ETOM PROCESS TO MANITOR AND CORELAT IPTV QOS IN IMS

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ABSTRACT

As the network convergence with services for both static and mobile networks has been the principal object of the next generation networks, the recent research focus is converging in the direction of standardizing common infrastructure based on all-IP networks. IMS is a recent initiative. Moreover, designing and deploying a standard QoS provisioning mechanisms in large networks is not a trivial matter. IPTV services are considered between the important IMS flow, the actual QoS management mechanisms proposed by 3GPP allow providing the IMS network components control and efficient service delivery, however the 3GPP approach focuses entirely on the step of providing the service, but there is no mechanism for monitoring Qos dynamically. This paper discusses the issues, design and analysis related to on demand dynamic QoS control in these next generation networks and fuss both Quality of Service (QoS) information signaling and IPTV traffic engineering options that may serve as key components of IPTV service specific QoS policies, which are designed to accommodate with customer requirements and resource availability by using the eTOM process to monitor the Qos values and to propose optimal solution to provide the quality of delivered content. The eTOM process interact with implemented marking entities which execute an algorithm to marking IPTV packets, this cooperation must improve the quality of service of the IPTV traffic.

KEYWORDS

IMS (IP Multimedia System) ;IPTV; QoS(Quality of services); VoD (video on demand);BC(broadcast);PvR(personal video recorder); eTOM (enhanced Telecom Operations Map); SLA (Service Level Agreement); WS (Web Service);openIMS;

1. INTRODUCTION

The NGN network evolution and growth of demand in the trafficking of IPTV technology namely the video broadcasting(BC), video on demand(VoD), and The Personal Video Recorder(PvR), also the requirement of QoS have stimulated the market to opt for service convergence solutions that implement mechanisms to improve the quality of service provided to customers.

The main objective of this policy is to ensure QoS priority including dedicated bandwidth, controlled jitter and latency that are required by the IPTV traffic mainly the BC one including improvement of loss characteristics.

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To catalyze the implementation of policy-based networking, which helps streamline network operations and provides for scalability we can appeal to the SLA (service-level agreement).

At the same time, ensuring prioritization IPTV sub traffic via policy is another important aspect of managing service-levels.

In addition, it is important to ensure that to prioritize traffic in a IPTV or IMS client should not affect traffic in the skins of those IPTV or other consumers.

Under the process implemented by the 3GPP approach to improve the quality of IPTV service in the IMS, QoS procedures should be performed during initialization of streaming without taking into account the differentiation between the IPTV sub trades, neither between users of it, hence the interest of a new approach for differentiation of traffic as that of IPTV users.

For handling such constraints, the system must monitor the network parameters and guarantee network resources for the traffic flows. This is achieved using a comprehensive QoS management scheme based on the eTOM process, together with an algorithm for classifying packets IPTV.

To model and analyze the network and the service activity a functional charter called eTOM (enhanced Telecom Operations Map) is used.

By projecting the eTOM process on the IMS we note that the latter is designed as an end-to-end call management infrastructure that provides quality of service (QoS) between two call endpoints, Once the service is delivered there is no effort to monitor the receipt of media by the customer, The eTOM framework proposes a complete set of hierarchically layered processes describing all operator activities in a standard way, that can be used to monitor the quality with which the IPTV flow is distributed and propose corrective actions to remedy the degradation of QoS..

From this perspective, this paper proposes an IPTV QoS policy design and enforcement scheme based on eTOM process that precisely relies upon the combination of a set of elementary capabilities that is meant to help IPTV service providers in better providing hard guarantees about the level of quality associated to the delivery of VoD, lineare TV and PvR services that can benefit from the IP multicast transmission scheme.

The rest of this paper is organized as follows. We introduce the details of IPTV service system components in Section II. Then, we describe the IMS and Service Monitoring in section III. In Section IV, we describe the eTOM framework projection in the IMS context. Results are in Section V.The paper is concluded in Section VI

2. IPTV TRAFFIC COMPONENTS

This section describes briefly the IPTV as the main technology which provides multimedia services; this service class is mainly unidirectional with high continuous utilization (few idle/silent periods) and low time variation between information entities within a flow. However, there is no strict limit for delay and delay variation, since the stream is normally aligned at the destination. Additionally, there is no strict upper limit for the packet loss rate.

IPTV has different video traffic (Broadcast, video on demand, PVR, nPVR) which has variable data rate due to the dynamic nature of the captured scene and the Encoding process:

- **VoD** content/movies (Vidéo à la demande) : allows users to select and view a video on demand. The VOD content can be transmitted through the platform IMS-based IPTV, which includes a library of movie titles, music on demand.
  In most cases this implies the support of trick functions for stream control like play, pause, and stop via the Real Time Streaming Protocol (RTSP).

- **PvR** (personal video recorded): allows the user to record the broadcast content.

- **Linear TV** service/Broadcasting TV: enables the client to request and retrieve live TV via unicast and multicast channel using MPEG 2 TS or MPEG4 AVC (H.264).

These types of traffic are different in their sensitivity to latency, if we use an EF behavior to video stream in the DiffServ network there will be a problem because Broadcast video can't support latency compared with VoD/PVR one, and due to the fact that multiple IPTV streams are placed into the same flow aggregate (FA), it is hard to design a maximum limit for traffic policing at the ingress router of a DiffServ domain. if a lot of EF traffic enter into the DiffServ domaine, the core router can cause latency to broadcast packets by serving continuously EF packets at the highest priority, this behavior increases delay. Excessive EF traffic in the core network will therefore lead very fast to full queues and large packet drops.

The logical components needed for broadcast/VoD services can be divided in components needed for VoD, for broadcast or general components needed for both services.

