(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 December 2001 (13.12.2001)

PCT

(10) International Publication Number
WO 01/95206 A1

(51) International Patent Classification[7]: G06F 17/60

(21) International Application Number: PCT/US01/17291

(22) International Filing Date: 30 May 2001 (30.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/585,424 2 June 2000 (02.06.2000) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 09/585,424 (CIP)
Filed on 2 June 2000 (02.06.2000)

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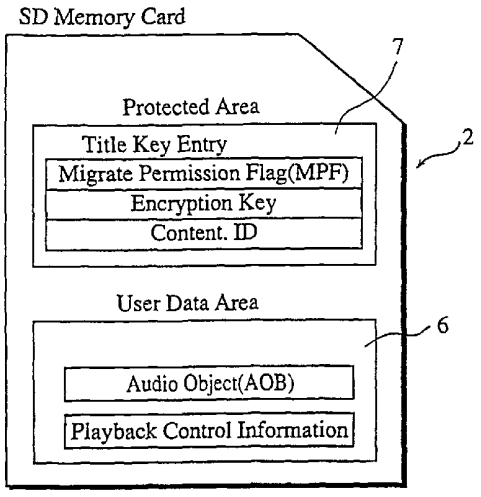
(81) Designated States *(national)*: AU, CN, ID, JP, KR, MX, US, VN.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

[Continued on next page]

(54) Title: RECORDING MEDIUM, LICENSE MANAGEMENT APPARATUS, AND RECORDING AND PLAYBACK APPARATUS



MPF : 0
Migration Prohibited
(Right Management Information corresponding to AOB already generated)

MPF : 1
Migration Permitted
(Right Management Information corresponding to AOB not yet generated)

(57) Abstract: A License Management Apparatus, see figure 2. Each Audio Object (AOB) is put in correspondence with a Migrate Permission Flag (MPF) which is set to ON to show that a migration procedure is permitted. When a Right Management Information (RMI) does not exist for an AOB the MPF is set to OFF to show that a migration procedure is not permitted.

WO 01/95206 A1

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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DESCRIPTION

RECORDING MEDIUM, LICENSE MANAGEMENT APPARATUS, AND RECORDING AND PLAYBACK APPARATUS

FIELD OF THE INVENTION

The present invention relates to a recording medium, a license management apparatus, and a recording and playback apparatus, and in particular an improvement in recording audio data which is obtained as a backup of packaged content recorded on a CD or a DVD-Audio.

BACKGROUND OF THE INVENTION

Technology for backing up CDs using compression CODEC such as MP3 is, ironically, becoming a threat to the profits of copyright holders of the content. This is because the act of distributing audio data obtained for making a back up (hereinafter "backup audio data") through the Internet and so on without the authorization of the copyright holder occurs throughout the world. In light of such circumstances, SDMI (Secure Digital Music Initiative) specifies the following two methods for backing up packaged contents recorded on a CD.

In the first method, a license management apparatus

makes a backup of the CD, and in the second method a portable device makes a back up of the CD. A license management apparatus is equipment such as a personal computer that is equipped with software which is called a licensed compliant module (hereinafter "LCM"). A portable device (hereinafter "PD") is an audio device not equipped with an LCM. The LCM in a license management apparatus allows it to perform the function of managing audio data obtained by backing up. In detail, the license management apparatus performs the function of generating and updating copyright management information about backup audio data . In contrast, as a PD does not have an LCM, it does not perform such a management function, but is limited to performing functions such as recording and playback of audio data. Both PDs and license management apparatuses encrypt, using a predetermined encryption key, audio data which is obtained by compression coding of packaged contents, and then record the audio data on a recording medium. In principle, PDs and license management apparatuses prohibit copying of audio data from the recording medium to another recording medium. Consequently, it is not possible for backup audio data to be sold over a network. Check-in and check-out procedures performed by the license management apparatus are an exception to this principle of copy

prohibition. Check-out, just as a guest leaves a hotel, is the act of recording backup audio data managed in the license management apparatus on a portable recording medium such as a semiconductor memory card. According to this, backup audio data can be transferred from the license management apparatus and used in a PD. Conversely, check-in, as if to call the guest back to the hotel, is the act of returning the backup audio data recorded on the portable recording medium to the license management apparatus. By returning the audio data recorded on the portable recording medium to the license management apparatus, the portable recording apparatus can be used to store other audio data.

However, as PDs cannot perform right management, when backup is performed in a PD, exceptional copying such as check-in and check-out cannot be performed. This gives rise to a problem that the user is given an impression that usability is poor compared to technology which makes a backup using a license management apparatus.

DISCLOSURE OF THE INVENTION

A way to solve the above-described problem is to have a license management apparatus perform migration of audio data which is recorded by a PD. Migration means a license

management apparatus generating right management information for audio data which has been recorded on a recording medium, and placing the audio data under the management of the license management apparatus, in correspondence with the right management information. However, when audio data recorded by a PD and audio data recorded according to check-out by a license management apparatus are recorded on the same recording medium, and the license management apparatus tries to perform migration, the following problem occurs. There is no problem when the audio data recorded by the PD is migrated, but there is a danger that the audio object obtained according to check-out will also be migrated.

The audio object obtained according to check-out already has right management information stored in a license management apparatus, therefore, if this audio object is migrated, the right management information for the one object will be duplicated. Right management information includes a number of permitted check-outs, for example 3. Therefore, if the audio object for which right management information has already been generated is migrated two or three times, the right management information will be generated in duplicate or triplicate, meaning that in reality check-out is permitted six or nine

times. This means that check-out is not only performed more times than necessary, but leads to an endless chain of copying.

