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MEMs – Mobile Electronic Memos: efficient information capture and sharing for mobile users

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Abstract— **In this paper we describe "MEMs" (Mobile Electronic Memos). MEMs are electronic notes containing a structured set of attributes describing associated with a specific class of information e.g. information describing a location, a person, a service, or a Web site. Users can automatically capture MEMs from the environment or from other services, store them for future use, share them with other users and send them as input to other services and applications. With MEMs, users can capture information that would otherwise be lost and drastically reduce the amount of information they have to input manually. We describe our current design hypotheses. In this hypothesis, each MEM consists of a data structure associated with a specific class of information, and meta-information, used for management. The authors argue that MEMs should be seen as an extension of the traditional clipboard, a uniform mechanism allowing users to store output from one service and provide it to other services. MEMs thus make it possible for users to participate in complex workflows involving other users and multiple services and extending over many different sessions. We suggest that this possibility could play an important role in encouraging the take-up of mobile services by private and business users.**

Index Terms— Simple mobile services, context-aware services, location based services

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Information Capture and Storage for Mobile Users

Imagine a tourist traveling through London. Sometimes she needs information – for instance on how to reach a particular destination. Sometimes she needs to perform an action – like purchasing a theater ticket. Well-designed mobile services serve these needs well. But although much of the necessary technology exists, current commercial services give her little help in capturing information from the environment. If she sees the time of a show on a poster, all she can do is try and remember it, or write it down on a piece of paper, or perhaps on a PDA. If she wants to tell a friend to come and meet her at a certain café she has to ask the owner for the address. And even when the information comes in electronic format it is usually unstructured (e.g. a web page with part of a train timetable, an email confirming an airline or a hotel booking).

This kind of information is hard to retrieve and share. If the user is not sending it immediately, she will have to search for it. And once she has found it, she will probably send it by email, forcing the recipient to find and interpret the relevant data. If the recipient wants to use the information in another program or give it to a third party service, she will have to "cut" it from its original location and "paste it" to where it is needed. In many cases she will need to parse the information (e.g. to see which parts of an address go into which field in an address book) or even translate it from one language into another. And of course she has no way of knowing whether the information she receives is authentic. An email confirming a purchase, contains nothing allowing secure identification of the merchant.

The manual and semi-manual techniques just described, are risk prone, clumsy, time-consuming and insecure. Memorized information can be forgotten; business cards and paper notes are easily mislaid; emails and stored web pages may be hard to find; copying is a common source of error.

The next generation of mobile services should try and overcome these problems. In particular they should make it easier for users to capture and reuse information from the environment and from other services. This is one of our goals in the European Simple Mobile Services (SMS) project ([1],[2]). To reach this goal, the project introduces the concept of the MEM (Mobile Electronic Memo). The goal of MEMs is to allow mobile users to capture and store information from the environment and from other services and to securely share this information with other applications, services and other users.

Current Solutions

Current mobile users receive information from a range of non-electronic and electronic sources: passers-by, posters, advertisements, presentations, phone conversations, email, the Web, text messages and a small number of dedicated mobile services. Where the information comes from a non-electronic source, the only way to store it on an electronic device is to input it manually into an application or document (e.g. an email address book, a note pad, a dedicated corporate application, a text document or spreadsheet). Where the source is electronic, the application that receives the information can store it in its own native format (though on the Web this can be problematic). Alternatively users can “cut and paste” the information into another application. In its Windows and Apple implementations “cut and paste” stores the information in a number of different formats, allowing the receiving application (or the user) to choose the most appropriate format for the paste operation. What it cannot do is parse the information. Thus there is no way of automatically copying a date, written in one format into a web page requiring it to be written in a different format. This kind of “intelligent” operation has to be performed by hand. The authors of this paper believe that the ergonomic difficulties associated with manual input and copying of information are important obstacles to the uptake of mobile services

To circumvent these difficulties, software manufacturers have proposed standard formats for specific kinds of information. Examples include (proprietary) electronic “Business Cards” available with certain brands of mobile phone, the popular vCard [3] format from IETF (also used for business card data), proprietary formats for appointments (e.g. the format used in MS Outlook®) and the IETF iCalendar [4] format for calendars (also known as iCal). Other formats have been proposed by the Microformats community [5] which is attempting to develop a set of simple open specifications for specific classes of data (e.g. contact info, calendar info, reviews…). To date however, relatively few mobile applications exploit the potential of these formats to facilitate transfer of information between mobile users.

