I-centric Services in the Area of Telecommunication 'The I-Talk Service'

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In the last years, a variety of concepts for service integration and corresponding systems have gained momentum. On the one hand, they aim for the interworking and integration of classical telecommunications and data communications services. On the other hand, they are focusing on universal service access from a variety of end user systems. Many of the technical problems resulting from the service integration and service personalization have been solved during the last years. However, all these systems are driven by the concept of providing several technologies to users by keeping the peculiarity of each service.

Looking at humans' communication behavior, it is obvious, that human beings interact with a set of objects in their environment habitually. The individual preferences and needs, persons to interact with, and the set of devices to be controlled by each individual, defines his personal communication space. Following this view, a new approach is to build communication systems not on the basis of specific technologies, but on the analysis of the individual communication spaces. The result is a communication system adapted to the individual demands of each individual (I-centric). The communication system will act on behalf of users demands, reflecting recent actions to enable profiling and self-adaptation to contexts and situations. I-Centric services adapt themselves to individual communication spaces and individual environments and situations. In this context "I" means I, or individual, "Centric" means adaptable to I requirements and a certain user environment.

This paper introduces I-centric service as a new approach to integrate different services, and it illustrates how this approach can be applied to the area of telecommunication systems. The scenario proposed is derived from numerous development projects in the areas of: unified messaging systems, object and person tracking, mobile guides, smart homes and cars which have been implemented with industrial partners by our group in the last four years

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The original version of this chapter was revised: The copyright line was incorrect. This has been corrected. The Erratum to this chapter is available at DOI: 10.1007/978-0-387-35522-1_37

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1 I-centric Communications

In the former days, the communication space of human beings has been limited to the actual surrounding physical environment (like a home or a village) in general based on the geographical reachability of human senses. With the introduction of telephony, the spatial dimension of this space has been expanded. Now, it became possible to talk with people regardless of their actual location. With upcoming asynchronous services like email and fax, the dimension of time has been expanded. People can send emails and need not to care, if the addressee is ready to receive the message or not. That is, technology has eliminated distances in time and space or at least made these boundaries almost invisible. [1]

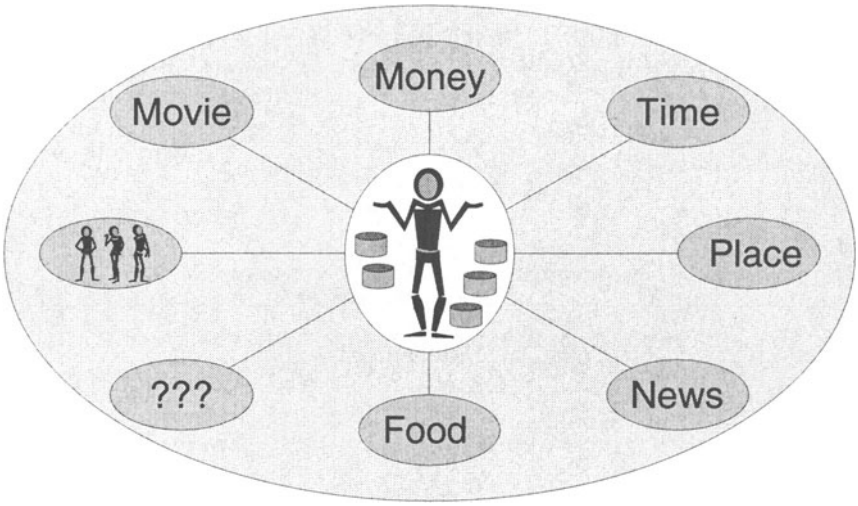

Figure 1: Objects in the Communication Space of Human Beings

I-centric means to take a bottomless look at human behavior and to adapt the activities of communication systems to it. Human beings communicate with their environment in different ways. They meet with other people to talk, to celebrate, they read and travel, they are listening to news or to music, they make decisions, just to give a small range of examples. People interact with several 'things of interest' to solve the problems of daily life: money and bank accounts need to be managed, food has to be bought and to be prepared for eating, movies can be watched for entertainment, places are visited and news are consumed to improve the education, other people are met for discussions. All these contexts and the related objects define the communication space of a human being. A context represents a certain "universe of discourse" in an individual communication space. In general, human beings communicate with 'objects' in their environment in a certain