The object of the present invention is to provide a recording medium that has an information structure that prevents right management information for one audio object being managed in duplicate or triplicate, while limiting execution of migration to audio objects generated by a PD. The above-described object is achieved by a recording medium for use with a plurality of apparatuses, the following being recorded thereon: an audio object, and a flag which is (a)set to off, when right management information for the audio object has been generated by any of the plurality of apparatuses, to show an instruction that a migration procedure is not permitted, and (b)set to on, when right management information is yet to be generated, to show an instruction that the migration procedure is permitted. Here, the migration procedure is one of the plurality of apparatuses retrieving the audio object from the recording medium and generating the right management information for the audio object.

According to this recording medium, the flag shows whether migration of the audio object is permitted, thereby permitting the audio object for which right management

information does not exist to be migrated only once. Therefore, right management information of an audio object for which right management information has already been generated will not be duplicated. As a result, an audio object obtained according to check-out can be recorded on the same recording medium as an audio object obtained by a PD without violating the concept of copyright protection.

Here, the license management apparatus may include a connecting unit operable to connect to a recording medium on which an audio object and a flag in correspondence have been recorded, a first judgement unit operable to judge whether a migration procedure of the audio object is permitted, by referring to a set value of the flag, a storage unit, and a migration procedure unit operable to perform the migration procedure only when the migration procedure is permitted. Here, the migration procedure is retrieving the audio object from the recording medium, generating right management information about the audio object, and writing the audio object and the right management information in correspondence into the storage unit.

According to this license management apparatus, an audio object obtained by the recording and playback apparatus compression coding can be obtained without the

audio object being compression coded in duplicate. As a result, the time that the license management apparatus takes to obtain the audio object is shortened, improving convenience for the user.

Here, the license management apparatus may be used with a recording and playback apparatus for performing reading from and writing to a recording medium on which (a) a first audio object for which corresponding right management information has been generated by the license management apparatus, and (b) a flag set to off, are recorded, the recording and playback apparatus including: a playback unit operable to reproduce the first audio object when a playback instruction is performed by the user, a signal receiving unit operable to receive an external audio signal when a recording instruction is performed by the user, an encoding unit operable to encode the audio signal to obtain a second audio object, and a writing unit operable to write the second audio object and the flag set to on into the recording medium. Here, the flag shows (c) by being set to on, that a migration procedure is permitted, and (d) by being set to off, that the migration procedure is not permitted, the migration procedure being the license management apparatus retrieving the second audio object and generating right management information about the

second audio object.

Application of this recording and playback apparatus is not limited to simply reproducing audio objects recorded on a recording medium by check-out, but extends to backing up packaged content recorded on a CD. Therefore, a recording and playback apparatus having a higher product value can be provided for the market.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, advantages and features of the invention will become apparent from the following description thereof taken in conjunction with the accompanying drawings which illustrate a specific embodiment of the invention. In the drawings:

FIG. 1 shows the structure of one SDMI domain in an SDMI system;

FIG. 2 shows the internal structure of the SD memory card;

FIG. 3 shows the internal structure of the recording and playback PD;

FIG. 4 shows the internal structure of the license management apparatus 1;

FIG. 5 shows an operation example of the SDMI system of the first embodiment when migration is performed without

using a migration permission flag;

FIG. 6 shows an operation example of the SDMI system of the first embodiment when migration is performed using a migration permission flag;

FIG. 7 shows an operation example of the SDMI system of the first embodiment when a MPF is used;

FIG. 8 shows an operation example of how migration of an AOB is performed, when the recording and playback PD of one of the SDMI domains in the plurality of SDMI domains writes the AOB on the SD memory card;

FIG. 9 shows the structure of the physical layer of the SD memory card 2;

FIG. 10 shows the structure of the directories in the user data area 6 and the protected area 7 of the SD memory card;

FIG. 11 shows the internal structure of the TKE;

FIG. 12 shows what kind of content is reproduced when each AOB contained in an AOB file is reproduced in succession;

FIG. 13 shows the correlation between TKIs, AOB files, and TKEs;

FIG. 14 shows the internal structure of a TKI;

FIG. 15 shows how TKIs are set when two tracks are combined into one;

FIG. 16 supposes that one track is divided into two tracks;

FIG. 17 shows the internal structure of the secure R/W unit 17 and the secure R/W unit 22;

FIG. 18 shows the internal structure of the secure write unit 31;

FIG. 19 shows the internal structure of the secure read unit 32;

FIG. 20 shows a migration procedure being performed on eight AOBs and eight TKEs;

FIG. 21 shows the structure of directories and files in the local storage 21;

FIG. 22 shows the eight AOBs and the eight TKEs stored in the SD memory card 2, according to check-out;

FIG. 23 shows the contents of the local storage 21 after check-out has been executed;

Fig. 24 is a flowchart showing the procedures of the LCM 23 of the second embodiment; and

FIG. 25 shows a setting example of the MPF of the third embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

The following explains, with reference to the drawings, a recording medium, a license management apparatus 1, and a recording and playback apparatus (recording and playback PD), of the present embodiment, that are used in an SDMI system. The SDMI system includes a plurality of domains. FIG. 1 shows the structure of one SDMI domain in the SDMI system. As shown in FIG. 1, the SDMI domain includes a license management apparatus 1, an SD memory card 2, a recording and playback PD 3 (hereinafter "rec/play PD 3"), a CD 4, and a CD player 5.

