

Method for the Home Service of Digital Cinema Contents

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Abstract— This paper proposes the method for home service of digital cinema contents. In old times, however, it is possible for digital cinema to play only in a theatre, in these days it is also able to play the digital cinema contents in home according to the growth of the performance of a computer, display devices and network. It is difficult to provide theatre-like environment, however, the method proposed in this paper can get rid of the restriction of time and space and theatre business can be expanded. For this, this paper will expand the KDM of DCI specification.

Keywords— Digital cinema contents, theatre, home service, KDM, DCI

I. INTRODUCTION

Digital Cinema will enable the motion picture cinema industry to gracefully convert from the century-old medium of 35mm film into the digital/wireless communication era of today. This advanced technology will benefit all segments of the movie industry. The Digital Cinema system delivers motion pictures that have been digitized, compressed and encrypted to theatres using either physical media distribution (such as DVD-ROMs) or electronic transmission methods, such as via satellite multicast methods. Authorized theatres automatically receive the digitized programs and store them in hard disk storage while still encrypted and compressed[1].

At each showing, the digitized information is retrieved via a local area network from the hard disk storage, then is decrypted, decompressed and displayed using cinema-quality electronic projectors featuring high quality digital sound[1].

But these high definition digital cinema contents like as 2K, 4K and 3D are played at a theatre until now. Due to the restriction of the display devices, network bandwidth, computing power and etc, digital cinema contents cannot be played in home, however, the growth of the performance of a computer, display devices and network make it possible to see movie in home.

In case of copyright protection, DCI(Digital Cinema Initiatives) specification prescribes that it uses KDM(Key Delivery Message). Digital cinema contents are generally encrypted and distributed to theatres. And for playing them, they need KDM for the decryption of the encrypted contents. KDM is distributed to trusted devices in the theatre. But it cannot be used as it was for home service of digital cinema

contents. It needs to be expanded for changing to be serviced not only in theatres but also in home [2][4].

And a player for the exclusive use of digital cinema contents distributed to home is needed for protecting movies from an illegal distribution and providing this service well. For playing digital cinema contents, the player is looking for the KDM issued from the theatre or content provider. If it exists and is valid, player decrypts and decodes them. And before displaying movie to screen, player inserts the fingerprinting(or forensic marking) of user into decoded contents like DCI Specification.

Forensic marking prescribed in DCI is inserted into image and audio immediately after they were decoded. And it has 35bits' information that is consisted of time and place. Fingerprinting to be used in this paper includes time(contents was played) and user(like as User ID, resident registration numbers and etc) information.

II. OVERALL SYSTEM OVERVIEW

Figure 1 shows the overview of the overall system.

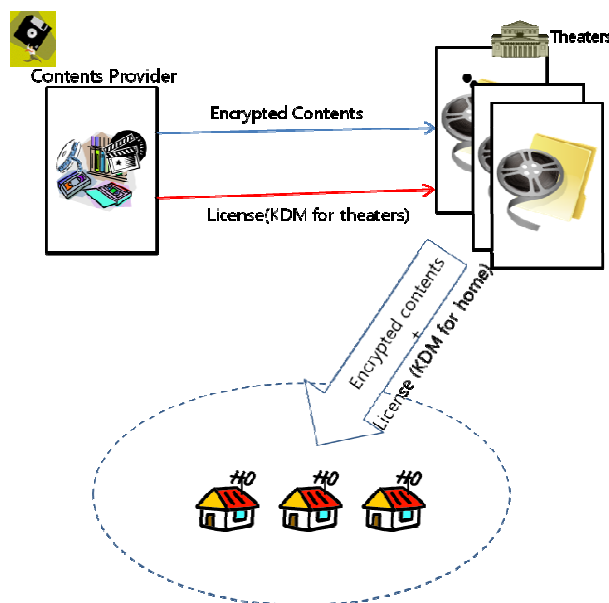


Figure 1. Overall system

Previously, contents provider had provided digital cinema contents and license to theatres and then theatres played received contents using the received license like shown in upper side of the fig.1. But now contents and license can be transferred to home and digital devices of the home deserve to play them recently. Computing power was upgraded enough to decrypt and decode the contents and network speed was improved to Giga bps. And the resolution of display devices was getting higher as days go by.

But KDM cannot be used as DCI had been specified for home. It is needed to be modified. We propose two types of KDM for servicing digital cinema contents to home.

