The Simplicity Project: Personalized and simplified communication spaces for mobile users

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ABSTRACT

Key features of systems beyond 3G are personalized communication spaces across a heterogeneous networking infrastructure [1], [2]. Users will be able to access different service domains through a variety of terminals with adapted user interfaces and without being aware of the underlying heterogeneous technologies. The European research project Simplicity [3] is investigating these features by focusing on two main concepts: i) the introduction of a personal device simplifying the creation of a personalized communication space and ii) a network-based Brokerage Framework supporting the adaptation of terminals, services and network resources. User scenarios were developed to explore and illustrate the potential of these concepts. The analysis of the scenarios highlighted common aspects and led to requirements that will be used to define the Simplicity architecture and to guide the system design as well as the development of a prototype.

I. INTRODUCTION

Motivation:
As technology develops, people are using an ever broader range of ICT devices and network-based services. New areas of research, such as pervasive computing, will further increase the diversity of the devices and services with which they have to deal. The result is an enormous burden of complexity on the shoulders of users, service providers and network operators. Excessive complexity, in turn, creates obstacles to effective exploitation and acceptance of beyond 3G systems such as ambient intelligence, context-aware services and novel access technologies. The goal of Simplicity is to reduce this complexity by: i) providing automatic customization of user access to services and the network; ii) automatically adapting services to terminal characteristics and user preferences; iii) orchestrating network capabilities.

Key idea of Simplicity (see Figure 1)**:**
The project focuses on two basic concepts: the Simplicity Device (SD) and a Brokerage Framework.
The SD may be a plug-in physical device (e.g., Java card, Java ring, enhanced SIM card, USB pen, etc.) or a functional entity (e.g., a software agent) that stores user preferences, allowing automated customization of terminals and/or services, including, for example the policy-controlled selection of network interfaces. If the SD is a physical device, users could personalize terminals and services by the simple act of plugging the SD in the chosen terminal. User preferences could take the form of e.g., i) a standard profile defined by a Service Provider; ii) a pre-

defined template whose parameters can be configured by the user; iii) an open profile managed by the user through a GUI or by using a high-level description language.
The device will be compatible with a broad range of different terminals (e.g., laptop computers, PDA's, mobile phones). The Brokerage Framework provides easily extensible, policy-based mechanisms, making it possible to orchestrate network capabilities (e.g., mobility support, QoS, security) and to adapt these to user preferences and to the characteristics of user terminals. The same mechanisms can be used to re-configure terminals via policy-controlled downloads.

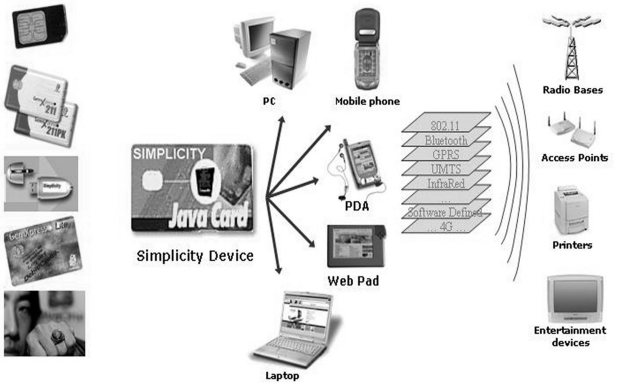

Figure 1: Simplicity Overview

Main objectives:
- Describe user scenarios and business models.
- Use these to derive system requirements.
- Explore new mechanisms and policies for a Brokerage Framework in a multi-access networking environment.
- Design a universal multi-application Simplicity Device, providing users with a simple and uniform mechanism for customizing services and terminals.
- Validate the feasibility and benefits of the Simplicity approach in a test-bed.
- Contribute to relevant standardization bodies.

Project partners (see also [3]):
RadioLab, Italy (project coordinator),
DoCoMo Communications Labs, Europe,
Ludwig-Maximilians-Universität Munich,
National Technical University of Athens,
Siemens AG, Munich and Austria,
Siemens Business Services, Paderborn,
TriaGnoSys GmbH, Munich,
Technical Research Centre of Finland (VTT),
Telecom Italia Learning Services S.p.A.,
University of Lancaster, United Kingdom.

Start of Project: 01/01/2004
End of Project: 12/31/2005

II. USER SCENARIOS

In this section two typical scenarios describe how the user can profit from simplified communication spaces. In the Mobile Worker scenario a software assistant installed in the network or on the SD card provides easy and convenient communication between user and system whereas the Business/Leisure Traveler scenario shows how to establish a personalized environment anywhere and at anytime by inserting a Simplicity Device (e.g. a card) to any type of terminal. Generic functions are derived from both scenarios that will be considered in the architecture of a future Simplicity Systems and that will partly be implemented as a prototype.

