Personalised Placement in Networked Video

Jeremy Foss
School of Digital Media Technology
Birmingham City University
Birmingham, UK
+44 121 331 7416
jeremy.foss@bcu.ac.uk

Benedita Malheiro
Engineering Institute of Porto
Polytechnic Institute of Porto
Porto, Portugal
+351 228 340 500
mbm@isep.ipp.pt

Juan Carlos Burguillo
Telecommunication Engineering School
University of Vigo
Vigo, Spain
+34 986 813869
J.C.Burguillo@det.uvigo.es

ABSTRACT

Personalised video can be achieved by inserting objects into a video play-out according to the viewer's profile. Content which has been authored and produced for general broadcast can take on additional commercial service features when personalised either for individual viewers or for groups of viewers participating in entertainment, training, gaming or informational activities. Although several scenarios and use-cases can be envisaged, we are focussed on the application of personalised product placement. Targeted advertising and product placement are currently garnering intense interest in the commercial networked media industries. Personalisation of product placement is a relevant and timely service for next generation online marketing and advertising and for many other revenue generating interactive services.

This paper discusses the acquisition and insertion of media objects into a TV video play-out stream where the objects are determined by the profile of the viewer. The technology is based on MPEG-4 standards using object based video and MPEG-7 for metadata. No proprietary technology or protocol is proposed. To trade the objects into the video play-out, a Software-as-a-Service brokerage platform based on intelligent agent technology is adopted. Agencies, libraries and service providers are represented in a commercial negotiation to facilitate the contractual selection and usage of objects to be inserted into the video play-out.

Categories and Subject Descriptors

H.3.4 [**Information Systems**]: Systems and Software, Distributed systems, User profiles; H.5.1 [**Information Systems**]: Multimedia Information Systems; I.2.11 [**Computing Methodologies**]: Distributed Artificial Intelligence.

General Terms

Video, personalization, near real time.

Keywords

Personalisation; targeted advertising; interactive TV; object based video; metadata, multi-agent brokerage system.

1. INTRODUCTION

Personalisation of content is an increasing requirement to engage and narrow-cast (or niche-cast) to end-user consumers [1], [2]. The commercial media distribution industry is currently focussing on targeted advertising with projected revenue increases of several times the revenues of traditional spread-shot advertising. Product placement is now becoming an accepted method of advertising, although the current methods are not on a personalised basis. The continued integration of interactive services with networked video allows service providers an increasing capability to capture viewer usage habits, including Video on Demand (VoD) statistics and interactions, and potentially data gathered from Internet usage, *e.g.*, wish-lists, purchases and profiles from selected on line stores, social media interaction, *etc.*

The project described here focuses on two main aspects: (*i*) the video network and technologies to allow the integration of arbitrary external objects into the video play-out; and (*ii*) the commercial platform to allow objects to be selected and integrated into the original source content according to the viewer profile. This is a complex task considering the knowledge management effort required to process the various streams of information to achieve a high degree of personalisation. These two development aspects are discussed below to produce a solution for personalised placement of objects into networked media.

Figure 1 demonstrates the principle whereby objects hosted from independent libraries (*e.g.* content producer agencies) are sought and integrated into the source play-out programme. The scenario used to illustrate the concept is the personalisation of advertising content. In this context, content producers are advertising agencies eager to place advertising artefacts in the video streams of target viewers. Content distributors are video on demand providers that intend to offer viewers a personalised advertising experience. To achieve this goal, distributors have to build and maintain the viewer profiles. In this scenario there is a requirement for a sports car to be placed in to the scene. In a search for a suitable "sports car" video object, the library has a suitable match, so the object is selected and imported into the programme stream. The suitability of the match depends largely on the profile and the known personal preferences of the viewer. However, the sourced content may specify (via the metadata of the source file) that only specific classes of sports car are allowed. For example, to fit the editorial integrity of the programme, cars of a certain year of manufacture or colour may not fit the story line of the film. This is specified as a requirement and will be taken into account when the selection is made for a "sports car" object from external libraries. There would likely be a fee to be negotiated and paid by any agency wishing to have artefacts (objects representing their clients' advertising repertoire) placed into to a video play-out. Consequently a commercial brokerage of the objects is envisaged where objects are sought and traded in to the play-out in near-real time.

Clearly some objects are easier to integrate into a video scene than others. Static objects, *e.g.* a bottle of wine on a dining table, are relatively easy. The sports car example given above may be somewhat challenging if the car is in motion and undergoing many perspective changes throughout a scene.