The license management apparatus 1 is composed of local storage which can store a plurality of sets of SDMI protected content and right management information (hereinafter "RMI"), and an LCM, and performs check-in and check-out. In check-out the license management apparatus 1 writes an audio object into the SD memory card 2, and in check-in returns an audio object to the local storage 21. The SDMI protected content is encrypted audio data that only an LCM 23 can reproduce. An encryption key for decrypting the audio data is stored in the RMI. The RMI is encrypted according to a public key encryption method, and can only be decrypted by the LCM 23. In the SDMI domain, the rec/play PD 3, which is not equipped with LCM 23, cannot retrieve the encryption key from the RMI. Consequently,

in the SDMI domain, the SDMI protected content is treated as audio data which can only be reproduced in the LCM 23. On the other hand, the audio object (hereinafter "AOB") is encrypted audio data which is written into the SD memory card 2 together with the encryption key, and can be reproduced by a device belonging to the SDMI domain.

The SD memory card 2 is a recording medium into which a unique identifier (hereinafter "media ID") for identifying the individual recording medium is written, and is composed of a protected area which can be accessed only by devices in the system which are accepted as being authentic (the license management apparatus 1, and the PD 3), and a user data area which can be accessed not only by authentic devices, but also by devices that are not authentic.

The rec/play PD3 does not have the local storage 21 nor the LCM 23, and is a PD which reproduces AOBs written into the SD memory card 2, and writing of AOBs into the SD memory card 2. The rec/play PD 3 obtains audio data from an audio signal generated by the CD player 5 reproducing a CD, encrypts the audio data and writes the encrypted audio data into the SD memory card 2 as an AOB.

The CD 4 is a recording medium on which a packaged content is recorded. A packaged content recorded on the

CD 4 can be content copyright protected according to SDMI that has a watermark, or content produced before the application of copyright protection that does not have a watermark (generally called "legacy content").

The CD player 5 reproduces packaged content recorded on the CD 4, and outputs an audio signal to the rec/play PD 3. There are two types of audio signals that may be output from the CD player: IEC 958 digital signals (unprotected digital signals), and analog signals.

The characteristics of the above-described system are the rec/play PD 3 performing compression coding of an audio signal from the CD player 5, writing the obtained AOB into the SD memory card 2, and the license management apparatus 1 retrieving the AOB from the SD memory card 2.

This completes the explanation of the SDMI system. Next, the internal structure of the SD memory card 2 will be explained. FIG. 2 shows the internal structure of the SD memory card 2. The SD memory card 2 shown in this figure is composed of a user data area 6 and a protected area 7.

At least one AOB and a corresponding piece of playback control information are written into the user data area 6. A title key entry (hereinafter "TKE") corresponding to each AOB is written into the protected area 7. The TKE includes the encryption key used to encrypt the AOB, a

content ID which is an identifier for identifying the SDMI protected content which corresponds to the AOB, and a migrate permission flag (hereinafter "MPF"). The MPF, when set to "off", shows that the AOB corresponding to the TKE was written according to check-out by one license management apparatus 1 of a plurality of license management apparatuses, and that migration is not permitted to any of the plurality of license management apparatuses. The MPF, when set to "on", shows that the AOB corresponding to the TKE was written by the PD, and migration to any of the license management apparatuses is permitted. In the present embodiment, "off" is shown by "0" , and "on" by "1". The set consisting of the above-described AOB, the corresponding TKE, and the playback control information is called a "track".

This completes the explanation of the SD memory card 2. Next the internal structure of the rec/play PD 3 will be explained. FIG. 3 shows the internal structure of the rec/play PD 3. As shown in FIG. 3, the rec/play PD 3 is composed of a connector with which connection to the SD memory card 2 is possible, and also includes a user interface 8, signal input terminals 9, a screening unit 10 (a ripper 11, a watermark detector 12, a signal source checker 13, a ripper 14), an encrypting unit 15, a recording

and playback control unit 16, a secure R/W unit 17, a decrypting unit 18, and a playback unit 19.

The user interface 8 is composed of a display, a key pad, and so on. The user interface 8 receives instructions from the user to write into and reproduce from the SD memory card 2, and instructs control by the encrypting unit 15, the recording and playback control unit 16, the secure R/W 17, the decrypting unit 18, and the playback unit 19, according to these instructions.

The signal input terminal 9 is an input terminal which brings external audio signals into the recording and playback PD. There is an analog stereo type terminal, unprotected digital type terminal, and an analog monaural type terminal. The CD player 5 is connected to the analog stereo type input terminal or the unprotected digital type input terminal, while a microphone is connected to the analog monaural type input terminal.

The screening unit 10 prevents illegal compression coding of audio signals which are input via the signal input terminals 9, and also converts audio signals into audio data. The screening unit 10 includes a ripper 11, a watermark detector 12, a signal source checker 13, and a ripper 14.

The ripper 11 compression codes analog signals or

unprotected digital signals to obtain audio data. Analog signals or unprotected digital signals are successively input via the signal input terminals 9, the analog stereo type input terminal and the unprotected digital terminal. The compression coding is based on, for instance, MP3 (MPEG1 layer 3), MPEG-AAC (Advanced Audio Coding), or WMA (Windows Media Audio).

