The Human Communication Space: Towards I-centric Communications

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Abstract: In the last few years, a variety of concepts for service integration and corresponding systems have been developed. On the one hand, they aim for the interworking and integration of classical telecommunications and data communications services. On the other, 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 personalisation 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 behaviour and their communication space, it is obvious that human beings interact habitually in a set of contexts with their environment. The individual information preferences and needs, persons to interact with, and the set of devices controlled by each individual define their 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 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.

In this paper, we introduce I-centric Communications, an approach to design communication systems that adapt themselves to the individual communication space and individual environment and situation. In this context “I” means I, or individual, “Centric” means adaptable to I requirements and a certain user environment.

Keywords: Context awareness; I-centric Communication; Profiling; Service personalisation; Smart environments

1. I-centric Communications

I-centric means to take an in-depth look at human behaviour 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 listen 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 prepared for eating, movies can be watched for entertainment, places are visited and news is consumed to improve 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 the same objects may pertain to different contexts. Objects pertaining to a certain context can be active or passive at certain moments in time depending on the situation the user is in. They can be activated or deactivated by the user or by environmental conditions. They can be directly addressable or represent a set of physical entities performing a certain service as a whole.

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 phone calls. However, the same user can think this is a disturbance because they are involved in a conversation with other people. To be I-centric requires knowledge of the actual situation of a user. An active context defines a certain relationship of a human being to a particular number of objects of their communication space at a fixed moment in time. I-centric Communication systems have to be aware of the context a user is in and have to adapt their service provisioning to that very context in a certain temporal situation.

The multitude of devices, wearables, telecommunication technologies, positioning and sensing systems, 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.

Three main topics for I-centric Communications can be identified:

- **I-centric Services** describe the ability to define and manage contexts that are tailored to the preferences of single users in an individual way 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 individualised services for their actual demands. Self-learning capabilities are used to profile the behaviour of users, numerous services or several features of different services are combined on demand, and appropriate terminals and conversion strategies are evaluated.

- **Interaction with Smart Environments** comprises the functionality that is required in a certain context to sense the environment in order to be able to adapt to it. Temporal and spatial characteristics are only two examples of information that may affect the context and adapt the communication system to a certain situation. Temperature, noise level, light intensity, presence of other people and objects in the vicinity are additional parameters that may help to adapt the I-centric application to the user needs and profiles. Sensing the environment provides the information necessary for the choice from several types of equipment which have to be controlled (presentation terminals, handhelds), their quality of service (volume, brightness, etc.) that are connected via heterogeneous access networks to create an I-virtual private network.

- **I-centric Service Platform** is responsible for shaping of the communication system, based on the contexts identified and the actual sensed environment information. It activates the objects 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 services. The equipment is configured dynamically, its state is profiled, distributed objects are controlled, and the interworking among domains is enabled by the Platform.

The aim of I-centric Communications architecture is to devise a framework that models the entire communication behaviour 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 customised interfaces to each single user based on their own preferences and situations in time. Combining off-the-shelf developments for the area of microelectronic controlled devices, handhelds, the Internet and the World Wide Web, third generation mobile telecommunication networks, e-commerce, and context-awareness, I-centric Services can be provided to human beings in an easy, understandable and therefore acceptable way.

2. A Framework for I-centric Communications

The framework shown in Fig. 1 comprises the functional components that are responsible for the mapping of abstract information about the user’s communication space up to specific device instructions. The user himself employs I-centric Services and interacts with Smart Environments.

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 Things of Interest have to be considered in a certain context [1]. The user can benefit from I-centric Services via the interaction with their environment. That interaction can be a dialogue 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 recognise the updated information for a certain context. The component User Profiles contains information about user preferences as well as information about recent service usage. Probably, this component has to be updated, for instance when habitual behaviour is monitored [3]. Furthermore, the Context Handler deals with the problem of