SMS: Simplifying Mobile Services – for Users and Service Providers

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Abstract

To date, mobile services have failed to match the explosive growth of the World Wide Web. This, we argue, is because current services are difficult to use, design and deploy. In this paper we describe a concept for a new class of services, addressing these issues. We call these services ***Simple Mobile Services*** *(SMS). SMS will be simple for users to find, use, and trust; similarly they will be simple for providers to develop and deploy. Like the Web, they will provide technology and operator-independent end-to-end connectivity. But unlike conventional Web-based services they will target specific locations of interest to specific classes of mobile user with specific needs. We propose a design methodology and a set of related tools for the creation of SMS – based on the Model Driven Architecture (MDA) approach. We show how this methodology can support the design and deployment of SMS by service providers with limited technical expertise.*

1. Introduction

Business studies suggest that services for mobile users could have an enormous market. But many users find these services hard to use. Often they are unaware that they exist. And frequently they are unwilling to trust them [1]. As a result, the benefits are only available to a subset of the population - typically, the patient, the expert and the young [2]. A recent survey of 18,000 mobile phone users in Europe [3] found that although penetration of the market has reached an impressive 80%, only 9% of mobile users use 'the mobile Internet' from their phones. Operators and service providers do not invest in services for which there is little demand.

Service Oriented Architectures (SOA) [4] would make technically feasible for operators to open-up their networks to third parties – allowing service and content providers to compete freely. But this has not happened. The design and deployment of new mobile services is too complex – and involves too many intermediaries – to be feasible for small service providers (e.g. SMEs, local government departments, NGOs, individuals). If mobile services are to repeat the success of the Web they have to be simple to find, simple to use, simple to trust and also simple to develop. In this paper we describe a concept for a new class of services, addressing these challenges. We call these services Simple Mobile Services (SMS). The paper goes on to describe a software engineering methodology and related tools, based on open standards, empowering individuals and organizations to develop, deploy and manage their own SMS.

2. The SMS concept

The World Wide Web offers a practically infinite range of universal services – accessible to any user at any time in any part of the world. But these services

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mainly target users working from fixed locations (the home, the office). With a few exceptions (like train timetables and flight schedules services), they fail to address the specific needs of mobile users.

To address this problem, the SMS service concept focuses on simplicity. Unlike current universal services, each Simple Mobile Service will have a scope: it will target specific environments of interest to specific classes of mobile user performing specific activities. This means that SMS will be simple to find. Instead of "Googling" for services, users will choose from a small set of services appropriate to the activities and environment that they are currently interested in. When services target specific physical locations, it will be possible to advertise their availability with posters, signs, leaflets and electronic displays. Precise targeting of services to specific users and environments will make SMS attractive for advertisers.

SMS will be easy to use. Authentication and configuration will be automatic. User interfaces and content will be automatically adapted to the characteristics of the terminal. Services will maintain the same basic logic as users move between environments and networks, even though the resources (sub-services/content) used to provide the service are dynamically discovered and exploited. Like the services provided by the Web, SMS will provide technology and operator-independent end-to-end connectivity. SMS will be terminal and network independent, working with a broad range of mobile devices (e.g. PDAs, smart phones, Laptops) and network infrastructures (e.g. UMTS, Wi-Fi).

SMS will be trust-worthy, providing end-to-end standard-based mechanisms for positive user identification, authentication, and data encryption (both on terminals and during transmission). Security and privacy characteristics will be designed to take account of both provider and end-user requirements, including ease-of-use and the need to understand the implications of specific security options.

Last, but not least, SMS will be easy to design and deploy. The development of SMS will heavily rely on tools for automated code generation. Intrinsic to the SMS vision, such development environment will be targeted to non-experienced programmers and will itself be designed according to user centred methodologies, to maximise usability. These tool will be no more and possibly less complex than current Web authoring tools.

As a result of this approach, SMS will be an empowering technology: SMS methodology and tools will allow individuals, SMEs, NGOs and local government departments to compete with larger organizations as providers of mobile services. If successful, SMS will open the road to the same kind of explosive growth which has driven Internet development.

3. A scenario for SMS

Joe arrives at the airport three hours before his flight to Singapore. This will give him time to shop, have a coffee and relax before he gets on the plane and heads towards his meeting. As he walks into the departure hall his PDA beeps. "For information on your flight input the flight number here" Joe inputs his flight number. He starts walking around the shops. First, he stops at the bookstore. His SMS-enabled mobile phone detects where he is. Services provided by the bookshop appear in a special menu. He doesn't know whether to buy a novel or a history book, so he uses bookshop services to access reader reviews. He opts for the novel. Who wants to read history on the plane? "Would you like to charge the book to your credit card?" Joe presses OK, and inputs the code on the price tag. The secure payment system responds "Thank you and goodbye". Later the PDA beeps again, "Flight information service: time to check in". Joe rushes to the check in counter, eager to carry on shopping. After check-in, he decides to get a snack. The Airport guidance service comes in handy. He selects "Chez Nicole" – a seafood restaurant. The Airport Navigation Service helps him to find his way. As he eats he remembers he hasn't given his wife the phone number of his hotel. Using the "location menu" he shifts his virtual location to Singapore, locates the hotel, and copies the address to his SMS clipboard. He calls his wife to give her the information. Just as he finishes his lobster, the system tells him it is time to head to the gate...