The watermark detector 12 detects a watermark from the audio data output from the ripper 11. The audio data output by the ripper 11 is obtained by compression coding packaged content which is copyright protected. When a watermark is detected, the watermark detector 12 removes the watermark from the audio data, and then outputs the audio data to the encrypting unit 15. Audio data copyright protected but not having a watermark is not output to the encrypting unit 15. This is because it is assumed that the fact that there is no watermark, despite being copyright protected, means that the audio data has passed through the screening unit 10 in the past and the watermark has already been removed, and also because outputting such audio data to the encrypting unit 15 would mean generating the audio data in duplicate. However, when audio data output from the ripper 11 corresponds to packaged content which is not copyright protected (legacy content),

regardless of not detecting a watermark, the watermark detector 12 outputs the audio data to the encrypting unit 15. According to this, legacy content can be retrieved by the rec/play PD 3 even if a watermark does not exist.

The signal source checker 13 judges the authenticity of audio signals which are input into the rec/play PD 3 through the analog monaural type input terminal. In detail, the signal source checker 13 judges whether an input audio signal is monaural and has a bandwidth limitation. If the judgement is affirmative, the signal source checker 13 outputs the audio signal to the ripper 14. If the input audio signal is of the stereo type, or is monaural but does not have a bandwidth limitation, the signal source checker 13 assumes that a microphone is connected to the signal input terminal 9 improperly and does not output the audio signal to the ripper 14.

The ripper 14, which has the same structure as the ripper 11, compression codes analog signals output by the signal source checker 13, and outputs the signals to the encrypting unit 15.

The encrypting unit 15, when a recording operation is performed on the user interface 8, and audio data is output from the ripper 14 or the watermark detector 12, generates a unique encryption key for the audio data, and

encrypts the audio data using the encryption key to generate encrypted data.

The recording and playback control unit 16, when a recording operation is performed on the user interface 8, and encrypted audio data is output from the encrypting unit 15, writes the output encrypted audio data into the user data area 6 as an AOB. When a playback operation is performed on the user interface 8, the recording and playback control unit 16 reads the AOB from the user data area 6 of the SD memory card 2, and outputs the AOB to the decrypting unit 18.

The secure R/W unit 17, when a recording operation is performed on the user interface 8, and an encryption key is output from the encrypting unit 15, writes a TKE into the protected area 7. The TKE includes the output encryption key, a MPF set to "1", and a content ID uniquely identifying the AOB in the SD memory card 2. Furthermore, when a playback operation is performed on the user interface 8, the secure R/W unit 17 reads the TKE from the protected area 7, and sets the encryption key stored in the TKE in the decrypting unit 18 as the encryption key to be used in playback.

The decrypting unit 18, when a recording operation is performed on the user interface 8, and an AOB is output

from the recording and playback control unit 16, decrypts the AOB using the encryption key output from the secure R/W unit 17, and outputs the audio data to the playback unit 19.

The playback unit 19 reproduces the audio data output from the decrypting unit 18.

This completes the explanation of the rec/play PD 3. Next, the internal structure of the license management apparatus 1 will be explained. FIG. 4 shows the internal structure of the license management apparatus 1. As shown in FIG. 4, the license management apparatus 1 has a connector for connecting to the SD memory card 2, and is composed of a user interface 20, a local storage 21, a secure R/W unit 22, and a licensed compliant module 23.

The user interface 20 is composed of a display, a keyboard, a mouse, and so on, and receives an operation instructing retrieving of an AOB from the SD memory card 2, and an operation instructing check-out to the SD memory card 2. In the retrieving operation, the user interface 20 displays a list of all AOBs written in the SD memory card 2, and receives a specification, according to a drag operation, of the AOB to be retrieved. In the check-out operation, the user interface 20 displays all AOBs stored in the local storage 21, and, as with the retrieving

operation, receives a specification of the AOB to be retrieved, according to a drag operation.

The local storage 21 is an internal disk apparatus which can store a plurality of sets of SDMI protected content and RMI. For content from amongst the SDMI protected content which has been checked-out at least once, the number of permitted check-outs is decremented, and check-out history information is put in correspondence with the content. The check-out history information is the set of the media ID assigned to the SD memory card 2 on which the AOB is written in check-out, and the content ID which uniquely specifies the SDMI protected content in the SD memory card 2. The check-out history information is used when the LCM 23 performs check-in.

The secure R/W unit 22, when instructed to retrieve from the SD memory card 2, reads the TKE from the protected area 7, and outputs the TKE to the LCM 23. If check-out is instructed, the secure R/W unit 22 writes the TKE into the protected area 7.

The LCM 23, when instructed to perform data retrieving from the SD memory card 2, performs check-in and migration alternatively, and when check-out is instructed, performs check-out. When retrieving, the LCM 23 gives priority to judging whether or not migration is

permitted, ahead of whether or not check-in is permitted. The procedures of the licensed compliant module 23 in migration, check-in, and check-out are explained in the following, divided into (i), (ii), and (iii).

(i) When the SD memory card 2 is connected and an operation to retrieve from the SD memory card 2 is performed on the user interface 20, the LCM 23 judges whether migration is permitted. In order to do this, first the LCM 23 retrieves the TKE from the protected area 7, and judges whether the MPF is set to "1" or "0". If the MPF is set to "1", the LCM 20 performs the migration procedure. In the migration procedure, the LCM 23 retrieves the AOB from the user data area 6 of the SD memory card 2, and stores the AOB as SDMI protected content in the local storage 21. In addition, the LCM 23 also retrieves the encryption key from the protected area 7 via the secure R/W unit 22, generates RMI which includes the encryption key, and stores the RMI in the local storage 21. The result of the above-described process is that the AOB written in the SD memory card 2 is managed in the local storage 21 as SDMI protected content. Next, the LCM 23 overwrites the content ID and the MPF with "0", and overwrites the encryption key in the TKE in the SD memory card 2 with a random number. Overwriting the encryption key with a

random number means that the AOB corresponding to the encryption key is put in a non-reproduction state.