context. Note that same objects may pertain to different contexts. Objects pertaining to a certain context can be active or passive at certain moment in time depending on the situation the user is into. They can be activated or deactivated by the user or environmental condition. They can be directly addressable or represent a set of physical entities performing a certain service as a whole. [2][3][4][5]

A user might have different preferences in different situations. Sitting alone in a silent room might indicate that the user is willing to receive incoming communication requests. However, the same user can understand this as a disturbance being involved in a conversation with other people. [1] To be I-centric requires knowledge of the actual situation (context) of a user. A context defines a certain relationship of a human being to a particular number of objects of its communication space at a fixed moment in time. An I-centric service has to be aware of the context a user is in and has to adapt itself to that very context. [6]

The multitude of devices, wearables, different telecommunication technologies, positioning and sensing technologies, location-aware or context-aware applications etc. can be seen as enabling technologies for I-centric communications. Universal information access (including service interworking, media conversion), flexible control of equipment at facilities (e.g. smart homes), and personal communications (supporting personal mobility and terminal mobility) form the fundamentals of such systems. [7]

I-centric services describe the ability to define and to manage contexts that are tailored to the preferences of single users, facing individual ways to interact with the communication system. Based on the evaluation of 'profiles' that describe user preferences, service capabilities, and on sensing information about its actual environment, the user can be provided with individualized services for his current demands (the description of user demands opens a huge area of research, which has to cover both, technical parameters and abstract descriptions). Self-learning capabilities are employed to profile the behavior of users, numerous services or several features of different services are combined on-demand, and appropriate service facilities are evaluated.

Context influencing parameters with temporal and spatial characteristics like any user input, temperature, noise level, light intensity, presence of other people and objects in the vicinity are sensed by special sensing facilities like thermometers or microphones. Based on the sensed information, the I-centric service adjusts to the current situation and the user's needs. It chooses what equipment have to be controlled (presentation terminals, handhelds, microelectronic controlled devices), their quality of service (volume, brightness etc) to be finally connected via heterogeneous access networks (Infranets, Intranets, Internet, Extranets, telecommunication networks) to create an I-virtual private network. [8]

An I-centric Service Platform is responsible for shaping the communication system, based on identified contexts, which are adjusted, by sensed environment information. It activates the objects (things of interest) involved in the context, identifies causalities between them based on sensed environmental data, controls the services offered by these objects, and converts data structures and operations for interworking between different services. The underlying terminals and distributed computational objects are supervised dynamically by the platform to realize the physical service.

The aim of I-centric services is to model the entire communication behavior of human beings. This has to lead to an expandable system that is almost invisible to the user, that requires no time-consuming configuration, and provides customized interfaces to each single user based on its own preferences and situations in time. This paper shows that combining off-the-shelf technologies can provide I-centric services to human beings in an easy, for them understandable and therefore acceptable way.

2 Telecommunication systems and I-centric Services

The motivation for I-centric services is to enhance already implemented systems as well as developments, which are currently in standardization processes, by changing the way in which users have to interact with them. To give an example, in the following the application of I-centric services to the area of telecommunication systems, especially UMTS/VHE, is discussed. [8][9]

The idea of the Virtual Home Environment (VHE) has been introduced in the last years. It was proposed as the solution for the evolution from several different 2nd generation mobile systems to a single world standard for IMT-2000. This solution was thought to let user/service provider create and run consistent service and have the same 'look-and-feel' even when roaming to a dissimilar network.