The figure 1 provides a better understanding of the processes behind VoD/PvR and broadcast transportation.

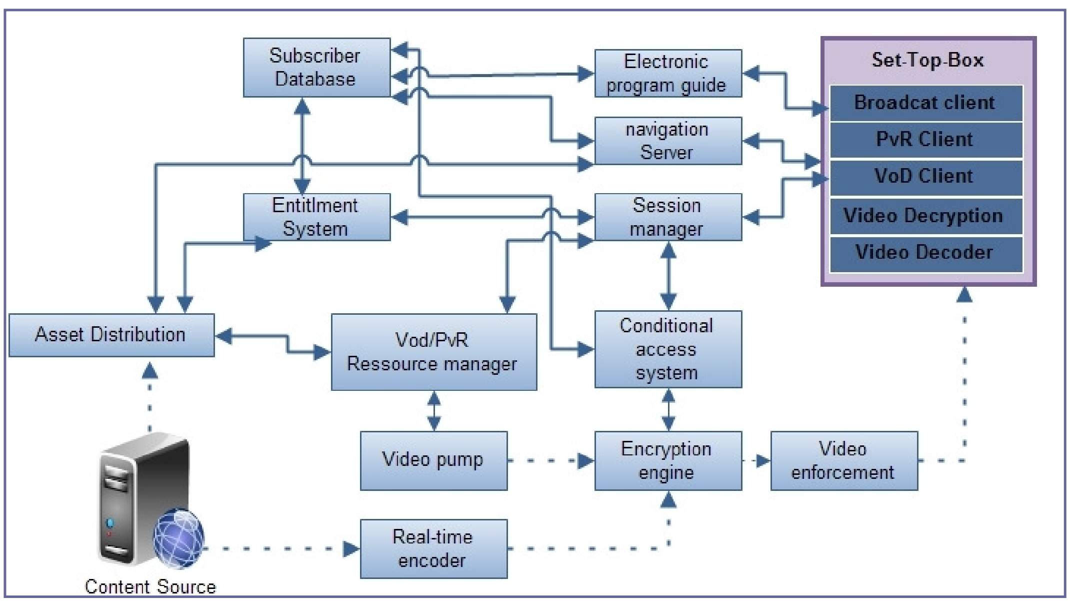

Figure 1: The logical components of The IPTV technology.

This high level architecture of IPTV shows it is possible to analyze the watching behavior of customers and customize commercials.

3. IMS AND SERVICE MONITORING

3.1. Provision Service in IMS network (IPTV Case)

The mechanisms for providing service in the IMS support different types of service such as data transfer (FTP), messaging but also requiring video and voice (IPTV, VoIP) services. Mechanisms capable of maintaining a high level of security, but also to facilitate the deployment of new services regardless of network topology.

As shown in Figure 2 the supply of a service begins with SIP INVITE sent by the client to the P-CSCF, this latter forward the constraints defined in the request to the S-CSCF to identify the appropriate application server communicating with the HSS. The application server negotiates with the client the type of codec to use before sending the RTP stream to the client.

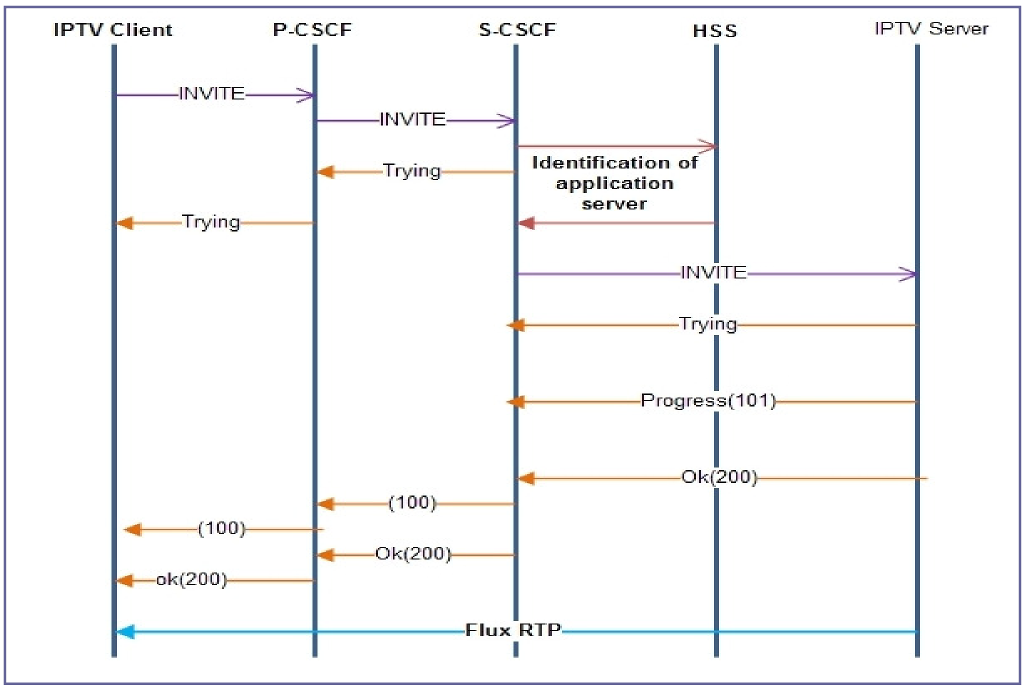

Figure 2: provision of service in the IMS (IPTV use case)

The provision of service in the IMS has no specification for IPTV that is classified as a single video traffic, the fact that this technology can be decomposed into three sub traffics: Broadcast, video on demand, personal video recorder, also the differing types of clients requires the integration of new mechanisms for QoS management that will support the variety of aggregated traffic in IPTV as well as diverse types of users.

