GENESISX: New Improvements in the Deployment and Start Up of Services in NGN Architectures

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Abstract. This article describes the proposed goals of the European Project GENESISX, once the obtained results of the previous project GENESIS have been analyzed. The main goal of the new project is to improve the work done in GENESIS adding a new layer of mobility in the service deployment and start up platform in order to investigate a pre-commercial prototype to offer, deploy and validate advanced communication services based on the premises of the NGN/IMS architectures. Users will access to the services using terminals connected to wireless access networks with WIMAX technologies. For those cases, where users will not have direct connectivity and, therefore, they will not have access to the platform; this will be achieved through ad-hoc technologies, including P2P (peer-to-peer). The offered services include multi videoconference applications with web access and assuring quality of service both in the access and in the backbone network.

Keywords: WiMax Mobile, NGN, IMS, Testbed, Telco 2.0, wireless, cellular and broadband networking, heterogeneity.

1 Introduction

The European project GENESISX, labeled as recognized EUREKA-Celtic projects, tries to achieve mobile solutions in the service deployment and start up platform developed in the previous project named GENESIS, where a pre-commercial

J. Rodriguez, R. Tafazolli, C. Verikoukis (Eds.): MOBIMEDIA 2010, LNICST 77, pp. 102–110, 2012.

prototype was built to develop, validate, deploy and execute VoIP and value-added services. The extended platform will be able to offer new advanced and integrated multimedia services over an all-IP network with user access provided by both: fixed and mobile devices. The platform will be developed following the IMS/NGN architecture premises and clients will access through wireless or wired networks, allowing roaming between them. In those situations where users will not be able to access directly to the GENESISX network, the platform will offer alternative access through ad-hoc technologies, including P2P (peer-to-peer). These networks will be able to combine the capabilities and characteristics of P2P and mobile networks.

In the service layer, users will have a set of advanced communication services available, among which it is worthy to point out the multiple videoconference service. Some services will have as a feature: Web integration, following the trend of unified communications. The new services will be implemented and developed over WIMAX mobile access networks (IEEE 803.16e) and integrated, as a final deployment scenario, with real users. To sum up, GENESISX, will be a valid prototype to deploy, validate and execute advanced communication services over wireless access networks and with the possibility of adding ad-hoc networks; all of them accessible through both fixed and wireless devices.

2 Background: GENESIS Project

GENESISX project is based on the work done in the precedent project GENESIS. The main goal of this project was to develop a pre-commercial platform to host and deploy in an integrated way a set of high value-added VoIP services available for small, medium and large companies, and also, for domestic users, and furthermore, over an operator network. To develop the advanced services, GENESIS defined an NGN/IMS architecture based on the ITU-T and 3GPP standards [1,3]. Users had the possibility of accessing to all the services from different access networks, including: wired broadband access (xDSL – Digital Subscriber Line, FTTH -Fiber To The Home) and also wireless (WiMAX- Worldwide Interoperability for Microwave Access). So, in this way, GENESIS achieved the convergence of services over IP networks, focusing on the opportunities to create differentiated and innovative services. As an example, in the framework of the GENESIS project, a network service of Automatic Conference was developed. This service was able to establish and liberate calls between two participants based on the availability of their agendas by using a NGN global service.

Besides, the advanced services implemented were available through Client Premises Equipments (CPE) compatible with the NGN and using standards as SIP (Session Initiation Protocol) [10] or Web Services. Therefore, the architecture used in the GENESIS environment, was able to create converged services in a quickly and aggregated way and to easily manage and deploy them over NGN IMS networks. Since it is possible to integrate service control session, control of calls, presence and other advanced services within the NGN and Internet framework, this enables a continuous and ubiquitous access to the services by users.

Main results of GENESIS include the creation of a pre-commercial testbed with advanced Telco 2.0 services over heterogeneous access networks, xDSL and WiMAX, via integration with advanced hardware devices, CPEs. The SIP framework was implemented on top of new generation networks using the IMS core to facilitate the development of new advanced VoIP applications to service providers.

