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# A Set-top Box with Virtual Platform Support for QoS Management in IMS Based Multiple Provider Networks

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**Abstract**—For end-to-end QoS in IMS, our STB is designed to support virtual platforms such that a service provider is able to manage its own multimedia streams using feedback mechanism and ensure the desired QoS. The STB also works as a Home Gateway and provide QoS support to client nodes.

### I. INTRODUCTION

Recent emerging technologies emphasize for the open solutions with focus on technology and access convergence and providing opportunities to the free market. IMS was defined by 3GPP (3rd Generation Partnership Project) [1] as a standard architecture which provides a horizontal, cross-functional layer of intelligence on top of IP, enabling the creation, control and execution of new and rich user-to-user services (video streaming), server-to-user offerings (IPTV) and multi-user media services (game-playing on the move and at home via PC). A set-top box (STB) is used as the end device to provide multimedia services to the consumers. As this STB is a service providers' owned equipment, it can be used by the service providers to manage their services such that to ensure end-to-end QoS. Furthermore, this device can also provide the functionalities of a regional or home network gateway.

In this paper, we present our enhanced STB designed to provide both of these functionalities. Next sections provide some related knowledge, the design and discuss the implementation & evaluation of our device. We conclude our work in section V.

### II. RELATED WORK

Many solutions are proposed to ensure end-to-end QoS in IMS architecture. These solutions make use of performance monitoring and ensure end-to-end QoS in the network.

For single service provider, managing the stream is easy if the STB is collaborating with the service provider. But with multiple providers, we need a different approach. One option is to enable the management of QoS using a centralized entity, while the other solution is to provide virtual or logical STB to each provider. Our STB also uses logical STB concept with platform virtualization.

To the best of authors' knowledge, the proposed STB is one of the first systems which provide network performance

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feedback for ensuring QoS management in IMS based systems as well as works as the Home Gateway. With the virtual platform support, this STB is able to provide management platform to multiple service providers.

### III. PROPOSED SET-TOP BOX DESIGN

We have designed a STB with focus on ensuring QoS in the IMS architecture. As the STB is the end user device on which the service provider has some control. The STB provides a virtual manager to each service provider so that it can manage its own flows and multimedia streams. STB also provides network performance parameters as a feedback to the QoS session enabler in IMS network. The STB uses simple SIP signaling to communicate with the management server, which monitors the network and ensures the optimal QoS.

STB monitors network parameters (such as round-trip latency, jitter, throughput and packet loss etc.) and signals them back to the management server and the service provider. The server & ISMS fine-tunes the network by prioritizing the flows, and service parameters accordingly, making it possible to create an end-to-end solution by integrating cooperative application (based on SIP) from different vendors.

#### A. Architecture

Fig. 1 shows the modular architecture of our proposed STB. Along with the usual subsystems of a conventional STB, our STB includes a QoS enabler, a UPnP server, a SIP module, and a Virtual Platform Manager (VPM). A QoS enabler is responsible for providing end-to-end QoS between the end user nodes and the service provider.

The working of UPnP server, SIP module (consisted of SIP Client and SIP server Module), Session Repository, and Video

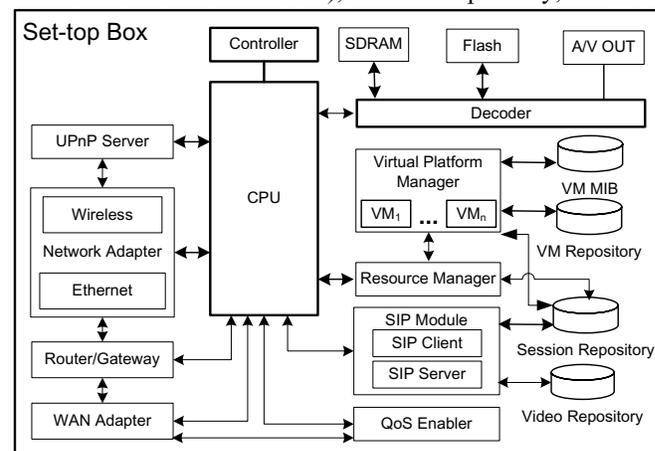


Fig. 1. Modular design of the proposed Set-top box, which includes the functionalities of a Virtual Platform Manager, Home Network Gateway and end-to-end QoS enabler.

Repository are discussed in [3].