3.2. eTOM Framework Presentation

The eTOM Framework (TMForum) is the operational part of NGOSS, which was established to provide a common language for identifying the business processes used by telecom operators. It develops a scope on the business processes.So it clearly identifies a set of processes to reflect their importance in the enterprise management and integration.

The eTOM provides several levels of abstraction depending on the operator need. The processes for each layer recognize four levels of decomposition, each of which details the processes identified successors. Each process encapsulates a set of operations dedicated to a specific field of activity (figure 3).

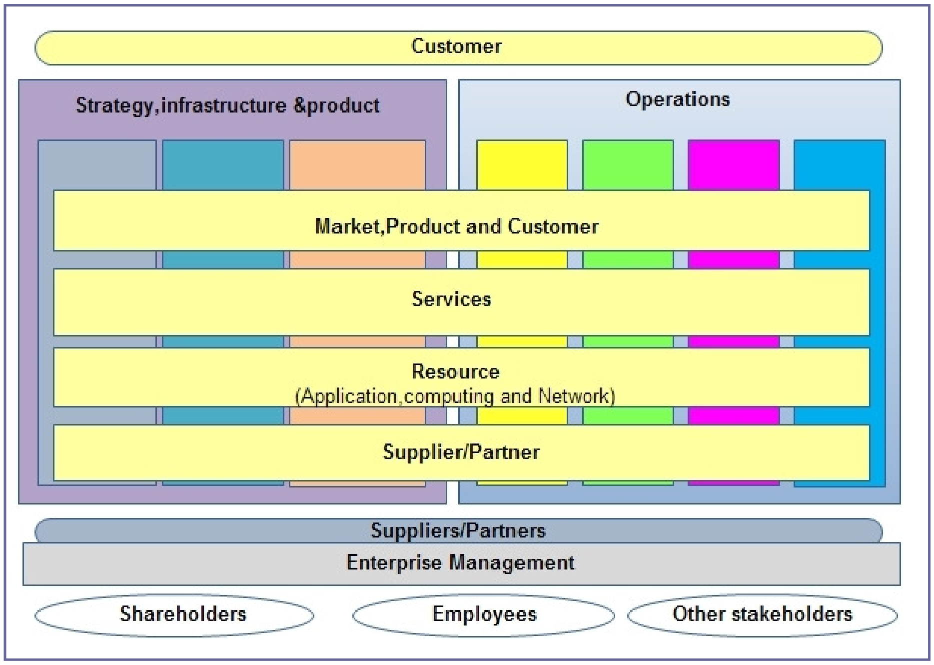

Figure 3: Decomposition of the eTOM framework

Similarly, the eTOM framework includes several scenarios dedicated to providing service and correcting the QoS deterioration. a scenario is a suite of end to end process which can lead to a series of actions reflecting a task of the operator.

2.3. Ordering Scenarios

The process of ordering as defined in the eTOM framework enables the delivery of service in a dynamic way according to the resources state, the service nature and customer type, indeed, the ordering scenario includes a set of processes which provide to make the optimal decision for resource configuration.

The sequence of the ordering process is as follows (Figure 4):

- Process Selling receives the client request before structuring the resource requirements in a standardized form; the written report is then forwarded to the next process.
- Order handling process supports the client's profile and identifies the constraints established in the Operator-Client contract SLA client before sending the report to the next process.

- Service Configuration & Activation Process identifies the resources status and depending on the requested service and the type of client it decides on the proper configuration to enable
- Resource provisioning process executes necessary scripts for activation of the required configuration.

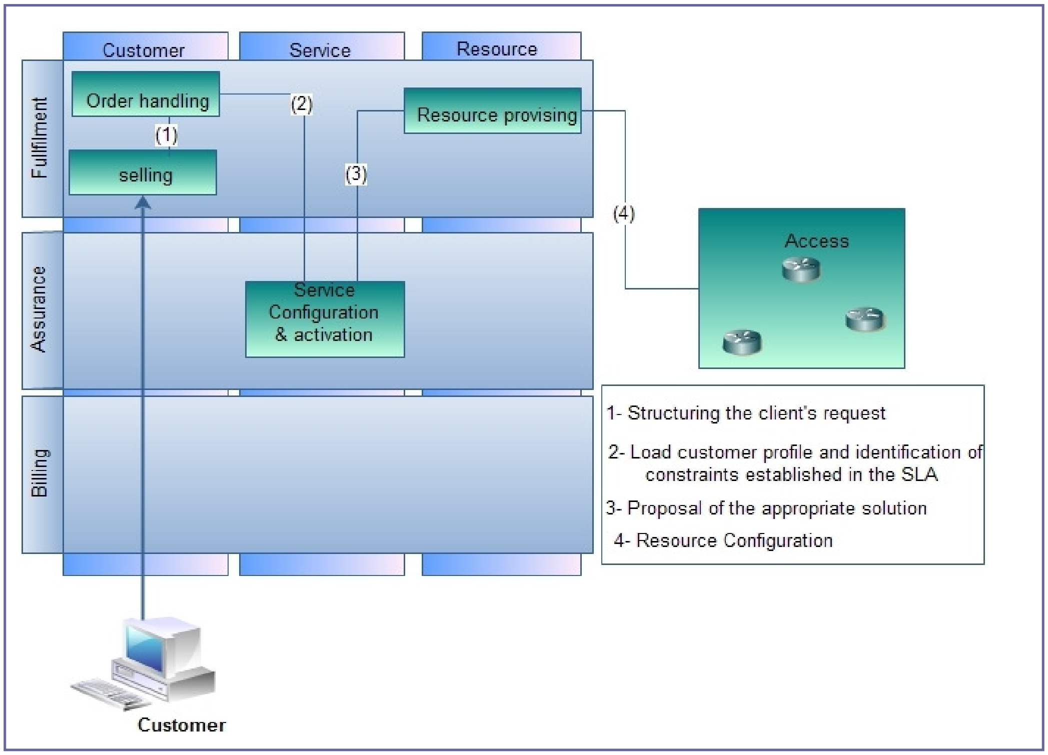

Figure 4 : Ordering Process Flow

Service provision is carried out by the IMS entities, eTOM processes involved in ordering operation focuses on the configuration of resources and also the collection of information necessary to monitor service (type of service, SLA, resources state).