(ii) Check-in is performed only when the LCM 23 judges migration not to be permitted. In other words, when the MPF is set to "0", the LCM 23 retrieves the content ID from the TKE, retrieves the media ID, and judges whether check-out history information matching the set of the media ID and the content ID exists in the local storage 21. If such matching check-out history information does not exist, the LCM 23 judges that check-out was performed in another license management apparatus and does not execute check-in. If such matching check-out history information exists, the LCM 23 judges that the license management apparatus 1 performed check-out, and the LCM executes check-in. In check-in the LCM 23 may move the AOB and the encryption key from the SD memory card 2 to the local storage 21, but in this case check-in takes time due to reading and writing of the AOB. Therefore, check-in is generally performed simply, in the following manner. The LCM 23 decrypts the RMI of the SDMI protected content which corresponds to the check-out history information, reads the number of permitted check-outs, and after incrementing the number of permitted check-outs, re-encrypts the RMI. In addition, the LCM 23 also overwrites the MPF and the content ID in

the TKE with "0", and overwrites the encryption key with a random number.

(iii) If an operation to perform check-out is performed on the user interface 20, the LCM 23 decrypts the RMI which corresponds to the SDMI protected content, and retrieves the number of permitted check-outs and the encryption key. After decrementing the number of permitted check-outs, the LCM 23 writes the number back into the RMI. Then the LCM 23 generates a TKE including the retrieved encryption key and a unique content ID, and writes TKE into the protected area 7. At this time, the LCM 23 does not update the MPF, and the MPF remains set to "0". Next, the LCM 23 reads the media ID from the SD memory card 2, puts the content ID and media ID in correspondence in the TKE, and stores the content ID and the media ID in the local storage 21 as check-out history information.

Next, an operation example of the above-described system will be explained. A characteristic of the system is that when the rec/play PD 3 writes an AOB on the SD memory card 2, it also sets the MPF. Therefore, the explanation of the system will be given comparing a case in which an AOB is written into the SD memory card 2 without a MPF being set, and a case in which an AOB is written into the SD memory

card 2 with a MPF being set.

First, an operation example of the case in which the MPF is not written will be explained. FIG. 5 shows the operation example of when migration is performed without using a MPF. In the present system, the CD player 5 starts to reproduce packaged content recorded on a CD, the rec/play PD 3 obtains an AOBx1 by compression coding the playback signal, and writes the AOBx1 into the SD memory card 2 without a corresponding MPF, as shown by ①. On the other hand, if a license management apparatus Y2 writes an AOBx2 into the SD memory card 2 by performing check-out of the SDMI protected content x2 which is inside the license management apparatus Y2 itself, as shown by ②, the result is that there is no way of distinguishing the AOB written by the rec/play PD 3 and the AOB written by the license management apparatus Y2. If the SD memory card 2 on which the AOBs are written is connected to the license management apparatus Y1, as shown by ③ and ④, SDMI protected content x1 and x2 corresponding to the AOBx1 and the AOBx2 and the corresponding RMI x1 and RMI x2 will be generated in the license management apparatus Y1. The AOB x2 already has RMI x2 in the license management apparatus Y2, and RMI x2 is also generated in the license management apparatus Y1, meaning that the rights of the AOB x2 are managed twice.

Next, an operation example of the license management apparatus 1 performing a migration procedure using a MPF when the PD makes a backup of the CD, will be explained. FIG. 6 and FIG. 7 show operation examples of when a MPF is used. In FIG. 6, when the CD player 5 reproduces a CD, and the rec/play PD 3 compression codes the audio signal output from the CD player 5 and obtains an AOB, the MPF is set to "1" and the AOBx1 is written in correspondence with the MPF on the SD memory card 2, as shown by ①. On the other hand, when the license management apparatus Y2 performs check-out, it does not set the MPF, and the AOB is written as is. As a result, the AOB written according to the license management apparatus performing check-out is stored in correspondence with a MPF set to "0" in the SD memory card. If the SD memory card in which the AOBx1 and the AOBx2 are stored is connected to the license management apparatus Y1, the license management apparatus Y1 refers to the MPF for each AOB, as shown by ③, and judges whether a migration procedure should be performed. The license management apparatus Y1 judges that a migration procedure for the AOB x1 is permitted because the migration permission flag is set to "1". Subsequently, the license management apparatus Y1 generates RMI x1 for the AOB x1 as shown by ④, and performs the migration procedure by

reading the AOB x1 into the local storage 21 as an SDMI protected content x1. Next, as shown by ⑤ in FIG. 7, the MPF is updated to "0", and the AOB x1 is put into a non-reproduction state, as shown by ⑥. Meanwhile, the license management apparatus Y1 refers to the MPF for the AOBx2 and judges whether the AOB x2 is permitted to be migrated. The MPF is set to "0", so the license permission apparatus Y1 aborts the migration procedure. According to this, generation in duplicate of RMI for an AOB for which there is already RMI is avoided.

