

A Methodology for the Integration of SCORM with TV-Anytime for Achieving Interoperable Digital TV and e-Learning Applications

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Abstract

The term t-learning refers to interactive access of video-rich learning materials, primarily within the home, through a digital TV set-top box. The effective development of t-learning systems and applications should be based on existing standardization efforts in the fields of digital TV and e-learning. In this paper we examine the compatibility between the international standard for digital TV (TV-Anytime) and the international standard for e-learning (SCORM). The purpose is to provide a methodology for interoperability between educational applications in digital TV environments and to facilitate the creation of educational metadata for digital TV programs. The approach is also applicable in audiovisual digital libraries providing educational services to their users. We also describe an implementation of the mapping between the two standards. The implementation allows the transformation of TV-Anytime metadata to SCO metadata for the creation of SCORM compatible courses that utilize educational material from TV programs.

1. Introduction

The term “t-learning” has been adopted as shorthand to mean TV-based interactive learning. t-learning is about having interactive access to video-rich learning materials primarily within the home, through a digital TV set-top box [1]. We investigate here the integration between digital TV and e-learning technologies by investigating the compatibility between the two corresponding international metadata standards for digital TV and e-learning, i.e. TV-Anytime [2] and SCORM [4]. Such integration may be used to provide interoperability between educational applications in digital TV environments and may also facilitate the creation of value added services providing educational metadata over digital TV programs.

In particular, the paper proposes a methodology that is based on the segmentation of digital TV programs to facilitate the re-use of distinct program segments as sharable learning objects (SCO's in the SCORM terminology).

Doing so, it is possible to create learning experiences that use video elements to achieve learning objectives or even elaborate assessment tests. The methodology presented covers a complete mapping between the metadata schemas of TV-Anytime and SCORM that allows for a semi-automatic transformation between them. A complete mapping is impossible due to intrinsic inconsistencies.

The advantages of such an approach are many. TV programs can be used for personalized learning experiences instead of producing special purpose educational video focusing on actual situations instead of scenarios loosely related to the real world; Added value is given to TV programs that can help producers exploit new ways for revenues. New value chains can be established around the creation and delivery of educational metadata along with appropriate segmentation of TV programs. Last but not least, the proposed approach could be exploited by digital libraries of audiovisual content in order to provide eLearning experiences to their users.

2. Related Work

There are many examples of how interactive digital TV is currently being used for what could be loosely called learning purposes. Although digital TV as a whole has been developing fairly rapidly all over the world, the various types of interactive services have tended to develop more slowly. Therefore, only a very limited number of examples are currently available and most examples are best described as “edutainment” -entertaining and educational.

Control over these developments is still primarily in the hands of broadcasters and service providers – who have tended to see their role as informing, entertaining and educating people rather than offering more structured and engaged learning. However, within certain learning contexts these “edutainment” services are generally educationally sound and certainly create interest in using a TV as an active learning medium compared to a passive learning medium – but they are only the very first stages of such developments.

Nevertheless, there is no work so far, exploiting the synergies between the TV-Anytime and the SCORM standards with the objectives discussed in this paper.

3. Background

3.1. TV-Anytime Metadata

In the context of the TV-Anytime Forum Metadata Specifications, segmentation refers to the ability to define access and manipulate temporal intervals (i.e. segments) within an audiovisual (AV) stream [3]. By associating metadata with segments and segment groups, it is possible to restructure and re-purpose an input AV stream to generate alternative consumption and navigation modes.

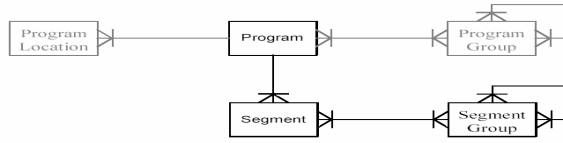


Figure 1: Entity-relationship graph for segmentation-related components of a TV-Anytime

Figure 1 shows an entity-relationship diagram of the various components of a (segmented) program -in TV-Anytime. A *Segment* is a continuous fragment of a program. A particular segment can belong to a single program only, but it can be a member of multiple segment groups. A *Segment Group* denotes a collection of segments that are grouped together, for a particular purpose or due to a shared property. A segment group can contain segments, or other segment groups. A Segment Group may contain either segments, or subgroups, but not both.

3.2. SCORM Metadata

The SCORM defines a Web-based learning “Content Aggregation Model” [5] and a “Run-time Environment” [6] for learning objects.