2.4. ISSUE

Sometimes, due to a change in network parameters such as degradation of performance, a certain resource may not be able to be provided to each flow according to its SLA. Many solutions exist, which compromise some flows for certain important flows. This SLA ignorance can cost a service provider a loss of customer to its competitors.

Also the 3GPP specifications for IMS networks offer a standard approach for any type of service and have no special for IPTV. Thus the three sub IPTV traffics have the same priority level in the resources, this shows a weakness in management of QoS. In addition the 3GPP specifications do not take into consideration the type of client when providing service.

Moreover the eTOM framework provides a set of scenarios for the supply, but also for monitoring of real time services. After all these specifications are considered standard and contains no specification for IMS networks.

Nous proposons ainsi dans ce papier d'intégrer des mécanismes de configuration et de prise de décision à base des spécifications eTOM aux réseaux IMS. Des mécanismes qui prennent en considération la nature du flux IPTV demandé mais les contraintes identifié dans le contrat SLA.Those after monitoring the network performance and end-to-end QoS by getting feedback from the set-top box at the customer's end.

3. ETOM PROJECTION FRAMEWORK IN THE IMS CONTEXT:

3.1. eTOM projection in the IMS context

To reach our approach we chose the scenario of ordering in the context of IMS. The most important step of our work is to identify the necessary components to the marriage but also to determine the information and actions to be performed by each component.

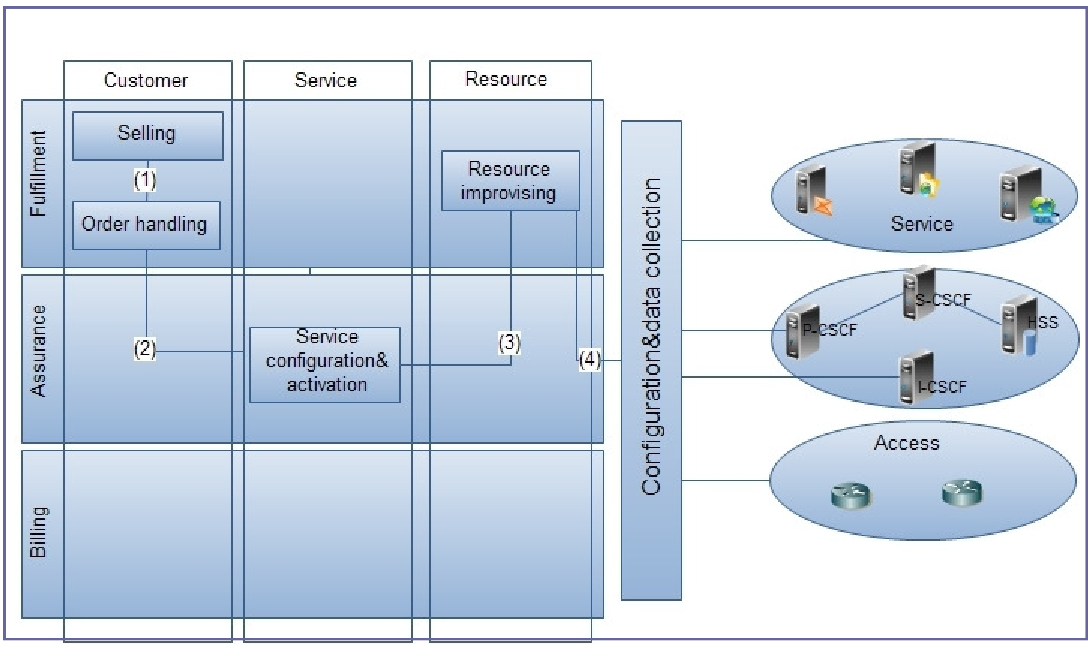

Figure 5: Interaction between eTOM processes and IMS entities

The interaction between the eTOM processes and entities of the IMS network is made through a new component called «Configuration & data collection. in fact, the diversity of entities and protocol of the IMS makes gathering information and enabling the configuration of resources a difficult operation. This requires the integration of three key entities which are as follows:

- The detection entity for the provision of service via the control layer of IMS.
- The services parameters identification entity via the service layer.
- The activation entity of the deployed configuration on the resources of the access layer.

3.2. System Architecture

To implement our new approach, we need technological tools capable of supporting communication protocols fast and reliable. The information structure also will allow both rapid accessibility and a level of safety.

We implemented a module entitled « Component of Decision mak » (figure 5) which includes all the eTOM processes involved in the operation of the ordering, together with the entities necessary for the collection and preservation of information for decision making.

The collection of information and enabling the appropriate configuration is done via agents deployed on the network (Figure 6).

