A Ubiquitous and Adaptable Services Delivery Platform for any Kind of Residential Environment

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Abstract. Nowadays, the medium access and network technologies for users who move across different access networks are already being developed, but the services level continues unexplored. In this work a new service delivery platform is going to be presented, which will support the new possibilities that the ubiquitous computing offers, especially in the residential environment. The platform is going to use the interaction between the user's personal mobile device and the devices that can be found in residential environments, ones home or another. An analysis of the technologies and standards which can support this kind of platforms is going to be carried out, and the study will focus on technical and security aspects.

1 Introduction

In the last years more and more terminal equipped with new features have appeared, as well as mobile communications technologies. As a consequence, more numerous and varied services can be delivered, with even more complex requirements.

With the aim to develop and deliver these new services, application providers appeared, so the variety and number of services grew considerably.

So, the actual scenario is formed of multimode terminals and numerous heterogeneous services, each one with its requirements.

In order to manage this scenario a new solutions has been discovered in recent years, easy to develop and introduce and an important source of revenue for the operators: the Service Delivery Platform.

This article arises from a previous study and later analysis that has been made within the framework of the SUMO project (**S**ervice **U**biquity in **MO**bile and Wireless Realm) [1], a European project that is being carried out within the ITEA program. Among the participants telephony operators (Telenor, Norway; Euskaltel, Spain), telcos (Alcatel, France), universities (University of Paris, France) and research centers (UNIK, Norway; INT, France) can be found. The main characteristic of this project is that, while the standardizing efforts are being made towards the data

link and network layers, SUMO puts a special emphasis in the services that are going to be offered with the new technology and the platform for the delivery of these services.

2 Service Delivery Platform

A Service Delivery Platform (SDP) is a set of integrated software modules that, working collectively, allow service providers to deploy and manage voice and data value-added services in a fast and efficient way. This services can be created by the providers itself or by third parties. It is important to remark that they are value-added services and not bearer ones.

This way the management of all kind of services a unique entity can offer can be centralized. Among the generic tasks a SDP can perform can be included the content adaptation, session security management (authentication, authorization, access control, user's identity protection, etc.) or the vertical handover processes management.

This article is going to analyze which are going to be the future tendencies and the technologies which are going to support them, emphasizing in security aspects. A novel service platform is going to be proposed, which will use the ubiquitous computing for is purposes.

2.1 The New Platform's Characteristics

- The key characteristics of the platform are:
- The use of home devices as service gateways.
- The platform is going to be adaptive, that is to say, is should adapt the content to the requirements the user has in each moment.
- The access to the services must be seamless and independent of the access network.
- The security mechanisms must also be seamless to the user. The user should be authenticated once and from that moment on the system itself should capable of applying the correct mechanisms.
- As a novel feature, the personal A/V environment must be accessible from anywhere.

2.2 A Model of Scenario

Next, a scenario in which the characteristics and capacities of the platform are reflected will be exposed.

> *"A user with his mobile device can identify himself and accede to the TV contents he is subscribed to. The same user, being in another place (in house of a relative, for example) can have access to those same contents, through the television set of another person. This can be carried out thanks to the fact that he uses*

his personal mobile device to identify himself and that a common service delivery platform exists, which allows to the provision of multimedia services.

Those same contents could be acceded through the mobile device while the user is moving and crossing different access networks, thanks to the service adaptation capability."

2.3 Architecture

The location of a service platform within the general network architecture is placed between the access networks to which the user terminals are connected and the application providers. In fact, the main objective of the service platforms is to manage the services offered by the application providers and to adapt them to the requirements of the users.

