B2B Platform for Media Content Personalisation

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Abstract. This paper proposes a novel business model to support media content personalisation: an agent-based business-to-business (B2B) brokerage platform for media content producer and distributor businesses. Distributors aim to provide viewers with a personalised content experience and producers wish to ensure that their media objects are watched by as many targeted viewers as possible. In this scenario viewers and media objects (main programmes and candidate objects for insertion) have profiles and, in the case of main programme objects, are annotated with placeholders representing personalisation opportunities, *i.e.*, locations for insertion of personalised media objects. The MultiMedia Brokerage (MMB) platform is a multiagent multilayered brokerage composed by agents that act as sellers and buyers of viewer stream timeslots and/or media objects on behalf of the registered businesses. These agents engage in negotiations to select the media objects that best match the current programme and viewer profiles.

Keywords: Media Content Personalisation; B2B brokerage.

ACM Classification Keywords: H.5.1. Multimedia Information systems; I.2.11 Distributed Artificial Intelligence: Multiagent Systems; K4.4. Electronic Commerce.

1 Introduction

Near real time media content personalisation is a major challenge of the media world. In this paper, this challenge is addressed from the business model perspective, *i.e.*, by proposing an agent-based B2B brokerage model for personalisation. The brokerage platform seeks media objects for near real time integration into viewer personalised streams on behalf of media content producers and distributors – see **Fig. 1**.

A methodology for personalised interactive broadcast video is proposed in [1], where playout source streams are personalized with objects (selected in accordance with viewer profiles) inserted into the stream. Furthermore, end-viewers may interact with the inserted objects (or objects already existing in the original source video) and may interactively participate with other viewers in a "closed group". A typical scenario would be personalized (targeted) product placement, where products are se-

lected based on individual viewer's profile and/or by agencies bidding to have their clients' products inserted into a specific user's stream. Other scenarios include interactive personalised quiz shows or educational programmes and personalised interactive documentaries.

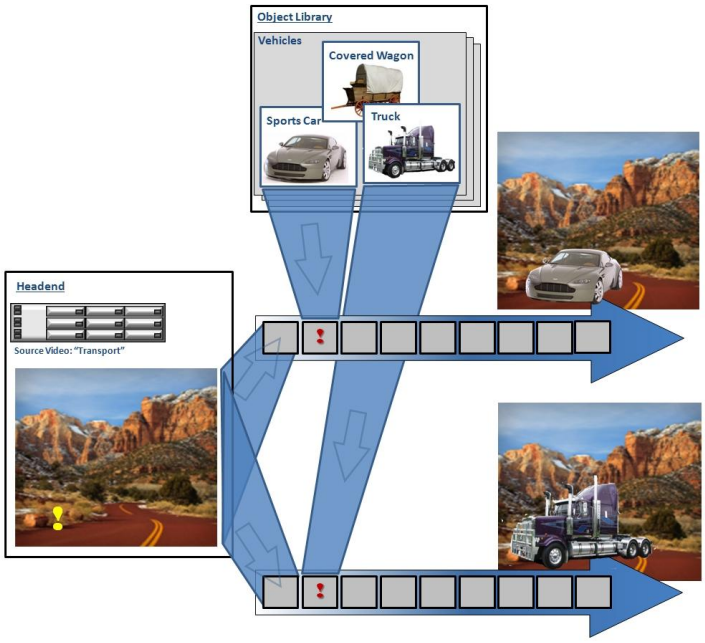

Fig. 1. Content personalisation.

The ultimate goal is to create a virtual brokerage agency for media content businesses that includes, among other features, contract establishment, provider and content selection and contract enactment. This paper is focussed on the media content personalisation platform, *i.e.*, the dynamic selector of media content.

1.1 Programme Annotation

In programme production, video content is authored to allow the insertion of objects at specific points called placeholders to identify existing personalisation opportunities. Objects must match a range of descriptions relevant to the requirements of the production. This is achieved using metadata to match the source video, the viewer profile and the potential objects for selection. The source video is produced using object based techniques [2]. Using a BInary Format for Scenes (BIFS)-type scene graph (or similar techniques) [3], the production can specify placeholders for future object placement, *i.e.* the types of objects required or disallowed. This way, editorial integrity is maintained to prevent unsuitable objects being utilised in future place-

ments (*e.g.* to maintain the integrity of plot-lines). The creation of this metadata is out of the scope of the platform.