Some of the achievements of the project are on one hand, ensuring the quality of service for voice services in real time in the WiMAX access network and, additionally, allowing WiMAX network operators modify bandwidth resources of each of the users classifying them under different service profiles. On the other hand, and from the point of view of the network operator, it should be noted the importance of connections with QoS guaranteed for the average, that allows to allocate bandwidth dynamically (when calls begin and end) getting the optimal utilization available by the operator.

Finally, in the project the following services were developed: the PRESENCE service (developed as a SIP Servlet v1.0 [4] and based on the SIMPLE [5] Working Group specifications), the ADVANCED AGENDA (web application based on AJAX [6]) with verification of presence, the AUTO-CONFERENCE service ,able to establish and manage audio conferences among multiple users of GENESIS, the CLICK2DIAL service allowing establish conference service directly from a web application and finally the TEXT2CALL service (developed as a SIP Servlet v1.0 [4] and based on translation of text to speech) where users were able to write a message for a targeted user that was listened when receiving a call. Basic conference services were offered by a server (Media Server) in a container based on SIP Servlets 1.1 JSR 289 specification [7]. Advanced services of GENESIS, such as AUTOCONFERENCE were deployed on an application server with a J2EE architecture [8], including a SIP Servlet container.

The final field trail occurred in a rural area of the Sobrarbe region in Huesca, Spain, which was identified as a potential market for the GENESIS platform. This was due to the 'digital gap' where broadband access and connectivity is limited in rural areas when compared to urban areas. The demonstration included different groups of users; 30% were made up of institutions such as municipalities or libraries, 40% were made up of SMEs (small to medium sized enterprises) with the remaining 30% made up of residential users. The purpose of the demonstration was to produce results relating to the Qos for the services provided to the GENESIS users. The QoS for the necessary Internet access was guaranteed through bandwidth reservation and allocation. To achieve realistic results a WiMAX infrastructure, with a total of 100 users spread across the 4 small villages of Palo, Boltaña, Attorney and Laspuña was implemented. These users had access to the advanced VoIP services equipped with WiMAX CPE, in addition of a Voice Gateway, an IP phone or a PBX.

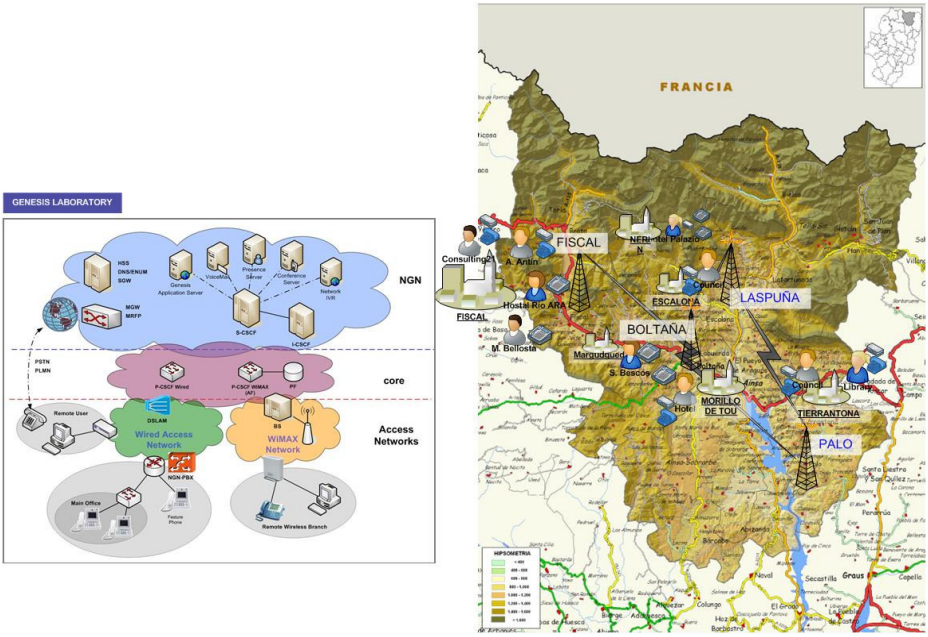

Fig. 1. GENESIS demonstration with real users in the Sobrarbe region - Huesca

The evaluation of the prototype with real users allowed validate the project as well as get valuable information from them that is being used to evolve the GENESIS platform through the GENESISX project.

