Service platform for interpersonal communication

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***Abstract*— The article deals with the SErvice Platform for Interpersonal communicAtion (SEPIA). It is based on dynamic group creation supporting people who may cultivate or develop a short- or a long-term social-emotional relationship. Opposite to classic messaging services which are passive in their nature, SEPIA is an active service based on information, e.g. location, personal characteristic, etc. about participants using this service. A rationale for such service platform and also for its implementation is described. The solution takes advantage of a transport system based on but not limited to ad-hoc peer-to-peer networks. Moreover a Sentry Information Service is established on the service platform. Furthermore generic functions reusable for further implementations have been identified on network and on terminals.**

I. Introduction

With the proliferation of mobile devices such as cellular telephones and Personal Digital Assistants (PDA) and the availability of wireless technologies, it is obvious that Peer-to-Peer (P2P) applications[1] and wireless technologies are an ideal counterpart. The nature of mobile devices being lightweight and portable makes them ideal instruments to form the peers of a global wireless network. The devices will be capable of discovering each other using ad-hoc technology, and adapting the types of service presented to the end user based on the methods of communication available, e.g. Global System for Mobile communications (GSM), Universal Mobile Telecommunication Service (UMTS) or Wireless Fidelity (WiFi).
The idea is to create a platform for ad-hoc applications[2] and services such as creation and management of virtual groups in a highly dynamic and distributed collaborative mobile environment.

II. Messaging Services

Short message service (SMS), multimedia messages service (MMS) and instant messaging is a great way to get a message across and move the mainstream in today's communication. Moreover emerging push-to-talk (P2T) services[7] are potential candidates to achieve commercial success. These message services are based on existing interpersonal relations and allow quick sending and receiving of messages between two or more dedicated partners.
The known messaging services are passive in their nature what means that they only execute the task of message transport. In fact a great benefit can be obtained, in case when somebody has a question or problem he get opportunity to contact unknown people who can get help and share related information. In this case a dynamic group of selected people should be created by a service platform on associative basis[3].

III. SEPIA Service

SEPIA service creates interest groups based on information about participants using this service. Members of the group are selected by criteria, either of personal characteristics, location or by other specified norm.

The key requests for the service are:

- Assist people to find others with similar interest,
- Provide tools for setting up and managing ad-hoc virtual groups based on different criteria such as location and preferences and the ability to find one another,
- Help to establish useful contacts within and outside of the organization or area,
- Provide a metaphor to illustrate dynamic groups for the user regardless of the devices used.

After the group is created, members can communicate and participate in chosen services.
SEPIA service has following advantages:

- *Groups are created in real time*. The group is built by the service in real-time
- *Information exchange is efficient*. The best predestinated people who are able to solve problems and/or answer questions are selected for the group.
- *Members acts in heterogeneous networks*. Group members connected to different networks can participate in the service.

The benefits of SEPIA increase according to the ensuing service. For instance "Sentry service" described in section VII improves safety, reduces frustration, optimizes usage of parking facilities, reduces vehicle costs by minimizing fuel consumption, decreases stress and anxiety and decreases air and noise pollution.

A. Algorithm for transferring messages

The SEPIA service creation of a group e.g. automatic selection of the best fitting members, is based on the following algorithm:

1) *Providing of a message by the message initiator*. The message can be written or spoken using natural language or it can be entered with a help of a predefined input form. The message goes through syntax and semantic

analysis, where the latter is based on chosen domain ontology.

