Integrated Metadata for Ubiquitous Multimedia Access

Chull Hwan Song[1] Seong-Joon Yoo[1] Byeong Ho Choi[2]

[1] School of Computer Engineering, Sejong University, 98 Gunja, Gwangjin, Seoul, Korea 143-747
schpeter@hanmail.net
[2] Digital Media Research Center, KETI, 270-2,
Seohyun-Dong, Pundang-Gu, Sungnam-Si, KyungGi-Do, Korea

Abstract

Integration of distributed heterogeneous multimedia resources is required to support ubiquitous multimedia access. This paper proposes metadata that enables ubiquitous systems to access multimedia data written in any form including XML, HTML and DBMS. The metadata is defined by integrating MPEG-7 MDS and TV AnyTime metadata. A procedure to integrate the two standards is described and relationship of their elements is also presented. The newly defined metadata can be utilized as a basis of multimedia ontology for context aware multimedia access.

Key words: multimedia metadata, distributed heterogeneous, ubiquitous multimedia access

1. Introduction

This paper aims at defining integrated metadata for ubiquitous multimedia access, which can search various types of metadata in distributed heterogeneous environments. Defining this integrated metadata starts from ensuring compatibility with the current international multimedia metadata standards. In other words, it is necessary to ensure compatibility mainly with MPEG-7 Multimedia Description Scheme (MDS) [1] and TV Anytime metadata [2]. These two standards include the widest range of elements and attributes related to multimedia-related metadata that have emerged so far, so that they can be a useful basis for defining integrated metadata.

For this purpose, MPEG-7 MDS and TV Anytime were compared and analyzed to identify commonness and differences between these two standards. Based on the results, metadata made up of a union of these two standards was created, based on which unique metadata was constructed. Investigating these two standards revealed that some definitions were expressed in different terms even though they have the same meaning. In this case, either ones were used or third terms were selected. In another case, an element or an attribute of a definition in one standard included the entire elements or attributes of a definition of the other standard, which was easily integrated. When two elements had an intersection with still having some differences, the intersection was defined with a newly adopted term while the remnants were defined with the terms originally used in their respective standard.

Chapter 2 presents the related studies, chapter 3 the standard and method of integrating MPEG-7 MDS and TV-AnyTime metadata, chapter 4 the integrated metadata, and chapter 5 conclusion.

2. Related Works

MPEG-7 MDS (ISO/IEC JTC1/SC29/WG11) is an international standard for multimedia contents, which enables efficient storage, retrieval and transmission of multimedia data by effectively expressing them. On the other hand, TV-AnyTime metadata was designed to fit the digital TV broadcasting environment. Therefore, most multimedia data deals with motion images. MPEG-7 MDS expresses much more information in XML schema format, in comparison to TV AnyTime Metadata.

Of these two standards, MPEG-7 MDS deals with all digital contents such as image information, audio, video, and 3D as well as motion images, unlike TV-AnyTime.

3. Procedures to Integrate MPEG-7 MDS and TV-AnyTime Metadata

The two standards are integrated through four steps. The first step is to investigate the similarities of their high level structures, which contributes to establishing the relation of inclusion between them. The second step is to examine the relationship among low-level elements of the higher structures. The low-level elements of one standard could be high-level elements of the other standard. The results of the first and the second steps

revealed a certain relation of intersection between the two standards, according to which their low-level elements were divided into four groups to clarify their relationship. In this process, relationship of inclusion and intersection between the two standards were established. The standard that occupied a large part in the relationship of inclusion became the standard for the proposed metadata integration method. For the relationship of intersection, if basic concepts of high-level elements were similar and those of their low-level elements were also similar, all of them were included in the standard for the proposed method. On the other hand, if concepts of high-level elements were similar but their low-level elements were divided into two or three different concepts, two or three different high-level elements were established in the standard for the proposed method, to include each of low-level elements. The third step is to construct a mapping table based on the results of the investigation of the relationship of the two standards. The mapped elements had element names common to both standards. The fourth step is to create new metadata that integrates all elements as well as those mapped elements.
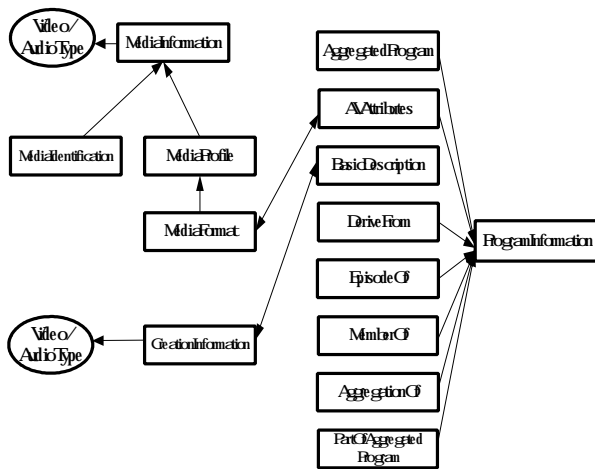

