

# TV Anytime as an application scenario for MPEG-7

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## ABSTRACT

The ISO/MPEG group has identified a wide range of application scenarios [1] for their emerging MPEG-7 standard on audio-visual metadata. TV Anytime with their vision of future digital TV services [2] encompasses a large number of them. As TV Anytime has also identified metadata as one of the key requirements to realize their vision, MPEG-7 is the natural candidate to fill that role. Here, we describe technically how metadata for the TV Anytime scenario can be created using MPEG-7.

## 1. INTRODUCTION

Digital broadcasting offers the opportunity to provide value-added interactive services, that allow end users to personalize and control the material of interest, an evolution of TV into an integrated entertainment / information gateway. Anticipating this evolution, a group of organizations has formed the TV Anytime Forum to direct development of standards, tools and technologies towards a common framework. In their call for contributions [2] they identified metadata as one of the key technologies enabling their vision.

The role of metadata within TV Anytime is crucial: it will enable selection of content - e.g. via searching or filtering -, capturing of content items for later viewing or further processing, navigation through stored and remote content, and access of content items. In addition, it may enable content referencing, user profiling and preferences, and even support the management of rights.

On the other hand, the Moving Pictures Expert Group (MPEG) within ISO is developing a standard (MPEG-7) to support creation of metadata on audio-visual data. The MPEG-7 collection of descriptors and description schemes for multimedia is able to fulfill the metadata requirements for TV Anytime.

In this paper we describe our view of how MPEG-7 can

accomplish the tasks envisaged by the metadata technology requirements for TV Anytime. We start by briefly explaining MPEG-7, the role of metadata in the TV Anytime vision, and their interrelation. Then we take an example service for TV Anytime and explain how metadata for that service can be created using MPEG-7. We conclude with a summary of existing and missing technology providers needed to set MPEG-7 to work on the TV Anytime vision. Please be aware that as both standards are very active, this paper can only reflect upon their current status.

## 2. HARMONIZING TV ANYTIME AND MPEG-7

MPEG-7 is an emerging standard of the ISO Moving Pictures Expert Group (MPEG) concerned with the creation of generic descriptions of video and audio material usable in a wide range of audio-visual applications. The MPEG-7 Description Definition Language (DDL) is based on XML schema [3]. The MPEG-7 standard will, therefore essentially consist of a collection of schema components – a library of tools – suitable to describe audio-visual material.

TV Anytime seeks to develop a framework to incorporate standards, tools and technologies enabling an integrated system that incorporates services such as movies on demand, broadcast recording, broadcast searching and filtering, retrieving associated information from web-pages, home banking, e-commerce, home shopping, and remote education. To enable their vision, TV Anytime has identified three distinct areas for which they seek to specify requirements and technologies: metadata, content referencing and rights management.

The first area – metadata – is the core business of MPEG-7. Thus a harmonization of the two standardization efforts is sensible. As MPEG-7 provides a library of thoroughly validated audio-visual description schemes, TV Anytime is able to make use of these without having to reinvent them. On the other hand, TV Anytime is a good application scenario to investigate the usability of MPEG-7 descriptions in practice and make corrections. As not all tools of MPEG-7 will be required for TV Anytime (e.g. low-level audio-visual features such as color or loudness), it forces MPEG-7 to discuss profiling for specific applications. In addition, TV Anytime may identify tools that they require and that are missing in MPEG-7, thus enabling a more complete coverage of MPEG-7.

The second requirement area for TV Anytime – content referencing – is also fulfilled by MPEG-7. Data (audio-visual

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material) and metadata (information about the AV material) are generally considered as separate entities in MPEG-7. Therefore, the source (digital or analog; cable or satellite) of the data is unimportant as long as the receiver can link and synchronize that data with the metadata that it may receive from a different provider/network. MPEG-7 supports this link via different reference and time descriptors. For example a program may be referenced by a *MediaLocator* link, its (absolute) start time may be captured by a *MediaTimePoint* and any reference to a segment by *MediaRelTime* giving a relative start time and *MediaDuration* specifying the segment's duration. So, content referencing is well supported by MPEG-7.

The last requirement – rights management – is also covered by MPEG-7, namely as a specific description scheme. This solution might however not fulfill security requirements of TV Anytime.

In addition, the recently introduced idea of a Package is useful to support searching and browsing of multiple MPEG-7 descriptions from multiple sources, thus ensuring interoperability among MPEG-7 archives.

Given the vast overlap of interest between the TV Anytime and the MPEG-7 standardization interests, it is not a surprise that harmonization efforts have already started.

### 3. USAGE OF MPEG-7 WITHIN TV ANYTIME

Technically, how would a TV Anytime application be able to make use of the MPEG-7 tools?