2) *Lexical, syntax and semantic analysis of the message*. Information which is necessary for searching and selection of group members from a set of all possible communication partners is extracted from the message.
3) *Gathering of additional information necessary for service execution*. Information selected from the message is extended by additional information which is important for the subsequent service. Additional information can be gathered from other hardware and software components. For example position information can be obtained from a Global Positioning System (GPS) receiver. Finally the assembled information will be composed to a standardized data structure. The information in the data structure constitutes a basis for the creation of a new task group.
4) *Matching of peers*. Connected peers are potential group members. Each peer has a profile where his preferences, qualities and other characteristic information are stored. Matching of peers is based on the data structure collected before, profiles of the peers and special service criteria, where weighed coefficients are assigned to profile items regarding their importance for the service.
5) *Peer selection supported by neural networks*. Selection of peers in a stochastic environment can be supported by a neural networks. It attempts to learn which peers (users) are better predestinated to create a closed group and therefore provide better performance in the execution process of the service. Thanks to a learning potential of a neural network the system will be capable to produce high-quality results in situations where static selection algorithms fail.

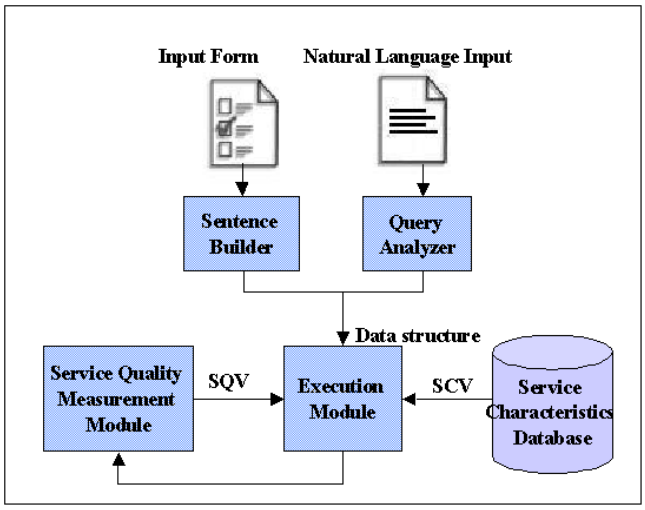

Fig. 1. Control Flow

The overview of the algorithm is shown in figure1. Components of the algorithm described in A1 (Providing of a message by the message initiator) and A2 (Lexical, syntax and semantic analysis of the message) are shown on the upper part of the figure1. Other algorithm components, the A3, A4 and A5 are wrapped in the execution module. The Service Characteristics Database contains description of different services which are service characteristics vectors SCV containing weighted criteria of services. The module Service Quality Measurement rates the quality of peers that took part in a service. The peers are rated in consideration of the usefulness to the service and to the user. The Service Quality Measurement Module creates a Service Quality Vector SQV that contains the rated peers. and is handed over to the Execution Module.

Some details of the Execution Module are shown in figure2. Based on the information of the data structure from the Sentence Builder or the Query Analyzer the Service Data Initializer obtains all missing data that is necessary to execute the service. The data structure is completed with additional information. The Service Data Initializer uses, for example GPS to determine the position of the user, and other hard- and software components to get additional needed information. Inputs to the Profile Selector Module are the profile of the group initiator and profiles of user subscribed to the SEPIA service, the extended data structure from the Service Data Initializer, the Service Characteristics Vector and the Service Quality Vector. The Profile Selector Module generates a peer list that contains peers best suited for the chosen service. The Service Characteristic Vector, containing important criteria of a service, influences determination of the group members. Furthermore the Profile Selector Module should also be adaptable in order to improve the selection of the group members and to bring out the best quality of them. That is why the Profile Selector Module is a combination of a static profile comparator and a neuronal net.