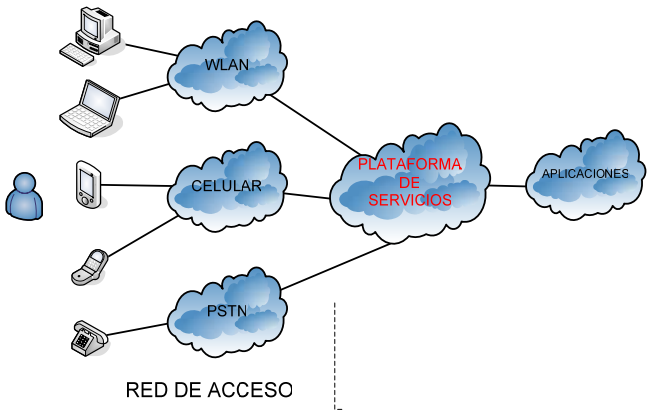

Fig. 1. Location of the SDP within the general network architecture

3 Technologies

The actual implementations of the service platforms are based on certain technologies. In this section those which offer more possibilities are emphasized:

- *IMS*: a series of standards that allow the mobile operators provide communication services based on IP over fixed and mobile networks [2].
- *OSGi*: platform created by an alliance of companies and institutions. It is an environment for network services, standardized and OO [3].

3.1 IMS

IP Multimedia Subsystem (IMS) is a service platform designed to provide services in fixed networks as well as in mobile ones. It uses a Voice over IP implementation based on a standardized implementation of SIP and works over IP [4].

It supports the packet switching telephony systems as well as those of circuit switching. IMS's objective is not only to provide new services but all the services (present and future) that Internet can provide. In addition, the users must be able to execute all the services while they are in roaming as well as when they are in their home networks.

For all this, IMS uses open IP protocols, defined by the IETF[1]. For that reason, a multimedia session between two users of IMS, a user of IMS and another connected to Internet, and between two users of Internet is established using the same protocols. In addition, the interfaces for the service developers are also based on IP protocols. This is why IMS achieves the complete combination of Internet with the cellular world: it uses cellular technology to provide an ubiquitous access and Internet technologies to provide attractive services.

3.1.1 Architecture

The vertical model, in which each access network provides its own services, is becoming obsolete and is evolving towards a horizontal network design. In this model, IMS assures the interoperability and roaming between networks access as well as all the common functions, as the bearer control, the billing, the security or the execution of services.

Over the control plane, the application servers provide the service logic through a SIP interface, although IMS also offers functionalities compatible with OSA[2] and CAMEL[3] in order to assure the interoperability of SIP with older application server.

Below the control plane, all the access networks are connected using gateways and interworking components with the purpose of maximizing the number of clients per network.

The most relevant elements of the architecture are these:

- **Proxy-CSCF**: is the IMS point of entry for all terminals. The P-CSCF address is discovered by DHCP and provided during the PDP context activation process for UMTS terminals.
- **Serving-CSCF**: is the interface between IMS and application servers, it triggers subscribed services as described in user service profiles, it also authenticates and registers users, manages the mobility and routes SIP requests.
- **Interrogating-CSCF**: is the initial point of contact for other IMS domains, it is the interface for incoming inter-domain SIP requests and can, if needed, hide the internal network topology.

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[1] Internet Engineering Task Force, in charge of developing and to promoting Internet standards.

[2] Open services Architecture, standard used to define UMTS services.

[3] Customised Applications for Mobile networks Enhanced Logic, standard used to define GSM services.

- **Home Subscriber Server HSS (HSS+AAA)**: it is the central information storage element the (static and dynamic) related to the users; for example, user IMS profile, public and private identities, identifiers (IMSI, MSISDN...), roaming authorizations and the initial Filter Criteria (iFC - files based on XML that indicate the initial rules to throw the services).
- **MRFC y MRFP**: these two elements are in charge of the streaming. They provide, mix and control the multimedia streaming.
- **MGCF y MGW**: control and gateway functions for all kind of services.

As key for the convergence of fixed and mobile communications, IMS has a great number of components of interworking such as signaling gateways and media gateways, but the service control logic is assured by a few elements: SIP x-CSCF servers and the HSS.

3.1.2 Security

In IMS each user has two types of identities [5]: a private one and one or more public. The private identity is bound to a subscription and identifies to the clients in the x-CSCF servers. On the contrary, the public identity is a SIP URI, used essentially for routing in the S-CSCF. It is important the fact that several public identities can be associated to an only private identity, although only one private identity is associated to a subscription.

3.2. OSGi

Open Services Gateway Initiative (OSGi) is a service platform standardized and oriented to services for a great variety of devices (embedded, mobile, servers, etc.). It is being developed by an alliance of companies created in 1999 and its objective is the provision and management of multiple applications and services to all class of devices that can be in the home, vehicles, mobile devices, etc.