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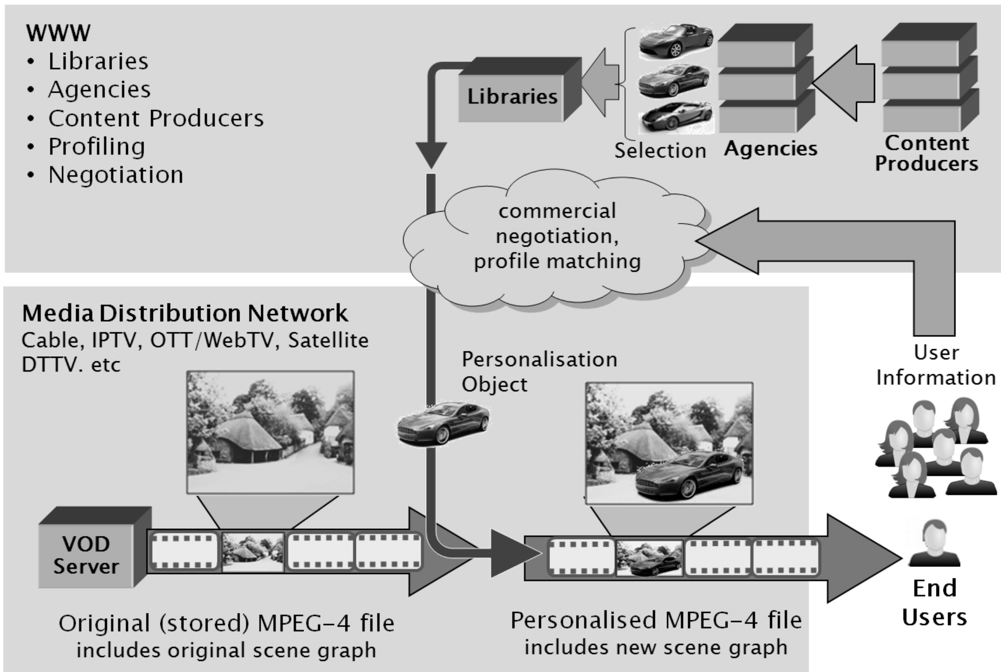

Figure 1. Objects can be acquired from a library and inserted into the source play-out

Video producers may shoot and edit programmes to allow for easier object integration, depending on the development of video processing technologies to allow for the seamless addition of object into a scene. Such considerations include the resolution of the added objects, lighting, dynamics, *etc.*

1.1 Video Technology for Integrating Objects

Apart from more efficient video compression, MPEG-4 [3] is specified to offer object based media components representing 2D and 3D graphics, audio and video (*e.g.*, sprites) [4]. Media objects are compressed and coded into the play-out file for transmission to the viewer. For commercial media distribution, the MPEG-4 file is served as part of a VoD service operator's network. Alternatives to MPEG-4 are also considered and will be briefly discussed in section 2.2.

In Digital Multimedia Broadcasting (DMB)[1] media objects can be assigned characteristics to potentially allow interaction, for example, allowing viewers to select objects and link to services (*e.g.*, Web sites) external to the presentation. In this paper we propose that this interactivity also allows personalisation of TV services. "Objects" may be arbitrary shaped video objects [5] which are video files to be multiplexed with other objects and the source streamed from the head-end.

In a typical DMB implementation, video objects are transmitted in a multiplex according to the Delivery Multimedia Integration Framework (DMIF) – MPEG-4 Part 6 [6]. Objects exist in relation to the time and dimensional space of the frame and these parameters are related to the video scene by the Binary Interchange Format (BIFS) – MPEG-4 Part 11 [7]; this is referred to as the "scene graph". For mobile rich media these relationships are related in the Lightweight Application Scene Representation (LASeR) – MPEG-4 Part 20 [7]. At the viewer-side equipment (*i.e.*, computer or set-top box), the objects will be re-assembled into the desired scene for playback to the viewer interface. Objects may be given specific properties, *e.g.*, for viewer interaction.

Personalisation of video can be achieved by selecting objects from an external library and integrating them into the "source video" play-out. Here, the term "source video" is the programme content stored in the video head-end.

To allow for the personalisation of the source programme, the content would be produced with suitable spaces where imported objects may be placed. The spaces are "placeholders" defined in the source video and its metadata. The properties of the placeholder define the type of object which may be inserted and would be in accordance with the editorial integrity of the content as specified by the producer of the source video. The metadata of the source content describes the restrictions and requirements of the objects sought for integration into the content. These objects would be stored in separate libraries by content producer agencies and would be made available for integration into any suitable source video. In a full commercial operation such libraries would be operated by third parties and used by, *e.g.*, advertising agencies to store their clients' artefacts for future placement.

Objects are described by their own metadata. Each "placeholder" in the source video would require an object to be sought, negotiated and integrated into the source. When a play-out request is made, the metadata of both the source programme and the external additional objects is utilised along with the profile of the viewer and a selection is made for suitable objects to import into the source stream.

For conventional MPEG-4 object based video, the original play-out programme consists of existing objects and scenes; these are related to each other by the scene graph. The receiving set-top box (or other platform) uses the scene graph to align the objects for synchronised playback to the viewer. To allow for the personalisation of broadcast content, the scene graph would be updated to include references to the added objects. Consequently, the "placeholders" are identified as such in the original scene

[1] WorldDMB: http://www.worlddab.org/about_worlddmb

graph and will be populated when the specific objects have been successfully traded in to the programme for transmission to the viewer. The viewer-side equipment will utilise the scene graph to assemble the personalised program.

