

# Middleware Architecture for User Centric 4G Mobile Systems

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## Abstract

We propose a logical architecture for service middleware suitable for user centric service delivery in 4G mobile environments using Smart Cards to interact with a user's environment. We consider Smart Cards are a deployment target of a subset of middleware components and take a crucial role in ubiquitous environments. We also introduce the dynamic service delivery pattern, to enable service interoperations with autonomous entities across a decentralized system.

## 1. Introductions

In the 4G mobile systems, we envision heterogeneous access networks and services deployed by multiple providers. There are no longer centralized points where services shall be registered. It is a peer-to-peer communication paradigm. In such a dynamic, open, and complex service environment, a 'user-centric' paradigm driven by focusing on the demands and the behaviors of users could evolve as an important attribute of 4G middleware.

Although other mobile devices support more powerful computation power and richer user interfaces, smart card holding highly sensitive information is the key device providing a direct and unique relation to the user and the service. Thanks to hardware evolution of smart card, it has enough power to participate in service interoperations by a P2P manner. Smart card may potentially processing highly important role in the middleware. For example, a single smart card providing a user-tailored configuration, by using a user profile may be plugged into a wide range of mobile equipments. It shall be a unique and simple way for acceptance of users, without unnecessary user interaction.

## 2. Architecture

Our service middleware is decomposed into three layers; i.e. user support layer, service support layer and network support layer. The criterion used for deciding to use a layered approach was to reuse the existing sub-systems in the traditional middleware.

The user support layer has autonomous agent aspects that traditional service middleware lacks. It consists of 4 sub-systems: 'Personalization', 'Adaptation', 'Community' and 'Coordination', to provide mechanisms for context awareness and support for communities and coordination. Introduction of this functional layer enables the reduction of unnecessary user interaction with the system and the provision of user-centric services realized by applying agent concepts, to support analysis of the current context, personalization depending on the user's situation, and negotiation for service usage.

The middle layer, the service support layer, contains most functionality of traditional middleware. The bottom layer, the network layer supports connectivity for all-IP networks. The dynamic service delivery pattern defines a powerful interaction model to negotiate the conditions of service delivery by using three sub-systems: 'Discovery & Advertisement', 'Contract Notary' and 'Authentication & Authorization'.

## 3. Future research plan

The proposed middleware architecture will be established on a peer-to-peer communication (such as JXTA) paradigm with applying the dynamic service delivery pattern. Intelligent agents (such as FIPA and MASIF) resides on smart cards enables to make provide a unique and simple way for acceptance of users without unnecessary user interaction, to reconfigure services and share resources with other devices. With taking the requirement of asynchronous communication, an attribute of agent mobility is also considered.