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Digital Broadcasting Contents Packaging for Storage Media

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***Abstract*--In this paper, we propose a package format which binds digital broadcasts with related data such as TV-Anytime metadata, additional resources, and usage history to store and reuse them. To achieve that, we adopt MPEG-4 file format as a container and apply a binary format for scenes (BIFS) for representing usage history. In addition, TV-Anytime metadata is used to describe broadcasts and to provide the additional resources, e.g., mp3s, jpeg images, as well. To verify the usefulness of the proposed format, we introduce an application scenario and test it on the scenario.**

I. INTRODUCTION

With the development of digital broadcasting, an end-user terminal such as a personal video recorder (PVR) or set-top box (STB) has been distributed widely and equipped with enhanced functions such as broadcast recording or usage history generation. In addition, HD-DVD and Blu-ray Disc are developed to hold videos or broadcasts with high definition quality. They enable a user to store his (or her) favorite broadcasts of his own terminal as recording his contents with DVD or CD in a PC.

Before long, TV-Anytime specifications will provide metadata not only describing a broadcast but also resolving locations of additional resources. Then, the terminal obtains the resources from service providers or a third party through content referencing [1], so that a user can enjoy a recorded broadcast with its metadata and various multimedia such as mp3s, jpeg images, text files, etc. At the same time, the terminal can give usage history of the broadcast, e.g., user's memo, voice or gesture recording, etc., which can frequently happen in cooking, dance, music, beauty culture, health, educational broadcasts, etc. When a user records a broadcast on a storage medium such as USB storage, HD-DVD, and Blu-ray Disc, they need to bind additional resources together and to keep the links between them.

To achieve that, we propose broadcasting contents packaging which specifies how to combine metadata with timed media information in a suitable format, which should facilitate exchange, management, editing, and presentation of the media [2-3]. In addition, we apply TV-Anytime specifications for broadcasting metadata and systems [4].

II. THEORY

It is expected that an advanced STB or PVR can obtain and store TV-Anytime metadata and additional resources as well as digital broadcasts. The additional resources denote auxiliary data where TV-Anytime metadata resolves their locations for downloading or accessing. For example, an educational broadcast for a foreign language requires mp3s for listening tests or short videos for analogue dialogue scenes. Also, as TV watching environment tends to offer user's interaction, input devices in TVs, e.g., a table board or keyboard will be available for user interactions. Then, the proposed format promotes industrial effect in the side of a PVR or STB and storage devices for HD-DVD and Blu-ray Disc. Moreover, the exchange of such devices between TV terminals and PCs is likely to be more active with the development of IPTV.

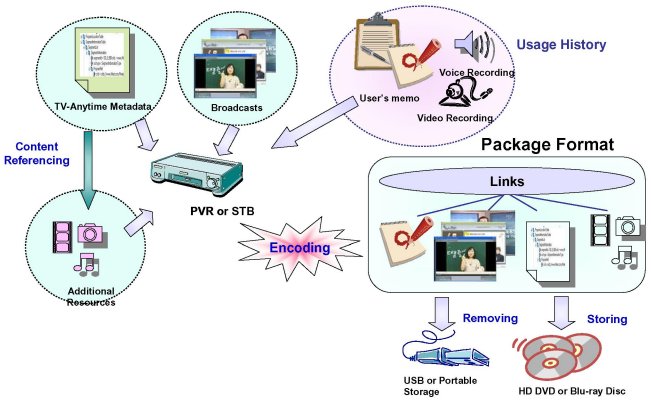

Fig. 1. Application scenario using the proposed package format for storing broadcasts.

For the case that a user moves his favorite broadcast of a STB or PVR using a USB device, or store it to HD-DVD or Blu-ray Disc, the proposed packaging format supports the binding of the multimedia resources with the broadcast as Fig. 1 shows. The format maintains temporal and spatial links between the combined resources so that it can guarantee removability and reusability of the broadcast resources. Its timed media information makes it possible to offer the same watching habit anywhere and anytime.