There are several possible variations to this process: (*i*) existing objects in the source video can be extracted and replaced with externally sourced objects; (*ii*) personalisation may refer to a group of viewers acting as a viewer group; and (*iii*) the source content may be scanned for suitable (undefined) spaces where objects may be inserted, although this may be precluded by the author of the source video to prevent any insertions which contravene the editorial or artistic requirements of the original programme.

1.2 Personalisation and Filtering

Nowadays, there are several techniques for filtering and personalization of contents:

- Content-based Filtering (CBF) uses the description of the resource and the viewer's interests to provide recommendations [9]. These recommendations do not take care about the information provided by other viewers; therefore the description of the resources is really relevant to provide precise recommendations.
- Collaborative Filtering (CF) techniques usually consider the comparison of ratings, provided by the viewers to the resources, with other similar viewers (concerning their profile) in order to produce recommendations. Viewer-based valuations or resource-based valuations are the two main alternatives in this approach. Recently, some hybrid approximations have been proposed, that usually are a combination of content recommendation and collaborative filtering [10], [11].
- Collaborative Tagging (CT) systems allow viewers to describe contents by means of tags and to share such description. These systems generate two different types of structures: tag clouds and folksonomies [12]. These structures can be used for content recommendation, and we can distinguish between two different approaches: (*i*) systems that use tagging information to improve recommendation algorithms [10], where we can find the ones that consider the number of resources tagged and the numbers of tags used [12]; and (*ii*) applications where only tagging information is used for recommendation [11].
- The Case-based Reasoning (CBR) paradigm covers a range of different methods for organizing, retrieving, utilizing and indexing the knowledge retained in past cases [14]. The CBR approach performs inexact reasoning based on the determination of the similarity between cases and includes four phases: retrieve, reuse, revise and retain. Basically, the system retrieves previous cases similar to the new one presented, reuses the closer ones (adapting them to the new context), revises the proposed solution(s) and, finally, if it was successful, retains the new solution for future use. Cases may be kept as concrete experiences or a set of similar cases may form a generalized case. CBR techniques provide a good solution to suggest recommendations that worked well in the past, taking into account the viewer context, the viewer profile and the resource descriptions.

2. NETWORK ARCHITECTURE

The proposed architecture for networked video personalised placement in is depicted in Figure 2. This multi-tier architecture is constituted of four main tiers: the content production tier, the content distribution tier, the content consumption tier and the artefact brokerage tier. The key players are the producers, the distributors and the viewers.

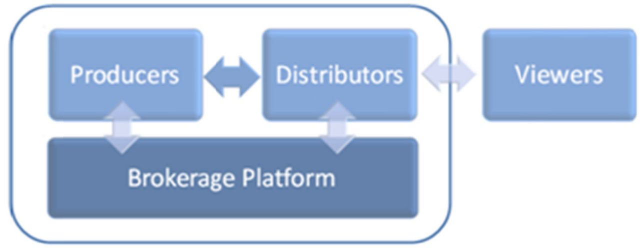

Figure 2. Personalised placement overview

End-user clients (PC clients, set-top boxes) need to support object processing, *e.g.*, decoding and rendering needs to be supported in advanced codecs. However, these developments will occur as a matter of course and are not limited to the proposals in this paper. Potential network implementations are discussed below, although the precise configuration is likely to be part of an ad-insertion section in the network. All current video distribution formats would be feasible, including Satellite TV, Cable TV, Cable Internet Protocol TV (IPTV), Telco IPTV, WebTV and Digital Terrestrial TV. The video head-end will be unaffected by the requirement to host the source content stream.

2.1 Dynamic Object Integration

Although the source files contain the placeholders for imported objects, the proposed architecture multiplexes programmes in a conventional manner. Object integration is achieved as shown in Figure 3. The content (*i.e.*, VoD) server hosts the source video which contains the original scene graph stating the position and details of reserved spaces into which objects may be imported.

The objects are to be selected and served via an associated broadband access from the set-top box to the Web-based brokerage platform and object servers. The set-top box can now assemble the source and the objects into the required play-out according to the personalised graph. In this architecture, unless objects are actually to be transmitted via satellite link for other reasons, there is no requirement for MPEG-4 Part-6 DMIF transmultiplexing.

The set-top box can adopt several strategies to define the content of the user play-out stream: (*i*) select, when default objects are transmitted, between the original source with the default objects and the personalised stream with the user-specific objects; or (*ii*) self-select (or user-select) from a group of pre-selected objects for more immediate context-specific reasons.

There is also the option for the object selection and transmission to be associated with the conditional access data as part of the user access to protected programme content. In both proposed architectures there are no proprietary coding standards and no development to existing head-ends. Consequently, implementation of the service is easily achievable in existing network deployments. The process is perfectly feasible in near-real-time.

