

# Scenario Construction and Personalization of PN Services based on User Profiles and Context Information

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**Abstract**— This paper discusses scenario construction and personalization of PN services based on work related to this area in MAGNET and ongoing work in MAGNET Beyond. The pilot services in MAGNET Beyond are based on the two main cases named MAGNET.Care and Nomadic@work, covering health care and professional work situations. The vision is to enable intelligent and personalized services for users of personal networks (PNs) by taking full advantage of user profiles and context information. Initial work is focused on developing a conceptual structure of user profiles, which is flexible and dynamic, supports trust management and conditional access control, and can be smoothly integrated with available context information.

**Index Terms**—Personal communication networks, personalization, services, user profiles, scenarios.

## I. INTRODUCTION

THE overall vision of MAGNET and MAGNET Beyond is to develop a personal network (PN) service architecture that can support and enable users to accomplish their tasks in a wide variety of circumstances or contexts. This presents a lot of challenges, e.g. understanding the user needs and requirements, being able to combine several pieces of information to deliver relevant and customized services, establishing policies for controlled access to personal profiles and context information, preserving trust and privacy, and offering a user-friendly navigation of available services.

In MAGNET we have developed a user-centred methodology for construction of scenarios and use cases that has formed the basis for deriving user and system requirements, see for example [1]. It is a general problem for this type of research that users can never fully imagine what they require

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from advanced technologies and how they can benefit from them. As they are constrained by the knowledge of the services delivered by technology available today, their wishes may be too restricted or conservative, but by applying an open structured approach the creativity of users can be stimulated to identify important user needs. However, the service architecture must be rooted in technology and based on sound economics, i.e., experts must complement the user requirements with technical requirements and business considerations to ensure the novelty and viability of the approach.

In general, all relevant and available information must be utilized to ensure the best service delivery, e.g. user preferences, location, presence, available services, and network conditions. Combining these elements in the right way can lead to personalized PN services that are intelligent, context-aware and attractive for the users. In its ideal version this would require a continuous processing and learning ability of the network, based on e.g. usage history and statistics, data mining and collaborative filtering, but here we only address the basic framework of such an architecture.

The main contributions of this paper are to describe the methodology for developing user scenarios for personalized services and to analyze the preliminary personalization requirements and interaction mechanisms from a list of use cases derived from the scenarios. The paper is organized as follows: Section II describes the methodology for constructing scenarios and use cases. Section III analyses and discusses the conceptual structure of user profiles and how local client applications can communicate and interact with the user's environment to enable and manage the service delivery. In Section IV we show how user profiles and context management can be applied to realistic use cases from the Nomadic@Work case, resulting in personalization and improved user experience. Finally, a brief conclusion is given in Section V.

## II. FROM SCENARIOS TO SERVICES

### A. Construction of scenarios and use cases

Scenarios and use cases are often used as a way to describe user requirements (as a basis for service discovery) in ICT system development. The procedure for writing use cases is well defined using the UML methodology [2], but it is not so easy to predict which (future) user activities will be the inter-

esting ones to transform into use cases. Therefore the scenario construction, and the methodology used, is important. The scenario illustrates the users' needs and requirements as a narrative understood by both users and developers and is thereby used as a common shared language.

Within MAGNET the aim of the developed user scenarios has been to represent the users' wishes and needs while simultaneously addressing relevant technology issues needed for the developers. Scenarios are here defined as: "*- a descriptive set of plausible and possible different futures*" (based on [3]). These futures are based on users in different situations using a particular technology, application and services. Therefore, the scenarios represent the users and their interaction with technologies for solving or functioning in particular situations, given trends and structural factors of the surrounding environment. The scenarios focus on longer-term ICT developments (5 years or more).

