A MULTIMEDIA IMS ENABLED RESIDENTIAL SERVICE GATEWAY

Vitor Pinto, Vitor Ribeiro

Portugal Telecom Inovação, Rua Eng. José Ferreira Pinto Basto, 3810-106 Aveiro, Portugal

Iván Vidal, Jaime García, Francisco Valera, Arturo Azcorra

Universidad Carlos III de Madrid, Avda. de la Universidad 30, 28911 Leganés, Madrid, Spain

Keywords: Multimedia, Residential Gateway, e-Care, TISPAN-NGN, QoS, OSGi, Triple Play, Multi Play, Broadband Network.

Abstract: Internet access has been, until now, the main driver for the generalization of broadband connections in the residential market. Simple IP based services like email and web browsing were, during many years, the typical services provided to residential customers. Today the telecommunications market is changing and operators are looking for ways to provide, through those same IP broadband connections, value added services. These will, in one hand, increase their revenues and on the other hand, provide to the customer a wider range of services until now inaccessible. Triple Play is already a reality, although, the convergence between mobile and fixed networks is bringing to the home a new range of IP Multimedia Subsystem (IMS) based services, which used to be exclusive of the mobile world. Although, to successfully achieve the delivery of these new services, the interface between residential and operator's networks must be meticulously defined and implemented, by what is usually called the residential gateway (RGW). This paper focuses on emerging residential services and the implications that these impose on the RGW. The coexistence between IMS based services and non-IMS based services are also approached on this paper, with a special emphasis on RGW Quality of Service (QoS) issues.

1 INTRODUCTION

During the last few years the amount of bandwidth offered by the telecommunication operators to the residential customers has increased at an incredible fast pace. If previous residential services were limited to little more than email and web browsing, the increase on the available bandwidth pushed the appearance of bandwidth hungry services like peer-to-peer file sharing or on-line gaming. Although these are important services to the user, they do not bring any additional revenue to operators. For this reason operators are now looking for ways to distribute added value services, like multicast IPTV, Video on Demand (VoD), Voice over IP (VoIP), among others, to their customers using an enhanced broadband access network. In this context, the European research project MUSE - "Multi Service Access Everywhere" (MUSE, 2004-2007) was created with the overall objective of researching and developing a future low-cost, multi-service, multi-provider access/edge network which allows to the European citizens access to this whole new range of multimedia services. The first phase of the project, which ran from January 2004 to December 2005, was mainly concerned with the definition of a network architecture that allows the distribution of advanced multimedia services to residential customers. For the second phase of the project, running from January 2006 to December 2007, it has aimed the convergence of this broadband network with mobile networks, which will result in the combination of both architectures in a single architectural model. This network level convergence will be translated in the end, on convergence of services, which means that services usually on the domain of mobile networks will be available to residential customers through this converged network.

On the other hand, nowadays, many initiatives are being proposed on Next Generation Networks (NGN), trying to cover the convergence between the fixed and the mobile world. In this respect, TISPAN group from ETSI is working on the specification of an IMS based NGN. As a result of this ongoing work, the first release of standards for TISPAN NGN (TISPAN, 2006) was published at the beginning of 2006. Nevertheless, in this release there are several identified open issues, being one of them related with QoS provisioning in the residential environment. In TISPAN NGN release 1 the QoS solution is only provided for the access network, but the real QoS perceived by the end user is end to end. In this respect, the work that is being performed within the MUSE project concerning the residential environment may be used in order to extend the TISPAN QoS solution to the end user network.

One of the most relevant entities of MUSE network architecture is the Residential Gateway (RGW), which is placed at the edge of the access network. Since the home network environment is quite particular and different from the access network environment, this device is responsible for making all the necessary translations between functionalities implemented on both networks, making them totally inter operable and functional. These functionalities are even more complex when value added services are provided and convergence between mobile and fixed services is wanted.

This article describes some of the key aspects and functionalities that the RGW must support considering the described scenario.