2.2 Alternative Video Technologies

MPEG-4 has been initially considered due to its predominance in major TV distribution networks. However, an increasing amount of video distribution is done via the Web, especially Web-based "over the top" (OTT) TV play-outs, with a predicted increase in the use of VP8 video coding. MPEG patent issues may complicate the use of scene-graph and transmultiplexing for object-based VP8 applications. Such content description and control allows editorial integrity which may or may not be an issue, depending on the view taken by content producers. Ideally they would retain full control

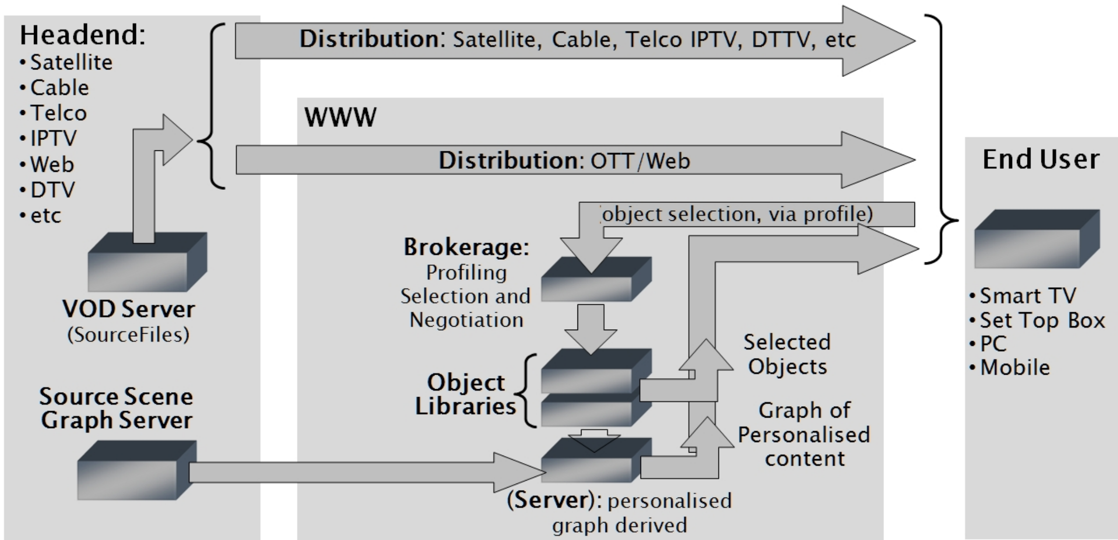

Figure 3. Network Architecture for a range of distribution formats

to restrict the types of objects traded in to their programmes. So, Web-based TV applications would still allow the brokerage of arbitrary objects into prepared source video content. Although technical development is feasible, one of the main issues is likely to be patents.

3. TRADED MEDIA COMPONENTS

In the scenarios envisaged here, objects are imported into predefined positions given by the scene graph of the source programme video. These imported objects have been defined externally to the source video capture and coding and may even belong to another presentation.

Objects are sourced from libraries of objects made available for trading by content producers. A likely business model is that the libraries are third party operated repositories and are populated by the object assets of, *e.g.*, advertising agencies where the objects represent the advertised merchandise or services. In this case, a number of advertising agencies are utilising the libraries for this purpose.

3.1 Networked Libraries and Brokerage

If media objects are to be utilised in this manner, we can consider the evolution of a more sophisticated and complex media market. Extending the scenario given in Figure 1, consider that the viewer of the programme has a profile known to the service operator which is likely to be based on previous viewing history, *etc*. This profile determines exactly which object is to be selected from a range of possible libraries. This activity would likely take place in a commercial environment in which the objects are traded (possibly in near-real time) from a library which provides the suitable object for an agreed contract and associated service level agreements.

In this scenario it is possible that the object could be selected from a trawl of a number of libraries. Content metadata is required to describe (*i*) the objects available in the libraries and (*ii*) the requirements of the video stream requesting the object. It is also likely that there is a commercial value attached to the objects, depending on the type of interactive service being offered. For example, if the video stream requires an object for an interactive service requested by the viewer, the object may attract a contractual usage fee, *i.e.*, an entertainment agency is paid for the usage. However, if the service is to place an object into the video stream for the purpose of advertising to the viewer, then there is a value to an agency (*e.g.*, an advertising agency) in placing the object into the stream. Consequently, there is a two way negotiation involved in the acquisition and usage of an object from a library.

Libraries would therefore be populated with video objects uploaded by content producers, advertising agencies, *etc*. The objects carry play-out rights to be negotiated as they are required.

Due to the growing interest of video content producers and distributors in personalised product placement, this proposal is also concerned with seamless interoperability, scalability and accessibility. For this reason the brokerage platform is offered as a Software-as-a-Service (SaaS), Service-Oriented Architecture (SOA) component with Web service interfaces, embracing simultaneously the Cloud and the Service computing paradigms. A similar approach has been proposed [16]. Whereas the "Cloud" provides computing and data storage services anywhere, anytime through a very robust infrastructure based on virtualization technologies, SOA facilitates interoperable services between distributed systems to communicate and exchange data with one another, thus providing a uniform means for service users and providers to discover and offer services [17].

3.2 Personalised Product Placement Service

Targeted advertising is now one of the main investment areas for commercial TV distributors. For example, Packet Vision provides technology for targeted advertising in IPTV based on viewer profiles. They claim that "the average increase in the value of a targeted ad spot is at least 50 %" [18]. They also claim a better viewer experience (because it is more relevant).