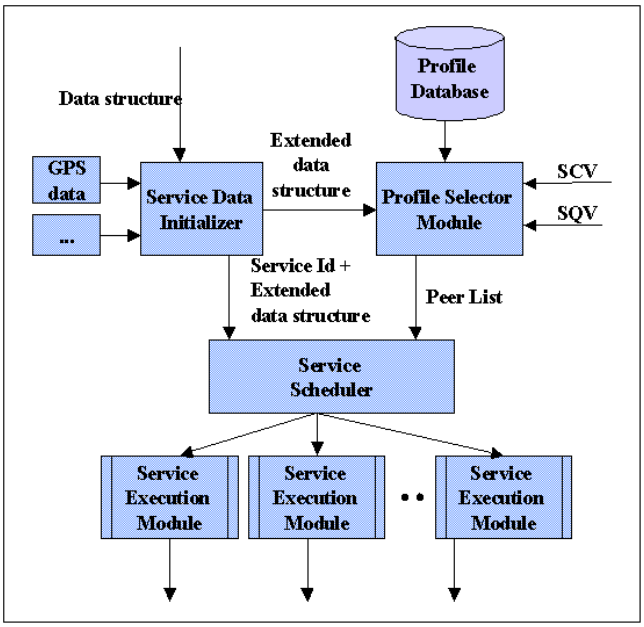

Fig. 2. Execution Module

B. General Architecture

The preferred embodiment of an exemplary service based on SEPIA consists of at least one ad-hoc network (AN) and a backbone network.

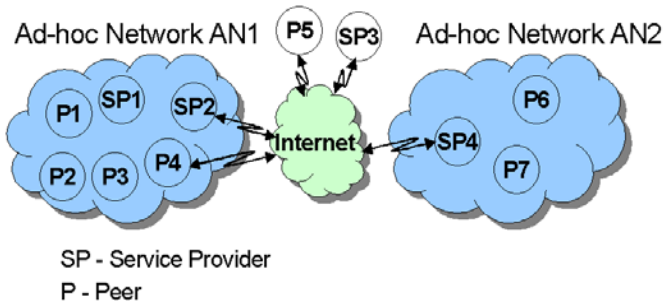

Fig. 3. The preferred embodiment

As shown in figure3 two ad-hoc networks AN1 and AN2 are connected together via internet playing a role of a backbone network.
In human centric peer-networks the peers are either users or service providers for information services. It is possible that one peer allows another peer to use his private communication or other resources. For example peer P4 in figure3 provides his own internet access via UMTS to peer P3 in the AN1 to establish communication with peer P5 connected to internet. However peers can take a role either of service requestors or in some limited sense of service providers (SP).
In the following specific example users are considered to be car drivers helping others to find a suitable parking. In addition SP3 connected to internet can be a service provider collecting parking rights for free private parking places and selling these rights to peers. Another service provider, for example SP2 provides gateway services allowing peers of AN1 to get internet connection peers of AN2. Service provider SP1 can be a service facility representing a car park and advertising for that car park as well as making reservations and selling parking places to peers. Demands of peers for parking information can be described by a set of standardized interaction scheme controlled by a number of attributes and their possible representation exemplary shown in table I. For example a peer in the role of service requestor can send a request message for a park place in vicinity of "Wiesen by Munich" or in vicinity of a transportation facility with convenient connection to "Wiesen" to be free in about 50 minutes for a period of two days.

Mentioned set of attributes and their representation can be used for specification of a convenient user interface supporting hands free requests and simplifying dialogues between peers.

TABLE I
PARKING ATTRIBUTES EXAMPLE

Attribute	*Representation*
Parking location	in the vicinity of ./ distance to . ¡ X / other transportation facility to . is available / in specified district of a city / in a city / at a highway / at a road / near of
Time to parking	immediately / day time (evening, night)/ in X hours / at X o'clock
Parking time	for X hours
Kind of the park place	car-park / motor court / motorway service area/ park place / road
Vehicle attribute	truck / truck with hanger / camping car / car with hanger
Park place attribute	price /height /length / opening time / location /rest rooms / restaurant / guard service / washroom / fax service

IV. SERVICES BASED ON SEPIA PLATFORM

Because SEPIA platform creates a dynamic group of people, it serves as basis for a lot of useful services. One of exemplary presented services is the Sentry Service. It is one of the services from a Driver Assistant package, a suite of wide range revenue-generating services that address drivers personal as well as professional interests. The pre-condition of all services based on SEPIA is a registration on the SEPIA platform.