Some of the conclusions obtained from the feedback by real users were:

- Great satisfaction from customers because of the possibility of having access to advanced voice and data services in an area where access to broadband Internet is not in all cases guaranteed. Definitely, the ' digital gap ' can be defeated.
- The quality of the voice was correct and there was no distortion. This was accomplished through the admission control system and the WiMAX network bandwidth management, prioritizing GENESIS multimedia traffic on the access network.
- In general, the impact of the agenda service was valued as more important for medium or large businesses than for small business or residential users, who appreciated as very interesting the possibility of using GENESIS services with users of other operators.
- The countryside users benefit in having a single provider of voice and data on the WiMAX access network.

In addition to the conclusions obtained from the feedback by users, the Embou operator also obtained relevant results about the platform and GENESIS services.

- The IMS core and quality of service protocols in WiMAX could be easily integrated into the operator network in order to deploy multimedia services.

- The development of this service platform allowed Embou, in a simple and fast way, to create new services depending on the needs of users, using capabilities such as: filtering calls, queue management, messages, etc.

Voice quality was measured in the laboratory where it was noted that the MOS coefficient increased by 15 % in the access network (4.42 MOS for codec G711) when the Continuous Grant dynamically allocated connections were used instead of the Best Effort or fixed established real time connections (and with a worst use of available bandwidth). Besides, end-to-end latency decreased by using techniques to ensure the quality of service both in the access network (thanks to the WIMAX admission and dynamic network bandwidth management control system) as in the backbone network (prioritizing GENESIS voice traffic).

3 Genesisx Architecture and Lines for Improvement

Few technologies have been developed as quickly as the mobile voice. Many users have adopted this technology in all aspects of their daily lives just in one decade. Moreover, since the adoption of mobile phones, and in parallel, an evolution of broadband, with demand and adoption of xDSL technologies, cable modem and wireless access, has emerged. Today, both trends (mobile and broadband) are progressing and converging towards a personal broadband that will be the next milestone of the communications developments. WiMAX is the most appropriate technology to provide personal broadband services because of its open standards (IEEE 802.16 ETSI HiperMAN), that provide value-added applications, such as: broadcast live video, data at high speed, voice quality or content multimedia applications, in addition with the entirely IP architecture that provides high-capacity, coverage and quality of service.

The GENESISX platform will be able to provide advanced multimedia services integrated into the Web; mainly IP networks with high speed access lines both fixed and wireless Broadband Mobile technologies. The services developed will include videoconferencing quality between several people with easy access via the Web, guaranteed quality of service (QoS) and making use of both fixed and mobile terminals.

GENESIS platform is extended to integrate GSM access networks directly onto the IMS network, which is an interesting alternative to interconnect the IMS core with GSM MSC (Mobile Switching Centre). Users of GSM will benefit from direct access to the IMS core services, including services available in the GSM network, without the need that traffic is transported through both networks, GSM and IMS. For those situations where users cannot access directly the GENESISX platform, the project will evaluate alternative access methods such as ad-hoc networks. These networks will combine capabilities and features of P2P networks and mobility. The main objective of this study is to investigate the services offered to mobile users on a P2P network or an instant network created when the user accesses a group of social networks or closed environment isolated from Internet. GENESISX will provide a scenario and a testing environment with real users. One of the test environments will have a mobile 2 G / 3 G access network, provided by Femtocell cells, and the other environment will provide WiMAX access. Both environments will be integrated with wired high-speed lines.

The IMS/NGN architecture developed in GENESIS can provide IP multimedia services to end users, who can be connected to the IMS/NGN network through multiple access networks. The services will be offered to the user only if the user has access to that network. However, there are some scenarios in which this access is not possible or is very limited. In such situations it would be possible to provide communications services to users with P2P technology. The new services will be tested and validated in this scenario consisting of two integrated environments. Thus, GENESISX will be able to validate much more complex scenarios including heterogeneous access.