Next, the way an AOB is migrated when a rec/play PD 3 in one SDMI domain of a plurality of SDMI domains writes the AOB into the SD memory card 2 will be explained. In an example in FIG. 8, there are a plurality of SDMI domains: Y1, Y2, Y3, Y4, and Y5. When a rec/play PD 3 included in one of the SDMI domains writes the AOBx1 in correspondence with the MPF set to "1" on the SD memory card 2, it is possible to execute migration of the AOB x1 to any of the plurality of license management apparatuses Y1, Y2, Y3, Y4, and Y5, as shown by arrows MR1, MR2, MR3, MR4, and MR5. In other words, the AOB x1, which was written by the rec/play PD 3, can be migrated by an SDMI domain license management apparatus of any of the SDMI domains Y1, Y2, Y3, Y4, and Y5. However, if migration of the AOB x1 is

performed once, the AOB x1 is put into a non-reproduction state, and migration cannot be performed a second time. Furthermore, even if the license management apparatus included in one SDMI domain Y4 writes the AOB x2 into the SD memory card 2 by performing check-out, another license management apparatus Y5 will not execute migration of the AOB x2 in any case. This is because the AOB x2 is written in the SD memory card 2 in correspondence with the MPF set to "0", therefore the AOB x2 is clearly distinguished from the AOB x1 written by the rec/play PD 3. Use of an AOB written by check-out by the license management apparatus Y1 is limited, such as an AOB x3 written according to check-out of the license management apparatus 1, to playback by a PD.

As explained above, according to the present embodiment, a MPF shows whether migration of an AOB is permitted. As a result, migration is permitted only once for an AOB for which RMI does not exist. Accordingly, RMI is not generated in duplicate for an AOB for which RMI already exists. This means that AOB obtained by check-out and AOB obtained from a PD can be written on the same recording medium without infringing protection of copyright.

Second Embodiment

The second embodiment relates to an improvement in data structure based on SD Audio specifications when storing and processing a TKE and an AOB.

The SD memory card 2 in the second embodiment is assumed to have a physical structure as that shown in FIG. 9.

FIG.9 shows the structure of the physical layer of the SD memory card 2. As shown in the drawing, the physical layer of the SD memory card 2 is composed of a system area 101, a hidden area 102, a protected area 103, AKE processing units 104 and 105, a Ks decrypting unit 106, a Ks encrypting unit 107, and a user data area 108. Comparing the internal structure of the SD memory card 2 shown in FIG. 9 with that shown in FIG. 2, in FIG. 9 the user data area 108 and the protected area 103 correspond to the user data area 6 and the protected area 7 respectively.

The system area 101 is a read-only area storing a media key block (MKB) and a media ID. The MKB and media ID stored in this area cannot be overwritten. Suppose that the SD memory card 2 is connected to another device such a the rec/play PD 3 or the license management apparatus 1, and the MKB and media ID read by that device. If the connected device correctly performs a specified

calculation using a device key Kd held internally, it can obtain a correct encryption key Kmu.

The hidden area 102 stores the encryption key Kmu having the correct value, in other words the encryption key Kmu that should be obtained if the connected device performs correct calculation using the correct device key Kd.

The protected area 103 stores a file (AOBSA1.KEY in the figure) which writes a plurality of TKEs.

The AKE (authentication and key exchange) processing units 104 and 105 perform mutual authentication between a connected device and the SD memory card 2 using the challenge-response method, verify the authenticity of the opposing device, and if the opposing device is invalid, stop processing. If the opposing device is valid, however, an encryption key (session key Ks) is shared by the device and the SD memory card 2. Authentication performed by the device connected to the SD memory card 2 has three phases. First, in a first challenge phase, the device generates a random number, encrypts the random number using the encryption key Kmu, and transmits the encrypted random number to the SD memory card 2 as a challenge value A. Then, in a first response phase, the SD memory card 2 uses the encryption key Kmu stored internally to decrypt the

challenge value A, and transmits the decrypted value to the connected device as a response value B. Following this, in a first verify phase, the connected device decrypts the challenge value A held internally using its encryption key Kmu, and compares the decrypted value with the response value B transmitted from the SD memory card 2.

Authentication performed by the SD memory card 2 also has three phases. First, in a second challenge phase, the SD memory card 2 generates a random number, encrypts the random number using the encryption key Kmu, and transmits the encrypted random number to the connected device as a challenge value C. Then, in a second response phase, the connected device uses the encryption key Kmu stored internally to decrypt the challenge value C, and transmits the decrypted value to the SD memory card 2 as a response value D. Following this, in a second verify phase, the SD memory card 2 decrypts the challenge value C held internally using its encryption key Kmu, and compares the decrypted value with the response value D transmitted from the connected device.

If the connected device uses an improper encryption key Kmu to perform mutual authentication, challenge value A and response value B in the first verify phase and challenge value C and response value D in the second verify

phase will be judged to be non-matching values, and mutual authentication will be stopped. If the authenticity of the opposing devices is verified, however, the AKE processing units 104 and 105 calculate an exclusive OR of challenge value A and challenge value C and obtain the session key Ks by decrypting the exclusive OR using the encryption key Kmu.

When an encrypted TKE that is to be written into the protected area 107 is output from another device conncected to the SD memory card 2, the Ks decrypting unit 106 supposes that the TKE has been encrypted using the session key Ks, and decrypts using the session key Ks. Then, the Ks decrypting unit 106 supposes the encryption key and the Content ID obtained from this decryption to be the original TKE, and are written into the protected area 103.