MEMs

Overview

In our vision, a MEM is an electronic “note”, containing a structured set of attributes associated with a specific class of information (e.g. information describing a location, a person, a service, or a Web site). Users can automatically capture, annotate and store MEMs associated with their current environment (e.g. a business card for the restaurant where they eating or the person they are talking to) or produced by a service they are using (e.g. a confirmation of booking from an airline service). MEMs will be readable both by humans and by computer applications. This means that users can browse their MEMs for useful information (e.g. the address of the restaurant) or pass them to MEM-enabled applications which use the information in the MEM to provide a special service (e.g. to purchase a ticket for a show described in the memo).

The software developed by the SMS project will make it easy for users to send MEMs to other users, to share them with a broader community, or to use them as input for online services. Thus a user in a specific location can capture a MEM for the location and send it to friend. The friend can pass the MEM to a navigation tool which will guide her to where her friend is waiting. . It will be possible to embed MEMs in email, or even in Instant Messages or SMS reducing the carried information. These adaptations make the MEM accessible to users who do not have special software.

A set of additional tools will make it easy for service providers to offer support for users from different countries speaking different languages. Cryptographic mechanisms will guarantee user privacy. The authenticity of MEMs of a sensitive nature (e.g. those containing details of a financial transaction) will be guaranteed by digital signatures.

The structure of a MEM – the end-user view

From the end-user point of view, a MEM appears as an icon which can be expanded into a "card" showing a certain number of fields associated with a specific context. When MEMs are transmitted via email, IM, SMS or other messaging systems, they may appear as URLs. Clicking on the URL (or passing it to an application) produces the same result as clicking on a MEM icon

Different classes of information (e.g. information about people, locations, web sites, services) will have different classes of MEM. Some of these will be pre-defined; others will be created by service providers (e.g. an airline could define a special class of MEM for "flights"). Users and service providers will have the possibility to expand pre-existing MEMs by adding new fields. For example parents of young children, could add a field to a restaurant MEM to indicate whether the restaurant is "child-friendly.

Creating and publishing a MEM

From a technical point of view, MEMs are represented by a standardized data structure (see section V). As a result, users and service providers will be able to use a range of different tools for creating and publishing MEMs.

In the simplest case, users choose a template from a Web site (e.g. a template for a restaurant MEM), adapt the content and layout to their needs, define the "context" where the MEM will be publicly available and "instantiate" the MEM for their own purposes (e.g. by inputting the name of the restaurant, choosing its location on a map etc.). To make the MEM available to users within a certain range of the restaurant, all they have to do is click the publish button on the web site.

More sophisticated users may design their own MEMs using tools similar to common web editors and upload them to a server providing MEM services (perhaps managed by their own organization).

Capturing a MEM

SMS envisions a number of ways in which a user can capture a MEM. Others may be invented by future developers. Our current vision includes:

Location-based capture: the SMS system identifies and lists MEMs associated with the user's current location (e.g. a restaurant). To capture a MEM the user simply clicks on it.

Capture via near field transmission: SMS lists MEMs associated with near field transmission devices in the vicinity of the user (e.g. a business card associated with the user she is talking to). Again, a single click is enough to capture the MEM.

Optical capture: a code representing the URL for the MEM (e.g. a bar code) is embedded in a physical artefact (e.g. a piece of publicity, a Powerpoint presentation). The user points his terminal at the code, and captures the MEM

Using MEMs

Once a MEM has been captured it can be annotated (e.g. the user can add comments) and saved in local or network storage. Users can retrieve the MEM from storage at a later date, view it in human readable format, or pass it to another application or service. Examples of such services might include booking or purchasing services which "buy" a service or a product mentioned in a MEM, "navigation services" which guide the user to a location mentioned in the MEM; and mapping services which show the location mentioned in the MEM on a map.

Sending and sharing MEMs

A key feature of MEMs is that they are easy to share and send to other users. Where users have installed the special software provided by SMS she can use special SMS services to send a MEM to a friend (e.g. a MEM with the time and place for an upcoming date). Alternatively they can embed the URL for the MEM in an email, IM or email message. MEMs intended for use within a specific community or for users at large can be published to "MEM servers" which make them available to end-users in the relevant context.