Fig. 2 shows the structure of the proposed format for digital broadcasts, which is based on MPEG-4 file format. In this structure, scene representation by a binary format for scenes (BIFS) and object descriptor (OD) is utilized for rendering and delivering usage history on a main broadcast. Core 2D scene graph profiles of BIFS [6] are utilized to generate and show usage history such as memos and voices. Each *trak* in *moov* box resolves the corresponding resource. An *xml* file in *meta* box includes usage history and gives a look-up table mapping the IDs of additional resources (CRIDs) into the IDs of resources located in the format.

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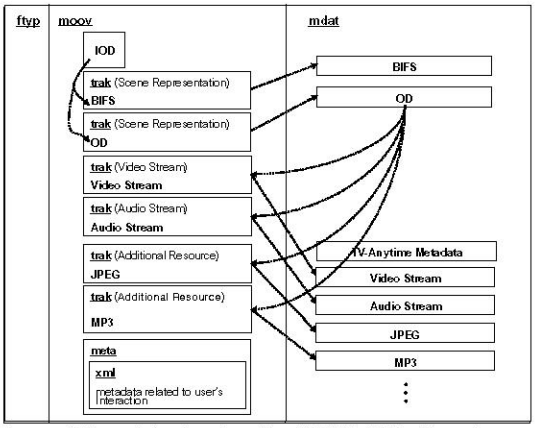

Fig. 2. Proposed format structure based on MPEG-4 File Format.

III. IMPLEMENATION

To demonstrate the effectiveness of the proposed format, we implement it on a Tablet PC, where a touch pen is utilized as a tool for user's actions. Educational broadcasts for English with additional resources consisting of mpeg-1 video clips and jpeg images are adopted.

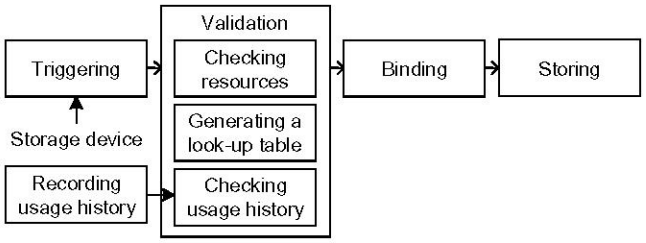

Fig. 3. Encoding process for binding a broadcast with additional resources

The encoding process of the proposed package format is represented in Fig. 3. In this work, the generation of the format is triggered by the event message for a USB or HD-DVD storage device. A user selects and drags a broadcast to the storage and then an encoder checks its additional resources. Via parsing TV-Anytime metadata, it recognizes that which resources are downloaded or not, and records the fact into a look-up table. The table changes the CRIDs of the additional resources of the metadata into the positions of the resources within the format. Then, an xml file is created with the table and the usage history. The schema of the usage history consists of "UserAction" and "SegmentSignification." The former includes user's memo, voice recording, the bookmarks of visiting webs, etc. Watching a broadcast, a user can reuse his own data from a storage medium. The latter gives importance of broadcast segments by measuring repetitive watching. For the binding, we use an mpeg-4 file generator supported by [5].

Fig. 4 shows a format player which encodes and decodes the proposed package format. For encoding, a user selects and drags a broadcast to a storage medium. Then, according to the procedure of Fig. 3, the encoding is performed. For decoding, the player represents usage history by using BIFS: Fig. 4 (a) gives user's drawings consisting of a circle and a saw line with a main broadcast. Fig. 4 (b) shows an analogue scene video clip in the left bottom and Fig. 4 (c) provides a button for accessing a visiting web site. The format player parses TV-Anytime metadata and shows its tree structure. By segment information of the metadata, key-frame sequences are offered and also keyword retrieval is available within the metadata.

So, the implementation results verify that a user can efficiently re-consume his own usage history and additional resources while enjoying a recored broadcast.

Fig. 4. Screen shots of a package format player

IV. CONCLUSION

In this paper, a package format is proposed for digital broadcasts. The proposed format makes it possible to combine a broadcast with its metadata, various additional resources, and usage history. Experiment on the proposed application scenario, shows that the proposed package format is useful for recording or storing broadcasts as keeping temporal and spatial links between related resources. Future points need to be made with regard to re-editing of the format after binding.

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