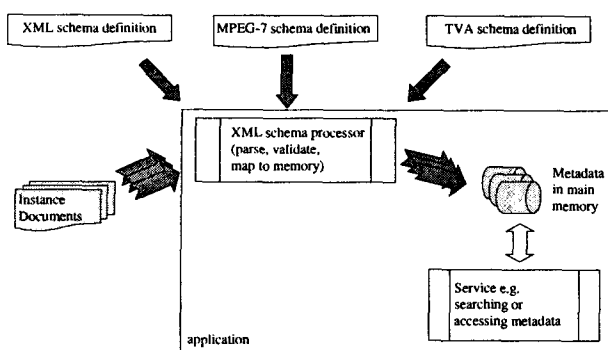


Figure 1: Metadata handling with MPEG-7.

In our understanding, an application (such as TV Anytime) requires its specific schema definition to specify exactly how a metadata instance document will look, i.e. which components will be put together to describe AV content. This schema definition makes use of the already defined components in the MPEG-7 schema definition to define its own schema. Instance documents (i.e. metadata itself) may then be created according to the application's schema definition.

An application that processes metadata instance documents will then consist of two logically independent modules (see Figure 1):

- an XML schema processing module that has to parse, validate and map the required metadata to main memory according to the generic MPEG-7 and the specific TV Anytime schema definitions, and

- the application modules that for example perform a search on the metadata or access AV material according to information stored within the metadata.

An example application envisaged by TV Anytime is an Electronic Program Guide (EPG). It will enable a viewer to discover and access selected programs, parts of programs, or documents originating from digital TV broadcasts, the web, or elsewhere. A Core Experiment (CE) within MPEG-7 [5] is already examining this application. One service that could be part of an EPG is the browsing of highlights of selected programs. This is currently not incorporated in the MPEG-7 CE on EPG. We will now demonstrate a possible implementation for TV Anytime of this highlight example service using MPEG-7 descriptions independent of the MPEG-7 EPG.

### 4. EXAMPLE SERVICE

Every broadcast contains segments of higher and of lesser importance. A couple of the segments of high importance may be marked as the highlights of that broadcast. Examples are goals in soccer broadcasts, key scenes in movies, or news overviews. TV Anytime viewers of the future might be supplied with a service to search and browse highlights of past, present and future broadcasts in order to gain an impression or an overview of their content.

For example, if a viewer would like to see all the soccer goals of the past week, he could specify a query e.g. in a web interface. The associated service provider software would collect all metadata instance documents of soccer games of the past week from metadata providers and compose a list of links to the soccer games and their respective highlights. This would be sent back to the viewer's Personal Digital Recorder (PDR; the TV of the future) which would access the AV material and playback the referenced segments. Recording user preference at this stage would help in further customising the content.

The way the metadata describing a broadcast program's highlights could be constructed using MPEG-7 will now be examined in detail. Figure 2 shows a simplified extract of the MPEG-7 schema definition consisting of the high-level schema components required for the example [4]. It contains the definitions of:

- *MediaTime*, which enables time-exact linking into AV material,
- *MediaLocator*, which enables physical location of the AV material including some time offset,
- *StructuredAnnotation*, which takes in human entered comments on some AV material in some language, and
- *HighlightSegment*, which enables the specification of a segment of AV material as a highlight being located via a video- and/or audio-segment.

A simple example for such a schema is given in Figure 3. It describes metadata for a program that is composed of *generalInfo* and a set of *highlights*. *GeneralInfo* consists of an *annotation* for the program and a *link* to the AV material. A *highlight* consists of a *segment* and an *annotation*. Note how *generalInfo* and *highlight* are specific to TV Anytime, but both rely upon the MPEG-7 schema components *StructuredAnnotation*, *MediaLocator*, and *HighlightSegment*. (In order to keep it simple, at this stage, *User-preference* has not been included in the schema.).

A sample instance document that is valid with respect to this program schema definition is given in Figure 4. It describes the soccer final of the 1999 Champions League in Europe.

## 5. CONCLUSION AND OUTLOOK

We have demonstrated how the MPEG-7 metadata schema component collection can be set to work within the TV Anytime application scenario. This still requires that service- and application-specific schema definitions are created by TV Anytime. MPEG-7 might also define profiles to support specific services or applications such as required by TV Anytime. In this case, TV Anytime could make use of such higher level components, but would still face the task of putting them together in their specific application scenario.

