A Direct Marketing Platform for IMS-Based IPTV

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***Abstract*—The widespread adoption of the IP Multimedia Subsystem (IMS) by operators faced many challenges. Currently, telephone companies (telcos) all over the world are rolling out next generation networks (NGN). Moreover, a number of operators already have an IMS infrastructure in place. Deploying an IMS architecture requires heavy investments. Thus, telcos need means to recoup the investment costs within particular timeframes.**

Direct marketing is a technique that enables product sellers to reach a specific target consumer group. This results in a higher turnover.

The IMS provides a platform for personalised applications like IPTV. In this paper we explore the design of an IMS-based intelligent advertising system for personalised direct marketing to incentivise IMS rollout. The system utilises IPTV communications. We also explore implementation requirements for an advertisement application server. The implementation is based on the University of Cape Town (UCT) Advanced IPTV server, to be deployed in the UCT IMS testbed.

***Index Terms*—Advertising, Direct Marketing, IMS, IPTV**

I. INTRODUCTION

THE IP Multimedia Subsystem is a framework that is based on NGN architecture and is designed to provide multimedia applications to subscribers. However, many of these applications are already available free of charge over the Internet. For example, users can access streaming video via YouTube and iPlayer; VoIP and video conferencing using Skype; and instant messaging via gtalk and msn. Thus, there is need for a motivation that is strong enough to make these users pay for similar services when delivered over the IMS. The IMS provides critical enhancements to service delivery. It offers advantages such as security, quality of service (QoS) guarantees, convergence of services and billing, and personalisation of services. This is achievable due to its highly managed, customised and user-centric service provisioning platform [1].

Personalisation is a key critical feature of new and upcoming multimedia applications. The current trend in creating rich communication services involves service convergence and personalisation. The IMS inherently is an ideal platform for facilitating service convergence and personalisation.

Since the hype phase of the IMS is over and NGN rollouts have begun all over the world, telcos need incentives to adopt the IMS on a wide scale. One of the reasons the IMS did not receive wide scale adoption is the lack of income generating opportunities to complement 3G services. Moreover, it is essential for telcos to recoup the costs of IMS investments within viable time frames. However, telcos have been experiencing a decline in the Average Revenue Per User (ARPU). There is no "killer application" off which telcos can make a hefty profit.

Network operators and service providers have been provisioning marketing and advertisement services in order to make additional profits. Typically, the marketing trend involved broadcasting of similar advertisements to lists of users. It is evident that these advertisements would reach a large number of unintended users. A very effective form of marketing is known as *direct marketing*. This is a form of advertising that delivers messages directly to the intended consumers. Hence, advertisements can directly target individuals based on particular characteristics.

Since there is no "killer application" in IMS and the ARPU keeps declining, it is essential that lucrative services be enhanced to further boost network revenues for telcos. The goal of this paper is to investigate a possible incentive for telcos to encourage investment in NGN rollout. In particular, the following research questions will be investigated:

- Will marketing offer enough of an incentive?
- Is the IMS capable of offering a direct marketing platform?
- How will the user's Quality of Experience (QoE) be affected?

We propose and explore the design of a direct marketing platform for the IMS. The design is based on the IMS IP Television (IPTV) application. IPTV is a system whereby digital television content is delivered to subscribers via an IP network infrastructure. It differs from WebTV in that it is a highly managed system, offering guaranteed QoS and involving user subscriptions. The IMS-based IPTV provides a great avenue for a direct marketing system due to its personalised and interactive nature.

In this paper we examine current marketing techniques and various IPTV architectures. We then propose the design of a direct marketing platform utilising an advertisement application server based on the IMS IPTV. We utilise the

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European Telecommunications Standards Institute (ETSI) Telecoms and Internet Converged Services and Protocols for Advanced Networks (TISPAN) IMS-based IPTV architecture [2]. For implementation purposes, modifications to the UCT Advanced IPTV system are necessary. These modifications are detailed in section V. The rest of the paper is structured as follows: section II reviews literature related to IPTV and marketing; section III presents an architectural framework for an IMS based direct marketing platform; section IV presents implementation framework considerations; section V presents testing and validation procedures; and section VI concludes the paper.