A. Mobile Worker Scenario (see Figure 2)

Anthony is an ambitious manager who performs his business job with optimized support from latest available technologies and minimum technical know how. Therefore Anthony acquired a Simplicity System that talks to him in an easy and convenient way. A Simplicity Personal Assistant (SPA) is his virtual counterpart (in the network or on the SD card or distributed on both units) that is automatically activated after login and that receives all user requests and provides automatic responses taking into account e.g. user specific wishes and preferences, available terminal capabilities, network access technologies and location and network based services. Key feature for success in his job is using almost the same working environment anywhere and at any time.

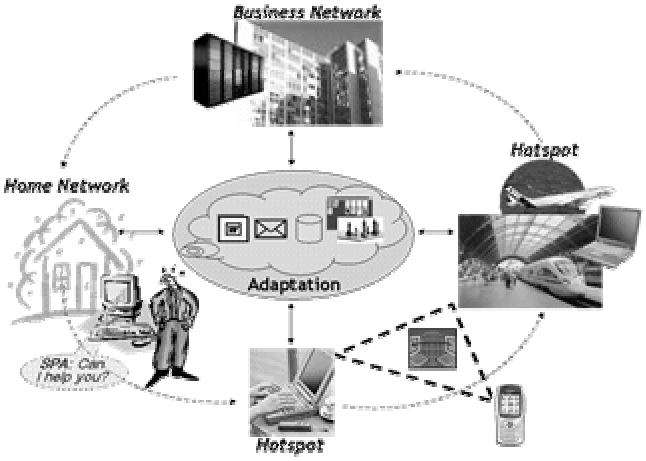

Figure 2: Mobile Worker

Anthony's working day starts at home. After breakfast he wants to have a quick look in his latest documents and in his e-mails. He opens his home working place and asks for access to the company server. The SPA configures the remote access and performs log in and authentication procedure. When he wants to leave his home Anthony asks the SPA to perform closing the work place, e.g. close all applications, save their status and finally shut down all devices so that he is free for other (more important) things. Before leaving Anthony unplugs his Simplicity Device (SD) from his desktop computer and inserts it into his mobile phone. Anthony takes a train to his office, expecting to continue working during the one hour trip. He asks his SPA to configure a train working place and to

establish a high speed and secure access to the company server but if this is not possible a cellular connection should be used instead. Closing the work place is done by the SPA as described above.

When reaching the campus, Anthony is automatically registered as company's employee and more specifically as member of the new project called "moving work place". The SPA communicates with the company server to find free work places and proposes them to Anthony for today. Anthony takes his choice and then the SPA can configure a work place with access to all business applications, data storage systems of Anthony as well as the hardware equipments (e.g. printers, fax) identified at this location. Anthony is guided to his new working place and is ready to work.

In the evening Anthony attends a meeting but doesn't need his laptop since he can connect to any computer with his SD card and his mobile phone. Hence, Anthony connects via Bluetooth to a flat screen in front of his desk.

After the meeting he resumes his work at the work place and at the end of the day Anthony closes his company work place. According to the "moving work place" project the SPA will mark this place as "free" again.

B. Business/Leisure Traveler Scenario (see Figure 3)

Anthony, as introduced above, is also a frequent traveler. He performs booking, e.g. his trip to Rome, at the company work place with Simplicity support. For ticket reservation over the Internet, he is asked to use the official Internet form and to type in his data such as name, address, bank account, his preferences regarding a window seat in a non-smoking area and a broadband internet connection at his seat. Afterwards when booking a hotel room over the Internet, the previous data is already filled in, because the Simplicity System 'remembers' the data from the booking before. Further on the corresponding form it is pre-selected that Anthony wants to order a non-smoking hotel room (Self learning feature).

During his trip Anthony uses a very convenient feature offered by the Simplicity System. It is "Simplicity Data Roaming" that provides transparent "roaming" between providers, operators, network technologies and pricing structures, according to a personalized profile, as he moves from one place to another. The Simplicity System also offers Anthony extended access coverage by combining network infrastructure – e.g. W-LAN access at airport via one provider and at the train station via another provider, GPRS access via several different providers along the rail track, and even GPRS/UMTS/W-LAN access on-board the plane via another provider, as well as automatic selection between alternatives according to a user-defined profile and policy rules, stored on his Simplicity Device (SD). For example Anthony's preferred policy rule for the selection of an access network is "minimize access cost while guaranteeing acceptable performance".