The overall principle for the MAGNET scenario construction has been to use a participatory design process, see e.g. [4], focusing on interaction between users and engineers in the development of future technologies and applications. The scenarios can then include aspects, which are wishful thinking, as well as situations that the users have not yet evaluated positively or negatively. In order to secure that the scenarios will provide valuable input to technologies developed for the future, the scenario construction focuses on providing a general overview of trends, situations that could be part of the future, and letting the users free themselves from today's technology use. Since the users have to think about the future, the design methodology includes workshops based on creativity methods that support the users to fantasize and extend their world to possible situations in the future. There are two types of workshops that together create the information needed; the creative user workshop and the expert workshop. The user workshop focuses on the users and their needs and wishes and includes users as participants. The expert workshop - with technical developers and engineering designers as participants - then works with these ideas to secure that the user needs and visions are brought to a state where they are challenging and interesting, technology-wise, and are discussed in terms of possibilities and limitations for the technical design. The user scenarios are then re-written and extended with the new elements of interest to form so-called "rich" scenarios (see [1] for details).

The rich scenarios are the basis for identifying use cases. Each scenario includes a number of relevant use cases or situations, in which users interact with a device or network to carry out different activities. The use cases are written using a formal UML structure. Furthermore, the functionality covered by the use cases is discussed and commented on by the technical developers and engineers to make these more detailed in terms of devices and system requirements.

In MAGNET Beyond it is decided to focus on two user domains: the MAGNET.Care and the Nomadic@work case. MAGNET.Care focuses on providing technical support to users (both professional as well as end-users) and on handling health care related issues more efficiently than today. The Nomadic@work case seeks to provide a better understanding of the user requirements in the professional sector, in particu-

lar for nomadic workers with high demands on bandwidth and security such as journalists. Use of case studies provides a sound basis for discussing and deriving different service needs with varying degrees of focus on personalization, context awareness, security, mobility and pricing and billing. The two cases address different physical situations and usage situations and therefore provide a basis for various services and handling of these. More information on the cases can be found in [1].

Within the Nomadic@work case study a new participatory design usability set-up is currently being developed. The concept is based on the previously described creative user workshops and a mobile probing tool-kit. In a non-technical way the concept will cover the following important issues: Number and size of devices, how to input/output data, personalization and user profile, how to handle information and data processing, and management of all devices in the PNs. Above these issues are all kind of activities, taken from a journalist point of view. The already developed use cases, originally evolved from the previous MAGNET workshops, will hereby be aligned and further developed with respect to the journalists' needs and wishes, in order to secure that the final developed services and applications will be usable and useful in the real world.

### B. Types of Services

From the scenarios and use cases different types of services and their requirements and potential for personalization can be identified. The term *service* implies that the personal network serves the user and enables the user to accomplish his or her tasks under variable conditions, pushing the borders for what is technologically feasible and enhancing the user satisfaction and experience. The user's interface to navigation of services is typically an Electronic Service Guide (ESG), which reflects the user's personal preferences and the available/relevant services in a given context.

There have been many attempts to classify the end-user services. The UMTS Forum has identified 6 service categories for 3G: Customised Infotainment, Multimedia Messaging Service, Mobile Intranet/Extranet Access, Mobile Internet Access, Location-based Services, and Rich Voice, covering a wide range of services involving service providers [5].

MAGNET also has a strong focus on peer-to-peer interaction, and a variety of business models have been analyzed, ranging from a traditional service provider model to a purely self-organized model. Special challenges for personal networks are to discover resources and services, e.g. in a cluster, and adapting services to user profiles and available context information. The use cases discussed in Section IV mainly address VoIP, audio/video streaming, file transfers and various web services.

## III. CONCEPTUAL STRUCTURE OF THE USER PROFILE

### A. Global initiatives

The technical means for the realization of personalized and context-aware services and application are the user profiles and context. The building of a user profile and context model requires a standardized and extensible framework. In the pres-

ence working group of IETF, the rich presence information RPID [6] has been proposed, which defines a structure and a transport mechanism for presence information. The model associates a person to several devices and services (such as VoIP, chat, etc.) and is fully extensible being based on the mark-up language XML. Ideas for distributed profiles with a single point of access can be found in the 3GPP generic user profile [7] work. This concept links application or service specific profile sub-structures to a central structure and deals with the distribution, protection and management of the whole entity. Similarly to P3P [8], the privacy model in the Internet, a policy framework has to be in place to control the exchange of profile and context information. Policies advertised by external applications declare the parts of profile and context needed by that service. Only a matching of such a policy with the internal user privacy rules will lead to the exposure of the required profile data [9].