II. Related Work

Many different IPTV architectures have been proposed by the various standardisation bodies and vendors. They can be classified into two types of architectures: dedicated IPTV systems and IMS-based systems.

A. *Dedicated IPTV Systems*

In these systems, a dedicated subsystem within an NGN platform is used to provide all the required IPTV functionality to network subscribers [3]. The functions include service control and user profile management.

These systems have the advantage of dedicated resources, resulting in better performance and reliability [4]. However, they depict higher complexity due to interworking requirements with other NGN elements in order to provide convergence of services.

B. *IMS-based IPTV*

This framework allows the system to use IMS functionality such as authentication, authorisation, accounting, etc. [4]. The IMS provides single sign-on, user subscription management, session management, roaming, QoS and unified charging and billing. Furthermore, the system may use SIP-based service initiation and control mechanisms. This results in a more scalable system. Other advantages are support for mobility, interaction with NGN service enablers, service personalisation, media adaptation and convergence of voice, data, video and mobility (quadruple-play) [3]. IMS-based IPTV also allows the IPTV stream to be adapted to suit the available network resources and different user terminals.

The framework proposed in this paper is based on the ETSI TISPAN IMS-based IPTV architecture [2] since it is the most widely adopted IMS-based framework in evolving standards and research. Figure 1 illustrates a simplified IPTV architecture and its operation.

The user equipment (UE) interacts with four entities. These are the Proxy Call Session Control Function (P-CSCF), the IPTV Application Server (AS), the Media Control Function (MCF) and the Media Delivery Function (MDF). Communication with the P-CSCF takes place when the user requests services. Interaction with the IPTV AS allows service discovery, selection and control. The UE communicates with the MCF to achieve trick play functions, i.e. pause, fast forward, rewind and play. The MDF link is used to deliver the media stream to the user.

Once the P-CSCF receives a service INVITE request from the UE, it routes it through the IMS core. The P-CSCF forwards the request to the Interrogating CSCF (I-CSCF) which queries the Home Subscriber Station (HSS) to discover the Serving CSCF (S-CSCF). The request is then forwarded to the S-CSCF. The S-CSCF utilises the user's service profile that was downloaded from the HSS upon user registration to determine the IPTV AS to which the request is forwarded. The IPTV AS then retrieves the user's subscription information from the HSS and authorises the service request. Once validated, a request is sent to the MCF and MDF via the S-CSCF. The service request is made on behalf of the user. The MCF controls the media delivery to the user (according to user policies) through the MDF, which is responsible for delivering the actual media stream directly to the user. The MDF is also responsible for processing, encoding and transcoding of the media to suit various terminal capabilities.

For simplicity, other service control entities, i.e., the Service Selection Function (SSF), the Service Discovery Function (SDF) and the Service Control Function (SCF) are co-located within the IPTV AS. The SSF and SDF provide the user with information required to select an IPTV service, e.g., a TV channel. The SCF handles the requests from the user and is responsible for service and session control.

The IMS core only performs session management. Hence, IPTV media does not traverse the IMS core [1]. The media delivery takes place directly between the MDF and the UE. However, it is the responsibility of the IMS core to facilitate the delivery of the media stream according to network resources and parameters specified by users.

This architecture is fully compatible with the 3GPP IMS specifications [5], and allows for a fully personalised and interactive service.