A. Sentry Service

The Sentry Service helps drivers to organize sentries at car-parks without video surveillance to avoid robbery while drivers sleep.
Drivers participating in the Sentry Service organize frequently control at an arranged parking place. While one of the drivers keeps watch at the night and can raise alarm if something unexpected happens, the others can rest easily in their trucks. The drivers can communicate in an ad-hoc network but also communication with support of Location/Profile server is possible.
Exemplary configuration of such service architecture is illustrated in figure4.

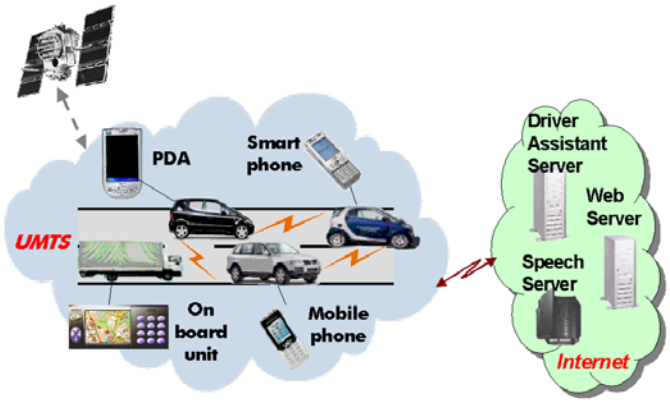

Fig. 4. Ad-Hoc Network

1) Scenario: Somewhere along the way to Munich the driver Pete registered on the SEPIA platform sends a message

asking for a sentry service on a not necessary defined parking place on his way to the destination. The SEPIA service performs a database search in its database containing personal characteristics, preferences and location of other drivers who may give the answer. Following the group of potential informants from a best suited set is created.
Chosen members of the group are drivers Steve, Nelly, Adam and Marc; obviously Pete is also a member of this group. The drivers see/hear now the message of Pete and can decide if they are willing to participate in the group communication. Any of the drivers can simply leave the group at any time. All drivers staying in the group receive messages sent by other group members.
Suppose Steve being also on the way in south direction knows a parking place best appropriate for a night stay. He can send a message describing proposed sentry location and a suggested meeting time. Also he can send information about himself and his truck to ease find him while arriving at the parking place. Other drivers can make other proposals but at least Pete, the message initiator, decides where to meet together.
Drivers can finish the communication or terminate the application at any time.

2) Implementation: Diverse PDAs and Laptops act as user terminals. Terminals are connected via UMTS with a Service Provider placed in the Alcatel Intranet. The Service Provider

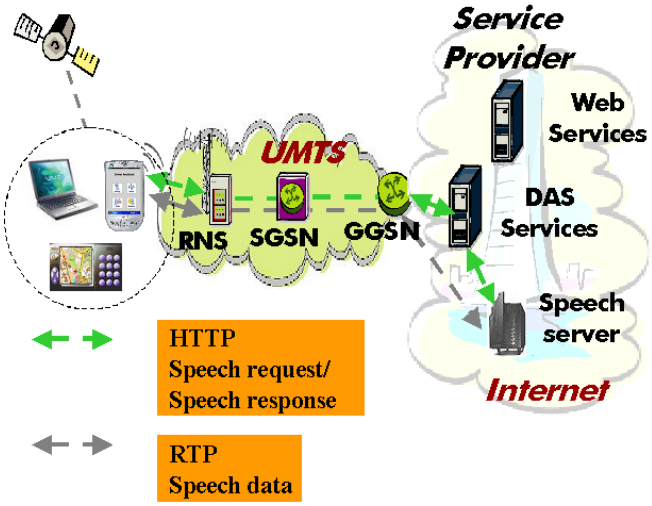

Fig. 5. Sentry Service Architecture

offers a Driver Assistant Server (DAS) in combination with the Speech Server which handles the speech interaction of user terminals (see figure5).
Currently a new device, the On Board Unit (OBU) is going to be integrated. The implementation for a OBU is based on the OSGi (Open Service Gateway initiative) framework[10]. OSGi provides a container for dynamic software components called bundles (completely selfcontained standard JAR files) that can interact with each other. As bundles can be deployed to devices dynamically without restarting the container, the OSGI platform is an ideal choice for mobile applications.