Once on board of the air plane to Rome, Anthony activates his SD connected to his mobile phone. He opens the policy application and defines that incoming calls during the flight are not announced by ring tone. At first Anthony decides to read latest news. According to the capacities of the mobile phone, pictures are immediately omitted while displaying the detailed news. Afterwards he decides to download a tour guide application for Rome onto his handheld using the airplane's onboard wireless communication facilities. Anthony changes the terminal. He connects the SD to his handheld and the tour guide application becomes personalized according to his preferences. For example his native language is English, so the tour guide application will display all information in English. The flight is quite long and Anthony decides to see one of his favorite videos at his airplane terminal. Yesterday he purchased some new movies from an online "buy music and video" service provider. They were copied to his personal space on a network disk and at the home server in his Home Environment System (HES). They are available to him from any Simplicity enabled device that supports audio/video streaming. After being authenticated, he loads his profile, which is stored in the SD, to his airplane terminal. Now he has the same profile settings like at home and he is able to select a video file out of his home server. The data is then streamed from the HES or from his personal space on a network disk.

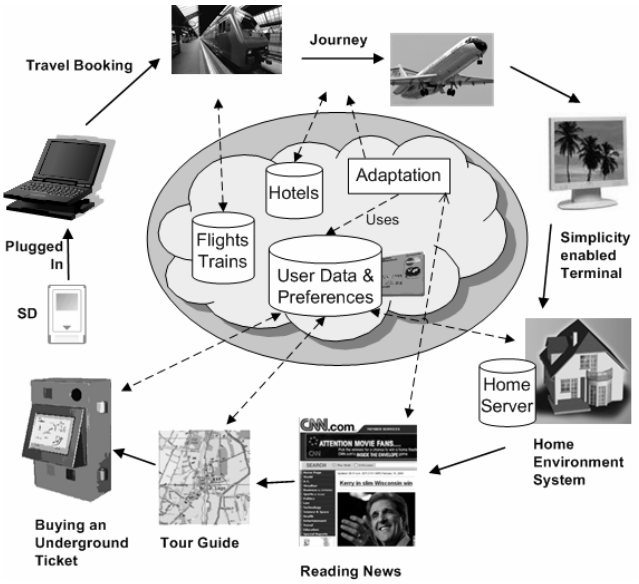

Figure 3: Business / Leisure Traveler

Depending on the available network structure and the settings in the profile (e.g. bandwidth vs. cost preferences), the transport is negotiated and the video file is transferred and presented in the corresponding quality on the airplane device according to its capabilities.

After watching the movie, Anthony remembers that he must remotely program his video recorder at home for his favorite talk-show. He changes the entries of his Multimedia Favored Profile (MFP), which contains his favorite TV shows, movie/music categories and this update is synchronized with the data stored at the HES. The HES programs the Video Disc Recorder after scanning the Electronic Program Guide to find the selected program.

When Anthony arrives in Rome, the tour guide application guides him to the nearest station of Rome's underground transportation system. Here an application specifically tailored to that location informs Anthony how to purchase a ticket. E.g. that may be done by plugging his SD into a Simplicity enabled ticket machine. Based on the information stored in the SD about Anthony's schedule and destination, an appropriate ticket is pre-selected. He confirms the selection, his bank account is charged and the ticket is issued, e.g. as e-ticket stored in the SD.

Then Anthony travels to the hotel and checks in. The hotel room contains a Simplicity enabled alarm clock, which checks Anthony's calendar and programs an alarm one hour before the next day meeting.

The next day at the meeting, Anthony uses his laptop as terminal for his SD. In order to use the network (either the local intranet or/and the Internet), he is not obliged to manually configure his laptop (proxies for Internet access, VPN configurations, security settings for the wireless network) and to set the correct Internet configuration (network, browser, e-mail access etc.). His brand new SD automatically undertakes these tasks since it provides the user with mechanisms: to facilitate first time configuration in a new environment, to automatic update an already used configuration in case of change, to delegate to the user device the selection and activation of the proper context (through identification of the service environment), to secure access to services, authentication of the returning user, control of expiration of the authorization etc. In addition, every time Anthony gets access to a new Intranet/Internet environment and he intends to use services in this specific environment e.g. the airport lounge, the hotel etc. usage permission is negotiated on the fly. After the meeting, Anthony decides to go sightseeing and then to have a nice dinner. He changes his terminal and plugs his SD card into the more suitable handheld. The tour guide application retrieves Anthony's preferences stored within the SD and proposes some interesting attractions that he might want to visit and a nice vegetarian restaurant near his hotel.

IV. ANALYSIS

The project started with defining up to 27 different user scenarios. The two scenarios described above can be seen as typical extract, e.g. for the Mobile Worker 3 of the 27 scenarios were merged and for the Business/Leisure Traveler 7 of them were combined. In the project all 27 scenarios were thoroughly analyzed in order to get a comprehensive list of general functionalities (see Table1). This list defines the functional requirements that have to be fulfilled in a future Simplicity System. It includes 21 main functionalities (bold fonts) and various sub functionalities (normal fonts).

