Dependent Services over the internet and mobile devices from both a service provider's and a customer's point of view. A service provider extends his opportunities to provide more attractive services, establish new business models and increase revenue. The customer is given individualized and context sensitive services faster and more effectively. On the other side, the arising risks must also be considered. New technologies are needed to automate the customization of a service to the individual demands. As the value of personal information increases and the exchange of digital profiles is been facilitated, they may become an object of interest and trade. Thus, the protection of privacy becomes an important factor to be considered.

Initial examples for SDS are mobile Location Based Services or personalized internet services. By now, LBS are based on a low level of situation dependency and use mostly simple filtering techniques with database lookups. For the development of services with a higher level of situation dependency, it is necessary to get a better understanding of the user's situation. Therefore, the term "situation" is examined in more detail in this paper. The measurable aspects of a user's situation, that may be relevant for customizing a service, are summarized in a framework. The paper also provides an overview of major technologies that are used to determine the user's situation automatically.

Understanding the User's Situation

Depending on the scope of interest, there are several definitions of the term "situation". For the development of SDS, it is sufficient to define a user's situation as the totality of all aspects that have a measurable influence on the individual. To reduce complexity furthermore we will focus only on those aspects that are measurable over the internet or mobile devices and are relevant for customizing a service.

Concerning the development of Situation Dependent Services, there are already existing classifications to categorize the relevant aspects of a user's situation. These classifications concentrate on mobile and location based services in special. Table 2 compares the classifications focused on mobile as well as internet services with the classification proposed in this paper.

Table 2. Comparison of Different Classifications of a User's Situation

Proposed here	Figge (2001)	Scheer et. al. (2002)	Gessler and Jesse (2000)
– **Time**	– Time	– Time Context	– Time
– **Position**	– Position	– Local Context	– Location
– **Static Profile**	– Person	– Personal Context	– User Context
– **Dynamic Profile**		– Action Based Context	– (Object Context)
			– (General Context)

Figge (2001) differentiates only three dimensions and uses these to adapt mobile services. Scheer et al. (2002) differentiates four types of context that are similar to the dimensions proposed here. Their classification is solely used to outline context sensitivity and not to develop and improve SDS. Gessler and Jesse (2000) classify *Time*, *Location* and Context. Context is further subdivided into User Context (the user's characteristics), Object Context (other relevant objects nearby i.e. a restaurant) and General Context (other information for example weather). We believe that the Object and General Context do not directly belong to the user's situation but may help to identify the user's behavior.

In this paper we propose to categorize the measurable aspects of a user's situation according to four dimensions: *Time*, *Position*, *Static* and *Dynamic Profile*. *Time* and *Position* are the common and most obvious dimensions that are easy to measure. *Time* can be specified absolutely and accurately up to $5*10^{-9}$ seconds, whereas the *Position* is precisely defined by longitude and latitude. The *Static Profile* summarizes the properties of a person that might change occasionally, only. It includes demographic information like identity, name, gender, date of birth and place of residence. The *Dynamic Profile* describes the behavior of a person in a particular situation. The main reason for the differentiation of the Static and Dynamic Profile lies in the different techniques used to identify relevant aspects. Aspects of the *Dynamic Profile* are much harder to measure than any other but are still analyzable (Runte 2000). For instance most web server write log files, which provide an exact protocol of any data transferred from and to the user. By analyzing log files, the behavior of a user can be predicted to a certain level.

A Framework for the Classification of Situation Dependent Services

In this section, a framework is introduced to summarize relevant aspects of a user's situation that may be relevant for customizing a service. Additionally, an overview of major technologies is given, that may be used to determine the user's situation automatically.