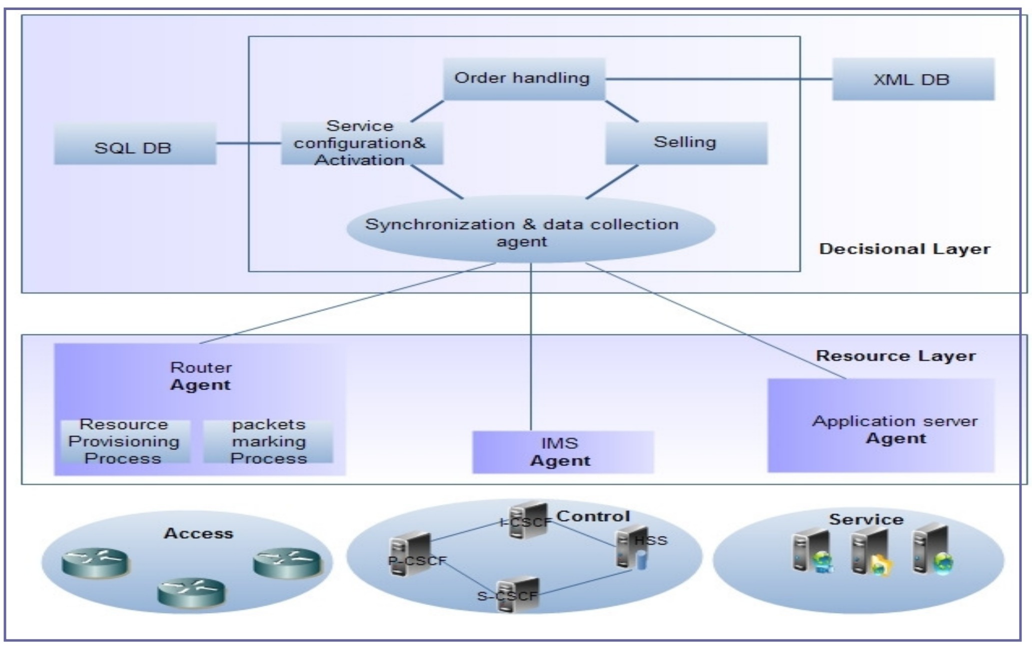

Figure 6. System Architecture

Figure 6 describes our system architecture which has two abstraction layers, each of which focuses on QoS management aspect:

- **Decisional layer:** includes the eTOM process responsible for deciding on the optimal configuration. But also the necessary structures for data backup.
- **Resource Layer:** which includes information-gathering entities but also entities responsible for resource configuration.

3.2.1. Network Agent

We have defined three agents in our architecture which is as follows:

- The IMS agent which enables the detection of network events in particular the provision of service.
- SA agent responsible for the collection of service parameters such as listening ports, the client's IP address and type of service provided (Broadcast, PvR, VoD).
- The Router Agent that implements the two processes «Resource Provisioning» and «packets marking» that are responsible for implementing the solution identified by eTOM process superiors.
- The synchronization agent that allows synchronization between the agents deployed in the network, and also the updating of databases of network state.

Communication between agents is realized via the TCP / IP to optimize the communication time but also minimizes the load on the network.

3.2.2. Data structure

To structure the information necessary for decision making in an easily accessible and secure, We define two database that are as follows:

- **XML DB** includes static information such as SLA registered customers and the network topology and protocols supported by the resources.
- **SQL DB** which has the status of each resource especially bandwidth used, the current configuration, and the number and type of stream

3.2.3. Making decision Component

The decision of the configuration to apply is done after delivery (Figure 4) as indicated in the process of ordering. The solution proposed is based on the DiffServ model for resource reservation according to the importance of customer (Platinum, Gold,..)

In the case where three users of the same type (Platinum, Gold, ...) call at the same time an IPTV traffic ,since the latter is treated by DiffServ as a single type of traffic, data of these consumers will be treated in best effort which give the impression to users that do not have priority over other customers.

To ovoid this limitation we propose a list of PHBs called IF(IPTV flows) whose classify the packets by priority on based on their sensitivity to latency .we use 3 DSCP bits to recognise the IPTV packets by sensitivity to latency in the same stream.

For IPTV traffic, we will set the three first DSCP bits for all packets, to differentiate between BC, VoD, PVR we will change the other three bits (101xxx), mapping these DSCP values to corresponding PHBs can prioritize BC packets for report those of PVR and VoD.

Our PHBs is defined for high-priority; low latency/loss and jitter traffic is similar to EF.

3.3. Scenario of Service Provision

The scenario of resource configuration in the implemented platform is realized as follows.

- The IMS agent detects service delivery and identifies the client's identity before notifying the synchronization agent
- The synchronization agent communicates with agent SA to load the parameters of services and the client IP address.
- The decision module identifies the appropriate solution for resource configuration before transmit it to the agent router.
- The routing agent performs necessary scripts for activation of the proposed solution.
- When activating a configuration router agent notifies the synchronization agent to update the SQL DB.
- When the IMS agent detects the end of service it notifies the synchronization agent. . This latter sends a notification to router agents to release resources.

4. EXPERIENCES AND RESULTS

The aim of these experiments is to validate our QoS management architecture by putting himself in practical cases for provision of multimedia services provided by IPTV technology in an IMS network.

4.1. Tests Bench

Our test bench consists of two routers (Linux) (Figure 7) which one is connected to an application server and the other is connected to client terminal. And two servers one of which includes the entities of the IMS solution deployed by OpenIMS and another that includes the decision module and XML databases and SQL.