The source video and objects are transmitted to the end-viewer along with an updated scene graph which correlates the source content with the inserted personalization content. Using these elements, the reception platform (set-top box or similar) integrates and renders the personalized video for the viewer. The objects are transmitted via Web irrespective of the main distribution format, supporting all current distribution formats with minimal change to the architecture. The resulting solution is similar to a Hybrid Broadcast Broadband TV (HbbTV) architecture.

Object selection is based on the user profile derived from interaction history, social network usage, context (location, device, relevance within user groups, *etc.*).

1.2 Profiling

Viewers are represented through profiles that are dynamically created and maintained by matching data from social networks and user interactions to establish the viewer interests as well as via the viewer context, allowing the selection of relevant objects. The matching between content profiles uses several technologies (see [4]), but mainly the viewers, programmes and media objects are represented through taxonomies. For example, viewers and programmes are represented by a taxonomy inspired in the BBC programme categories [5], ads use a taxonomy based on the Yellow Pages classified ads categories [6] and advertised products are additionally classified using the United Nations Standard Products and Services Code (UNSPSC) taxonomy [7]. The personalisation of the source content can additionally take the form of adapting the video or audio according to viewer context, *e.g.* location and mobility factors. Media adaption can also be applied on the basis of input and output devices, *e.g.*, the use of multi-screening, sensors for the recognition of user situations or several displays, including the viewpoint of objects in 3D.

1.3 Brokerage

The commercial trading of objects is to be achieved through the MMB platform where agents represent the various parties in the process. Depending on the scenario, distributors and producers may play opposite negotiation roles. For example, in the case of advertising transmission, distributors are sellers and producers are buyers of timeslots, whereas, in the case of news, films or series transmission, producers are sellers and distributors are buyers of timeslots. This process can take place in near real time just before the playout of that section of the stream.

2 Related Projects

The term "personalisation of video" has been applied to the selection of programme content to build personalised programme playlists, *e.g.*, personalised electronic programme guides [1], or to the social recommendation of peer-to-peer content such as in

the EU FP7 SARACEN project [2]. The MMB platform can work together with recommenders to get the initial set of media object candidates for each placeholder.

"Interactive television" has been applied to a range of technologies and services. Some examples are the MiSPOT project [3], which addresses the personalisation of advertising through semantic reasoning techniques, and the BBC red button service [8], which was one of the first interactive TV services.

More recently, interactivity is increasingly addressed by associating mobile device applications with programmes, *i.e.* "second-screen apps" for social network activity relating to the main screen program. The EU FP7-ICT project LinkedTV [9] focuses on integrating the TV and Web experience, allowing users to access extra information. A current approach to interactivity and supplementary content is via the hybrid approach used in HbbTV [10] in which the traditional distribution (cable, satellite, digital terrestrial, IPTV) is supplemented with associated content delivered via the Web to the viewer. The supplementary Web-based content is over-layered on the screen or appears alongside the main video on the screen. A more progressive range of services is being addressed in the EU FP7-ICT project HBB-NEXT [11]. As a dynamic content selector based on viewer and media object profiles, the MMB platform can be used for HbbTV as well as other types of media personalization.

A similar business model for personalised interactive TV advertising was proposed by the iMEDIA project [12]. The MMB business model has identical players and goals, but relies on diverse approaches (social viewer profiling or agent-based negotiation), technologies (ontologies, business process modelling and Web services) and is applicable to any type of media content (advertising, product placement, *etc.*).

3 Brokerage Platform

The MMB platform is a multiagent system composed of three layers: interface, enterprise and market. Each layer includes a layer manager agent, which is responsible for the creation and elimination of all agents within the layer, and producer and distributor related agents. The MMB platform is a multiagent system composed of three layers: interface, enterprise and market. Each layer includes a layer manager agent, which is responsible for the creation and elimination of all agents within the layer, and producer and distributor related agents. **Fig. 2** displays the platform architecture.

The interface layer holds dedicated interface agents for all registered businesses, *i.e.*, for each producer and distributor business. An interface agent allows the interaction between a real business and the platform.

The enterprise layer has an enterprise agent, *i.e.*, a producer or distributor enterprise agent, for each business registered at the platform. The enterprise agents model the businesses within the platform and receive and report data via the corresponding interface layer agent. The enterprise agents are coarse self motivated autonomous agents that are eager to trade viewer stream timeslots and media objects. Whenever a transaction opportunity is sensed, the involved distributor and producer agents launch dedicated delegate agents in the market layer.