However, it is likely that advertisements will become increasingly personalised, sophisticated, and will find their way into the main programme content. Personalised product placement is a consequence of this. For example, a media object specifically selected based on the viewer profile is acquired following negotiation for contractual usage fees and integrated into the content at an appropriate position in the programme.

It is significant to note that product placement has been under great debate. Recently, the UK regulatory body Ofcom has withdrawn restrictions on product placement and this practice is set to continue. One of the driving forces is the requirement to fund the large growth in TV channels.

Whilst the majority of TV delivery is via satellite, cable and terrestrial TV, Telecommunications operators (Telcos) are moving into the TV delivery market to maintain the revenue growth of their broadband installations. This has resulted in the growth of IPTV in the Telco market and is now driving cable TV providers towards an all IP platform, including their own IPTV service [19], [20].

The advantage of all-IP platforms is the integration of all user services (including Web browsing and voice services). This allows user data to be collected and processed, resulting in user profiling. The next growth area for TV delivery is increasingly personalised services. Targeted advertising is currently an area of massive investment.

3.3 Further Commercial Services

Beyond the product placement scenario, we envisage group viewing, training, education, social networked user generated content or culture-based personalization as potential future commercial services. The interactivity of personalised services allows groups of viewers to be addressed by content personalised to the group rather than the individual, allowing more sophisticated group-working and group-entertainment activities. Informational content, training and education are areas likely to benefit from the personalisation of content. For example, training video content may adapt to the attainment levels achieved by the individual, or adapted to an individual's context, location, *etc.* The inserted personalised clips may also be from user generated content derived within a social networking group or circle allowing group-authored and shared content. Finally, objects can be replaced depending on the cultural traditions of the viewer audience, *e.g.*, the removal of alcoholic content from a video scene.

In many of these examples existing content is reused for different target audiences. It also allows content to maintain topicality, freshness and avoid obsolescence.

4. VIEWER PROFILING

In order to achieve a good viewer profiling and to provide the best possible object insertion experience, we consider a combination of the techniques described in section 1.2 . Under this approach, we will explore new combinations of those isolated techniques that we have applied successfully to other contexts in the past ([21], [22], [23], [16]), adapting them to the particularities of the media scenario.

The approach we propose considers the creation and maintenance of viewers' profiles as CBR cases containing information about personal, social, professional, cultural, political or religious data. On the one hand, the use of CBR techniques can be very useful when managing ontologies and semantic data. On the other hand, with Web 2.0, profiling has evolved from an individual to a social activity, allowing the profile of any viewer to be enhanced by social networking, especially by means of folksonomies that emerge thanks to the use of collaborative tagging [22]. These tags are used to compose three different tag clouds, which are used to calculate the recommendations:

- The **user tag cloud** (Figure 4) contains all the tags provided by the user weighted by the ratings he/she has provided; *i.e.*, the higher the number of times the user has used a tag to describe a video and the higher the ratings he/she has given to that video, the higher the weight of the tag in the tag cloud.
- The **video tag cloud** (Figure 4) contains all the tags users have provided to describe a particular video. The higher the number of users who have described this video with a particular tag, the higher the weight of this tag in the tag cloud.
- The **target user tag cloud** (Figure 4) belongs to a video and it describes the tag cloud that the perfect visitor of this video should have. This tag cloud is composed from the tag clouds of the users who have rated this attraction weighted by the given ratings.
- Finally, a **group tag cloud** can be constructed considering the sets of tags from a group of users in order to recommend video contents that can be suitable for the whole set of users.

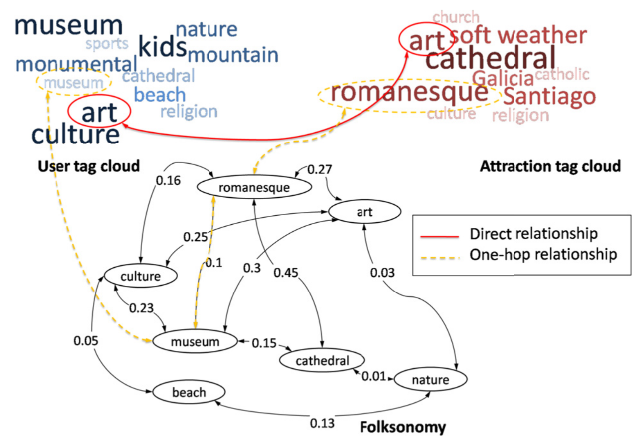

Figure 4. Social content-based filtering

Altogether, a folksonomy (bottom of Figure 4) is created as an undirected graph where nodes are the tags in the system and arcs represent the relationships between the tags they link [21]. This relation is increased every time two tags appear together in a video tag cloud. Hence, this structure reflects the relationships among the tags of the system.

Therefore, in order to find the best possible objects to insert within the main stream, we model every viewer as a CBR case that contains all his/her personal and semantic data together with his tag cloud resulting from his social interactions in the Web site of the content distributor provider or from the previous selection of video streams he/she has done. From all this data, a CBR engine will use classical filtering techniques [21] enhanced with collaborative tagging [22] to search for recommended objects to be inserted. In case that the objects are distributed over a set of databases, we can follow a P2P scheme as the one that we describe in [20] to perform the distributed search, selecting the most appropriate objects concerning their characteristics and the viewer profile.