The function **Using 3rd party services** in Table1 includes the access to the services of service provider's, *e.g.*, users connect to the car rental service and Simplicity System reserves a car with end-user preferences.

Using 3rd party service
Network access
WLAN Network access
PAN Network access
Cellular Network access
Fixed access networks
Location awareness
Receive coordinates of target location
Identify location of user
Navigation
Personalization based on user preferences
Device personalization based on user preferences
Connection personalization based on user preferences
Personalization of application based on user preferences
Personalization of network service based on user preferences
Content Adaptation
Network and bearer discovery
Service discovery
Determine cost, QoS, *etc.* of network/bearer
Connection monitoring
Storage functionalities
SD Storage Card Functionalities
Simplicity Network Database / Storage utilisation
PIM (Personal Information Manager)
Authentication & Payment
Network authentication
Service authentication
SD login
Identity and Payment
Delegation of credentials and/or privileges
Session saving / transferring
Terminal capability discovery
User preference gathering
Tasks automation
Context/environment awarness
Download/upload information to SD
SD pluggability support

Table1. List of general functionalities

The Simplicity System has also to support different kinds of underlying networking technologies defined in the term, **Network access**, and to apply these depending on the user preferences and/or coverage of networks. Moreover, the Simplicity System should provide a **location awareness**, for example, to guide the end-user to the destination. **Personalization based on user preferences** is one of the most important key factors behind the Simplicity System. Device, connection, application's functionality etc. are automatically adapted according to the preserved user preference, e.g. stored on SD card. The Simplicity System should also supports **network and bearer discovery** functionalities applying these according to the user

preferences, for example using company's own WLAN connection instead of available commercial GPRS connection. In a similar way, the Simplicity System should also supports **service discovery** functionality and find out available service provider's services. It also **determines costs** of different kind of connections, for example according to the quality of service (QoS) levels. The Simplicity System should also be able to **monitor the connections** to the network. Required **storage functionalities** can be defined for the SD card, (e.g. USB – stick like memory functionalities) and for the network (e.g. database storage functionalities). **Authentication and payment** functionality includes SD login, network and service authentication, identification and payment as well as delegation of credentials and privileges. The Simplicity System also has to **save and reactivate sessions** during and after session interruptions. One very crucial required feature is the ability to **discover terminal capability** before adapting and configuring terminal, connections and services. The Simplicity System should also be able to **gather user information** during the use and adapt the sessions accordingly. It should also **automate** different kind of predefined **tasks**, like update calendar information during the reservation of flight tickets via it. The Simplicity System should understand contents of its environment, *i.e.*, be **context aware** and support **upload/download of data** over the network connection. Furthermore, the Simplicity Device should be a **plug in type device** in order to spread easily to the commercial markets.

In a next scenario analysis step up to 7 resulting scenarios were elaborated that include all the functionalities listed in table1 representing the capabilities of the Simplicity System. Each of these scenarios is analyzed in more detail, subdividing each scenario in a number of typical use cases. The UML (Universal Modeling Language) tool was used to formalize these use cases in diagrams and to define first level sequence diagrams to explore the functional relationships between them. Later on consistency, omission and ambiguity of functionalities will be examined, *i.e.*, is each functionality consistent with the overall objective, are the functionalities described at the proper level of abstraction, are all the functionalities really necessary, are all the functionalities bounded and unambiguous, is there a source for each functionality, is each functionality technically achievable and is each functionality testable once implemented.

The scenario analysis phase results in basic requirements to be considered in the architectural design and after selecting an appropriate set of features a DEMO system for Simplicity will be implemented.

V. CONCLUSIONS

The Simplicity project is addressing a key issue for systems beyond 3G: the design of a flexible and adaptable architecture across terminals and networks to achieve personalized communication spaces [3].

Describing and analyzing scenarios is considered as a very useful method to illustrate and to analyze the potential of the system proposed by Simplicity. First results show that issues regarding authentication and security features, service discovery and adaptation, automatic configuration of terminal equipment, adaptive user interfaces and personalization are reoccurring among user scenarios. These issues may form the core features of the Simplicity framework, on which the Simplicity vision of simple management of ubiquitous personalized services will be realized. These features are portrayed on a Personal Assistant service that serves as an overall system view of how the user will handle Simplicity. Based on this analysis, the project will specify the architecture with Simplicity Device and Brokerage Framework as main components. It will not only develop the concepts, but also provide a proof of them by building prototypes. Finally, we mention that two companion papers provide, respectively, i) a first sketch of the overall architecture [4]; ii) a survey of state-of-the-art candidate technologies for implementing the Simplicity architecture [5].

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