A TV DIGITAL ASSETS INTERCHANGE FRAMEWORK BASED ON EMERGING STANDARDS

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ABSTRACT

This paper presents a work consisting in the design of a framework for interconnecting parties in a TV market, facilitating the interchange of digital assets between TV producers and broadcasters, content aggregators, educational institutions or other kind of organisations over the Internet. The framework is based on the combination of the Open Archives Initiative (OAI) protocol for metadata harvesting with the new standard from MPEG, the MPEG Query Format (MPQF). Regarding Digital Rights Management (DRM) issues, the paper suggests using the rights expression language MPEG-21 REL to define the business models between distributors and broadcasters.

Index Terms— TV, digital assets, search, framework, MPQF, Open Archives Initiative, MPEG

1. INTRODUCTION

During the last decade, the broadcast value chain has been immersed in a significant transformation as the evolution of Information Technologies has revolutionised the TV industry. The performance of the three essential indicators behind digital infrastructures (bandwidth-storage-processing) has improved at an exponential pace, fostering important advance in audiovisual technologies. These underlying changes have motivated TV broadcasters to transition away from physical media and analogue signals toward new ways of producing, storing, cataloguing, interchanging and delivering content. The convergence of the IT world with those of radio and television broadcasting has modified the usual way of understanding the editorial output (e.g. video and audio clips or still images) which now is usually abstracted as a series of digital assets, that can be identified, exchanged and distributed using an advanced digital infrastructure.

Probably one of the most important challenges facing broadcasters today is how to manage these increasing libraries of digital media and metadata so that they can be easily accessed, reused and redistributed. Internally, modern broadcast data workflows are usually managed by the so-called digital asset management (DAM) systems, which have conclusively emerged as a key component of modern broadcast infrastructures. Essentially, DAM is the process which covers the triplet storing-cataloguing-retrieving of electronic digital assets. However, with a closer look, DAM is related to managing the entire content lifecycle process, from production to archive and distribution. The core of most DAM systems is a metadata database (a catalogue) referencing the physically stored media, which is used in the creation of programs or to manage the storage and retrieval of finished programs.

1.2. Motivation

The deployment of metadata-annotated media repositories facilitates one emerging aspect of the TV market, the interchange of digital assets between the different involved parties. The distributed access to content among truthful and untruthful, commercial and non-profit organisations raises several important challenges, like those related to metadata and interface interoperability, or those related to digital rights management (DRM).

There are many commercial DAMs which provide a complete set of storing-cataloguing-retrieving functionalities, however, when interacting among them, these implementations are characterised by severe limitations including the following:

- Lack of the ability to reuse digital assets metadata
- Lack of common interfaces for interchange digital assets metadata
- Lack of a common query format
- Lack of a common DRM model

Existing systems are implemented in a way that tightly couples many components of the content lifecycle process. This document provides an abstract architecture that allows an alignment of system design to a standard framework.

1.3. A TV digital assets interchange framework

This paper describes the design of a framework for interconnecting parties in a TV market, facilitating the interchange of digital assets between TV producers and

broadcasters, content aggregators, educational institutions or other kind of organisations over the Internet. The framework is based on the combination of the Open Archives Initiative (OAI) [1] protocol for metadata harvesting (OAI-PMH) with the new standard from ISO/IEC JTC1/SC29/WG11 (i.e. MPEG), the MPEG Query Format (MPQF [2, 3]). Regarding Digital Rights Management (DRM) issues, our proposal is to use MPEG-21 REL [4], the rights expression language defined by MPEG, to define the business models between distributors and broadcasters. Since MPEG-21 REL is not enough, existing and ongoing profiles are considered. The project is the materialisation of the conclusions obtained from a previous experience, the XAC project [5] (Xarxa IP Audiovisual de Catalunya, Audiovisual IP Network of Catalonia), a research project funded by the Catalan government in which several local Catalan TV channels participated trying to unify strengths to face the imminent analogue blackout in Spain.

2. FRAMEWORK DESCRIPTION

The main goal of this work is to reach a common understanding of a set of core, metadata formats and repository interfaces that would allow content from heterogeneous sources being interchanged in a consistent manner. Regarding metadata formats, the main international standardisation initiatives in this area are MPEG-7 [6] supported by the ISO/IEC, TV-Anytime published as ETSI Technical Specifications [7], the Public Broadcasting Metadata Dictionary (PBMD) [8] carried out by the Dublin Core Metadata Initiative and the SMPTE Metadata Dictionary [9] produced by the Society of Motion Picture and Television Engineers (SMPTE). To give support to the business models between distributors and broadcasters we also consider for the work metadata standards for digital rights management like MPEG-21 REL and its related profiles (extensions) for broadcasting and open release. The framework exposes interfaces that support harvesting, locating, identifying and retrieving digital assets. These features make the problem very similar to the one faced in the digital libraries discipline when facilitating distribution of library records.