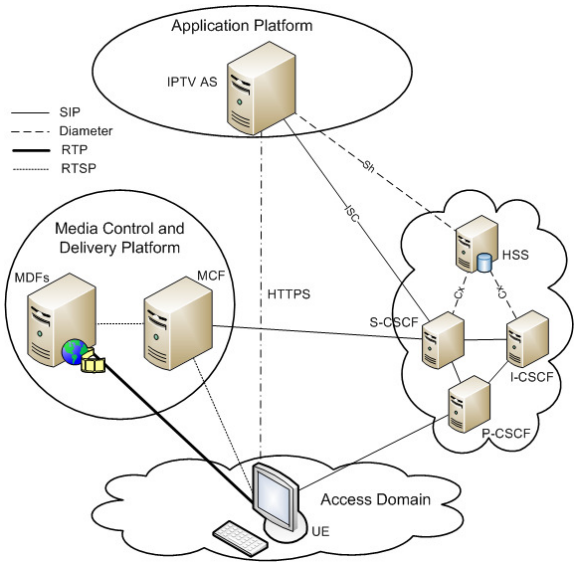

Fig. 1: ETSI TISPAN IMS-based IPTV architecture

C. *IPTV User Profiles*

Personalisation of services at the application level is possible in the IMS through the use of user profiles. IPTV related user profile information may enable users to receive

personalised electronic program guides (EPGs), advertisements and other communication services [4].

IPTV user profiles are similar to IMS user profiles and are stored in the HSS. There is an IPTV user profile for every user who subscribes to the IPTV service. This profile may be mapped to the default IMS user profile which contains information such as private and public user identities, authentication information, subscription information and filtering criteria. The IPTV user profile may contain details such as the user's age and gender. It also facilitates services such as parental control.

D. *Marketing Techniques*

Various marketing techniques exist which utilise channels like post boxes, telephony, email, print media and television broadcasts. Conventionally, these channels are used to implement mass marketing. The success of this marketing technique in relation to the cost which is incurred to send out broadcast messages can sometimes be worthwhile. For example, if a channel such as email is used the turnover could be quite high. However, when dealing with a premium marketing medium like television, the turnover may not always be worthwhile. Moreover, these marketing trends have the advertisements reaching unintended audiences; thus the cost of advertising on media like television doesn't tally with its effectiveness. With direct marketing, target viewers may be reached without incurring broadcast costs. Low advertisement costs would appeal to more companies and viewers do not receive irrelevant advertisements.

E. *Direct Marketing*

As mentioned earlier, direct marketing is a form of advertising where messages are delivered directly to consumers. Examples of this technique are flyers in your post box, marketing emails and television advertisements. However, these messages can sometimes be unsolicited. A perfect example of this is spam emails. What makes direct marketing so promising for personalised applications like IMS-based IPTV is that it has the potential to be directed at consumers with certain desirable characteristics. This means that the advertising messages will be delivered directly to the target market only, thus saving money on mass advertising. The integrity of IMS communications may ensure the prevention of spam advertisements. This characteristic would result in a higher turnover and is therefore much more attractive to marketers than the mass marketing model.

There are implementations of personalised advertising in the Internet. We see Google AdSense [6] which uses Google AdWords to place relevant text, image and video advertisements on websites; Yahoo! Search Marketing which is also a keyword-based pay per click Internet advertising service [7]; and Amazon's personalised advertising and recommendation system which uses distributed user profiles to achieve its personalised advertising [8]. Google and Yahoo's personalised advertising solutions are offered free of charge to website publishers and allow them and the company being advertised to earn on a pay per click basis. Amazon's solution is a more proprietary one, designed for the user's benefit and advertises other Amazon products which the user may be interested in, based on purchase and viewing history.

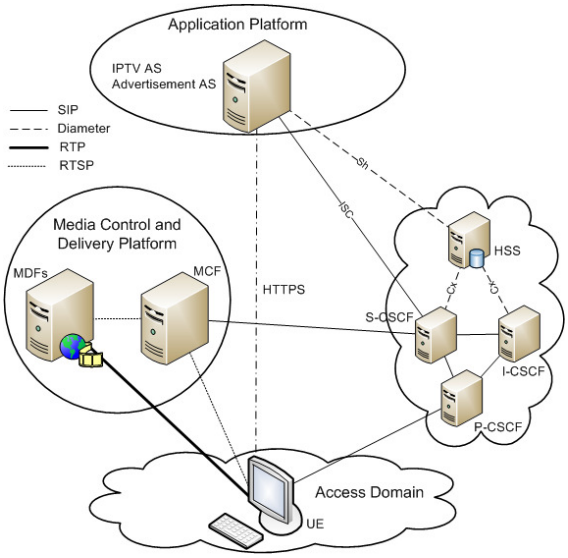

Fig. 2: Advertisement platform for IMS-based IPTV

III. Architectural Requirements for IMS-Based Direct Marketing

To offer an interactive and personalised application, certain architectural requirements are necessary. Firstly, a two-way communication system is needed between the client and the server to provide user intractability. This feature is inherent in all IMS communications. The IMS uses the Session Initiation Protocol (SIP), which is a peer-to-peer protocol. Furthermore, users require the capability to personalise services through modification of profiles stored in the HSS. These profiles contain each user's attributes that can be used to personalise the user experience.