### B. The architecture

In order to present the architecture and the interactions that allow service personalization, we first analyse the communication environment a user perceives when connected to other nodes:

The user may address a **MAGNET cluster**, which is based on a geographical **place** such as myCompany, myHome. From the cluster addressing layer, the user should be able to navigate or to lookup for the persons (e.g. colleagues in the office, family members), resources (e.g. camera) or services (file service, streaming service) in this cluster. In addition, there could be one or more **foreign node(s)** running a service the user has access to, e.g. myNewsService.

The architecture is **person**-based, because the user is always-on and connected virtually with colleagues, family members and friends through presence, location services, etc. (which is also the ideas expressed in the user scenarios). His relationships are well described by contact lists and their organisation in groups. We assume that to become a contact means to build a certain trust relationship defined by a temporary agreement to expose certain context attributes such as location, presence, etc. Other than in the cluster case, user A for example wants to know User B's context without knowing whether she is at home, at work or driving – as the traditional buddy list works.

We can distinguish between the **MAGNET** case (User B acts within a MAGNET PN) and the **non-MAGNET** case in which User B is just a 3G/IMS or Internet user with corresponding communications, presence and location devices.

A special case is the Private PAN (P-PAN) [10]. Detailed context information from sensors and the network context has to be available. Under **network context** we describe the local system of the user's P-PAN: the status of its network interfaces, the available bandwidth, the devices and the services available on these devices, the cost of these services if available, etc.

In Fig. 1 we illustrate a high-level architecture that achieves personalization and context-awareness. It is based on the assumption that the P-PAN consists of several connected de-

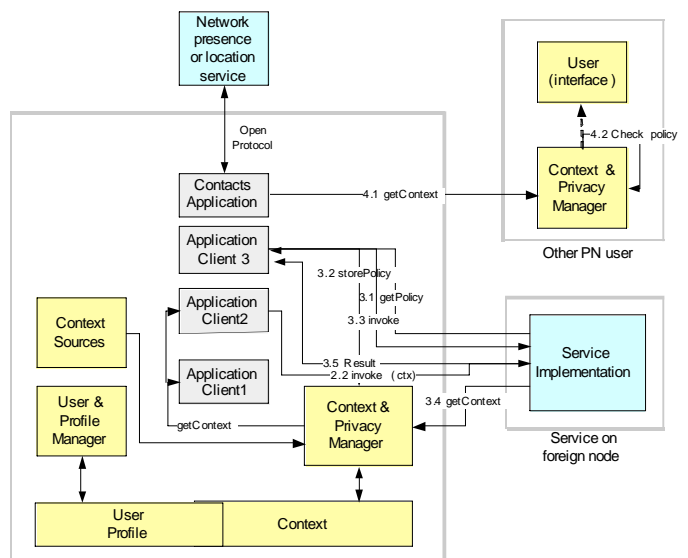


Fig. 1. High-level architecture for personalization and context awareness.

vices with different processing and presentation capabilities.

The generic entity named **context source** delivers raw information such as GPS location or temperature. Other, more sophisticated sources are related to the user preferences, rules, and actions. Another source of information is related to device capabilities, the status of power supply (battery), applications installed, and network connectivity performance. A number of local applications perform the services mentioned in section II, for example:

- a location application to fetch and monitor location information from other users
- a presence client to query presence information from other entities
- an application to manage and maintain contacts and their context attributes
- an application to initiate and answer to VoIP sessions
- an application to initiate a file transfer to other personal nodes
- an application to initiate media streaming from or to a server node
- a web-service client that connects to external service (to be defined)
- an application for the own network connection and context visualisation

The **user and profile manager** has the role to maintain the profile, identities and authentication credentials of the user, to associate them with context sources, maintain and infer preferences from user actions and history data. Depending on the distributed structure of profiles, the user manager maintains links to profile parts specific to services. A part of the profile and context data is requested by local and remote services. The **context manager** entity is responsible for controlling the access to profiles and context data. A detailed description of the context management framework is given in a companion invited paper [11].