2.1. Framework outline

Figure 1 outlines graphically the basic elements of the framework.

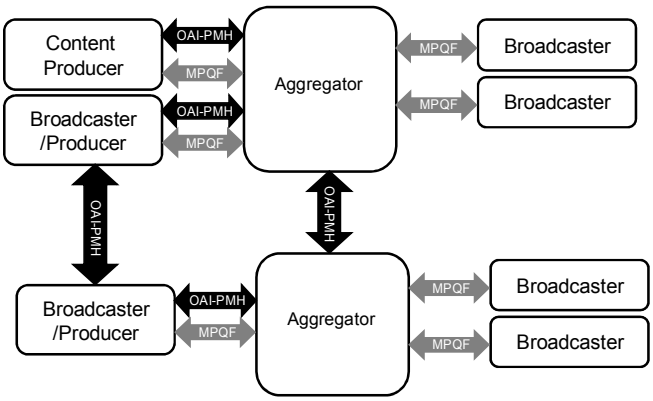

Figure 1 Framework outline

Content producers, who can be at the same time content consumers (because they are broadcasters or because they use digital assets from other producers), generate digital assets whose metadata are harvested by content aggregators (or even directly by broadcasters if they have the proper agreement). This process is performed by using the OAI-PMH protocol. The protocol is metadata-neutral and allows transmitting MPEG-7, TV-Anytime, PBCore, Dublin Core or any other XML-based metadata format. Aggregators expose their metadata for search and retrieval using the MPQF query language, which allows expressing complex audiovisual queries which can be resolved against the aggregated metadata.

2.2. From sources to aggregators. Metadata harvesting

The access method we have chosen for metadata interchange between content producers and content aggregators is metadata harvesting. Metadata harvesting consists on collecting the metadata descriptions of digital assets (usually in XML format) from a set of digital content repositories and storing them in a central server. Metadata is lighter than content, and it's feasible to store the necessary amount of it in an aggregation server so that real-time access to information about distributed digital content can take place without the burden of initiating a parallel real-time querying of the underlying target content databases.

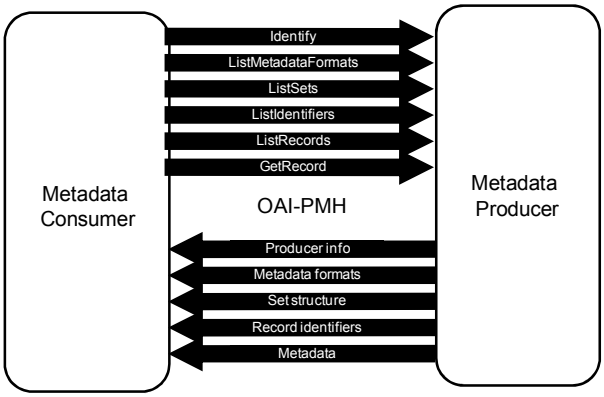

Figure 2 OAI-PMH messages

Nowadays the most used harvesting method is the one offered by the Open Archives Initiative (OAI), which defines a mechanism for harvesting XML-formatted metadata from repositories. The OAI technical framework is intentionally simple with the intent of providing a low barrier for implementers and users. The trade-off is that its query expressiveness and output format description is very limited. Consequently some repositories may provide other querying interfaces with richer functionality, usually in addition to OAI. We have selected harvesting and the OAI-PMH protocol as the core interface for "wholesale" metadata distribution.

Figure 2 outlines graphically some of the messages interchanged using the OAI-PMH protocol (*ListIdentifiers*, *ListRecords*, *GetRecord*, etc.). In OAI-PMH metadata consumers or "harvesters" request information on updated records from the metadata producers or "repositories". These requests can be based on a date stamp range, and can be only restricted to named sets defined by the provider. These sets provide a very limited form of selective harvesting, and do not act as a search interface. In OAI-PMH data providers are required to provide XML metadata at least in Dublin Core format.

2.3. From aggregators to users. Content search and retrieval

On the other hand, content "retailers", which include content aggregators and also some content producers (generally medium or big ones) should be able to deploy value-added services offering digital assets advanced search and retrieval capabilities. Regarding this, the initiative of standardisation of an MPEG Query Format (MPQF) has refuelled the research around the definition of a unified query language for audiovisual content. The goal of MPQF is to provide a standardised interface to multimedia repositories. The initiative is being led by about a dozen institutions participating within MPEG (i.e. ISO/IEC JTC1/SC29/WG11). We have selected MPQF as the search interface for the digital assets distribution framework.