Fig. 1 Relationship of MediaInformation and ProgramInformation

Fig. 1 shows an example of elements relationship between a low-level element of MediaProfile in MPEG-7 MDS, and AVAttributes, a low-level element of ProgramInformation in TVA metadata. CreationInformation and BasicDescription parts are matched respectively.

The two elements MediaFormat and Attributes have their descendents and the relationships can be depicted as shown in Fig. 2.

We have defined ubiquitous universal media access (in short UT-UMA) metadata that can be used as global metadata for two or more synonymous elements. Table 1 shows the relationship between the lowest elements of the two higher elements of the example metadata shown in Fig. 2. We found that all of the lowest elements are equivalent to each other in this case.
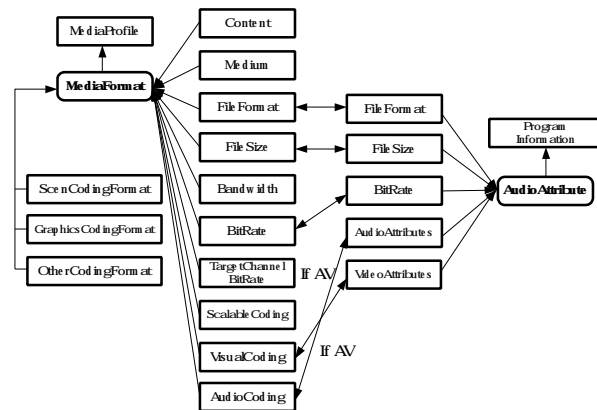

Fig. 2 Relationship of MediaFormat and AudioAttribute

Table 1. uT-UMA metadata for MediaFormat

MPEG-7 MDS	Relationship	TVA	uT-UMA
FileFormat	Is equivalent to	FileFormat	FileFormat
FileSize	Is equivalent to	FileSize	FileSize
BitRate	Is equivalent to	BitRate	BitRate
VisualCoding	Is equivalent to	VideoAttributes	VisualCoding
AudioCoding	Is equivalent to	AudioAttributes	AudioCoding

4. uT-UMA Metadata

This chapter describes a part of uT-UMA metadata that have been defined through the procedures described in the previous section. Even though we have derived a larger set of integrated metadata elements, we describe four of them.

4.1 Metadata for MediaFormat

Fig. 3 shows an integrated view of the elements of the MediaFormat and AudioAttribute. This describes technical attributes of profile, audio, and video of multimedia contents. It was created from the relationship between MediaFormat schema of MPEG-7 MDS and AVAttributes of TV-AnyTime. Here, the former includes the latter.
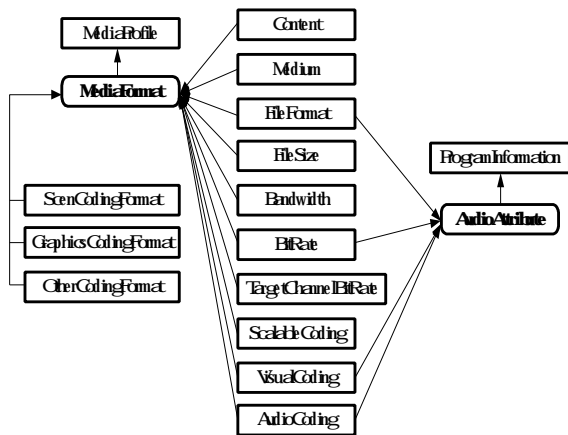
Fig. 3 Integrated View of Metadata Elements of MediaFormat and AudioAttribute