Table 3. A Framework for SDS

Dimension	Metaphor	State of the Art Technologies	Status Quo of Use	Major Problem	Examples
Time	*When?*	Clock, Calendar	Seldom used	Finding suitable applications	Alternate appearance of websites at different points of time
Position	*Where?*	Global Positioning System (GPS), Assisted GPS (A-GPS), Enhanced Observed Time Difference (E-OTD), Cell of Origin (COO), Cell Global Identity Timing Advance (CGI-TA), Time of Arrival (TOA)	Often used by explicit user request	Protection of privacy	Location Based Services (LBS), Fleet Management, Navigation Systems
Static Profile	*Who?*	Cookies, OPS, P3P	Often used	Protection of privacy	GMX, Yahoo, Amazon
Dynamic Profile	*In what context?*	Netlogs	Only used for simple applications	No standard tools for the data analysis	Context sensitive advertisement in search engines

Table 3 presents an overview of the framework for SDS. The framework points out the four dimensions which characterize a situation. The second column assigns a metaphor for each dimension. The next column indicates key technologies which are relevant for the respective dimension. Some of the mentioned technologies are still under development, while others have been standardized already. The fourth column illustrates the current usage of technologies, followed by the problems which might appear when implementing the respective technology. The last column names examples of best practices or future ideas for conceivable services.

There are two different strategies to gather information about the user's situation. The first strategy is to prompt the user to provide the relevant information. These user made information are very simple to handle but there is no guaranty for correct data. The other strategy is to detect the relevant information automatically. Such information can be retrieved from the interaction of a service provider with his customer. But some information are difficult to compute while other information are not computable, at all.

The framework may assist service providers who want to implement SDS in a systematical approach. First, the framework helps identifying the level of situation dependency for a given or intended service. Based on this initial analysis, the provider may inspect the other dimensions to conclude what functionality should be added to his existing services. Step by step the provider may decide either to introduce new and additional SDS or to improve existing mobile and internet services by selecting applicable technologies.

The following sections discuss the specific aspects of each dimension in more detail.

Situation Dimension: Position

Services that use the user's position significantly are called Location Based Services (LBS). Examples for LBS are route navigation, location dependent yellow pages or location specific advertising. To analyze the different positioning technologies, it is helpful to split them in two categories:

- **Terminal based technologies** use special components in the user's device. Their main advantages are preciseness and the fact that the user can decide, whether he wants to be located or not. On the other side, these technologies are relatively complex.

- **Network based technologies** use the infrastructure of the (mobile radio) network to locate the user's device through the network. There is no extra hardware needed in the user's device. In contrast to terminal based technologies, these technologies allow push services that are initiated by predefined events.

Table 4 compares different technologies for locating a user in respect to mobile and internet services. The selection of a particular technology depends primarily on the preciseness needed for a specific service (Ovum 2000).

Table 4. Summary of Positioning Technologies

Technology	Category	Preciseness	Usage	Devices	Future Tasks
GPS	Terminal based	~ 10 - 100 m	+	GPS-receiver	None
A-GPS	Terminal based	~ 10 - 20 m	-	GPS-receiver	Network expansion
E-OTD	Terminal based	~ 125 m	-	Not available	New software
COO	Network based	~ 0,1 - 35 km	++	Mobile phone	None
CGI-TA	Network based	~ 100 - 550 m	+	Mobile phone	Network expansion
TOA	Network based	~ 50 - 150 m	-	Mobile phone	Network expansion
W-LAN	Network based	~ 10 - 100 m	-	Network adapter	Network expansion
Internet	Network based	~ 1 - 5000 km	++	Internet-terminal	None

The major task of research is to generate descriptions of the user's position that are more appropriate for customizing a service than longitude and latitude. Examples for such descriptions are for instance static specifications like the name of the street, district and town or relative specifications like "within walking distance". To compute such descriptions additional information are needed.

Situation Dimension: Time

While the point of time is clearly measurable, the time context is harder to specify. Relevant time contexts are either rather unvarying like daytime, opening hours, weekend and public holiday or more user specific like working hours and spare time. An example for a time dependent service is a website with a different appearance at different points of time.

For encoding the time, standards like the *Coordinated Universal Time* (UTC) or the *Greenwich Mean Time* (GMT) exist. The next task is the definition of suitable rules and universal time frames to define the appropriate time context.

Situation Dimension: Static Profile

A *Static Profile* can be defined as an accumulation of properties that will be changed occasionally only. Relevant properties for service providers are demographic data i.e. age, income and long-term information i.e. interests, preferences, skills or more generally the affiliation to a target group of a service. A simple example for a profile based service is the different layout of a service for adults and children. Most static properties are provided by user made inputs and are thus difficult to verify. Some properties like preferences may be interpreted automatically by the service provider.