Figure 2 illustrates the proposed architecture which is based on the ETSI TISPAN IMS-based IPTV architecture; it introduces an advertisement application server at the application plane embedded within the IPTV AS. The interfaces with the IPTV elements are shown in the diagram.

When the IPTV AS receives the forwarded service request message from the S-CSCF, it communicates with the HSS to authorise usage of the service. It then selects the MCF and MDF. But, instead of forwarding its response back to the S-CSCF as in the IPTV implementation, the Advertisement Application Server processes the SIP message further. It queries the HSS to retrieve the appropriate user profile information. With this information it runs an algorithm to categorise the user. Each category is then mapped to a group of advertisement IDs (Ad IDs) using a look-up table. Once these processes are complete, the request is sent back to the S-CSCF with the Ad IDs included in the optional attributes section of the SDP (Session Description Protocol) body in the SIP message.

When the message arrives at the MCF, the Ad IDs are used to amend the requested IPTV media stream to include the relevant advertisements selected by the Advertisement AS in the requested media stream.

The algorithm running on the Advertisement AS is a basic decision loop. The ASM (Algorithmic State Machine) diagram in Fig. 3 describes its operation. The figure shows a

simplified version that considers only two variables. As the number of variables increases, the complexity of the algorithm will grow exponentially.

The first decision is based on gender, thus two possible branches follow. These branches then categorise the user according to age and the loop exits. The resulting category has a gender and age group associated with it. These categories are predefined and entered in a look-up table. If no information is shared by the user, the algorithm will assign a generic category before exiting the loop.

Advertisements are matched to certain categories or combinations of categories before hand, by the marketer, and each advertisement is assigned an ID. These IDs are entered into the look-up table, stored in the Advertisement AS, under their associated category. Once a decision is made by the Advertisement AS to categorise the user, the relevant Ad IDs, retrieved from the look-up table, are added to the SDP body of the SIP message going to the S-CSCF. This information is extracted by the Media Server on receiving the SIP message. It is then used to control the adaptation of the media stream to include the selected, personalised advertisements.

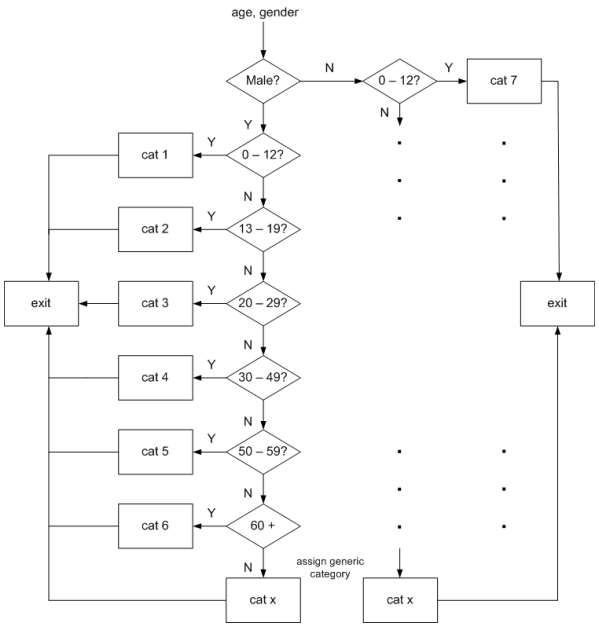

Fig. 3: Decision algorithm run by the Advertisement AS

IV. Implementation Considerations and Testbed Setup

The UCT IMS testbed is based on the FOKUS Open IMS Core [9]. This core provides all the call session control functions and a lightweight HSS. On the client side, the testbed makes use of the UCT IMS Client [10], which offers the necessary client side IMS features, such as registration, service selection, call setup, media preference settings and IPTV viewing.