4. Accessing SMS

SMS will be available to any user, using any kind of terminal, regardless of the network to which the terminal is connected. Inspired by 3GPP's vision of a universal SIM (USIM) card [5], the only requirement for access to SMS services is that the user should own a so-called Simplicity Device. The Simplicity Device – originally designed by the IST Simplicity Project (http://www.ist-simplicity.org/) [6] - is a trusted, secure device, that includes a tamper-proof SIM card, providing ubiquitous access to the user's identity, preferences and data, stored in the Simplicity User Profile (SUP) [7].

Users with a Simplicity Device will no longer need to carry a laptop. By connecting their Simplicity Device to a terminal they gain automatic, transparent access to a personalized working environment including the data they need for their work, their

configuration and application preferences and any services to which they have subscribed. The Simplicity project demonstrated three successful implementations of the Simplicity Device: i) on a mobile phone (connecting to terminal via Bluetooth); ii) as a pluggable Java card; iii) as a memory stick.

5. Human-computer interaction

SMS will be used in situations where the user has little attention to dedicate to the device. Therefore, it is essential that the human-computer interface eliminates unnecessary "navigation", ensuring that users quickly recognize services and commands and they can easily control system and service behaviour.

To achieve this goal, SMS will exploit the principle of "ambient combination". The concepts of Direct Combination and Ambient Combination were initially proposed by Holland et al. [8]. Direct Combination is a novel technique of user interaction, which associates options for user action, not with single interaction objects, but with pairs (or n-tuples) of objects. If the user identifies two or more interaction objects involved in a command he is willing to invoke, the system can use the information to restrict the search space, and present the user with a small set of relevant options [9]. In Ambient Combination users recognize and "select" the objects with which they wish to interact, and the system exploits the user's selection to identify relevant commands.

In line with this strategy, SMS development tools will enable service providers to associate services and commands with specific contexts: specific classes of user with specific preferences, performing specific activities, related to specific environments. This information will be stored in "service profiles". During service execution, components in the terminal will interact with network provider's localization technologies, smart spaces elements and server-side context provisioning services, to determine the user's current context.

The SMS runtime infrastructure will match user preferences and characteristics, stored in the Simplicity User Profile and the user's current context against the information in the service profile. The user interface will then give priority to services, whose profile matches the user's profile and current context. For example, if he or she is rushing to a departure gate at the airport, the system will limit itself to providing directions to the gate, and announcing the time left till the gate closes. When users are interested in information which is not directly related to their current context (e.g. information about the hotel where they will be going once they have arrived) simple mechanisms in the user interface will allow them to override the "default context".

6. Developing SMS

To implement the model just described, SMS will adopt a component-based approach, which leverages the use of pre-existing "service templates" as building blocks that describe the different aspects of the service to be developed. Mobility templates will allow the specification of mobility-specific functionality, e.g. context-discovery, location-determination and tracking functionality; user interaction templates will encapsulate specific ways of presenting and retrieving information towards the user; Web service templates will allow the incorporation of arbitrary Web Services (e.g. news, weather reports, product catalogues etc.).

The design of SMS relies on the composition and tailoring of templates into a new class of end-user services. Template and service design will build upon the Model Driven Architecture (MDA), an international effort towards software engineering standardization [10], [11]. The use of MDA raises the level of abstraction which is used to describe and specify a service. Instead of developing for a specific hardware and software platform (e.g. specific APIs and protocols), a high-level model of the service is created using UML (Unified Modelling Language). This is called the Platform-Independent Model (PIM). To implement the PIM on a specific hardware/software platform, it is transformed into a Platform-Specific Model (PSM). The same PIM can be transformed into PSMs for different platforms. The MDA idea is to keep these transformations as separate rules or programs. Specific language standards for the transformation are currently under development (e.g. QVT = Queries, Views, Transformations, see [12]).

SMS templates will be collections of Platform Independent Model (PIM) fragments, which the author of a service assembles into a composite service in the form of a PIM. But even when the technicalities of platforms have been abstracted away, working with UML/MOF models, as MDA mandates [13], is still too demanding for most developers. SMS will provide a user-friendly Web-based Service Creation Wizard that will guide them during every step of the process.