International support

The tools used to create MEMs will allow design of MEMs for use by people from different countries. The basic templates for MEMs will allow the use of alternative field names for users speaking different languages (for base classes (people, locations, events etc.) the translations will be provided by default. In the human readable section of a demo dates, numbers etc. will appear to end-users in the format with which they are most familiar (defined in a ‘user profile’).

Security and privacy

MEMs may contain sensitive personal data (e.g. identity data, credit card numbers, data on users’ personal habits, contacts etc.). Protecting this data is of key importance for public acceptance. SMS proposes a number of measures to guarantee users’ security and privacy:

By default, requests for MEMs will be anonymous or pseudonymous. Personal information will be included in the request (and in MEMs themselves) only when it is essential to the purpose for which the MEM is being used.

Digital signatures will allow service providers to prove their identity to end-users and vice-versa.

By default, MEMs sent to a specific individual (or group of individuals) will be encrypted, both during transmission, and when they are stored (on the local terminal or the network)

Extensible format

SMS will propose templates for basic classes of MEM (e.g. for people, locations, events, web sites, services etc.). These templates will include a set of pre-defined fields and field names. However, service providers and users will be free to extend the original templates by adding new fields (marked by a personalized “tags”). We expect that when other users recognize the usefulness of a tag they will start using it themselves. In brief, the MEMs extensible format creates rich opportunities for ‘emergent semantics’ [6].

The Value of MEMs - Scenarios

Overview

The motivation for the MEM concept is to make it easier for mobile users to capture data from their environment and to facilitate the exchange of data among users and between users and applications. The scenarios below illustrate the potential of this idea.

Use scenarios

Leaving for London - Mr Smith uses the web to book a flight from Athens to London, providing his personal information and credit card details in an encrypted, digitally signed MEM. At the end of the booking process, the airline sends him a MEM containing details of his flight. Mr Smith can view the MEM both on his home computer (where it comes as a link in an email message) and on his mobile terminal. A few days later, he arrives at the airport. Using the MEM data, the airport provides him with a “Take me to check in” service. The check-in agent uses the data in the MEM to check him in. Another service guides him through security to the departure gate. As he arrives he sends the MEM to a friend who will be picking him up on arrival. The friend will use the MEM to check for any delay in the flight.

Booking the show - Vanni is walking through the streets of New York when he sees a poster for a new show. He points his phone at the poster and captures the URL for the MEM (represented with a bar code). The MEM contains the time of the show, the dates when it is on, prices and other booking details. Later, at home, he gives it to a booking service to see if there are seats available for Monday. There are. So he sends the MEM to his girl friend to ask if she wants to come. It takes her five minutes to say yes. He books the show, by sending his personal MEM with credit card info. In return the booking sends him a digitally signed electronic ticket for two (also a MEM). On the night of the show, he and his girlfriend will give their MEMs, to the “Takeme2” service, which will guide them to the theater.

Late at night - When Paolo calls it’s nearly midnight. His plane was very late. “Where are you?” he asks. Francoise has no idea. She’s been sitting in the bar for nearly two hours, but she doesn’t know the address and she doesn’t speak German. She clicks on “Capture Location”. The system gives her a MEM with the name of the bar, its address and telephone number and its GPS coordinates. She sends the MEM to Paolo. He gives it to the “Takeme2” service which guides him through the complex one-way streets until he is just outside the bar. Francoise is very happy to see him.

Design and implementation

A generic MEM consists of a data structure associated with a specific class of information (containing either a single item or a collection of items), and meta-information. The meta-information includes a unique identifier, a version number, the name of the author and the creation date as well as security related information (certificates or references to certificates, signatures, access control information etc.) There are different possible technical approaches to define the MEM structure and to represent one MEM instance in a way that it can be shared. One possibility is to represent the structure of the MEM by an XML schema (XSD) and a MEM instances by XML. We are also investigating different approaches, for example representing MEM instances using a lighter-weight approach like JSON [7]. JSON (JavaScript Object Notation) is a lightweight data-interchange format, which could be more efficient and suited to devices with limited processing capabilities like cellular phones. Hereafter we will limit our discussion to the XML representation. Please note that the work is still ongoing in the SMS project to define the structure of the MEM and the MEM schemas for the different types of MEMs. Therefore the represented MEM instances are meant to show a work in progress rather that a finalized specification.

```
<SMS-MEM>
<meta-data>
        […]
</meta-data>
<data>
        <MEMItem>
            […]
        </MEMItem>
        <MEMItem>
            […]
        </MEMItem>
        […]
</data>
</SMS-MEM>
```