The UCT Advanced IPTV system [11] requires a third party Real-time Session Protocol (RTSP) media server to deliver the media stream. The RTSP server implements the basic functions of the MCF and MDF. The IPTV Application Server is a SIP-based Indirection server implemented as a user agent. The architecture of the UCT Advanced IPTV AS is shown in Fig. 4. The user requests the IPTV service, e.g., a TV channel of the form *channel1@iptv-as.imsdomain.ims*, through the P-CSCF. At the S-CSCF, the request is forwarded to the IPTV AS based on an initial filter criterion (iFC) downloaded to the S-CSCF at user registration. The IPTV AS then performs a hash table look-up and replies with an RTSP address corresponding to the requested media. This is sent back to the user equipment, which then contacts the RTSP Media Server directly to retrieve the content. The UCT IMS Client also supports basic trick play functions.

In order to setup the proposed direct marketing framework in the UCT IMS testbed, certain enhancements are required. The enhancements are described together with likely performance impacts on the IPTV system in later sections.

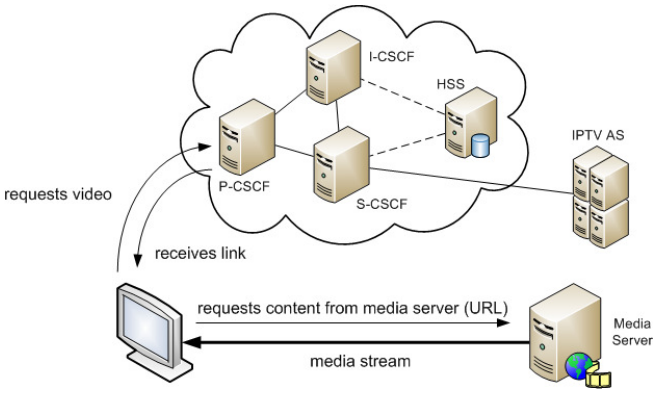

Fig. 4: UCT Advanced IPTV

A. User Profile Information

User profiles are to be stored in a Mysql database hosted on the same server as the HSS. The Advertisement AS would retrieve the user profile information from the repository. Users modify and send their profile information (i.e., age, gender, etc.) on the user equipment. A profile modification page on the UCT IMS Client is used to update user information. This information is then transported in the SDP body of the SIP INVITE messages at session setup. The information is included as optional attributes in the pre-conditions section of the SDP message. The information takes the form: '*a=gender:male*' for a male user, and '*a=gender:female*' for a female user. This information is extracted by the Advertisement AS and used by the customisation algorithm to categorise the user. The same INVITE message is used by the IPTV AS; this occurs before processing by the Advertisement AS. The IPTV AS performs its normal hash-table look-up to map the requested channel to the corresponding RTSP address. The RTSP address takes the form: *rtsp://media-server.tv.tv/media-file.*

B. Embedded Advertisement Application Server

The Advertisement Application Server is implemented as a part of the IPTV Application Server. Since the advertisement platform is based on the UCT IPTV setup, additional communication between the IPTV AS and Advertisement AS is eliminated. Moreover, processing of SIP INVITE messages is done sequentially for every request

at the IPTV AS. Using the UCT Advanced Indirection server for IPTV and advertisements enables the combining of the RTSP session information with an advertisement ID.

C. Implementation of the Advertisement System

The personalised advertisement algorithm uses a timer to schedule additional advertisements that would be sent to the UE during the lifetime of a TV session. Upon receipt of the channel request message at the IPTV and Advertisement AS, the timer is started. At the expiry of a timeout period (e.g., 10 minutes), the advertisement algorithm retrieves another Ad ID for that category of user. A SIP (advertisement) message is then sent to the UE, containing the RTSP address of the advertisement. This is a unicast message, sent to the UE.