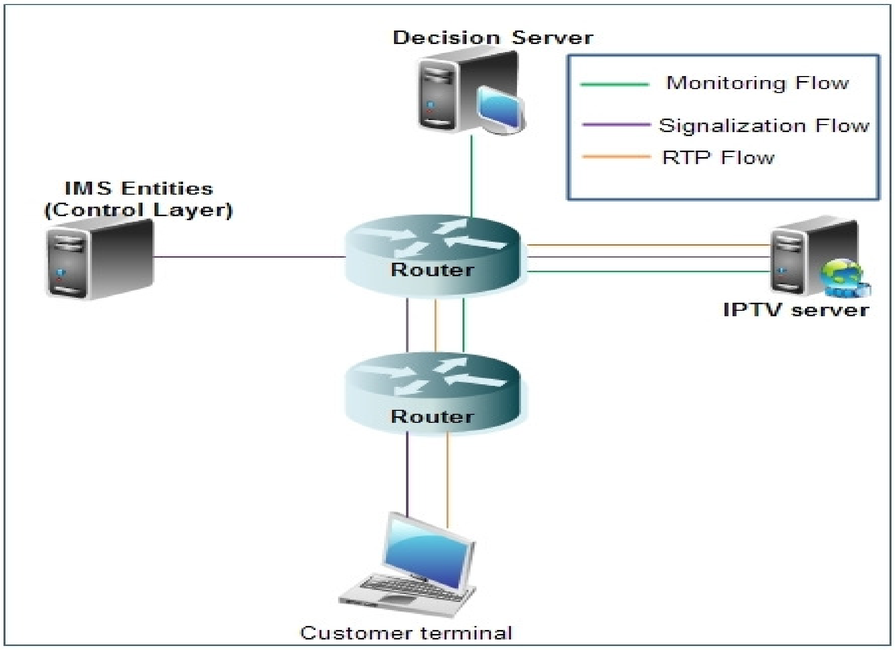

Figure 7. Banc de teste

4.2. Scenarios

In the first scenario three customers alice, bob and Moha are recorded respectively Platinum, Gold and Best effort. Alice asks the broadcast traffic, Bob requests VoD one and Moha requests PVR. Par subsequently the network is congested via FTP stream. Both cases are made with and without activation of the platform.

In the second scenario we assume that three users are like GOLD, and ask the same flow as in the first case, Par subsequently the network is congested via FTP stream. We carry out tests before and after the activation of our platform.

The following paragraph illustrates the results obtained so that the comments explain these results

4.3. Results

Figure 8 : captured images in case 1 for the tow scenario

The figure8 shows the images captured respectively for Alice, Bob and Moha in case 1. Quality is considered good in all three images, which reflects the state of the network that does not have competing services.

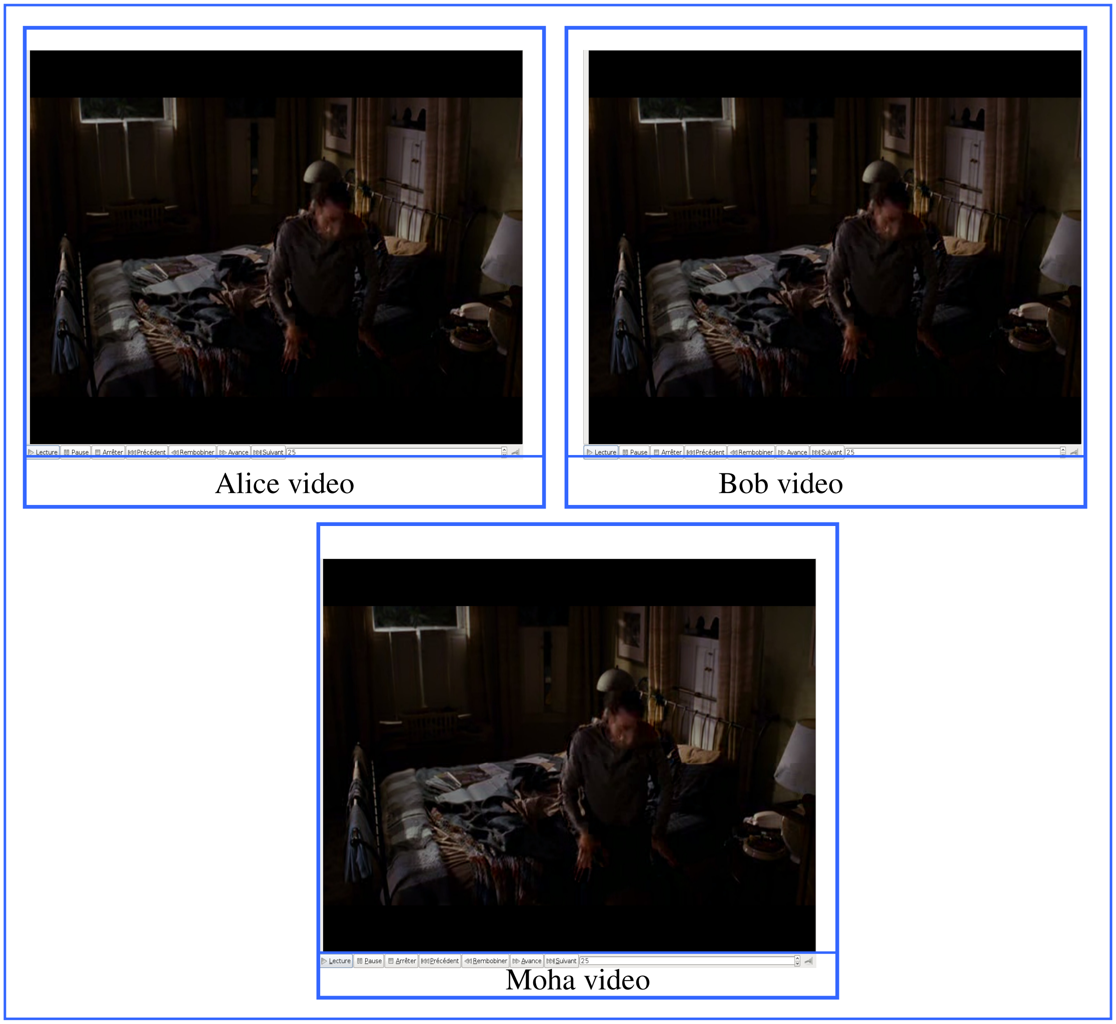

Figure 9: captured images in case 2 for the tow scenario, without configuration entities activation

The quality of images captured is considered critical for the three clients. Indeed the saturation of the network by FTP flows cause the appearance of pixels and a deterioration of the qualities of color. This can be explained by the overloading of routers Queues and no configuration mechanisms to give the first priority to the susceptible to overload flow.