The Ks encrypting unit 107 receives an instruction from a device connected to the SD memory card 2 instructing it to read the TKE, encrypts TKE stored in the protected area 103 using the session key Ks, and then outputs the encrypted TKE to the device that issued the instruction.

The user data area 108 can be accessed by a connected device regardless of whether the authenticity of that device has been verified, and stores a plurality of files which contain an encrypted AOB (AOB001.SA1 in the drawing)

and playback control information (SD_Audio.TKM). If the encryption key read from the protected area 103 has a correct value, the encrypted AOB stored in the user data area 108 can be correctly decrypted. Reading and writing of data from the protected area 103 is performed together with decryption performed by the Ks decrypting unit 106 and encryption performed by the Ks encrypting unit 107. Therefore, the protected area 103 can usually only be accessed by a device connected to the SD memory card 2 when that device has successfully performed AKE processing.

Next, the structure of the directories and the files of the SD memory card 2 will be explained. FIG. 10 shows the structure of the directories and the files of the user data area 108 and the protected area 103. In FIG. 10, an SD_Audio directory is provided in both the protected area 103 and the user data area 108. The SD_Audio directory in the user data area 108 has eight AOB files (AOB001.SA1, AOB002.SA1, AOB003.SA1, AOB004.SA1… AOB008.SA1), each of which stores eight AOBs and an SD_Audio.TKM, The SD_Audio directory of the protected area 103 has an AOBSA1.KEY. Numbers "001" to "008" used in the files names of the AOB files are AOB IDs. A number #1, #2, #3, #4…#8 showing the same number as the AOB ID is assigned to each of the eight TKEs included in the AOBSA1.KEY and to the track

information (TKI) included in the SD_AUDIO.TKM. An encryption key "EKEY" used when encrypting each AOB is stored in the TKE which has the same number as the AOB ID. Playback control information for reproducing an AOB is in the TKI which has the same number as the AOB ID.

Next, the internal structure of a TKE will be explained. FIG. 11 shows the internal structure of a TKE. As shown by arrows h1 in FIG. 11, the TKE is composed of a MPF, a seven byte encryption key "EKEY", an AVF, and a content ID. Please note that the MPF in the present embodiment is the same as that in the first embodiment, and is only set to "1" when the AOB is written by a recording and playback PD.

The content ID in the second embodiment is used with the availability flag (hereinafter "AVF") in the following way. When there is an AOB file corresponding to a particular TKE, the content ID in the TKE is set to any of "001" to "999". When there is no AOB file corresponding to a particular TKE, the content ID is set to "000". In addition, when an AOB corresponds to a number of TKEs, the content IDs in the TKEs corresponding to the AOB are all set to the same value. When a TKE and an AOB have a one-to-one correspondence, the AVF and the MPF are set to "1". When an AOB corresponds to a number of tracks, the

AVF and the MPF of the head TKE are set to "1". The AVFs and the MPFs of other TKEs are set to "0". If the content ID is not "000" and the AVF is set to "0", it is possible that a plurality of AOBs have the same content ID. Therefore, this is taken as a hint, and TKEs which have the same content ID are extracted. This means that it is possible to perform a search procedure that specifies a plurality of AOBs which correspond to the same content ID.

Next, what kind of packaged content corresponds to the eight AOBs written in each of the eight AOB files shown in FIG. 10 will be explained. Fig. 12 shows an example of the correlation between AOBs and packaged content.

The third row in FIG. 12 shows to what kind of packaged contents the AOBs correspond. The eight AOBs in FIG. 12 correspond to Content. A, Content. B, Content. C, Content. D, and Content. E. The second row shows the units into which the contents in the third row are divided, and the first row shows the eight AOBs written into the eight AOB files shown in FIG. 10. The broken lines AS1, AS2, AS3..AS7, AS8 show the correlation between the sections of the content and the AOBs. There is a silent section between each of packaged content A and B, B and C, C and D, and D and E, and the AOBs in FIG. 12 are generated with these silent sections as boundaries.

AOB#4 is the head section of a content (Content. D). The Content. D has a playback time of 30.6 minutes and AOB#4 has a playback time of 8.4 minutes. AOB#5 and AOB#6 are midpoints of the Content. D, and each have a playback time of 8.4 minutes. AOB#7 is the last section of Content. D and has a playback time of 5.4 minutes. In this way, the content which has a playback time of 30.6 minutes is divided into units of 8.4 minutes + 8.4 minutes + 8.4 minutes + 5.4 minutes, and is included in each AOB. As can be seen from this drawing, the playback time of all AOBs is kept within a time length of 8.4 minutes.

FIG. 13 shows the correlation between a TKI, an AOB file, and a TKE. The rectangular frame of the first row in FIG. 13 shows an SD_AUDIO.TKM, and the second and third rows show the eight AOB files shown in FIG. 10. The eight TKIs included in the SD_Audio.TKM are shown in the first row. Each TKI is assigned a number "#1", "#2", "#3", "#4"…"#7", "#8" which specifies the TKI, as a TKI ID. Each TKI corresponds to the AOB file whose assigned AOB ID is the same as the TKI ID number. Each TKE is given a number "#1", "#2", "#3", "#4"… "#7", "#8" which specifies the TKE. Each TKE corresponds to the AOB file whose AOB ID number is the same as the TKE number. Keeping this in mind and referring to FIG. 13, it can be seen that TKI#1 and TKE

#1 correspond to AOB001.SA1, TKI#2 and TKE #2 correspond to AOB002.SA1, TKI#3 and TKE #3 correspond to AOB003.SA1, and TKI#4 and TKE #4 correspond to AOB004.SA1. The arrows TA1, TA2, TA3, TA4... in FIG. 13 show to which AOB file each TKI corresponds. The arrows KA1, KA2, KA3, KA4... show to which AOB file each TKE corresponds.