Fig. 1 shows several interaction scenarios (based on the user scenarios and derived use cases) for providing personalization,

service adaptation and context awareness:

1. A local application (Client1) informs the user about the availability of different networks (Bluetooth, WLAN, UMTS, etc.) and about the status of resources such as bandwidth or battery. When context change events are received, the presentation is updated.
2. Another application (Client2) wants to invoke an external service and personalize it by adding context information in the request. The client application queries the context attributes needed by the interface and invokes the service.
3. A local application (Client3) has first to find out which context information is required by the external service. It requests the so-called policy of the service. The required context parameters are associated with the service name and stored in a policy accessible by the context manager. Then, the invocation is made and the interface name/address of the context manager is given. The service queries the context parameters on the context interface. The policy is now checked and the context parameters returned. The service can now complete and return the results to the client.
4. Same as above (Client3), but the context has to be monitored for change (context aware service). For this purpose the service subscribes to the needed context attributes. The subscription is compared against the stored policy and granted. When the context changes, a notify event is fired towards the service, which can complete and return asynchronously the results to the client.
5. Interactions between persons and their contexts: A contacts application may watch the location, proximity to other object or presence of another person. It connects to the context manager of that person (found among the contacts) asking for certain context information. As before, the policy, or the definition of what can be disclosed to that person has to be done prior to asking for the information or subscribing to it. The policy can be returned to the watcher automatically or with user intervention.
6. The same contacts application is supposed to access context information (location, presence) from contacts that are registered on centralized server systems (IMS/UMTS, MSN, etc.) and not necessarily equipped with the MAGNET infrastructure. Access policies are normally handled by the server.

#### IV. PERSONALIZATION OF SERVICES IN MAGNET BEYOND

As already described, the user-centric approach of MAGNET has lead to a set of PN-based use cases. In order to promote user-centricity, personalization capabilities of various scenarios will be explored, designed and developed in the months to follow.

##### A. Service adaptation and personalization

Table I shows a selection of use cases for journalists in Nomadic@Work, supplemented with user profile and context information. The Table is very useful for identifying tasks and services that can benefit from personalization and context information, and the use cases can then be linked to the architec-

TABLE I  
NOMADIC@WORK USE CASES AND CONTEXT INFORMATION

Use Case	User Profile and Context Information
<b>Personalized Travel Service:</b> <i>A journalist is on a trip to produce a story and wants to make use of personal preferences and context to manage in an unknown environment</i> - travel planning - input: destination, duration, estimated budget	<ul style="list-style-type: none"> <li>• current location</li> <li>• time</li> <li>• weather (possibly)</li> <li>• age</li> <li>• user profile               <ul style="list-style-type: none"> <li>○ transportation preference (pub transportation, taxi, car, ...)</li> <li>○ transportation company preference (airline, ...)</li> <li>○ accommodation preferences (type of room, ...)</li> <li>○ accommodation provider preference (hotel chain, ...)</li> <li>○ lifestyle (smoking, allergies, vegetarian ...)</li> <li>○ transportation network(s) topology</li> </ul> </li> </ul>
<b>Personalized news service:</b> <i>A user wants to get news delivered while on the move, using personal preferences and any available devices and networks</i> - user requests new service discovery	<ul style="list-style-type: none"> <li>• network context               <ul style="list-style-type: none"> <li>○ available WLAN/Bluetooth/... networks</li> <li>○ output devices (capabilities, e.g. resolution</li> <li>○ processing power, battery, ...)</li> </ul> </li> <li>• user profile               <ul style="list-style-type: none"> <li>○ preferences for news topics/general interests</li> <li>○ preferences for news providers</li> <li>○ spoken languages</li> </ul> </li> </ul>
<b>Query for resources related to a specific story:</b> <i>A journalist in the field wants to retrieve information from team mates and headquarter</i> - find other journalists (P2P, PN federation)	<ul style="list-style-type: none"> <li>• location</li> <li>• affiliation</li> <li>• subject/general area</li> <li>• network context               <ul style="list-style-type: none"> <li>○ available networks (step 1)</li> <li>○ available journalist PN for building federation (step 2)</li> </ul> </li> </ul>
<b>Personalized video delivery / stream media adaptation:</b> <i>Context adaptation of service</i> - setup streaming - adapt to changing network connection - adapt to changing availability of devices	<ul style="list-style-type: none"> <li>• network context               <ul style="list-style-type: none"> <li>○ available networks (WLAN, Bluetooth, GPRS)</li> <li>○ output devices (capabilities, e.g. resolution, processing power, battery, ...)</li> </ul> </li> </ul>
<b>Task Management:</b> <i>Collaborative work</i> - retrieve tasks from office server	<ul style="list-style-type: none"> <li>• network context</li> </ul>
<b>Temporary Office:</b> <i>Conditional secure access depending on location etc.</i>	<ul style="list-style-type: none"> <li>• identity</li> <li>• location</li> <li>• network context</li> </ul>