III. KDM REQUIREMENTS FOR HOME SERVICE OF DIGITAL CINEMA CONTENTS

We will describe the content to be modified in the KDM of DCI specification for convenience.

Figure 2 shows the KDM part of DCI specification to be modified.

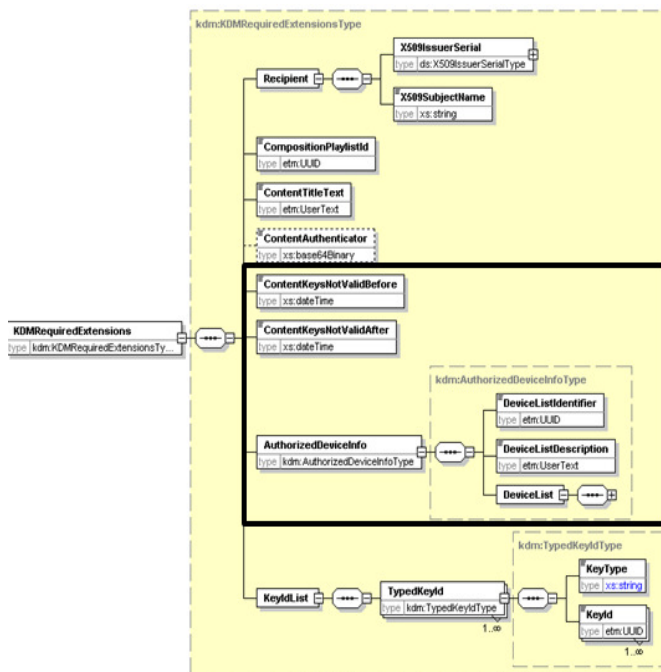


Figure 2. KDM part to be modified

In the fig. 2., the thick unbroken line refers to the rights to be authorized and subject to use them. These parts can be modified to two types according to who services the KDM.

Firstly, KDM can be serviced to users directly by contents provider. Secondly, it can be serviced by theatres. In this case, theatres transfer the KDM to users after modifying that of being received from contents provider.

TABLE 1. TAG TO BE SUPPLEMENTED OR MODIFIED

Type	Before modification	After modification	Note
Type1	ContentKeysNotValidBefore	ContentKeysForJustOneTime	Modification
	ContentKeysNotValidAfter	ContentKeysNotValidAfter	
	AuthorizedDeviceInfo	AuthorizedUserInfo	
Type2	-	ContentKeysForJustOneTime	Supplement
	-	AuthorizedUserInfo	

In type1, ContentKeysNotValidBefore tag had better be changed to ContentKeysForJustOneTime tag because KDM is serviced not to businesses but to users. And the second item of type 1 has same tag in before and after modification. But the contents of tag are different each other. One refers to the playing period of movies and the other refers to the number of times of playing those. Of course the third item of type 1 should be modified to tag for users like as shown in table 1.

In type 2, new two tags are added to the existing KDM tag. The meaning of tags is same as type 1. But two types are different to each other on beneficiaries. The beneficiaries of type 1 are contents providers and those of type 2 are theatres.

As you know from the above explanation of tag, the information which refers to the number of times of playing on tag has to be changed. That is to say, if it is decreased to zero, digital cinema contents should not be played any more.

IV. A PRIVATE PLAYER

For playing the digital cinema contents securely, a player for exclusive use of them is needed. Fig. 3 below describes the composition of a private player.

In private player, SPB(Secure Processing Block) module plays an important role. This module is in charge of decrypting contents using the KDM, decoding the contents and forensic marking them.

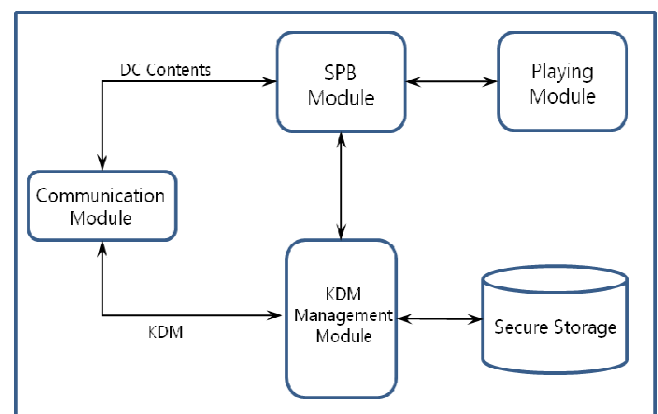


Figure 3. The composition of a private player

Fig. 4 refers to the working diagram of it. It works as soon as the digital cinema contents are input to the communication module of it. The communication module sends the ContentID extracted from the metadata of the received DC(Digital Cinema) contents, the UserID and the PublicKey to license