2.3.1. MPEG Query Format (MPQF)

Formally MPQF is Part 12 of ISO/IEC 15938-12, "Information Technology - Multimedia Content Description Interface" better known as MPEG-7 [6]. The process started in July 2006 with the release of a "Call for Proposals on MPEG-7 Query Format". However, the query format was technically decoupled from MPEG-7 during the 81st MPEG meeting in July 2007, and its name changed to "MPEG Query Format" or simply "MPQF". The standardisation process has proceeded and it is expected that MPQF will become an ISO/IEC final standard after the 85th MPEG meeting in July 2008.

Basically, MPQF is an XML-based query language that defines the format of queries and replies to be interchanged between clients and servers in a distributed multimedia information search-and-retrieval context. The two main benefits of standardising such kind of language are 1) interoperability between parties (e.g. content providers, aggregators and user agents) and 2) platform independence; developers can write their applications involving multimedia queries independently of the database used, which fosters software reusability and maintainability. The major advantage of having MPEG rather than industry forums leading this initiative is that MPEG specifies international, open standards targeting all possible application domains and which, therefore, are not conditioned by partial interests or restrictions.

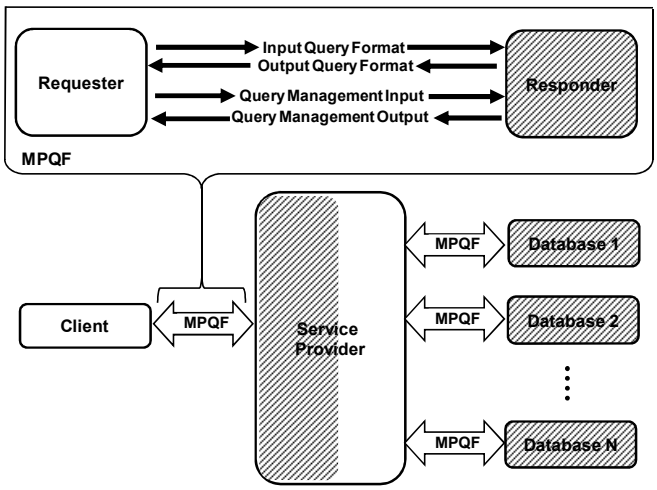

Figure 3 MPEG Query Format diagram

Figure 3 shows a diagram outlining the basic MPQF scenario. In the simplest case, the content requester may be a user's agent and the responder might be a retrieval system. However, MPQF has been specially designed for more complex scenarios, in which users interact, for

instance, with a content aggregator. The content aggregator acts at the same time as responder (from the point-of-view of the user) and as requester to a number of underlying content providers to which the user query is forwarded.

One of the key features of MPQF is that it is designed for expressing queries combining the expressive style of Information Retrieval (IR) systems (e.g. query-by-example and query-by-keywords) with the expressive style of XML Data Retrieval (DR) systems (e.g. XQuery [10]), embracing a broad range of ways of expressing user information needs. Regarding IR-like criteria, MPQF offers a broad range of possibilities that include but are not limited to query-by-example-description, query-by-keywords, query-by-example-media, query-by-feature-range, query-by-spatial-relationships, query-by-temporal-relationships and query-by-relevance-feedback. Regarding DR-like criteria, MPQF offers its own XML query algebra for expressing conditions over the multimedia related XML metadata (e.g. Dublin Core, MPEG-7 or any other XML-based metadata format) but also offers the possibility to embed XQuery expressions.

2.4. Digital rights management (DRM)

Our proposal is to use MPEG-21 REL, the rights expression language defined by MPEG-21, to define the business models between distributors and broadcasters. In this standard, an authorisation model is also defined, that authorises the use of a licensed digital content based on a chain of issued licenses. The MPEG-21 REL can be extended to support new business models defining extensions. From the currently existing extensions we have selected the Dissemination and Capture (DAC) profile, designed to be able to represent the concept of the OMA DRM v2.0 Extensions for Broadcast Support and to facilitate the interoperability with the TV-Anytime Rights Management and Protection information, and the Open Release Content (ORC) profile, defined to support the different types of Creative Commons licenses.

3. ACKNOWLEDGMENTS

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4. CONCLUSIONS AND FUTURE WORK

This paper has presented a digital assets interchange framework for interconnecting parties in a TV market. The framework is based on the combination of three standard technologies: the OAI-PMH protocol from the Open Archives Initiative, the MPEG Query Format and the MPEG-21 Rights Expression Language. The design has been guided by the conclusions of a previous experience, the XAC project, from which several lessons were learned, as the necessary separation between metadata harvesting and real-time search and retrieval, or the necessity to choose a more appropriate query format than XQuery. Currently we are working in an implementation of the framework, which will update the technologies supporting the XAC network for digital assets interchange among TV channels and content producers. It is worth mention that it is expected that from this work it will emerge the first known implementation of an MPEG Query Format processor. Currently, parts of the ongoing implementation are being contributed to the MPEG standardisation process in the form of Reference Software modules.

5. REFERENCES

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