The viewer profiling activity is carried out by profiler agents launched by the distributors to monitor all relevant viewer interactions – see Figure 5.

By relevant interactions we mean all types of viewer interaction that can be filtered by the distributor: selected video streams, Internet browsing activity, social networking, *etc.* The profiler agents rely on the proposed approaches to create and maintain the individual viewer profiles.

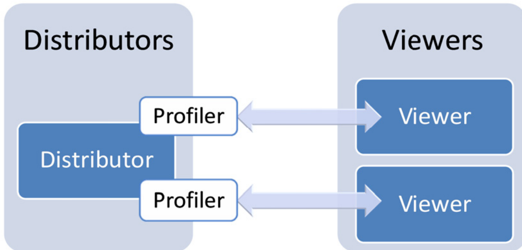

Figure 5. Viewer profiling

5. BROKERAGE PLATFORM

An overview of the platform is shown in Figure 6. The artefact brokerage tier is responsible for the dynamic selection of the objects to be inserted in the viewer play-out stream. This is achieved through automated agent-based negotiation involving the video content producers and distributors. This functionality is exposed to the involved parties as a Software-as-a-Service component. A service-centric model is proposed to provide producers and distributors an automated negotiation service based on Web Service interfaces, SOA and SaaS approach. Such combination is, according to [24], an interesting attempt to combine the strengths of SOA, Web Services, agent-based systems and instant messaging technologies. The idea of developing a multi-agent automated negotiation system integrated in a service-oriented architecture is feasible and meaningful for e-commerce oriented intelligent trading applications [25].

The producers and distributors of media content are modelled by autonomous intelligent agents. These so-called enterprise agents must, on one hand, be entirely controlled by their real world counterparts to ensure the privacy of the company strategic knowledge and, on the other hand, be fully compatible and interoperable with the remaining components of the framework. The latter is achieved by the adoption of a Web Service interface guaranteeing interoperability and allowing the creation of loosely coupled enterprise agents that can enter and leave freely the proposed transaction environment. The resulting SOA relies on Universal Description, Discovery and Integration (UDDI) service registries to hold the descriptions of existing agent services. On one hand, producers and distributors can publish, update and remove their service descriptions – metadata descriptions of the objects they hold or seek to insert in the viewer stream. On the other hand, any entity can discover, download and interact with any service (agent) automatically. Distributors and producers negotiate the price of programme timeslots.

All video objects are MPEG-4 instances annotated in an MPEG-7 based OWL ontology. This applies both to the source video objects (the viewer-selected video streams) and to the external video objects (automatically selected and inserted by this framework).

The brokerage platform is a competitive Multi-Agent System (MAS) where enterprise agents (producers and distributors) and market regulator meet in order to trade media components according to the market profiles of the agents and the rules of the market. The resulting MAS, which is structured in three layers, is composed of:

- Enterprise Interface Agents that constitute the interface of producers and distributors with the platform. They are responsible for taking the inputs, spawning or reconfiguring the enterprise agent accordingly and reporting back the results. Each company can specify new media objects, create and update viewer profiles and define and refine the enterprise market behaviour.
- Enterprise Agents that represent producers and distributors within the platform. These coarse grain agents are configured via the corresponding Enterprise Interface Agents. They participate, upon invitation, in specific negotiations by launching delegate agents at the marketplace.
- Market Profiler Agent that is the administrator of the platform, *e.g.*, specifies the negotiation protocols available.
- Enterprise Delegate Agents that are small grain agents responsible for trading programme timeslots on behalf of Enterprise Agents at the marketplace. Their ephemeral life terminates upon success or failure in the negotiation round for which they were invited to participate.
- Market Agent that governs the marketplace. Delegate Enterprise Agents are required to register with the Market Agent in order to participate in any negotiation.