At the UE, the advertisement would appear as a banner across the bottom of the screen with text describing the product or service and prompts the user to click on an RTSP link to view the video advertisement. In this way, the advertisements are non invasive, hence not degrading the users Quality of Experience (QoE). If the user clicks on the link, the IPTV content is paused and the advertisement is streamed to the user directly from the Media Server. If the user does not click on the link, the advertisement expires after 30 seconds and the banner is removed from the screen. The IPTV AS is notified when the user clicks on the link in order to implement discounts or charging changes, depending on the advertised product. Typical signalling call flows for an IPTV system with and without advertisements are shown in Fig. 5 and Fig. 6 respectively.

V. Testbed Validation and Evaluation

The enhancements required on the Advanced IPTV AS will not result in major performance degradation of the IMS procedures. This is because the proposed framework does not add any severe additional overhead or processing needs to the current IPTV setup. Similarly, the testbed setup does not add any major processing overhead load.

An evaluation of the effectiveness of direct marketing using the proposed framework may only be done by actual product marketers and telcos. However, it is expected that an IPTV based direct marketing system will boost marketing effects and minimise related costs. In the implemented IPTV based system some tests were done.

In order to perform proof of concept tests in the testbed described in the previous section, certain use case scenarios are explored. In each of these scenarios, a number of parameters can be tested, namely: user registration delay, session setup delay, channel change delay, the effectiveness of the algorithm to categorise the users correctly and the effectiveness of the media server to add the correct advertisements to the media stream.

A useful parameter to measure the success of the framework as a whole is to look at the user's QoE. There are standard delays which are typically expected in IPTV services. In order to achieve an acceptable user QoE, these delays should not be exceeded. Table 1 shows some typical latencies for VoD (Video on Demand) [4] which is one of the available IMS-based IPTV services. The other services which are available are broadcast services such as live TV and PVR services [3].

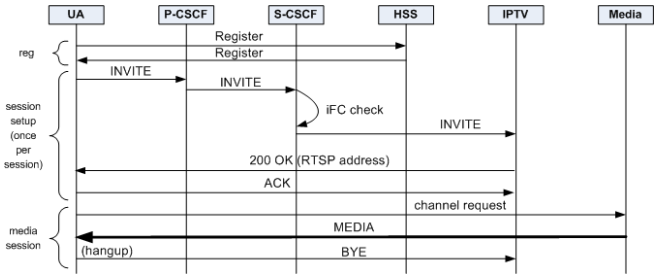

Fig. 5: UCT Advanced IPTV call flow

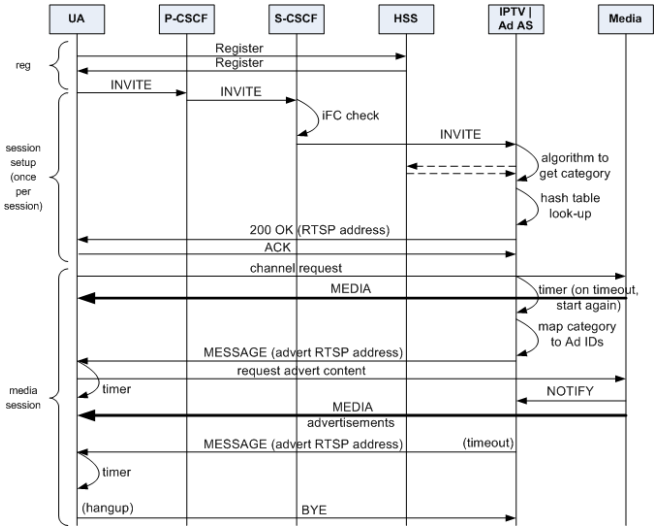

Fig. 6: Advertisement framework in UCT IPTV call flow

TABLE I
Typical Latencies for VoD Functionalities

Function	Elapsed Time (seconds)
UE registration	0.8
IPTV service subscription	1.3
VoD access	< 5
Channel change	0.4

A. Scenario 1 – No advertisements are clicked on

In this scenario, an IPTV session is setup and content is requested by the user. The user then views the IPTV content and a banner advertisement appears on the screen after the timeout period. However, the user does not click on the RTSP link. The expected result is for the banner to disappear after 30 seconds and the user should be able to continuously view the requested media with the banner advertisements appearing and disappearing with no degradation of the IPTV user experience.