Figure 10: captured image in case 2 for tow scenario, the client Alice.

Figure 10 shows the captured image after saturation with activation of configuration entities. The image quality is considered good. Which can be explained by the Reflecting the flow priority in the routers queues.

Figure 11: captured image in case 2 for the tow scenario, the client Bob.

The quality of video received by bob is less good than Alice, which is explained by the difference between the constraints defined in the SLA to each according to his type. This difference shows itself well in the priority flow and thus in the quality of the video received.

Figure 12: captured image in case 2 for the tow scenario, the client Moha.

Activation of entities configuration has no significant impact on the quality received by the client Moha. Reflecting the type best effort that has any priority.

4.4. Discussion:

The new approach dramatically improves the video quality received. Thus the priority flow is determined by type of client needs and requested services that optimizes the use of network resources.

The following schemes shows the change in latency (Fig 13), Loss(Fig 14) depending on the throughput of the different traffics flow up the IPTV one before applying the new DSCP values.

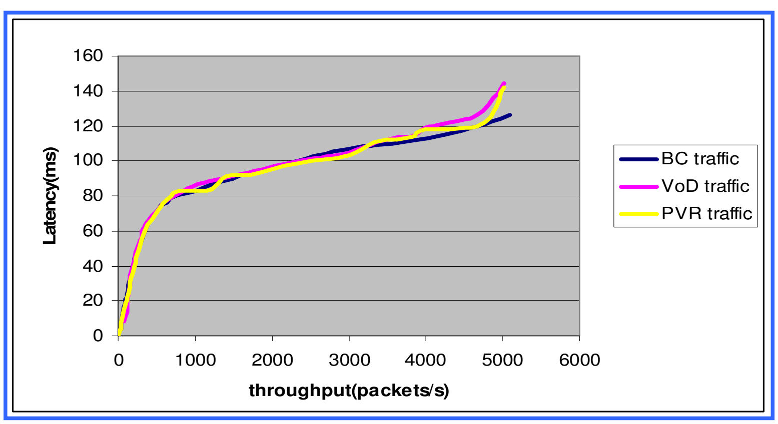

Figure 13: first scenario: Latency of BC, PVR and VoD traffics before the change of DSCP values.

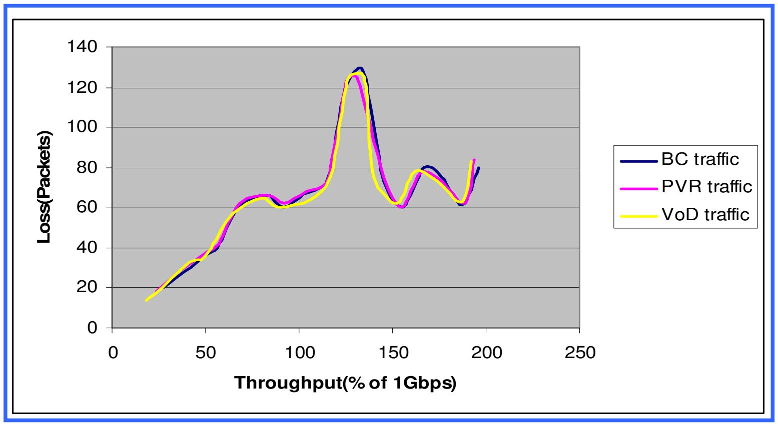

Figure 14: first scenario: Loss of BC, PVR and VoD traffics before the change of DSCP values.

After the implementation of our policy of parts marking, we obtained the results shown in Figures 15, and 16

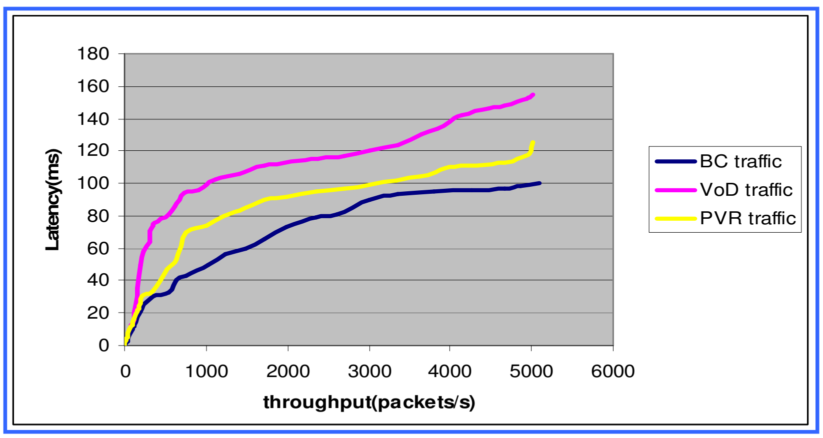

Figure 15: Latency of BC, PVR and VoD traffics after the change of DSCP values.