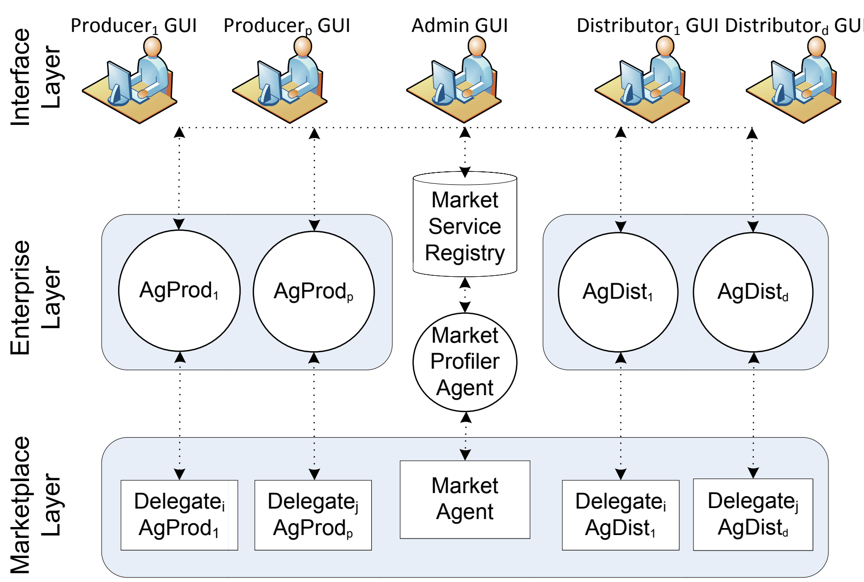

Figure 6. Brokerage platform

The top layer – the Interface Layer – is composed by enterprise interface agents, including the platform administration interface agent; the middle layer – the Enterprise Layer – holds coarse grain agents representing producer and distributor enterprise agents as well as the market profiler agent; and the bottom layer – the Marketplace Layer – contains finer grain delegate agents and the market agent.

The MAS brokerage platform is being implemented using the Java Agent Development Framework (JADE), the Web Service Integration Gateway (WSIG) add-on, the Web Service Dynamic Client (WSDC) add-on and the UDDI4J API to interact with Web Services. The UDDI service registry used is jUDDI, an open source Java implementation of the UDDI specification for Web Services. All interlayer communication is achieved through the Web Service interfaces.

5.1 Personalisation of Advertising Content

Suppose there are three content producer enterprises (advertising agencies) – *bcu*, *uvigo* and *tum* – and a content distributor enterprise – *isep* – registered at the platform. Furthermore, *isep* is looking for an ad alignment for a viewer with a strong sports profile and an expressed interest in cars.

The content distributor, triggered by this need, searches the UDDI registry for appropriate content producers, finds *bcu*, *uvigo* and *tum* and invites them for a negotiation round using the Iterated Contract Net negotiation protocol (ICNET) [26].

Upon acceptance, four new delegate agents are launched at the marketplace layer: (*i*) *isep_convertible_delegate* representing the *isep*'s viewer ad alignment; (*ii*) *bcu_jaguar_convertible_delegate* representing the convertible ad proposed by *bcu*'s agency; (*iii*) *tum_bmw_convertible_delegate* representing *tum*'s convertible ad; and (*iv*) *uvigo_citroen_convertible_delegate* representing *uvigo*'s convertible ad. Figure 7 shows the enterprise agents Graphical User Interface (GUI) and the list of enterprise and delegate agents in the platform.

The first action of each delegate is to contact the master enterprise agent and download his negotiation profile. In this example, the negotiation profile includes, among other features the negotiation protocol, minimum price per second, maximum price per second, price adjustment tactic, *etc.* The three advertising agencies have identical price per second boundaries, but different price adjustment tactics, resulting in diverse negotiation profiles: *bcu* has an exponential price adjustment tactic, *uvigo* a linear price adjustment tactic and *tum* a random price adjustment tactic.

The *isep_convertible_delegate* takes the role of the ICNET initiator, issuing calls for proposals, and the *bcu*, *uvigo* and *tum* delegates the role of proposal proponents. When the negotiation round finishes, all delegates report back their results to the corresponding enterprise agents. The initiator agent – *isep_convertible_delegate* – accepts the highest proposal that satisfies his minimum price per second value and rejects all proposals that do not meet this criterion. In this example, the winner was *bcu* with an exponential price per second adjustment tactic.

Figure 8 shows the behaviour of the different delegates in the marketplace.