Today, the VHE is a key concept within 3rd generation telecommunication systems that aims to provide access to services customized to the needs of end user irrespective of the serving network and terminal. Fundamentally, the vision of I-centric systems orientates to this. Because of its origin, the VHE concept is more related to mobile telecommunication networks (also considering data services). However, the idea behind can be adopted to all kind of communication systems - the user should be provided with his personalized usual environment that realizes a common look and feel of interface and service experience regardless of location, network and terminal type. Exactly this characteristic is also targeted by the I-centric concept.

I-centric services provide a high degree of personalization. The separation of I-centric services into the service logic itself and the user-interaction part enables the flexible adaptation to different kinds of end devices. That means the user can access services by using the communication equipment that he

has on his disposal at the moment regardless of the particular service. The I-centric services are realized with multiple components that are distributed in the network in contrast to the classic approach of Intelligent Networks to have centralized service logic. At all possible edge devices (mobile or fixed devices) that are connected to the core network, users can access the services realized inside the network. [10]

3 I-centric Service Framework

Figure 2 depicts the main functional components of the I-centric service framework. I-centric services, Interactions in Smart Environments, and the I-centric Service Platform are decomposed to describe their functionality in more detail. Together, they are responsible for the mapping of abstract information about the user's communication space down to specific device instructions that realize a service physically. The user himself employs I-centric Services and interacts with Smart Environments using a human-machine-interface his current location provides.

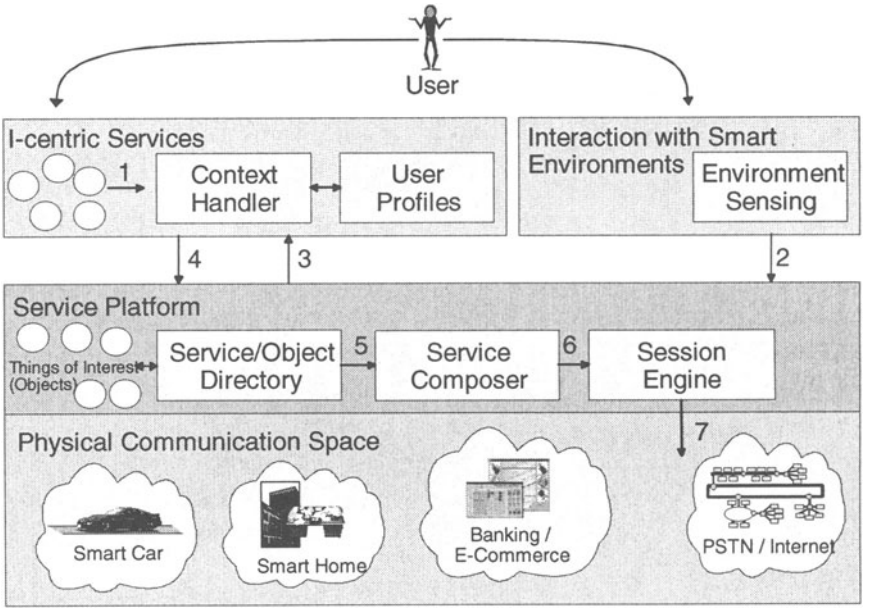

Figure 2: Architectural Framework for an I-centric Communication System

I-centric Services and components, able to sense the environment, are settled on top of the Service Platform. I-centric services process their tasks supported by the Context Handler, which determines what Objects (things of interest) have to be considered in a certain context (1). The user can benefit from I-centric services via the interaction with his environment. That interaction can be a dialog with an interactive user interface (touch-screen application, telephone, microphone/audio speaker combination) or a daily action,

which is sensed by the Smart Environment automatically (e.g. the user enters a room and is located instantly). The knowledge about the interaction is transmitted via the Service Platform to the Objects (2), where the Context Handler can recognize the updated information for a certain context. The component User Profiles contains information about user preferences as well as information about recent service usage. This component has to be updated, for instance when habitual behavior is monitored (3). Furthermore, the Context Handler deals with the problem of interpreting/converting any kind of user input, sensed information, and occurred events. It maps resulting information or user instruction into information the I-centric service can 'understand'[1]. Finally, the I-centric Service interacts with the determined Objects, facing User Profiles. The results in a formal description of the requested service, the configuration of involved Objects, and information needed to perform the I-centric services.

