Demo of Triple Play Services with QoS in a Broadband Access Residential Gateway

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***Abstract*— This paper describes a complete demo scenario where a Triple Play configuration (video, audio and data) with quality of service will be shown. This scenario could be considered as the aim of the Next Generation Networks (NGN) where a unified network is used to transport all possible kind of traffic towards a broadband Ethernet access multi-provider network. Although a NGN is a glue of different network parts, we focus this demo in the customer premises, more precisely in the Residential Gateway (RGW) that is the interface between the end user and the access network.**

I. Introduction

The world of the telecommunications is merging and converging. The aim of a service provider is to deliver any kind of service using the same transport technology to minimise the operation, administration and the management (OAM) of its equipments. Meanwhile, a customer does not care about this and his or her main requirement (costs apart) is the quality of the service (QoS).

To achieve an end-to-end QoS is not easy in the Internet. In Europe there are many initiatives to promote a European broadband network standard to improve data communications between member countries. MUSE (Multi Service Access Everywhere [1]) is a large integrated European project belonging to the 6th Framework Programme with the overall objective of researching and developing a future low-cost, full-service, multi-provider access/edge network to allow European citizens access to real broadband services.

The MUSE project is divided in different work packages focusing their research in specific points of the complete network: the core network, the access network and the customer residential gateway (RGW). This demo shows our work in the residential gateway (RGW) and how the QoS is achieved in the last mile of the access network, as well the RGW authentication process. Although our work is focused in the RGW device, for all the tests we developed several dummies to create a complete testbed. The rest of this paper is structured as follows. The following section presents how the RGW was implemented showing the main functional blocks. We then provide the most important characteristic that must be trialled to validate the whole scenario. Section IV explains the complete demos we plan to present at a high level to demonstrate that the low level works exactly as it is configured. Section V details all necessary equipment for the demo and a physical space estimation and finally we conclude with the main objectives of this demo.

II. RGW implementation

Linux was selected as the prototype operating system due to its high performance, open source code and license, hardware availability, etc. Since the RGW has to manage low level packets (link layer) and Linux does not natively provide this manipulation, it was decided to use the Click! modular router [2]. All the architecture was previously validated by several tests including a specific hardware performance one [3].

Fig. 1 represents the complete picture at the bottom level where all functional blocks and their relationship are depicted. Incoming and outgoing traffic flows are represented and the two separate paths show that these two flows never use the same resources at Click! level. Dotted arrows represent unknown outgoing traffic. Click! level sends these packets to the CSD (Click! Signalling Dispatcher) to treat them and then it sends the packets to the corresponding Signalling Process (SP) to handle it. Finally, the SP returns the packets to Click! level. Dashed arrows are frame copies that Click! sends to the CSD or the IMS (IP Multimedia Subsystem) due to special characteristics (signalling frames, for example). There is also an OSGi bundle-CSD communication where the Manager can configure Click! on behalf of OSGi and vice versa.

III. Characteristics to be Trialled

The most important characteristic of this prototype developed within the framework of a FTTH scenario is that it is a MUSE compliant RGW since it presenting different properties that have been adopted or proposed by MUSE architectural design group or MUSE RGW specific taskforce.

The Queue and Scheduling Functional Blocks inside the RGW device are the principal blocks to be tested to assure a complete end-to-end QoS. There are two different blocks one for each direction (downstream and upstream) and both elements must be tested to accomplish the end-to-end behaviour. The following is a short explanation of how these blocks are implemented:

- **Queues:** in Click, the implementation of these queues is based on the invocation of four different queue elements. Each queue represents a different CoS. There are several ways to accomplish the requirements imposed by a specific CoS. For example, a fix size queue can be used to avoid queue delays.
- **Scheduling:** working with two or more queues implies the use of some algorithm to extract a packet from one queue at each time. It is even more complex to elect the right one when priority queues exists. There are many scheduling algorithms to treat this problem: Priority Queuing, Weighted Fair Queuing, Class-based Weighted Fair Queuing, etc. There is a Click element called PrioSched that implements a Priority-like Queuing. New scheduling algorithms implementation is for further study.

Regarding QoS, the main RGW operation characteristics to be tested in the trials are the following:

- Queues and scheduler systems
- Multicast functionality
- Signalling processing
- Remote management