To prevent problems with the user's privacy, service providers may apply different technologies to handle storage and protection aspects. Table 5 summarizes major technologies for handling profiles.

Cookies are integrated in all current internet browsers. As P3P includes almost all innovation of OPS, it will become more important in the future. Furthermore, it's standardized by the W3C (Pandaya 1999). The vCard is a specification to store profile information which is especially suitable for mobile services.

A key issue is the identification of the user's identity. Several techniques exist, to automate the identification of a user:

- **Service identification module (SIM) card number**, which is included by any cellular phone.
- **Mobile Station International Subscriber Directory Number (MSIDN)** is used to route and address telephone calls.
- **Phone number** may be transmitted by an outgoing call when not disabled by the user.

- Medium Access Control (MAC) number is the number of the network interface and allows the unique identification of a computer.

The first three are used in mobile networks normally. The MAC number is typically used by devices in internet networks. As the information gained in any kind of profile is a valuable object of trade, the handling of identities and the protection of sensitive information must be considered carefully.

Table 5. Storage and Hosting Technologies for Profiles

Technology	Storage	Application	User-Control	Usage
Cookies	User's harddisk	Internet browser	Switch on/off	++
OPS	User's harddisk	Special application	Access management	–
P3P	Repository at the Trusted Third Party	Internet browser planned	Access is negotiated	+
vCard	Provider	Internet browser, mail client, PDA, mobile phone	User Agent Profile (UAProf)	++

Situation Dimension: Dynamic Profile

A *Dynamic Profile* can be defined as an accumulation of information that change more frequently than the information of the *Static Profile*. Such information summarize the short-term behavior of a user. Examples are short-term preferences concerning the content as well as the way of using a particular service. They are for instance used by search engines to place context specific advertising or to provide a better navigation support.

The *Dynamic Profile* is not directly measurable, instead it can be interpreted by analyzing the behavior during interaction. Because of the short-term characteristic only an automatic detection of the Dynamic Profile is of interest. Additionally, the computation of the *Dynamic Profile* depends heavily on the customization potential of a particular service. One computational method for internet services is the analysis of net logs. Net logs save information about every requested and transferred file. These information include the users IP address, date, time, request method, filename, file status code, file size and referrer log. By now, computational methods that are commonly applicable do not exist and the dynamic adaptation of services is rarely used. The main reasons lie in the complexity and the diversity of possible interpretations.

Outlook

The presented framework intends to simplify the complex topic of situation dependency for services provided over the internet and mobile devices. By now, the framework helps to classify services according to relevant situation dimensions. The discussion of major technologies that are used to determine automatically the user's situation, may help to improve an existing service. Dimensions that are not covered at all by a service may give hints for further improvements.

In the future, we intend to expand the framework to provide a methodical help for the development and improvement of SDS. We want to refine the framework into a *Balanced Scorecard* (BSC) for SDS that is based on the situation dimensions defined in this paper. According to the key concepts of the *Balanced Scorecard* approach, it is necessary to specify objectives, measures, targets and initiatives for each dimension. Figure 1 illustrates a BSC for SDS. A *Balanced Scorecard* approach should provide an in-depth support for the ongoing development of SDS that are beneficial to the customers as well as to the service providers.

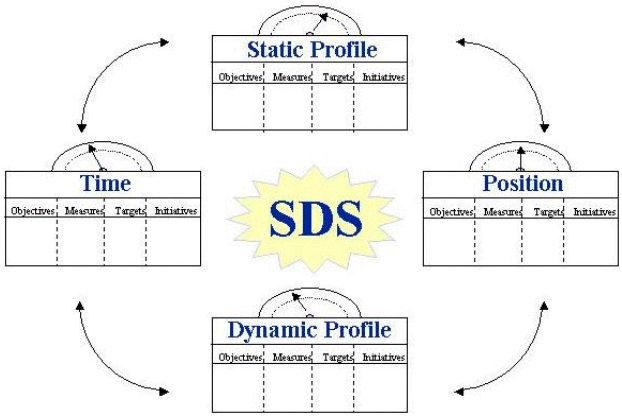

Figure 1. A Balanced Scorecard Approach for Situation Dependent Services

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