B. Scenario 2 – Advertisements are viewed but with no profile changes

In this scenario, the user clicks on the RTSP link in the banner advertisement. The expected result is for the IPTV content to be paused when the advertisement is responded to by the user. The IPTV media should then automatically

resume playback when the user has viewed the complete advertisement. In this scenario, there are no changes to the user profile. No banners should be displayed while viewing advertisement content. It must be insured that the advertisement cannot be skipped once the user has clicked on the RTSP link.

C. Scenario 3 – Advertisements are viewed with profile change(s)

This scenario is similar to scenario 2; however, the advertisement in the banner offers a charging discount on the IPTV service if the advertisement is viewed. The expected result is therefore similar, but changes in the user's charging profile should be correctly recorded.

Tests are currently underway. The expected results are promising due to the low overhead which is added to the SIP messages. It is expected that the latencies will be within the constraints outlined in table 1 and the algorithm will correctly categorise the users based on the information received by the Advertisement AS. Preliminary results involving the UCT IPTV server with the addition of functionality like charging are shown in Fig. 7. It can be seen that although some additional latency is observed with call setup, the user's QoE was not noticeably affected.

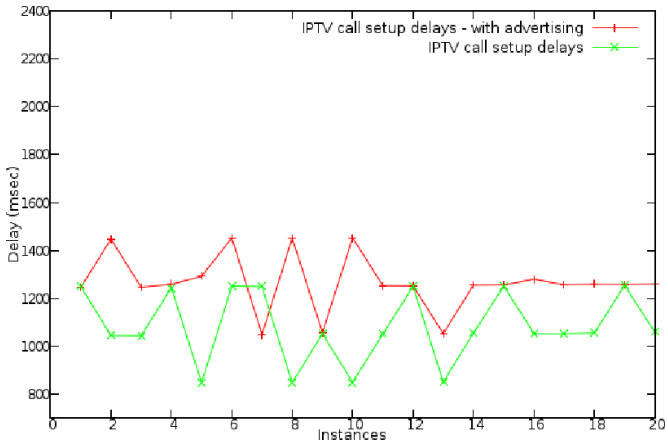

Fig. 7: IPTV and Advertisement Services session setup delays

VI. Conclusions and Future Work

It is clear that telcos require incentives to invest in NGN rollout with the current decline in the ARPU and the absence of a "killer application" with IMS. A direct marketing platform for personalised and interactive multimedia applications like IMS-based IPTV is a worthy incentive due to the promise of higher turnover over traditional mass marketing techniques.

This paper proposed an Advertisement AS to interact with current IPTV servers to provide a direct marketing solution. This system delivers personalised advertisements to the user upon service request and schedules subsequent advertisements during the lifetime of an active session. The IMS service delivery platform is capable of offering such a personalised and interactive platform.

The implementation framework was achieved according to the UCT IMS testbed layout. The enhancements required on the UCT Advanced IPTV server to implement the Advertisement AS have been carefully considered in order to ensure minimised impact on the user's QoE. Tests are currently underway as more functionality is added to the advertisement system.

Future work includes completing the tests for each scenario. Once complete, the results will be analysed and possible improvements identified. Any further future work will be dedicated to improving the framework by offering additional features. These features will be added to the profile modification page on the UCT IMS Client. One possibility is a drop down menu where users may choose between different charging profiles. An implementation of this in the UCT IMS testbed is currently being evaluated. This feature can be interworked with the advertisement platform to ensure that a higher charging profile corresponds to fewer advertisements, i.e. a higher timeout value. A second addition would be to base the algorithm not only on the user's age and gender, but also on attributes such as marital status, income bracket and interests. Hence, a more intelligent advertisement system will be created.

This paper has made apparent, not only the need for such a marketing platform in IMS-based IPTV, but also the need to explore the topic further.

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