Context Awareness in Future Life Scenarios: Impact on Service Provisioning Platforms

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Abstract

Looking at future life scenarios we discover that personal communication devices are expected to play a central role in the organization of the user's life, enabling him to access any information he needs at any time, and taking what action which is useful in his specific situation. This will be done by taking individual preferences and context information into account.

Still, these scenarios most often do not outline the impact on the technology platform behind. In this paper we picked up the example of service portals as a simple, well introduced aspect of service provisioning and describe how the enrichment through context awareness will bring us one step closer to those future life scenarios.

1. Introduction

Nowadays the user has access to an almost infinite number of services and information via his device, typically a cell phone or WI-FI enabled PDA The user organizes his preferred and most often used services by customizing toolbars and hotlists. Besides, more services are accessible in service portals, which provide some kind of classification and pre-selection to ease the search and selection effort of the user. However, the process of identifying a suitable service or information is still unhandy for the user; considering the limited capabilities of PDAs and Smartphones (display size, user interface, etc.), more advanced service handling models are required.

We propose a model which introduces the consideration of situational information into the service filtering process. The process itself shall be performed permanently in an automatic manner. This concept allows the presentation of an intelligent, situation aware service portal, which proactively lists and offers the services which are assumed to be most suitable in the current situation.
Furthermore the service portal provides the ability to access a personalized profile and thus perform an additional filtering step according to the user's preferences.

2. Requirements

Market evolution, backed by standardization bodies such as OMA and 3GPP, have opened the floodgates for third parties to provide an amount and variety of services that had never been available before. Therefore, service categorization, and proper search methods become a must.

Furthermore, the limitations of the terminal interfaces and the user perceived complexity play a major role in the acceptance of platforms, and therefore, proactive service provisioning becomes ever more important.

Finally, situation awareness, in what regards the understanding of the user necessities, and what services he is willing to receive, becomes a logical next step. A more detailed description is given in the following section.

3. Situation awareness

Situation awareness involves behavior adaptation depending on the circumstances in which the service provisioning occurs.

The first aspect is traditionally referred to as "context information", and includes ambient data, such as temperature, weather, type of location and speed of the user. This formation can either be obtained directly from sensors on the mobile terminal, or by polling other external servers.

The second aspect regards the users, known or not, that are relevant to the user, be it because of their location, availability, or other parameters.

The combination of both types of information provides the system with the raw data that it can later on use to infer on the user situation, and therefore propose or provide suitable services.

4. Provisioning model

Figure 1 depicts the proposed model. Because of the limitations of today's available mobile terminals, a classical server-client architecture is chosen . In this model, a number of user preferences are combined with the actual capabilities of his current terminal, in order to further filter the services that are offered to the user.

Therefore, this mechanism is justified by the necessity for adaptation of services and contents with regard to the terminal that the user is using. Not only device constraints such as a small screen or a limited processing power, but also the requirements of silence in a meeting, or low power consumption in a travel situation requires different service configurations.

4.1 The Service Portal Client as Buddy List

The Service Portal client lists the services proposed by the server, and filtered by user preferences and terminal constraints. The user experience provided by our service portal can be compared with a 'Buddy List' known from instant messengers like ICQ or MSN, rather than with classical service portals. This is due to the dynamic update of the list of offered services, in which services disappear, while others show up for the first time. In fact, the availability of a service can be considered as its 'presence'. Instead of chat buddies, services are displayed in a structured way. The primary category are services which are considered to be necessary. Useful services are displayed in the second category (necessity and usefulness are discussed later in this document). For the latter one, we distinguish between locally available services (i.e. services with strong links to the actual position of the user, such as a printer machine, or a bus stop) and services independent from the user's location, since the number of such services is much greater than those in the first category, and requires more accurate filtering. Of course, the design of the service list can be further refined by introducing subcategories, which structures the service list, e.g., according to their functionality.

Furthermore, the client also hosts the capability to access a locally stored user profile with preferences and is able to perform a second service filtering process. In this second filtering step the capabilities of the device are taken into account as well.

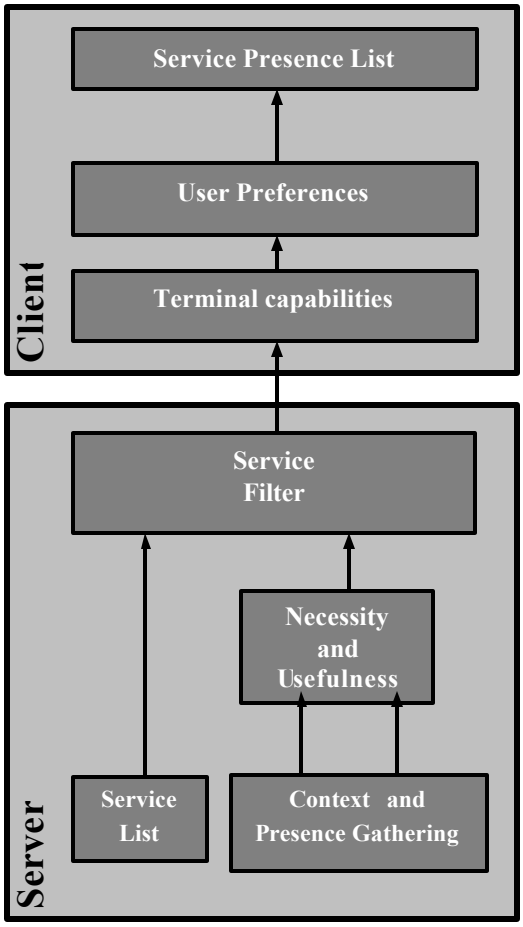

Figure 1: Intelligent Service Portal Model

4.2 The Service Portal Server

The service portal server side task is in general the selection of the services, which shall be offered to the user. Its main component are the service filtering mechanisms, the context gathering functionality and situation analysis, which provide the means to decide on the necessity or usefulness of services. Of course, the underlying database with the list of known existing services, obtained via service registration of service search mechanisms from classical service portals is also necessary here.