ture of Section III for practical implementation of service adaptation and personalization.

The use case *personalized travel service* includes personal preferences such as smoker/non smoker, window or aisle seat in airplane, allergies and preferences in entertainment. In the *personalized news service* a personalization on specific topics of interest (both professionally and personally) can be applied. Moreover, on the *personalized video delivery and streaming media adaptation*, the media transmission could be adapted according to the user's device memory and processor capabilities, as well as network limitations. For *task management*, we could offer a filtering of the notification regarding tasks, according to the user settings for privacy (for example someone

could ask not to be disturbed for some period, or a backup journalist could be a candidate for being informed in the case the first option is not responding). Finally, the *temporary office* is one of the most important areas of application of personalization, through the provision of personalized UI for accessing and managing different devices (for example different icons, existence of sound alerts colours, font size).

### B. Access control

Access to profile information is a crucial matter related to the user's privacy [10]. MAGNET Beyond's authentication and access control mechanisms will extend into handling requests for profile information access, according to either custom rules or privacy requirements imposed by regulation [12], [13], and a lot of policies must be implemented and managed for the PN services. Access control throughout the PN is a challenging task. Besides the lack of a centralized authority due to connectivity restrictions, connectivity is again not guaranteed to every cluster inside the PN. Therefore, certain clusters might be out of reach of the owner-administrator. Access control modules are instead distributed throughout the PN clusters and interconnected in order to form an overlay tier on which access control can be performed ubiquitously in the PN.

### C. Service adaptation management

Adaptation of services to user preferences and context is applied through all tiers of related service applications, namely *data processing*, *application logic* and *presentation*. Most personal preferences are related with the data processing tier, mostly concerning data disclosure and content filtering issues. User preferences set the filters through which privacy and anonymity requirements are met. On the other hand, filters are set to only include data and content of a specific area of interest according to the user profile. As far as the application logic is concerned, a special effort on service and application modularity must be made with an emphasis on re-configurability and ability to accept changes dynamically. To this direction, solutions based on XML should be preferred, since XML helps keeping applications modular, generic and customizable. On the presentation tier, personalization can be adapted through use of a set of Cascading Style Sheets or a similar set of proper GUI skins. These will adapt the visual experience of each service according to the user preference.

Managing adaptation of services according to user preferences and context is actually a matter of user profile distribution across the Personal Network. Namely, the user is responsible for declaring his preferences, areas of interest and privacy requirements through a proper GUI. As a result, a personalized User Profile is created and subsequently updated. Appropriate mechanisms must make sure that the necessary parts of the user profile are available when needed in the PN overlay network. Such a mechanism could be the INS/Twine – Chord based- architecture [14], or similar P2P resource discovery systems. P2P architectures are in general preferred in order to overcome problems derived from the distributed nature of personal networks, such as granularity and possible lack of a centralized infrastructure.

## V. DISCUSSION AND CONCLUSION

In this paper we have shown how to proceed methodologically from analysis of scenarios and use cases to the communication actors and their interactions and requirements for user profiles and context. To realize the overall vision of MAGNET Beyond we need to combine the tools associated with scenario construction, user profiles and context awareness. We need to fully understand the interplay between requirements to bandwidth, devices and services available on these devices, and the cost of these services, in a viable personal network (PN) service architecture. Viable in the sense that it can support and enable users to accomplish their tasks in a wide variety of circumstances or contexts, where they potentially are willing to pay the relevant actors enough to make them realize the infrastructure including services and applications.

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