3.1 Access Network

GENESISX uses the previous project GENESIS platform and extends it with WiMAX Mobile mobility enablers and new advanced multimedia services. Broadband provided by WiMAX and also its capacity of mobility will allow end users to enjoy to use the advanced multimedia services developed in the project wherever the user will be. In addition, the GSM network access will be provided directly from IMS, so GSM users will benefit from direct access to the IMS core services, including services available in the GSM network, without that traffic being transported through both networks, GSM and IMS. For those situations where users cannot access directly the GENESISX platform the project explores alternative access methods such as ad-hoc networks, which combine capacities and characteristics of both, mobile and P2P networks. The main objective of this study is to investigate the services offered to mobile users in a P2P network or an instant network created when the user accesses a group of social network or closed environment isolated from Internet.

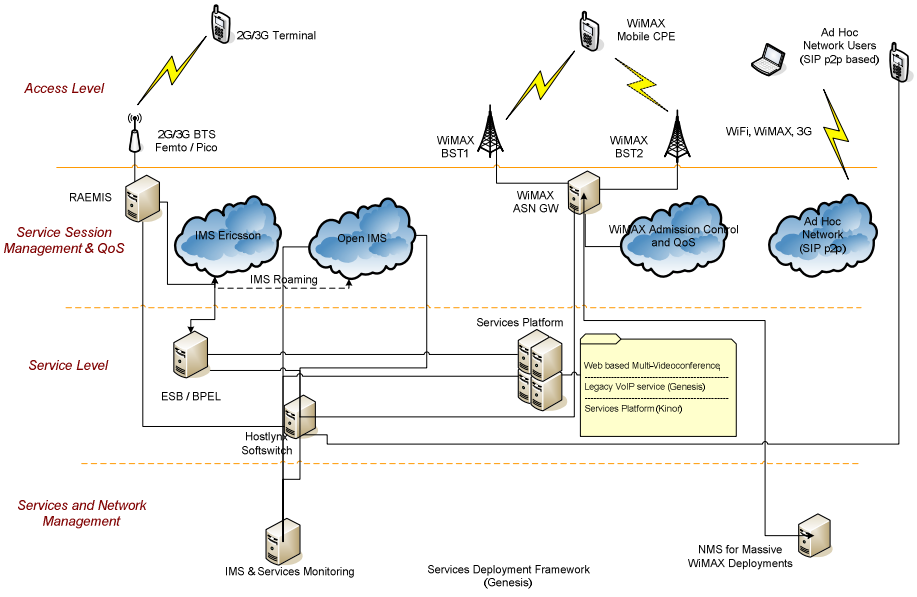

Fig. 2. Pre-commercial GENESISX platform architecture

3.2 Service Layer

With the increasing availability of fixed and mobile broadband access networks, an increase in the demand for videoconference services [9] is expected. These services require a complex network infrastructure to manage session establishment, control flow as well as mix of audio and video. In addition, such services need high bandwidth and CPU resources. These requirements make the multi-videoconference service one of the most appropriate services to be offered online by the service provider, because this service cannot be easily provided by end-user computers. Therefore, one of the objectives of GENESISX is the research and development of systems to provide these services.

On the other hand, most of the activities of users in IP networks include the use of a web browser. In the past, the interaction between browsers and multimedia platforms was very limited: one-way communications, based on text, etc. This restriction can be resolved by applying plug-ins that supports multimedia communications such as videoconferencing. In fact, this solution has been used for viewing multimedia content on the Web (Flash, Silverlight [11] or Java technologies). Advanced communication services offered by GENESISX are integrated with the Web, following the current trend of telecommunications operators towards the Telco 2.0.

It is precisely the fact of having a client in the web browser of the user as videoconference terminal, as well as its ease of use, that differentiates the multi-videoconference service developed in GENESISX from other existing videoconferencing services.