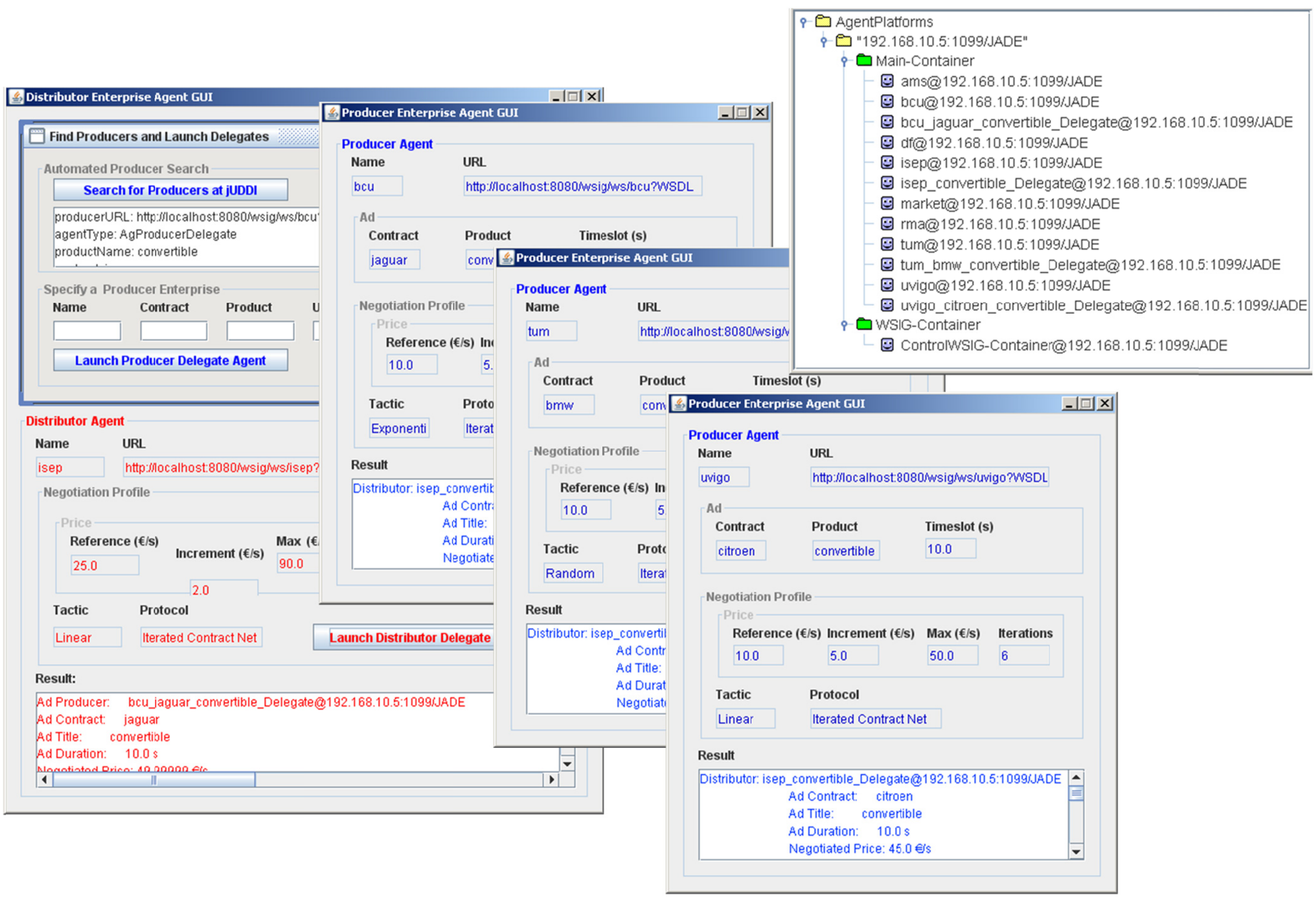

Figure 7. Enterprise agents and the list of JADE agents

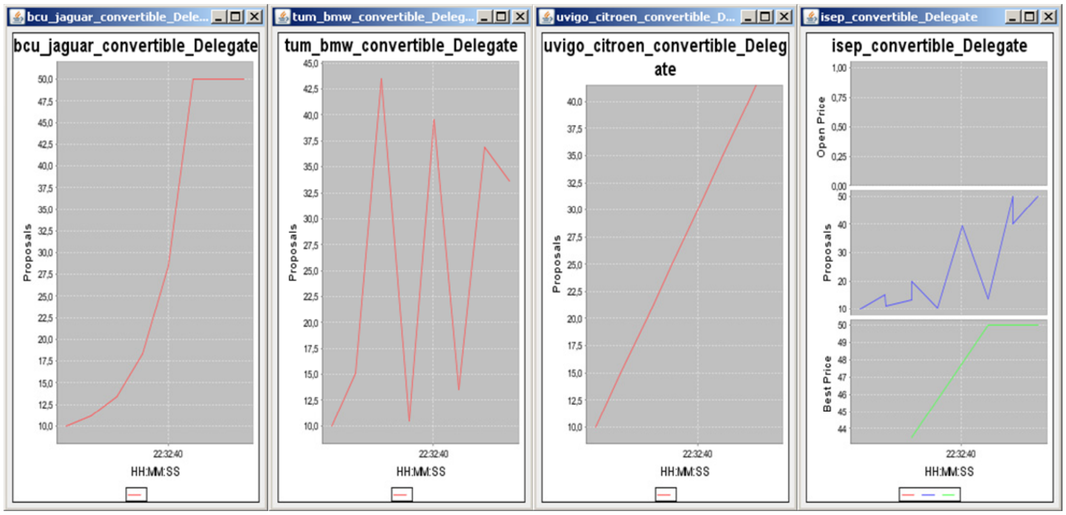

Figure 8. Delegate agents negotiation behaviour

6. CONCLUSIONS

This proposal for personalised video is based on the viewer's current profile and context (the programme selected, the location, the day of the week, the season, *etc.*) and is achieved through the automated insertion of dynamically selected video objects into the viewer's play-out stream. The proposals here allow an automated (and near real-time) approach to the personalisation and adaption of networked video.

We are focussed on the personalised product placement scenario, which is a relevant and timely service for next generation online marketing and advertising, although a number of other commercial personalised video services are equally applicable. Our approach is based on MPEG-4 standards using object based video and utilising MPEG-7 for metadata storage. All major TV distribution formats are achievable with the architectures addressed in these proposals, and no proprietary technology or protocol is proposed.

To trade the objects into the video play-out, we adopt a brokerage platform based on intelligent agent technology that is exposed as a Software-as-a-Service component, ensuring interoperability and allowing the migration of the platform into the Cloud. Agencies, libraries and service providers are represented in a commercial negotiation to facilitate the contractual selection and usage of objects to be inserted into the video play-out stream.

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