2 RGW AS A MULTI SERVICE GATEWAY

MUSE access network allows the distribution of multiple services using the Ethernet/IP technology, although, in the home environment services are sometimes terminated on end devices that do not support this kind of technology (e.g. TVs, POTS telephone handsets, simple medical appliances, etc.). Therefore, a function that performs the adaptation of service data encapsulated in Ethernet/IP to a format that is reproducible in those end devices is required in the home network for every specific service. In a broader way, this functionality is implemented by devices that are usually referred as service gateways. Examples of service gateways are the Set Top Boxes for an IPTV video service or an Analogue Terminal Adapter for a VoIP service terminated on a POTS

handset. In a Triple Play scenario, usually, each service has its own dedicated service gateway. Although, as the number of services increases a number of advantages arises if a single device acts as a service gateway for different services, namely:

- Possibility of interaction between services, allowing the generation of new services, which is in line with a Multi Play scenario.
- As the number of residential services increases, the configuration and management of services will be easier if these are centralized in a single device.
- The same approach can be used for all services running on the service gateway regarding access, control and personalization of services by the user.
- The cost of the hardware platform that supports the service gateway can be shared between the different service providers that use it to deploy their services.

Considering that the RGW is directly facing the broadband access network and has several interfaces to home network devices (where services are typically terminated) and that all services data must pass through the RGW, the RGW is, therefore, an optimum point for the deployment of this common service gateway. In MUSE RGW, an implementation of the OSGi Service Platform (OSGi, 2003) is executed, so the RGW can also act as a service gateway, which can support a variety of value added services. Advantages of using the OSGi platform include, among others, hardware independence, possibility of remotely install/remove services, remote management of the life cycle of services, remote configuration of services and the possibility of having different services interacting, as it is assumed in a Multi-Play scenario.

3 VALUE ADDED SERVICES

Taking advantage of MUSE multi service RGW, a remote medical monitoring service has been implemented as a set of OSGi bundles (software modules in OSGi terminology). This service allows a patient to be at home and through simple medical equipment submit, automatically and periodically, sets of medical measures to a hospital remote medical database. There, they can be analyzed, checked for alarm conditions, etc. Since all the setup and installation of the service can be quite complicated for a residential user, apart from the physical connection of the medical equipment to the RGW, all the tasks must be remotely and if possible

automatically performed by the service provider. Figure 1 presents the entities that intervene in the service.
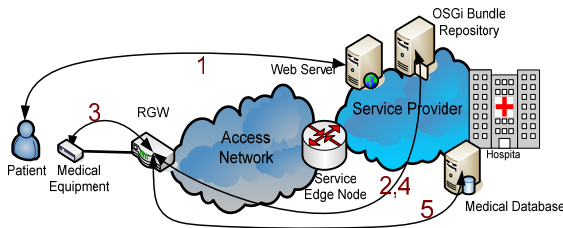

Figure 1: Remote medical monitoring service entities.

The first action is the subscription of the service by the customer, which can be done in several ways. One way, is through a web page, where the customer can access and subscribe the service (Figure 1, step 1). This action triggers the automatic transfer of a bundle (that implements part of the service) from a bundle repository to the RGW, as well as its installation and activation (Figure 1, step 2). When the user connects the medical equipment to the RGW (Figure 1, step 3), a process of drivers selection occurs and ends with the automatic transfer, installation and activation of a new set of bundles that allows the communication between the OSGi platform and the medical equipment (Figure 1, step 4). This last set of bundles is used by the first installed bundle and together they implement the remote medical monitoring service. For this moment on, measures taken to the patient by the device are periodically submitted to the remote medical database (Figure 1, step 5). When the service is no longer needed, the customer can access the same web page as before and unsubscribe the service. This action triggers the automatic removal of the service from the RGW (i.e. of the bundles that together assemble the service).

As this service demonstrates, MUSE RGW implements a service gateway that is remotely manageable and is able to support the automatic installation and removal of networked services, without any input of the user regarding configuration or management of those same services.

4 QUALITY OF SERVICE

In order to achieve the aforementioned functionalities and to support the e-care service (or any other added value service), the RGW must be prepared to provide a certain degree of performance per traffic flow. In other words, every packet traversing the RGW (upstream or downstream direction) must be properly treated using the configuration parameters installed (manually or automatically). With this mechanism, some packets with higher priorities will be forwarded before the lower ones. With these ideas in mind, the RGW has been developed to provide two functionalities regarding the QoS:

1. Configure the QoS. An end-user or an administrator must configure the QoS parameters in the RGW in advance. It is also possible to configure the RGW using other kind of methods (for example, using the SIP information during a session establishment). This stage could be dynamic and the parameters could be changed during the normal operation.
2. QoS treatment. The RGW will forward packets as configured in the previous step.

The RGW architecture is well documented in (Vidal, 2006) where it is explained that the RGW is divided in two levels: the data and application level. The data level is where the packets flow and where the QoS is performed. The application level is used to configure all available RGW parameters and the QoS is one of them. The SIP method used to configure the QoS is a bit different because those packets are extracted from the data level and forwarded to a special application called SIP SP (SIP Signalling Processor). This SP uses the information transported in the packet to infer the QoS parameters for the next data packet flow.