Thanks to the OSGI framework the Sentry Service bundle can be installed/updated/deinstalled at any time.

The SEPIA platform and the Sentry Service are implemented in JAVA and are located on every end user terminal (PDA). JEODE is used as the JAVA virtual machine [11].

Fig. 6. PDA user interface

Ad-hoc Peer-to-Peer network is realized with a help of the JXTA platform[9][6]. The algorithm described in section III is implemented in a simplified way.

Generally both the Sentry Service and the subscriber profiles are described as a set of representative keywords. The keywords are weighted. For matching query, service description and driver profiles the Classic Boolean Retrieval Model is used.

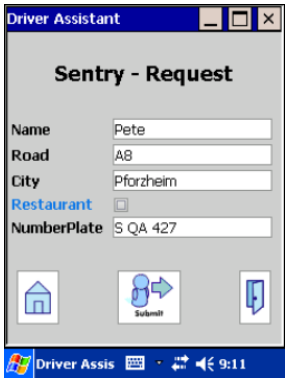

Fig. 7. Sentry Service Request

The Speech Service is implemented as a web service[4][5]. It offers clients speech recognition and speech-to-text services. Requests and responses to the Speech Server are transmitted via Simple Object Access Protocol (SOAP)[8], the speech itself via Real Time Protocol (RTP).
The Sentry Service is one of four services the user can choose from (see figure6).

For efficiency the dialog with the user is implemented as a number of forms filled in a multi modally way, it means via speech or via graphical input. Announcements are supported by Text To Speech synthesis (TTS) and graphically.
When the user wants to organize a sentry he says: ”Sentry”. For completion of a sentry request we let the user fill a form as presented in figure7.

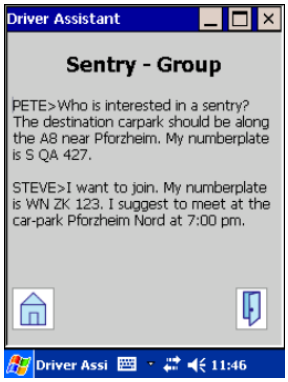

Fig. 8. Sentry Service Dialog

In a dialog the user is leading by the system. For instance, he is asked ”Do you prefer a car park with restaurant?”. After the form filling is completed the system generate a sentence from the entered request and

send it to a newly created group. The group members hear the request of the group initiator via audio output and additionally see it on the display, and answer the request by filling a response form. In turn an answer sentence is generated and send to all group members (see figure8). The answer is read out to all group members. Finally the group members hear the final announcement, for example: "The destination car park with restaurant should be at the A8 Pforzheim Nord. My number plate is S QA 427".
The group members drive to the car park Pforzheim Nord where they can accomplish a safe break.

V. Conclusion

Mobile devices will be capable of discovering each other using ad-hoc technology, and adapting the types of service presented to the end user based on the methods of communication available.

The Service platform for interpersonal communication SEPIA provides a framework supporting services based on dynamic group creation and can be installed on both ad-hoc P2P network and/or a centralized server. Methods for transferring and selecting of messages and the matching of peers are indispensable components of the platform. The exemplary implemented Sentry Service provides the user with context and preference information of group members for improving communication efficiency and computer aided human-to-human interaction.
Further effort needs to be spend for implementing complete algorithm concerning the neural network and providing appropriate ontologys for efficient communication. Moreover security and privacy mechanisms for P2P services are indispensable and need to be integrated in the SEPIA framework. Recently the integration of speech recognition and speech synthesis as web service has been performed enabling multi modal dialogs[13]. In the future development also the distributed speech recognition should be taken into consideration[12]. Multi modal interaction i.e. the combination of speech, graphics, and pen may solve many usability problems and may have the potential to alleviate the input bottleneck for future mobile services.

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