The Service Creation Wizard will make sure that service creation components are presented to the developer in a user-friendly manner that allows for visual service composition. The code generated from the service creation wizard is based on an intermediate process description language, and on a language for describing user interface components. Service code can then be further transformed to create several platform-specific versions of the same service, using a single service model. We are also working towards

specification of a Virtual Machine, to be run on a SMS-enabled device, able to interpret HCI (Human-Computer Interaction) and process model generated by the wizard. The overall SMS development architecture is depicted in Figure 1.

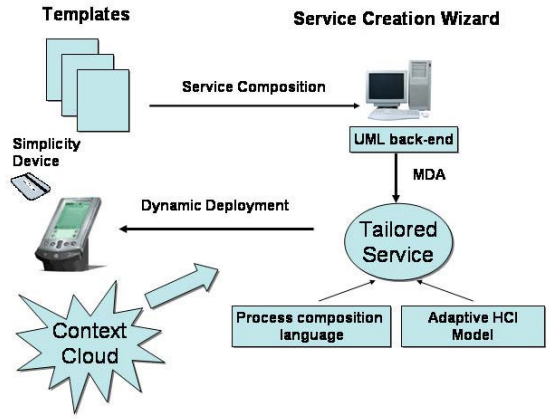

Figure 1: SMS development cycle

7. Service Discovery and Real-time Adaptation

After an SMS service has been developed it is "published", i.e. placed in service repositories. The discovery process is initiated by the SMS user. The service repositories addressed during the discovery process will depend on user context, and on the user profile and policies residing in the user's Simplicity Device.

Once the service is discovered, it is offered to the user in a context-sensitive way. This is a dynamic adaptation process that is carried out continuously throughout service execution. On the server side, the business logic will continuously adapt to changes in user context. These changes will trigger context-dependent user policies. It may happen that some service provider components cease to be available. These may be replaced by other components that offer similar functionality. Server and terminal side components will cooperate to ensure efficient service adaptation to device capabilities and to minimize unnecessary interactions with the user.

8. Location

One of the basic building blocks in the SMS toolkit will be the user location system. The options offered by the toolkit will depend on the infrastructure available in the service delivery environment. The platform will inform the service author of the functionality available in target locations and hide the specifics of the underlying localization system. Implementations of end-user components for specific terminals will include functions to determine the position of the terminal.

The SMS concept is independent of any specific localization technology. It will be possible to report the user's position in terms of geographical coordinates and/or proximity to labelled devices located in the environment. Coordinates may be determined using any possible combination of GPS, triangulation from GSM base stations, and triangulation from Wi-Fi access points. Labelled devices may be RFID tags, UWB transponders, Wi-Fi access points etc. To provide this level of modularization and transparency, the project will investigate ways of transforming raw location data from specific localization systems into a standard and easily exploitable form. Semantic technology, is a strong candidate in this area [14] .

9. Security and privacy

Although there are already many technical solutions to security and privacy issues, most of them suffer from poor usability. SMS will address these problems by integrating security and privacy mechanisms into the authoring process, ensuring that all service providers comply with the best practices incorporated in SMS development tools. Often, users are faced with a yes/no choice: services are considered either as completely secure or completely insecure. This approach ignores the way users deal with real life security issues, and does not take account of their previous experience with services. To alleviate this problem SMS will provide users with context information, helping them to decide on security issues. As an example, an SMS terminal might automatically determine that an airport is a public space (for a traveller) or a trustworthy space (for an airport security officer) – and automatically configure services accordingly.

SMS will follow a similar approach to ensure user privacy. Some users may wish to protect their anonymity while using a service; other users may wish to restrict the information they provide to commercial service providers. Here again SMS will provide a user-centered approach, allowing users to explicitly choose the degree of privacy they require, and presenting the choice in easily understandable terms.

SMS security will be based on the Simplicity device, since SIM cards are tamper-proof secure devices. Executing security primitives and other

critical application parts on the SIM card can provide a good level of security. In SMS we will consider the option of basing security on a high-end card – for instance a 3G UMTS IC card (UICC) - overcoming some of the limitations of 'traditional' smart-cards.

10. Conclusions

The SMS concept is based on the assumption that the needs of mobile users differ in fundamental ways from those of 'desktop' users, and simplicity of use as well as adaptivity to contextual conditions are the key challenges yet unsolved. Also, the development of mobile services should be made much more accessible to a variety of businesses, especially small ones. It is the failure to meet these needs that has prevented mobile services from replicating the success of the Web.

SMS proposes an open, end-to-end solution which addresses the needs both of end-users and of developers – simplifying the use, design and deployment of new services. While the specific technical choices we are taking are obviously open to debate, the authors believe strongly that the future of mobile service industry requires solutions which meet these key strategic goals.

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