4.2.1 The Service Filtering. The necessity/usefulness block generates a list with the categories of services that the system deems necessary and/or useful for the user. At the same time, the service list provides a categorized view of the available services, and both these inputs merge in the service filter block. This is

essentially a correlation engine, which tries to match the received necessities with the available services. A suggested set of services is thus chosen and sent upwards, where they are further verified to meet the terminal capabilities and fit the preferences of the user. Finally, these services are presented in the service presence list, as detailed in section 4.1.

4.2.2. Necessity and Usefulness of Services. Crucial for the service selection process is the identification, if a service is necessary or if it is at least useful.

Useful services are those services that can give a benefit in a certain situation to the user, but which will not necessarily be selected by the user. This is the case, if the service only offers an added value, but the situation does not really require the invocation of it. An example for this is the possibility to access the train-schedule inside a main station. Of course, every service has a specific level of 'usefulness', the development of high quality assessment strategies is a major challenge to be able to perform an appropriate ranking.

Classified as necessary are services, for which the situation unambiguously requires their invocation. It is obvious, that the assessment here requires a high degree on reliability for the situation analysis process. Especially if the service propagation is accompanied by an explicit notification alert in the portal client.

4.2.3 Context and presence interpretation. The interpretation operations work on the raw data from both the user environment and the presence of known persons around the user (in [1] methods are presented for the classification and feature extraction from such data in order to interpret the context of the user).

This data is combined and processed to infer the situation that the user finds himself in, and therefore, based on learned patterns, what demands he has, and also what services could be useful.

A possible example is a scenario in which someone is walking on the street on his way home, when it suddenly starts raining. The raw data here is "moving at walk speed", "Raining", and possibly "My brother is busy, using the car". From this, the system is able to understand that the user is walking on the street, and that the rain suddenly makes this undesirable. Moreover, the fact that his brother is driving implies that the car is unavailable. Finally, the need for a public transportation means is inferred, and this directive is passed on to the service selection.

The list of existing services list is categorized based on what the services offer. Once the mentioned directive is received, correlating it to a service that provides "public transport" or any other necessity, becomes feasible.

The interpretation we propose is based on the Description Logic mechanisms [2], which works with the concepts extracted from the raw data, and tries to subsume them into more general, easily identifiable ones.

4.2.4. Interpretation sharing. Looking beyond raw data for situation inference, we now focus on the reuse of the analysis results. The context information comes from one of two sources: sensors within the mobile terminal of the user, and remote sensors, that either broadcast their information for all users to analyze or provides them on demand to authorized entities.

There is still another option, though, which can dramatically increase the interpretation power: a user might behave as a sensor, thus broadcasting context information that has already undergone some interpretation process within his domain of knowledge.

This is particularly useful when a user visits an environment that is not known to him. The interpretation engines at his reach will have no prior knowledge of the concepts available there, and how they combine into a meaningful interpretation.

Let's take the example of an industrial environment, where a plethora of sensors broadcast the status of valves, temperatures and pressure readings from the different parts of a manufacturing process. A visitor might be allowed to receive all this information, but his system would not know how to make any sense out of it. On the other hand, a regular employee has already trained his system to aggregate all the information into proper interpretations. For instance it could detect anomalies in the system, and broadcast the information "danger on this location" to all nearby peers. In doing so, the employee is using its interpretation capabilities to "explain" to the novice users what their context means. This could actually be an iterative process, and the knowledge of many individuals could be aggregated into higher level interpretation capabilities.

5. Next Steps

Once the situation analysis has identified the necessity of a service invocation it can be imagined, that this is done automatically without intervention of the user. While services classified as useful should be confirmed by the user before execution, necessary services could be launched automatically to improve user friendliness. For instance, automatic payment facilities in public transportations are good candidates for necessary services that could be executed without explicit user confirmation. However, often it remains advisable to at least inform the user about the execution of a service. An adequate service description

and corresponding decision mechanisms are a prerequisite. Another challenge for this kind of proactive service invocation is the consideration of the security requirements to meet an appropriate level of trust.

Special consideration needs to be taken on services in the grey area between being 'necessary' and 'useful': For example the situation requires the invocation of an action, but there are more than one services eligible. This the case if several services offer the same action or if the user has different options in a situation.

6. Conclusion

In this paper, we have shown how the abundance of services and the limitations of the user terminals, require an enhanced service selection method.

Furthermore, the possibility of solving the selection process by using context information has been explored, and a suitable model that fulfills the necessities of this system has been presented.

Of special interest is the concept of a context based service presence list, reminiscent of an instant messaging buddy list, as an alternative for a provisioning portal interface.

7. References

[1] R. Mayrhofer, H. Radi, A. Ferscha; "Recognizing and Predicting Context by Learning from User Behavior"; *MoMM 2003*

[2] F. Baader, *The description logics handbook*, Cambridge University press, January 2003.