The Service Platform has two main objectives, the conversion and exchange of information between all components of the framework, and the mapping of causalities of Objects to causalities of legacy services. Each 'thing of interest' is realized as an Object inside the platform and can be managed by an I-centric Service and updated by 'Interaction with Smart Environments' (real world objects which are not realized as objects inside the platform cannot be used or accessed at least by the platform). The Service Composer receives the request from the Objects. The Service & Object Directory contains necessary information about services, service features, service building blocks, and policies for the mapping of causalities. The Service Composer can combine legacy services to fulfill the request or it can create new services on-demand out of a pool of service building blocks (5). Additionally, it selects appropriate terminals, devices, and/or applications (6). The Session Engine represents the final component in the processing of a service request (7). It controls legacy services and configures selected hardware and software.

The mechanism how the system combines different legacy services to provide one I-centric service is described in [10]. We used our recent experiences from the area of Unified Messaging, Media Conversion, and Job & Stream Control to develop the I-centric service platform. [1][10]

4 I-Talk

Based on the proposed framework several I-centric services have already been implemented at the department for Open Communication Systems of

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[1] Note: In this paper we use the Context Handler as a container for several functionalities. For the physical architecture we have decomposed the Context Handler in several functional components to separate tasks (e.g. one component is responsible to handle user preferences in an extendible XML-based profile database).

the Technical University Berlin. They cover areas including telecommunication, home automation, mobile guidance, and electronic commerce. In this paper, the I-centric service "I-Talk" from the area of telecommunication is introduced.

4.1 I-Talk – the service

I-Talk realizes an I-centric telephony-service, where a user has no longer to type in or to memorizes any telephone-numbers (Figure 3). He only has to say his personal nickname of the person he wants to talk to, or he can request a person that has never been contacted before by saying the whole name. After that, I-Talk analyzes the user input and contacts the requested person via telephone. In case that I-Talk cannot determine automatically which phone number belongs to the requested person, the user can dictate a phone number and assign a name (alias) to it for later usage.

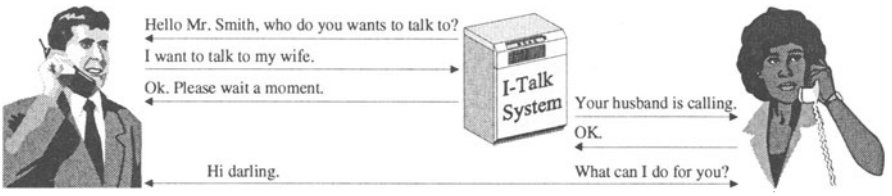

Figure 3: I-Talk service scenario

The I-Talk service features the functionality of an electronic secretary, which hides the peculiarities of different kinds of telephony services (IP-T, PSTN, ISDN) to the user. It does not matter, what kind of physical service underlies the I-Talk service – users just contact and talk.

4.2 I-Talk – the realization

Following the framework, now it is discussed what kind of functional components are used for I-Talk.

The Interaction in Smart Environments component is responsible for the interaction with the user. In this case, it provides a telephony based speaker independent and speech driven human-machine-interface. The interface is realized within an Interactive Voice Response (IVR) server that is based on specialized hardware. The front-end for users can be each kind of telephone able to dial the I-Talk service number. This gives users the freedom to use their personal I-Talk service from any telephone they want.