## REFERENCES

- [1] MPEG Requirements Group: "MPEG-7 Applications Document v.9", Doc. ISO/MPEG N2861, MPEG Vancouver Meeting, July 1999. (available from <http://www.cseit.org/mpeg/>).
- [2] The TV Anytime Forum: "Call for Contributions on Metadata, Content Referencing, and Rights Management", Document: TV0114r3, 17<sup>th</sup> Dec. 1999. (available from <http://www.tv-anytime.org/>).
- [3] World Wide Web Consortium: "XML Schema", Parts 0,1,2; W3C Working Draft, 7<sup>th</sup> Apr. 2000. (available from <http://www.w3.org/XML/Schema.html> ).
- [4] MPEG Multimedia Description Schemes Group: "MPEG-7 Multimedia Description Schemes WD (Version 4.0)", Doc. ISO/MPEG N3465, MPEG Beijing Meeting, July 2000.
- [5] Sharp Laboratories of America "Proposal for an Electronic Program Guide description scheme", Doc. ISO/MPEG N3472, MPEG Beijing Meeting, July 2000.

```
<schema xmlns="http://www.w3.org/1999/XMLSchema"
  xmlns:mp7="http://www.mpeg7.org/MP7Schema"
  targetNamespace="http://www.mpeg7.org/MP7Schema"
  elementFormDefault="unqualified" attributeFormDefault="unqualified">
...
<!-- Schema component to locate material in time -->
  <complexType name="MediaTime">
    <choice>
      <element name="MediaTimePoint" type="mp7:MediaTimePoint"/>
      <element name="MediaRelTime" type="mp7:MediaRelTime"/>
    </choice>
    <element name="MediaDuration" type="mp7:MediaDuration" minOccurs="0"/>
  </complexType>

<!-- Schema component to locate material physically -->
  <complexType name="MediaLocator">
    <element name="MediaURL" type="mp7:MediaURL"/>
    <element name="MediaTime" type="mp7:MediaTime" minOccurs="0"/>
  </complexType>

<!-- Schema component to annotate material -->
  <complexType name="StructuredAnnotation">
    <element name="Who" type="mp7:ControlledTerm" minOccurs="0"/>
    <element name="WhatObject" type="mp7:ControlledTerm" minOccurs="0"/>
    <element name="WhatAction" type="mp7:ControlledTerm" minOccurs="0"/>
    <element name="Where" type="mp7:ControlledTerm" minOccurs="0"/>
    <element name="When" type="mp7:ControlledTerm" minOccurs="0"/>
    <element name="TextAnnotation" type="string" minOccurs="0"/>
    <attribute ref="xml:lang"/>
  </complexType>

<!-- Schema component for segments being a highlight in the material -->
  <complexType name="HighlightSegment">
    <element name="VideoSegmentLocator" type="mp7:VideoSegmentLocator" minOccurs="0"/>
    <element name="AudioSegmentLocator" type="mp7:AudioSegmentLocator" minOccurs="0"/>
    <attribute name="name" type="string" use="optional"/>
    <attribute name="themeIds" type="IDREFS" use="optional"/>
  </complexType>
...
</schema>
```

Figure 2: Extract of MPEG-7 schema definition.

```

<schema xmlns="http://www.w3.org/1999/XMLSchema"      xmlns:mp7="http://www.mpeg7.org/MP7Schema"
        xmlns:tva="http://www.tv-anytime.org/TVASchema"
        targetNamespace="http://www.tv-anytime.org/TVASchema"
        elementFormDefault="unqualified"      attributeFormDefault="unqualified">

  <import namespace="http://www.mpeg7.org/MP7Schema" />

  <element name="program">
    <complexType>
      <element name="generalInfo" type="tva:generalInfoType" />
      <element name="highlight" type="tva:highlightType" minOccurs="0" maxOccurs="unbounded" />
    </complexType>
  </element>

  <complexType name="generalInfoType">
    <element name="annotation" type="mp7:StructuredAnnotation" />
    <element name="link" type="mp7:MediaLocator" />
  </complexType>

  <complexType name="highlightType">
    <element name="segment" type="mp7:HighlightSegment" />
    <element name="annotation" type="mp7:StructuredAnnotation" />
  </complexType>
</schema>

```

**Figure 3: Example schema for programs**

```

<program xmlns="http://www.tv-anytime.org/TVASchema">
  <generalInfo>
    <annotation lang="eng">
      <Who>Manchester United - Bayern Munich</Who>
      <WhatAction>soccer champions league final Europe</WhatAction>
      <Where>Barcelona, Spain</Where>
      <When><Y>1999</Y><M>5</M><D>29</D></When>
    </annotation>
    <link><MediaURL>http://...</MediaURL></link>
  </generalInfo>

  <highlight>
    <segment>
      <videoSegmentLocator> ... </videoSegmentLocator>
      <themeIds>goal</themeIds>
    </segment>
    <annotation>
      <Who>Mario Basler</Who>
      <WhatObject>Bayern Munich</WhatObject>
      <When><M>6</M></When>
    </annotation>
  </highlight>

  <highlight>
    <segment>
      <videoSegmentLocator> ... </videoSegmentLocator>
      <themeIds>goal</themeIds>
    </segment>
    <annotation>
      <Who> Teddy Sheringham</Who>
      <WhatObject>Manchester United</WhatObject>
      <When><M>91</M></When>
    </annotation>
  </highlight>
  ...
</program>

```

**Figure 4: Sample instance document**