4 Impact and Expected Results

The main objective of GENESISX is to research, design and develop a set of advanced services for an IMS/NGN Platform. GENESISX will use the previous GENESIS platform and it will increase its capacities with mobility enablers and advanced multimedia services, which include an advance multi-videoconference service accessible by IP terminals and PCs, and multimedia services built into the Web, including a Web client for multimedia communications. All these services will include mobility thanks to mobile CPEs based on WiMAX mobile.

GENESISX will improve dynamic QoS and the WiMAX admission control mechanisms developed in GENESIS and, it will adapt them for using the mobile WiMAX network. In addition, GENESISX will introduce the ability to deploy mobile services in large-scale networks as well as the possibility of providing these services at any time, place and practically in any condition.

For integrating 2 G / 3 G networks directly into the IMS core, a protocols adapter prototype will be developed so the IMS services will be accessible from 2 G / 3 G terminals. The IP PBX switchboard developed in GENESIS will be integrated with a Femtocell. And the mobile terminal that connects to the Femtocell will be integrated with the PBX protocol stack; thus it will behave as an extension of the NGN network.

GENESISX will develop a component of communications for audio and video session scenarios with decentralized architecture. This is a transparent adapter

component for switching existing clients to ad-hoc based communication, to be used over WiMax, WiFi or fixed line networks.

The mobility features provided by wireless access will open the possibility of a large number of location-based services (LBS) on WiMAX mobile access networks. Examples of these LBS include: monitoring of resources/persons, notification based on proximity (e.g. custom advertising), performance based on proximity (e.g. toll payment), etc.

GENESISX will have a direct impact on European industry by providing a new vision of several aspects: broadband mobile services and applications, IP networks, integration of 2 G / 3 G with IMS networks, P2P and advanced multiple videoconferencing services. In GENESISX, services are developed and executed based on a cooperative environment composed of new generation elements provided by ISPs services providers, mobile operators and equipment manufacturers.

The concept of anywhere bandwidth availability is growing in importance. Users, more than ever, require faster access to more information and access services regardless of their location. To offer advanced services in user devices, it is also needed to ensure the highest quality with a robust technology. WiMAX Mobile has the appropriate capabilities to support these needs. In addition, these types of networks are also part of all-IP networks which are much easier to operate and maintain, identifying them as networks with a positive cost-effect relationship. As a consequence, WiMAX will increase its importance in emerging markets and it is expected that such technology will be massively extended over the next years. In this context, GENESISX is considered a strategic project that also provides access to services for users that are not directly connected to the access network, but through point-to-point technologies via ad-hoc networks based on P2P.

On the other hand, the development of advanced voice and data services will provide an important contribution to the decrease of the digital gap. The project focuses on technologies that enable the development and deployment of advanced voice and video services over IP for all possible scenarios. The demand for services such as multiple user videoconferencing increases in relation with the bandwidth and, thus, users expectations increase; on the other hand, the fact of offering a web interface to access such services, helps to extend the functionality of the service reaching a greater number of users.

5 Conclusions

The GENESISX project is extending the telecommunications platform developed in the project GENESIS, capable of providing innovative next-generation services on broadband access network. Based on the results of the project GENESIS new lines of action were assessed, such as the inclusion of new services of multi videoconference or the extension of the platform providing mobility, and both for WiMAX mobile users and also integrating the GSM network users through the IMS core architecture. Furthermore ad-hoc solutions will be evaluated for users that do not reach directly the GENESISX network. Also, and in the framework of the CELTIC/EUREKA cluster,

the GENESIS platform has been integrated within the pan-European laboratory proposed by CELTIC, to deploy and validate a complete system of communications VoIP services looking for the integration of new services and the new platform during the execution of this project GENESISX.

Acknowledgments. This work is part of the CELTIC GENESISX project (Next Generation Services Extended) as an evolution of the previous project GENESIS (Deployment of Next Generation Services), both of the EUREKA programme. Thanks to all members of both projects for their comments and suggestions to improve the conceptual model. Thanks also to the Ministry of industry, Tourism and Commerce because of the project support within the Avanza R&D plan.

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