The IVR application deals with receiving user input and responding to it. The Context Handler, which is part of the I-centric services component, evaluates the user input. Within this component, we provide on one hand Automatic Speech Recognition (ASR) to recognize which person should be contacted, and on the other hand Text-to-Speech (TTS) conversion to generate voice-prompts dynamically for negotiating with the user. The separation of user

interface (Interaction in Smart Environments) and the evaluation of user input (Context Handler) lead to a flexible system architecture. Both, the user interface and the logic behind the interface can be exchanged without affecting the other.

The Context Handler analyzes each user input by applying an ASR to it. The result is evaluated considering the User Profile, which contains a personal phone book for each I-Talk user. The phonebook entries are used by the Context Handler to map user input (spoken words) to persons, which has to be contacted. Each entry consists of a list of words, representing personal aliases for other persons, and the name of a person, which is mapped later to a phone number (e.g. saying 'Cynthia', 'Ms. Smith', or 'boss' means: 'talk to user Cynthia Smith').

A very important component in our system is the ASR. The more reliable the automatic recognition of user input will be processed, the more the I-Talk users will be satisfied. Therefore, we separated the ASR component for being exchanged quickly, if a new and better technology is available.

I-Talk (as an instance of an I-centric service) receives the result of the context evaluation (e.g. 'talk to user Cynthia Smith') from the Context Handler and queries the Service/Object Directory to find a service 'talk to' and an Thing of Interest (object) 'Cynthia Smith'. The Service Composer establishes the service 'talk to' using the legacy service ISDN. The phone number, which has to be called to talk to 'Cynthia Smith', is taken from the corresponding object. Each person who could be contacted via an I-centric service is represented inside the Service Platform by an object. Information necessary for I-centric services (e.g. the whole name of a person) as well as technical parameters (e.g. corresponding phone number) are stored in such objects. Finally, the Session Engine connects the IVR application via ISDN to the phone number that belongs to the request person.

The implementation is based on Euro-ISDN on top of a Dialogic™ BRI80SC-ISDN board and a supporting Dialogic™ Antares™ ASR/TTS board. The I-Talk system can handle 8 simultaneous talk-requests, providing real-time ASR and TTS on each line. The host computer is a state-of-the-art Pentium III with 128 MB running Windows NT 4.0.

The functional component, which have been mentioned above, are realized as CORBA-objects using the C++ CORBA 2.0 implementation Orbix™ from IONA Technologies. Therefore, the system can be set up on a single host system or it can be distributed for scalabilities reasons.

5 Conclusion

This paper has introduced the vision of I-centric services and how these services relate to today's and upcoming communication systems. After that, a

general framework for the realization of I-centric service has been shown and finally, a first realization (I-Talk) has been illustrated.

I-Talk shows how an I-centric service can be applied to the area of telecommunication. Facing the service personalization requirements of 3rd generation mobile telecommunication systems, I-Talk can be seen as partial realization of the VHE concept. Therefore, we are going to integrate I-Talk in two UMTS/VHE trial implementations (Eurescom / IST). The main advantage of services like I-Talk is that the service logic and processing is realized inside the network, instead of having it on the terminals. This let users access their services from different terminal not caring about what kind of terminal it is and what person the terminal owns.

Further developments: We want to enhance our Interactive Voice Response System with automatic speaker recognition to enable automatic authentication procedures for security reasons. The separation of user interface and analyzing the user input offers the possibility to exchange the telephony-based interface with a microphone speaker combination. The idea is to equip a room or a car with this kind of interface to enable hands free I-Talking.

The targeted implementation should realize the functionality of today's immobile phones inside the network. That comprises many features like phone book, recent call lists, and the handling of incoming calls especially. This functionality will be available within the next half year.

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7 Acronyms

ASR	Automatic Speech Recognition
CORBA	Common Object Request Broker Architecture
IMT	International Mobile Telecommunication
ISDN	Integrated Service Digital Network
IVR	Interactive Voice Response
PSTN	Public Switched Telephony Networks
TTS	Text-to-Speech
UMTS	Universal Mobile Telecommunication System
VHE	Virtual Home Environment