Figure 1 XML representation of a MEM

```
<MEMItem>
<personal-info>
<meta-data>
        […]
<data>
        <Identity>
        .................. <FullName>John Smith </FullName>
        ...........................<FirstName>John</FirstName>
        ..........................<LastName>Smith</LastName>
        ..... <CountryResidence>UK</CountryResidence>
        ............................. <Nationality>UK</Nationality>
        ............ <DateOfBirth>01/03/1978</DateOfBirth>
        ......................... <Username>johnny</Username>
        </Identity>
        <Contact>
        .........<Email>john.smith@company.com</Email>
        ......................................................<Homepage/>
        .................................. <TelephoneWork>+nn-nnn-
nnnnnn</TelephoneWork>
        ...................... <TelephoneHome>+nn-nnn-nnnnn
</TelephoneHome>
        ........................ <TelephoneMobile>+nn-nnn-nnnn
</TelephoneMobile>
        </Contact>
        <CreditCardData>
        ................................<CardType> xx </CardType>
        ........ <CardOwner> SMITH JOHN </CardOwner>
        <CardNumber>    3445    3455    1234    5522
</CardNumber>
        ..........<ExpDateMMAA> 0209 </ExpDateMMAA>
        </CreditCardData>
</data>
</personal-info>
</MEMItem>
```

Figure 2 MEM representation of personal information

Figure 1 shows the data structure for a "generic MEM". The "<data>" section is a list of one or more "MEMItems", where each item represents a piece of information relevant to the memo, e.g. personal information about the user, information about a location, ticket information, and so on. As far as possible the formats used for specific classes of information are based on existing standards and solutions, with particular reference to the work of Microformats community [5]. In the rest of this section we provide examples from our current prototype implementation. These should be seen as work in progress which will be further refined in the course of the SMS project.

Figure 2 shows the <MEMItem> structure for a MEM containing personal information. The data structure is based on the user profile defined in [8] (see also [9]), which in turn is based on the work of the Liberty Alliance Project [10]. In the "Leaving for London" scenario John Smith encrypts the information and sends it to airline during the booking process (details of the encryption procedures are outside the scope of this paper)

Figure 3 provides an example of the structure of the memo the airline returns to John Smith. The complete memo contains details of two flights. Figure 4 provides an example of the flight information for the Athens to London segment.

End-users will work with a user-specific view of the data contained in the memo. This is determined by the characteristics of the end-user terminal, by explicit user actions, and by previously defined options, memorized in a user profile. It will also be possible to map MEMs into (x)html, so that the MEM can be directly rendered on a browser.

```
<MEMItem>
<TravelInfo>
<meta-data>[…]</meta-data>
<data>
        <FlightInfo> (see Figure 4 ) </FlightInfo>
        <FlightInfo> […] </FlightInfo>
</data>
</TravelInfo>
</MEMItem>
```

Figure 3 MEM representation of travel information

```
<FlightInfo>
<meta-data>
        […]
</meta-data>
<data>
        <DepartureDateTime> 2007-07-21 10:45
        </DepartureDateTime>
        <DepartureAirport> Athens </DepartureAirport>
        <DepartureAirportCode>                          ATH
</DepartureAirportCode>
        <ArrivalAirport> London Heatrow </ArrivalAirport>
        <ArrivalAirportCode> LHR </ArrivalAirportCode>
        <FlightCode> XX2378 </FlightCode>
        <TicketNumber> WE87334HJUS </TicketNumber>
        <TicketClass> Economy </TicketClass>
</data>
</FlightInfo>
```


Figure 4 MEM representation of a single flight

Conclusions – MEMs as an extended clipboard

In this paper, we have briefly illustrated the concept of the MEM, as developed within the EU SMS project. MEMs should be seen as an extension of the clipboard concept which plays such an important role in all modern GUIs. During a typical session of work, the clipboard allows individual users to transfer data between applications linking them into a workflow. MEMs extend this concept in space and time, supporting the creation of complex workflows involving multiple users and services and extending over many different sessions. We suggest that this possibility can play an important role in encouraging the take-up of mobile services by private and business users.

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