issuer [7]. License issuer checks the validity of user and sends the license or lists of license the user can select about the downloaded movie. And then the model of type 2 plays the movie through the SPB module and the KDM management module. SPB module decrypts, decodes and fingerprints to the DC contents [2].

But in case of the model of type 1, the process of the user's selection of license is left. If the user selects the proper license, license issuer establishes the rights which the user has selected and sends to the user. And then the private player plays the contents through the SPB module.

The figure below shows the detail filtergraph of the SPB module.

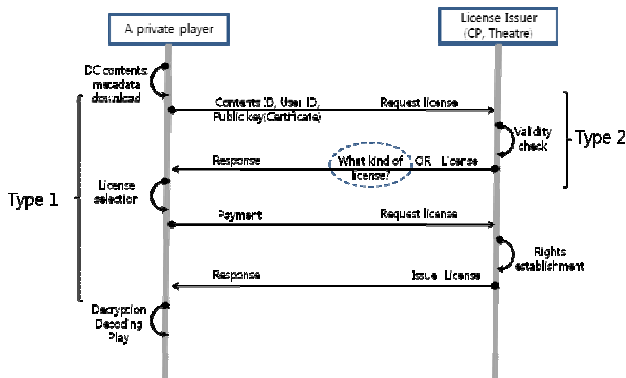


Figure 4. The working diagram of a private player

Firstly, SPB module ingests the contents from theatres. Because these contents were encrypted, we have to decrypt them using the decrypt key in the KDM. The decrypted contents are decoded using the J2K(JPEG2000) decoder.

Before the digital cinema contents are played, forensic marks are embedded. Forensic marks are generated from userID or a unique user identifier and they include the played time and user information.

In case of audio, it goes through the similar process with video.

V. CONCLUSIONS

In this paper, we proposed the method that digital cinema contents could be also played in home through a little modification of DCI's KDM specification and a private player.

According to the business model a various modifications of the KDM and the player exist, however, this paper focused the method the movie could be played in home. We divided the service model into two according to who serviced the KDM to users.

It is expected that the system using the proposed method get rid users and theatre operators of the temporal and spatial restrictions. And the profit structure of corporations can be expected to get better

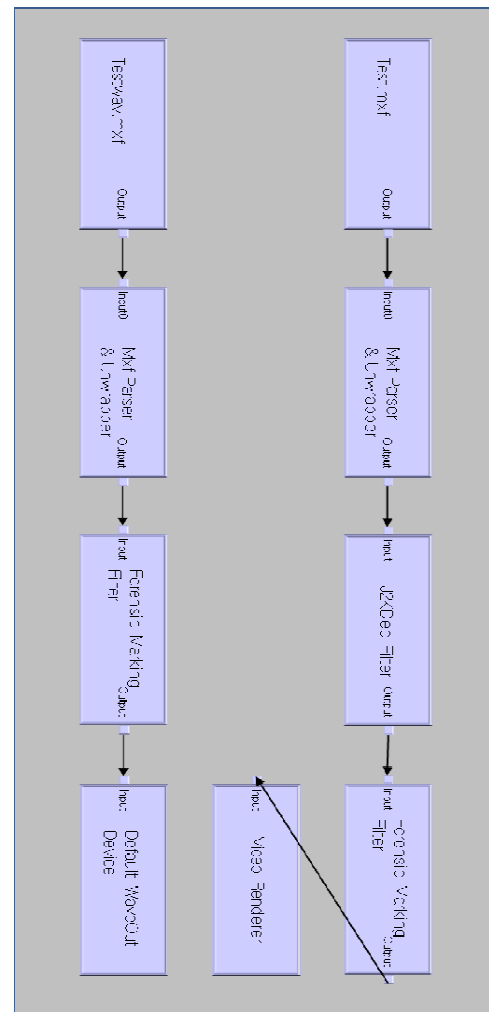


Figure 5. The example filtergraph of the SPB module.

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