The components that form this platform can be independent applications or libraries that can dynamically discover, use and offer their services to other components.

3.2.1 Architecture

The architecture of the platform is based on a framework [6] that is divided in four layers and whose main functions are:

- **Execution Environment (L0)**: is the core of the framework and the Java execution environment.
- **Modules (L1)**: in this layer the class load criteria are defined.
- **Life cycle (L2)**: adds bundles (applications) that can be installed, executed, stoped, updated and uninstalled dynamically.
- **Service Registry (L3)**: provides a model of cooperation for dynamically executed bundles.

3.2.3 Security

OSGi makes an wide use of the security functions of Java [7], and this way the components can be executed in safe environments (sandboxes) without putting the system in danger. In addition, it adds some propietary mechanisms to achieve a safe cooperation between the components with the appropriate permissions.

4 Analysis

In order to make the analysis of the proposed technologies it is necessary to consider certain points in which we will have to fix the attention:

- **Multimodality**: the selected technology must be compatible with all the access technologies underneath, since one of the most important characteristics of our platform is the capacity to use any access network seamlessly for the user.
- **Multimedia capabilities**: the offered services are value added ones and the platform must be able to manage multimedia contents which need very strict requirements (delay time, error level, S/N relation, etc.).
- **Security**: the technology must be able to interwork between several access networks and to apply the correct security mechanism in each case (protection of the data and identity of the user, as well as authentication, access control and billing of the services). And do everything seamlessly.
- **Adaptability/scalability**: the platform can add new services and capabilities that can require a change in the architecture. It is necessary to assure the possibility of a future extension.

The two alternatives presented in this article cover some of the identified requirements. About the multimodality, the most suitable technology is IMS (in the OSGi platform nothing concrete is specified), thanks to the three layers in which the architecture is divided. The transport layer isolates the access networks from the rest of the components of the platform.

The two technologies analyzed have multimedia services treatment capabilities [8] [9]. In the OSGi platform this capability is supported by the L2 layer. But in this aspect, the IMS architecture is again more robust since it contains two entities, MRFC and MRFP, dedicated exclusively to the management of multimedia contents. The platform presented in this study is focused to a residential scenario, it will be dedicated to use for leisure at home. The security and robustness that exclusively dedicated elements offer make IMS superior to the OSGi platform in this aspect.

The security of the user operations in which must be insisted in the platform. In fact, it is thought to be the aspect that must be treated and improved more strongly in order to create a robust platform, since no of the two analyzed proposals offers specific mechanisms to assure a vertical handover session between several access technologies.

IMS defines two types of user identities: one private and one or more public. With that it is possible to cover (partially) one of the requirements that had been identified, the user's identity protection. And although it has mechanisms to carry out the rest of

security tasks, the specific mechanisms that assure a trustworthy interoperability between the different access technologies will have to be included.

OSGi, although it has its own security mechanisms for a safe cooperation between applications, is based on the mechanisms that Java offers. Although the own mechanisms of the OSGi platform are oriented exclusively to the cooperation between different components, the security of the vertical handover processes is not assured.

Finally, the content adaptation is supported by IMS and by OSGi, although each one uses different mechanisms. The services platform designed for this study is going to be able to make use of these mechanisms so that the services are accessible through devices with different capacities (mobile phones, PDAs, TV sets, PCs, etc.).

5 Conclusions

The new platform has own characteristics that will have to be implemented using the possibilities that the technologies we have analyzed offer.

Although the complexity that entails to work with IMS is a big disadvantage, is the platform that offers more possibilities, and most robust between the two. The clear direction of this platform towards the multimedia services and the so called "be-yond 3G" services makes this platform the most suitable.

Against the OSGi platform the fact that it is based entirely on Java is the key. Having to be continuously executing the Virtual Java Machine (JVM) means having to support a big processing charge.

As it were mentioned in the beginning, with this platform an emphasis in the security aspect is wanted to be made, and in that concrete aspect IMS is superior to OSGi since it offers more flexibility to implement the algorithms and mechanisms required by the new platform.

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