The market layer contains ephemeral enterprise delegate agents: producer and distributor delegate agents. These fine grained delegates are responsible for negotiating a single item (trading a viewer programme timeslot for inserting a given media object). The delegates adopt the negotiation behaviour specified by the corresponding enterprise agents and, upon completion of the timeslot negotiation, report back the negotiation results and terminate.

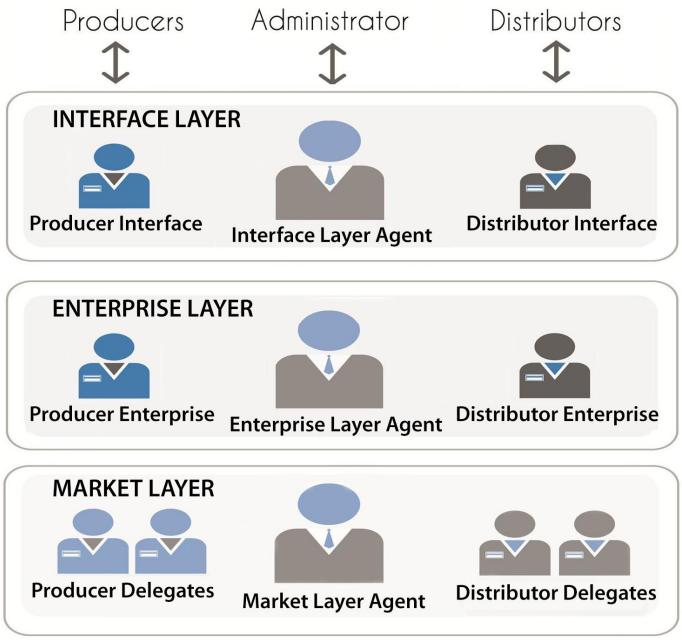

Fig. 2. MMB platform architecture [13].

The platform activity is supported by a Universal Description, Discovery and Integration (UDDI) Web Service (WS) registry where businesses (distributors and producers) register using the corresponding North American Industry Classification system (NAICS) code. Furthermore, businesses register as WS and classify the set of media objects they hold using the United Nations Standard Products and Services Code (UNSPSC) categories.

3.1 Platform Services

The platform offers external and internal WS. The external WS are exposed by the interface layer agents for external consumption and include platform administration and dedicated business interface services. The internal WS are mainly offered by the enterprise layer agents and implement the interlayer communication. Additionally, layer manager agents offer inner layer management services, *e.g.*, layer agent instances. The external WS provide producer and distributor businesses with registration/deregistration and data upload/download operations. The internal WS implement

the interlayer communication and are mainly offered by producer and distributor enterprise agents. The market layer manager agent allows setting the market negotiation protocol and launching new delegate agents.

3.2 Personalisation Opportunities

Enterprise distributor agents are constantly searching for personalisation opportunities, *i.e.*, placeholders, within the programmes that the viewers are watching. Whenever a placeholder is found, the distributor generates the placeholder profile based on the programme, placeholder and viewer data available, queries the platform UDDI service registry for businesses (producers) with media objects that generically match the resulting placeholder profile and invites them to negotiate the placeholder timeslot.

3.3 Candidate Objects

The invited producer agents represent content producer businesses holding one or more media objects that generically match the placeholder profile. Each invited producer agent identifies his media object with the highest similarity ranking with the placeholder profile and launches a producer delegate agent in the market layer to negotiate with the distributor delegate the occupation of placeholder timeslot. As a result, only the set of the best matching candidate objects, at most one per invited producer, will be negotiated.

3.4 Timeslot Negotiation

Individual timeslot negotiations regarding a viewer programme placeholder take place between the viewer distributor and the invited producer delegate agents at the market layer. The negotiation can include several dimensions, such as the price/s, the similarity between object and placeholder profiles or the time left to the transmission, and use diverse negotiation protocols. Upon completion, the delegates report the outcomes to the corresponding enterprise layer agents and terminate. This process is performed in parallel for each viewer, programme and programme placeholder, resulting in a collection of personalised `<viewer, programme, placeholder, object>` quadruplets.

4 Conclusions

The MMB platform proposes a generic business model to support media content personalisation, *i.e.*, to search and select in near real time the media objects that best match a given viewer and programme profiles. It accepts as inputs viewer, programme and candidate objects profiles and outputs personalised placeholder contents for the video integration module.

The platform is, thus, a core module of any virtual media brokerage agency where producers and distributors negotiate contracts and trade viewer stream timeslots ac-

cordingly. Due to the adopted technologies, the platform is an open, scalable and interoperable system.

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