4.2 Metadata for Creation Information

The CreationInformation element of MPEG-7 MDS is related with the ProgramInformation element of TV-AnyTime metadata. The two elements have descendents such as Genre, Language, CaptionLanguage, SignLanuage, and ParentalGuidance in common as shown in Fig. 4.
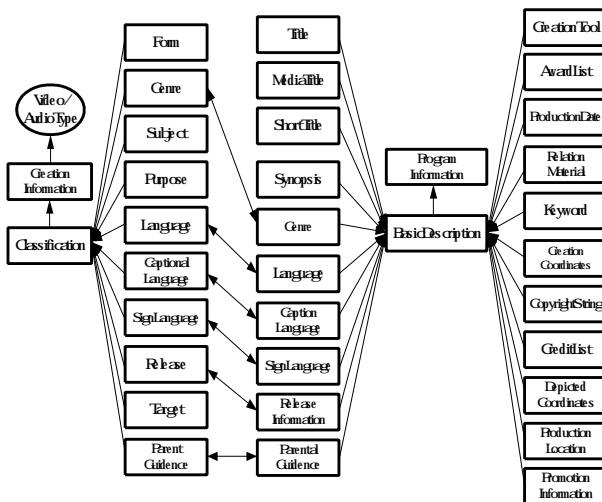

Fig. 4 Relationship of CreationInformation and BasicDescription

The common elements are semantically identical in both standards. The Release element of MDS is synonym of ReleaseInformation of TVA metadata. The Release element has descendents that are equivalent to the descendents of ReleaseInformation as shown in Fig. 5.

The relationship of the lower elements of the Release and the ReleaseInformation are summarized in Table 2. Table 2 also denotes uT-UMA name for the metadata elements.

Table 2. uT-UMA metadata for date and Region

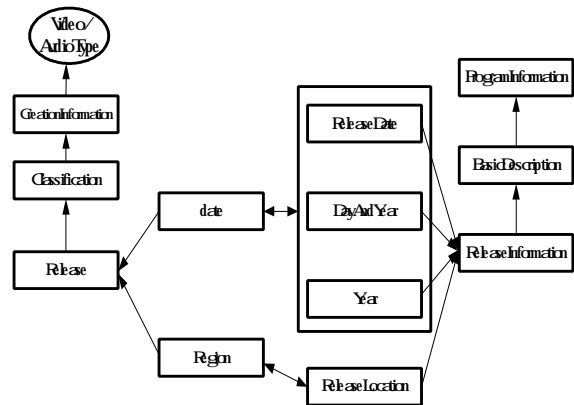| MPEG-7	Relation	TVA	UT-UMA
date	Is Union of	ReleaseDate, DataAnyYear, Year	date
Region	Is equivalent to	ReleaseLocation	Region

Fig. 5 Relationship of Release and ReleaseInformation

The CreationType element of MDS is related with the BasicDescription element of TVA metadata as shown in Fig. 6.
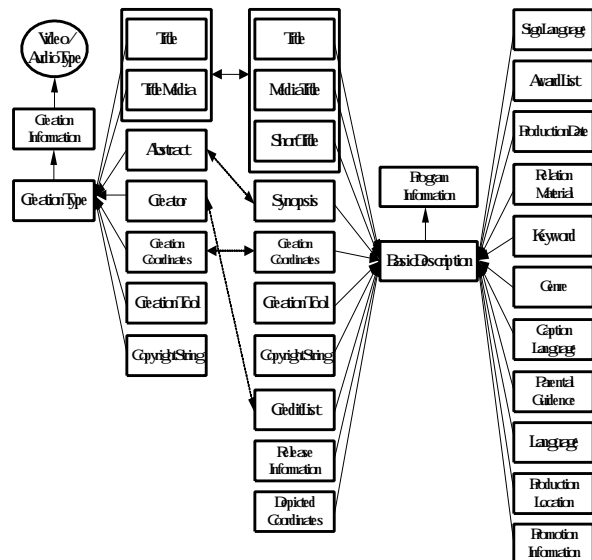

Fig. 6 The Relationship of CreationType and BasicDescription

The relationship between descendents of these two elements is summarized in Table 3. We propose new names for the lowest level elements.