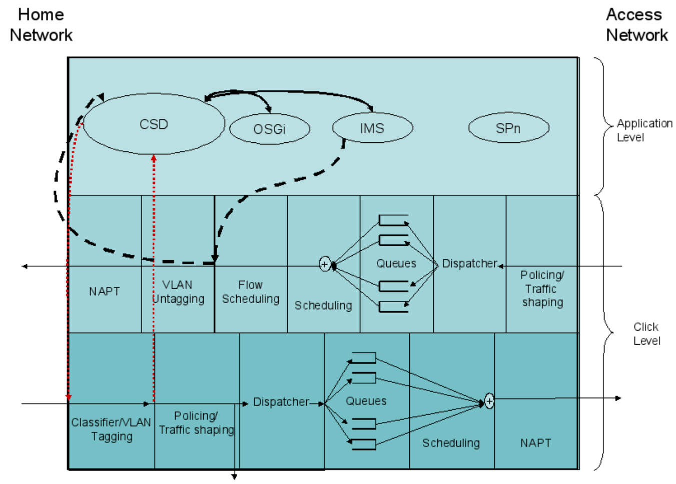

Fig. 1. RGW Functional Blocks

Apart from the above QoS characteristics, the following auto-configuration and authentication related features will also be demonstrated:

- Discovery of the number of NIC present on the hardware platform
- Discovery of the NIC connected to the access network
- Authentication of the RGW in the providers network

IV. Demo

Fig. 2 depicts the complete testbed we plan to spread and demonstrate. This scenario shows two RGWs from two different customers receiving video streaming from the video server, establishing a VoIP call between them and another call with a cellular mobile user from the outside and finally receiving a huge amount of traffic simulated by a traffic generating tool (Iperf). It is also possible to surf the web at the same time.

This demo will be divided in four parts [1]:

1) Both customers receive video at the same time: *user 1* with high priority while *user 2* with low priority. Our goal is to demonstrate how the video with the low priority is degraded due to the background traffic with a higher priority. This demo will be enhanced tuning the Iperf traffic to detect the maximum bandwidth allowed in the network to receive the video even with a poor image and sound quality.

[1]both customers receive Iperf traffic at 100 Mbps marked with medium priority

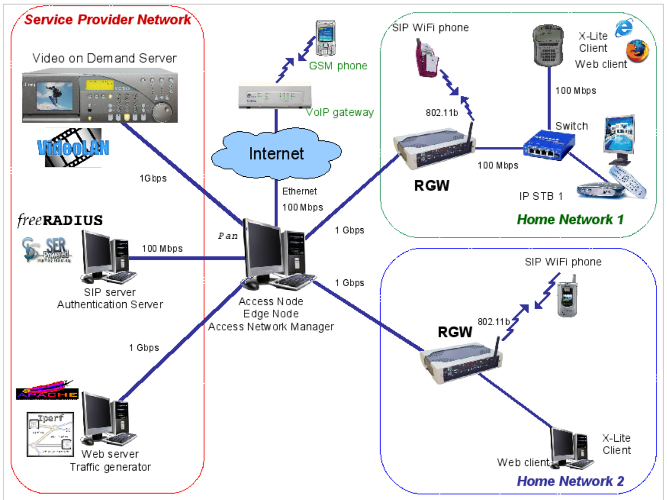

Fig. 2. Demo scenario

2) *WiFi SIP phone 1* establishes a VoIP call with *Softphone 2* using a high priority connection in both paths. *WiFi SIP phone 2* establishes a VoIP call with *Softphone 1* using a low priority (in both paths or just in one path). When the low priority is just applied to the incoming traffic, *user 1* will no perceive any degradation while *user 2* will hear nothing. When the *user 2* has configured both directions with the lower priority the same scenario than the above will occur. This is because just the incoming voice is affected by the Iperf traffic and not the other direction due to the resource separation in the RGW architecture.
3) *WiFi SIP phone 1* establishes a voice call with a cellular mobile phone from the audience using a high priority. *WiFi SIP phone 2* establishes a voice call with a cellular mobile phone from the audience using a low priority.
4) The last trial shows the complete Triple Play scenario working all together.

All these tests could be performed at any time and in whatever needed order.

V. Equipment Involved in the Testbed Scenario

Fig. 2 presents all devices needed for this demo. Two BookPCs are used as the RGWs positioned together and their respective devices (one laptop and one WiFi SIP phone in each home) at both sides. Both RGWs are connected to a central desktop PC that simulates all access network elements (Access Node, Edge Node, etc.). This PC is connected to the Service Provider PC where different services are provided (video server, VoIP server, web server, iperf, etc.) and with the rest of Internet too using a Ethernet connection provided by the organisation with at least one public IP address. The VoIP gateway and the GSM phone are not part of our equipment but necessary for the demo. The gateway is accessible using the Internet connection and it makes the connection with the mobile phone provided by the audience. All devices are PC based so no further space is necessary.

VI. Conclusions

This demo shows a complete testbed where triple play services are provided using Ethernet as the transport technology in the access network. After a successful authentication every customer flow is marked with a certain QoS using the p-bits header extension provided by the 802.1Q/p standard and, in the upstream direction (from the customer premises to the network), the RGW is the device in charge to put that header. Our RGW prototype is flexible enough to identify a flow and map it with a certain p-bits assignation. For this demo a web interface is used to configure it properly but other ideas are being researched [4].

Acknowledgements

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