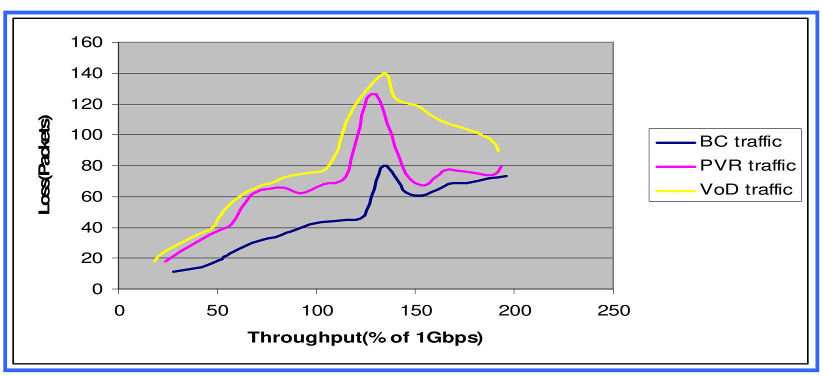

Figure 16: first scenario: Loss of BC, PVR and VoD traffics after the change of DSCP values.

The application of the new DSCP values and the corresponding PHB has allowed us to prioritize BC traffic compared to other Sub-traffic (PVR, VoD), such a change has allowed us to improve the quality of service of traffic which is sensitive to delay.

However, it is necessary to evaluate the cost of such an approach in terms of time.

The response time for service supply (IPTV use case) in IMS network depends on server application localization and its availability, it represent by formula (1):

$$\tau_{(response)} = \tau_{(1^{st}\ RTP)} - \tau_{(SIP=OK)} \qquad (1)$$

It's significant that the response time is relatively increases with the number of user (Figure 17).

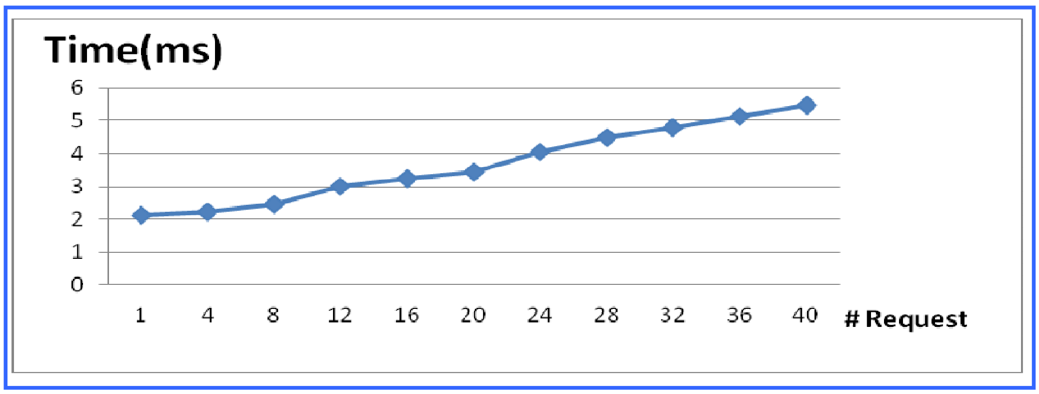

Figure 17: time provision of services in the IMS - IPTV case

Le temps d'exécution de la plate forme décisionnelle est composite, il dépend du nombre de service en cours mais aussi de l'état des ressources ainsi que la topologie du réseau (la communication avec les agents).

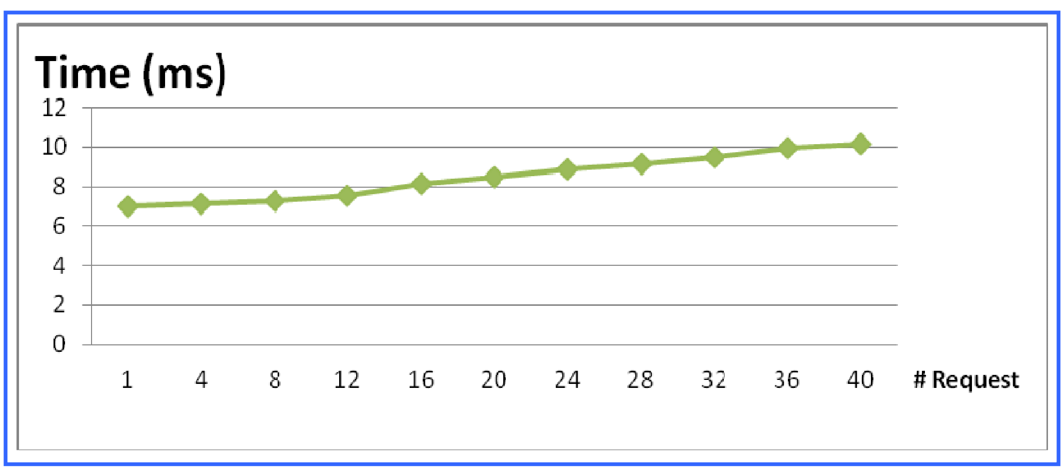

Figure 18: the execution time of the platform decision

The time required for the configuration of resources and decision-making is considered optimal. Indeed, the time difference between the platform and the provision of service in the IMS does not exceed a certain threshold (4 ms). This difference may be negligible due to the distributed aspect of the platform that minimizes the time but also to distribute the load on resources.

3. CONCLUSIONS

Most of the traffics in IPTV service delivery scenarios are video communication with constraints on delay and Loss. Hence, the system must monitor the network parameters and guarantee network resources for the traffic flows, and differentiates between IPTV sub traffic based on their sensitivity to latency and loss by using a comprehensive QoS management scheme. In this paper, we have discussed the use of dynamic QoS and SLA management in IMS networks. We have accomplished this by using a new approach which leverages the 3GPP QoS provisioning architecture with eTOM Assurance features monitoring QoS of the delivered flow in real time. to monitor the IMS network behavior, The platform will acts as proactive supervisor of the IMS network, it will correct and anticipate the QoS degradations before failures occur at customer premises. it is not a passive platform which only responsible for producing, managing and sending alarms based on events and thresholds in real time, but also it must correlate network performance and the propose optimal solutions.

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