An important functionality added to the RGW architecture is the Call Admission Control (CAC) mechanism introduced in (Vidal, 2007). With this mechanism enabled, the RGW guarantees that all flows will be handled as they are configured. Whenever there is a request for a new flow insertion, the CAC should evaluate whether it can be accepted or not. If it is possible, the CAC must refresh the available resources decreasing the previous ones with the new accepted.

The CAC mechanism was defined to easily introduce the RGW into the TISPAN NGN architecture because it can be inserted as is (the RGW performs a local CAC) or extended to provide an external interface where the core IMS can remotely configure it.

As some applications need to configure a flow even when the resources are exhausted (for example, for emergency calls or for the above mentioned remote medical monitoring service) the CAC mechanism could be deactivated using an "*unavoidable rule*".
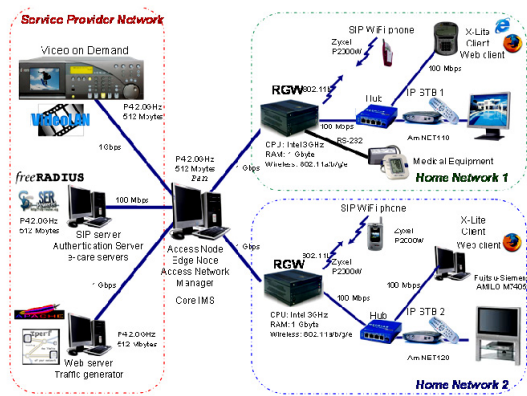
Figure 2: Testbed for the QoS trials.

5 CONCLUSIONS

This article presents a RGW prototype that has been developed and trialled in a broadband access scenario, such as the one specified in MUSE project. The presented RGW is not only able to support the three types of multimedia services that usually figure in a Triple Play scenario, but also more advanced services such as the ones considered in multi play scenarios. In order to achieve this, the presented RGW implements a multi service gateway which takes advantage of the central position that the RGW occupies in the home network. This multi service gateway permits the dynamic deployment of advanced added value services, such as the remote medical monitoring service described in this article. Moreover, the service gateway allows the remote installation, activation and configuration of such advanced services, without requiring any action from the user for the services configuration and management.

Although, in such a multi service environment, the convergence of multiple services (i.e. of the data flows belonging to those multiple services) through a single device, imposes several challenges to the RGW, namely at a QoS level. So, the presented prototype is also able to handle the different data flows belonging to distinct services according to different policies (Valera, 2006). Two methods are implemented in the RGW that permit the configuration of such policies. The first one is based on pre configured rules and the second one operates in a dynamic way, using information exchanged through signalling protocols (e.g. SIP). This last method together with a carefully designed CAC function implemented on the RGW, allows an easy integration of the prototype into the TISPAN NGN architecture. Therefore, besides the above mentioned services, our RGW is also suitable to operate in fixed mobile convergence scenarios, where residential customers can take advantage of multimedia services that used to be exclusive of the mobile world.

ACKNOWLEDGEMENTS

REFERENCES

MUSE, "Multi User Access Everywhere". European Union 6th Framework Programme for Research and Technological Development. URL: http://www.ist-muse.org, 2004-2007

TISPAN, "ETSI TR 180 001 V1.1.1: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Release 1; Release definition.", March 2006.

OSGi Alliance. *OSGi Service Platform, the OSGi Alliance*. IOS Press. Amsterdam, 1st edition. 2003.

Vidal, I.; García, J.; Valera, F.; Soto, I.; Azcorra, A. "*Adaptive Quality of Service Management for Next Generation Residential Gateways*" 9th IFIP/IEEE International Conference on Management of Multimedia Networks and Services, MMNS 2006. October 2006. Dublin, Ireland.

Vidal, I.; García, J.; Valera, F.; Soto, I.; Azcorra, A. "*Integration of a QoS aware end user network within the TISPAN NGN solutions*" IEEE 4th European Conference on Universal Multiservice Networks (ECUMN'2007). ISBN 978-0-7695-2768-0, pp. 152-160, February 2007. Toulouse. France

F. Valera, J. García, C. Guerrero, Vitor Pinto and Vitor Ribeiro. "*Demo of Triple Play Services with QoS in a Broadband Access Residential Gateway*", IEEE Infocom, Barcelona (Spain) 2006. April 2006. Barcelona, Spain.