The most significant concepts in the SCORM Content Aggregation Model are Assets, Sharable Content Objects (SCOs) and Content Aggregation. An *Asset* is a learning content in its most basic form. A *SCO* represents the lowest level of granularity of learning resources that can be tracked by a Learning Management System (LMS) using the SCORM Run-Time Environment. A SCO could be reused in different learning experiences to fulfill different learning objectives. A Content Aggregation is a map (content structure) that can be used to aggregate learning resources (SCOs) into a cohesive unit of instruction (e.g. course, chapter, module, etc.), apply structure and associate learning taxonomies. The content structure defines the taxonomic representation of the learning resources. An aggregation could also be grouped together under other

aggregations. Aggregations could be nested any number of levels. An entity-relationship diagram of the SCORM 1.2 terminology is shown in figure 2:



Figure 2: Entity-relationship graph for SCOs/Aggregations in SCORM

4. Methodology for Mapping

The correspondence between a TV-Anytime program segment and a SCORM SCO is obvious, because of their common characteristics (reusability, lowest level of granularity). This correspondence is the basis of our mapping methodology. The next step is to define a detailed mapping [10] between the elements of a program segment and the elements of an Item/SCO. This detailed mapping is done using the XPath language [8] that allows for the identification of parts of an XML document.

SCORM	TV-Anytime
/lom/general/title	/BasicSegmentDescriptionType/Title
/lom/general/language	/ProgramInformationType/BasicDescription/Language
/lom/general/description	/SegmentInformationType/Description/Synopsis
/lom/general/keyword	/SegmentInformationType/Description/Keyword
/item[@identifier]	/SegmentInformationType[@segmentId]
/lom/lifecycle/contribute/role	/Creator/Role
/lom/lifecycle/contribute/date	/ProgramInformationType/BasicDescription/CreationCoordinates/CreationDate
/lom/technical/format	/AVAttributes/FileFormat
/lom/technical/location	/SegmentationInformationType/ProgramRef
/lom/technical/size	/AVAttributesType/FileSize
/lom/technical/duration	/SegmentInformationType/SegmentLocator/MediaDuration
/lom/relation	/BasicSegmentDescriptionType/RelatedMaterial
/lom /relation/kind	/RelatedMaterial/HowRelated
/lom/relation/resource/catalogentry	/RelatedMaterial/MediaLocator

Table 1: Mapping table between SCORM and TV-Anytime metadata elements

Table 1 gives a mapping between SCORM and TV-Anytime elements in terms of pairs of XPath expressions that correspond to equivalent elements. We have excluded from the table the elements from both models that cannot be mapped due to intrinsic incompatibilities.

5. Implementation

We describe in this section a reference implementation of the mapping between the two standards. It is a Java application that provides a mechanism for the transformation of video segments to SCOs. It transforms TV-Anytime video segment metadata to SCO metadata, it creates an extension to SCO's metadata with metadata that describes educational objectives and, finally, it creates SCORM compatible courses, according to the user choices.

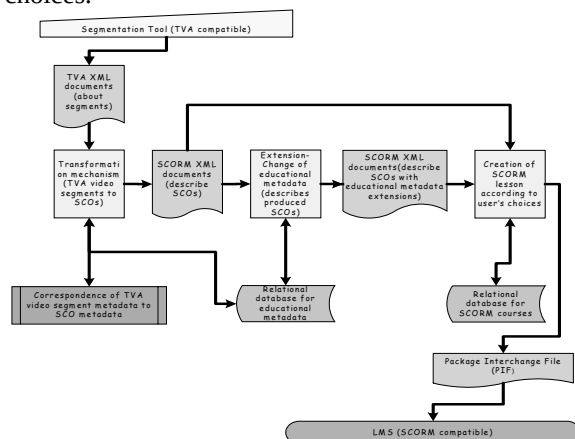


Figure 3: The flowchart of the most important functionality of the implemented application

Figure 3 shows the chain of processes that are involved in the application that we have developed. The initial input is a TV-Anytime compliant XML document describing the segments of one or more TV programs (it may be produced with a segmentation tool such as the one described in [9]). All the data (Title, Synopsis, RelatedMaterial, etc.) about segments described in this XML document are extracted and stored into suitable structures for future use. The result of this process is the generation of equal in number SCOs with the selected TV programs' segments. For each SCO, an XML document –compatible with SCORM v1.2- is created.

In the next step the user inserts the educational metadata (as described from SCORM standard) which describe each SCO, through graphical interfaces.

The third step is the creation of a SCORM lesson, which consists of SCOs – which have come from the transformation of TV program segments. The user determines the characteristics of the lesson through a specific sequence of graphical interface and he specifies the chapters in the course and the sections inside each chapter.

Finally, an imsmanifest.xml file is created, which describes the learning resources and the lesson structure. This file along with the necessary assets -video segments, xml files, etc. - is packaged in a zip file (Package Interchange File - PIF). The PIF can be inserted in any SCORM compatible Learning Management System – LMS.

6. Conclusions and Future Work

In this paper we examined the compatibility between the international standards for digital TV (TV-Anytime) and for e-learning (SCORM) in order to provide interoperability for educational applications in different digital TV environments, as well as to associate educational metadata with digital TV programs. Also, we presented an application that implements the mapping developed to provide a semiautomatic way of associating SCORM metadata with TV-Anytime metadata.

Future work will focus on the MPEG7 metadata standard and its integration with SCORM. This way we could overcome the deficiencies of TV-Anytime in terms of complete coverage of SCORM features.

7. Acknowledgments

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