Table 3. uT-UMA metadata for CreationType and BasicDescription

MPEG-7	Relation	TVA	UT-UMA
Title	Is equivalent to	Title	Title
TitleMeida	Is equivalent to	MediaTitle	TitleMeida
Abstract	Is equivalent to	Synopsis	Synopsis
CreationCoordinates	Is equivalent to	CreationCoordinates	CreationCoordinates
Creator	Is equivalent to	CreditsList	Creator

The MediaReview element, one of descendents of CreationInformation of MDS is identical with the MediaReview element of TVA metadata as shown in Fig.7.
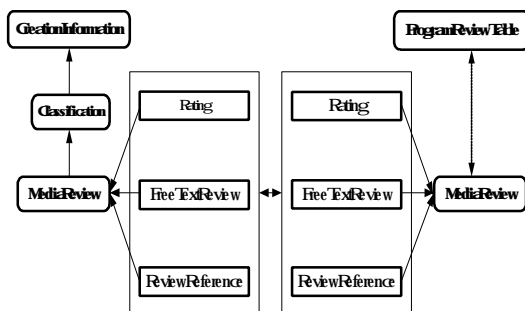

Fig. 7 Relationship of MediaReview's

4.3 Metadata for User Information

Fig. 8 illustrates metadata for User Information. TV-AnyTime has adopted User Interaction of MPEG-7 as it is. Therefore, for the metadata for User Information, the proposed metadata integration method adopted the metadata for User Interaction of MPEG-7 as it was. For reference, User Interaction of MPEG-7 consists of User Preference and User History.
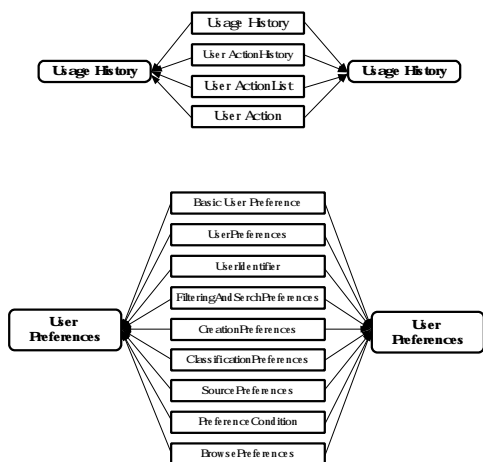

Fig. 8 Metadata for UserInformation

4.4 Metadata for Segment Information

Segment Information of MPEG-7 MDS (Fig. 9) includes much more information than TV-AnyTime does. That is, Segment [3] of MPEG-7 MDS contains temporal and spatial concepts as well as audios, videos, and motion images, while Segment of TV-AnyTime deals only with temporal characteristics of motion images. Actually, Segment part of TV-AnyTime adopted that of MPEG-7 MDS. Therefore, the proposed standard for metadata integration basically followed the relation of inclusion for Segment of MPEG-7 MDS.
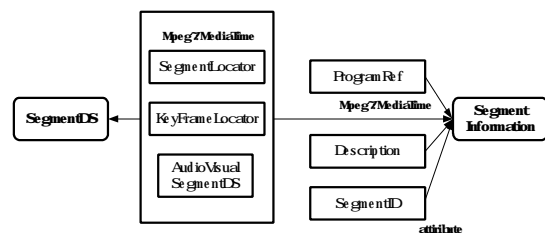

Fig. 9 Metadata for Segment Information

5. Conclusion

This paper accomplished defining a new metadata for multimedia contents. In order to define and construct the new metadata, two standards, which are internationally recognized to have the most multimedia information, were compared to investigate their relationship. In the future, this metadata for multimedia contents will be used in defining multimedia ontology language [3], like RDF or OWL, so that it can be used for context aware multimedia access.

References

1. J. Martinez, "Overview of the MPEG-7 Standard (version 5.0)", ISO/IEC JTC1/SC29/WG11 N4031, Singapore, March 2001. http://www.cselt.it/mpeg/standards/mpeg-7/mpeg-7.htm
2. TV-Anytime Forum, http://www.tv-anytime.org/
3. Jane Hunter, "Adding Multimedia to the Semantic Web-Building an Mpeg-7 Ontology", In International Semantic Web Working Symposium (SWWS), Stanford, July 2001
4. Matthias Ferdinand, Christian Zirpins, David Trastour: Lifting XML Schema to OWL. ICWE 2004: 354-358
5. OWL Web Ontology Language Reference, http://www.w3.org/TR/2004/REC-owl-ref-20040210/#EnumeratedDatatype