### B. Virtual Platform Manager

The basic idea of providing virtual platform is to isolate the different management agents of each service provider. VPM is responsible for providing virtual managers (or management platforms) to each provider for managing their own service flows. Using virtualization it makes sure that all service providers are isolated from one another. With each provider having its own separate management platform (logical STB), it can access, the parameters related to its flows and can guarantee the promised QoS. VPM uses a Virtual Manager (VM) Repository and Management Information Base (MIB) repository. VM repository maintains the VM running on the STB, while MIB repository maintains the performance parameters related to the services. This is enabled at the software layers, more specifically, at operating system or a middleware. Detailed discussion of how to design and implement a platform virtualization is provided in [2].

### C. Working

Along with the significant functionalities, the STB also works as the SIP server and client for establishing session calls, manager for the home network, and provides decoding for the video and voice channels. The major functionalities of the STB are discussed in [3] in details.

VPM manages all the virtual managers, such as; allowing the initiation of a VM when a new service provider is connected to the STB, registering the services and monitoring them to avoid conflict of resource access. Fig. 2 shows the basic ideology of the mechanism by which each service provider manages its flows.

When a SIP client at the STB sends an invite message to the service provider (SP), using the SIP INFO messages, the SP communicate with the VPM at the STB. VPM checks for a VM (in the VM repository) for the concerned SP. If that SP is already provided a VM, the connection to that VP is made. Else new VM is created and the added to the VM repository. For each VM, its sessions are saved in the session repository and the parameters related to each flow are saved in the MIB repository.

Each VM is managed by the SP, provides the services to the SP such as providing the multimedia flow state, the performance and the resources usage. VM provides the performance parameters of each flow as the feedback to the SP, so that it can fine tune the resources of the flows and guarantees the QoS according to the SLA. The feedback mechanism is shown in Fig. 3.

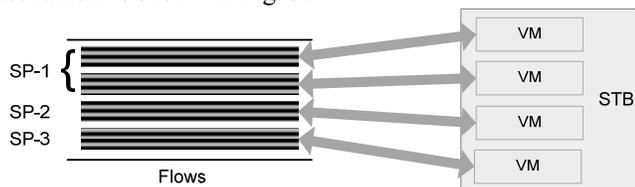


Fig. 2. Conceptual diagram showing that each service provider (SP) managing its own flows using virtual managers at the STB.

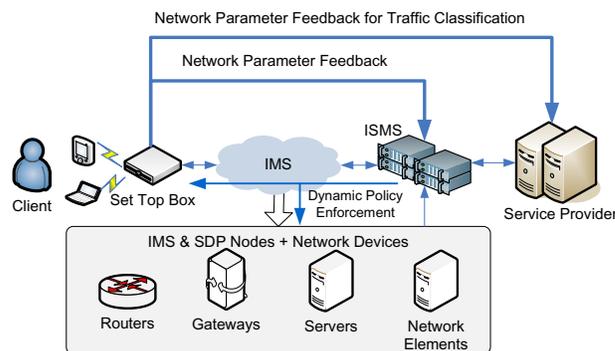


Fig. 3. Network feedback and signaling between the STB & ISMS (SME)

## IV. IMPLEMENTATION & EVALUATION

We have performed our implementation using OSGi and Java Virtual Machine (JVM) and evaluated on the base of simulations. JVM provides virtual platform support, but we also used OSGi on top of JVM. Because for the JVM, each application runs in a separated instance of the virtual machine, whereas when the OSGi Service Platform is used, all applications run in the same virtual machine. The platform handles the isolation of each application and provides several security mechanisms to control this.

A client uses a multimedia service, with intermediate nodes having high rate of entropy for network delay and available bandwidth. These delays are generated at each node randomly with simulating different flows. With the help of QoS feedback, SP are able to reserve better resources for each flow. We have compared for multimedia streams in the normal case and in the case of using our proposed architecture for end-to-end QoS enablement.

## V. CONCLUSION

In this paper, we have presented the design and working of our STB, which works as a home network gateway (regional gateway), enables end-to-end QoS in the IMS architecture and also provides virtual platforms. With this technology, an STB is able to provide a virtual manager to each service provider (SP), by which SPs are able to manage their own flows. This mechanism assures to assist in the end-to-end QoS provision mechanism by relieving the ISMS server and also reduces the number of messages passed between the SP and the ISMS server in enabling the QoS management.

## REFERENCE

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