The eight boxes in the fourth row show the eight TKEs. Each of the eight TKEs stores five EKEYs (EKEY#1, EKEY#2, EKEY#3, EKEY#4, EKEY#5), five content IDs (001, 002, 003, 004, 005), eight AVFs, and eight MPFs. Of the TKEs in FIG. 13, TKEs #4 to #7, which correspond to one content, Content. D, the MPF and the AVF of TKE #4 are set to "1", and the MPFs and the AVFs of remaining TKEs #5, #6, #7 are set to "0". Furthermore, a TKE #4 is written into only the TKE #4, while the remaining TKEs #5, #6, #7 are each overwritten with a random number.

TKIs in AOB playback control information are described below with reference to FIG. 14. Referring to FIG. 14, it can be seen that each TKI, as shown by the arrows h2, includes Track_General_Information (TKGI), a Track_Text_Information_Data_Area (TKTXTI_DA) recording text information unique to the TKI, such as an artist name, an album name, an arranger name, and a producer name, and a Track_Time_Search_Table (TKTMSRT) in which the playback

time is restricted to 8.4 minutes.

As indicated by the arrows h3 in this drawing, a TKGI includes various information items (TKI_ID, TKIN, TKI_BLK_ATR, TKI_LNK_PTR, ISRC, and BIT).

An ID with which the TKI can be uniquely identified is written into TKI_ID (in this embodiment, the ID is a 2-byte code "A4").

A TKI number in a range between 1 and 999 is written into TKIN.

An attribute for the TKI is written into TKI_BLK_ATR.

The following describes the settings of the TKI_BLK_ATR of each TKI in the example shown in FIG. 13. By referring to the TKI_BLK_ATR of each TKI, it can be seen that since the four pairs TKI#1/AOB001.SA1, TKI#2/AOB002.SA1, TKI#3/AOB003.SA1, and TKI#8/AOB008.SA1 each correspond to separate tracks, the TKI_BLK_ATR of each of TKI#1, TKI#2, TKI#3, and TKI#8 is set as "Track". The TLK_BLK_ATR of TKI#4 is set at "Head_of_Track", the TLK_BLK_ATR of TKI#7 is set at "End_of_Track", and the TLK_BLK_ATRs of TKI#5 and TKI#6 are set at "Midpoint_of_Track". This means that the AOB file "AOB004.SA1" corresponding to TKI#4 is the start of a track, the AOB files "AOB005.SA1" and "AOB006.SA1" corresponding to TKI#5 and TKI#6 are midpoints of the track, and the AOB

file "AOB007.SA1" corresponding to TKI#7 is the end of the track.

TKI_BLK_ATR can be set so that combine editing, in which any two of a plurality of tracks are combined to form a single track, and divide editing, in which one track is divided into a plurality of new tracks, can be easily performed. The following description concerns the change in TKI when two tracks are combined.

FIG. 15 shows how the TKIs are set when two tracks are combined to produce a single new track. The following description is based on the assumption that the user inputted an instruction to perform combine editing on Track.C and Track.E shown in FIG. 13 to generate a single new track. In this case, the AOBs that correspond to Track.C and Track.E are written into the AOB files AOB003.SA1 and AOB008.SA1 corresponding to TKI#3 and TKI#8, so that the TKI_BLK_ATRs of TKI#3 and TKI#8 are rewritten. FIG. 15 shows the TKI_BLK_ATRs of these TKIs after rewriting. In FIG. 13, the TKI_BLK_ATRs of TKI#3 and TKI#8 are respectively written as "Track.C" and "Track.E". However, in FIG. 15, the TKI_BLK_ATR of TKI#3 is rewritten as "Head_of_Track C" and the TKI_BLK_ATR of TKI#8 is rewritten as "End_of_Track C". By rewriting the TKI_BLK_ATRs in this way, TKI#3, TKI#8, AOB003.SA1,

AOB008.SA1, TKE#3, and TKE#8 end up being treated as parts of a single new track "Track.C". During this operation, TKE#3 and TKE#8 corresponding to AOB003 and AOB008 are respectively given the original content IDs "003" and "005", and the original encryption keys "EKey#3" and "EKey#5", and the MPFs and the AVFs are set to "1".

The following is a description of the change in TKI when a track is divided. FIG. 16 shows an example in which a track is divided into two new tracks. In this example, it is assumed that the user inputted an instruction to perform divide editing on Track.C shown in FIG. 13 to generate two tracks "Track.C" and "Track.F". When Track.C is divided into Track.C and Track.F, AOB#3 forming Track.C is divided into new AOBs. A number "009" is assigned to one of the new AOBs (a new AOB009 is obtained) because numbers between 001 and 008 have already been assigned to AOBs, and TKI#9 and TKE#9 are generated for AOB009.SA1. This results in the situation shown in Fig. 16. TKE#9 includes the content ID "003" assigned to AOB003, EKEY#3 used to encrypt AOB003, and a MPF and an AVF set to "0". This completes the explanation of the TKI BLK ATR. Next, the explanation of the constituent elements of the TKI will be resumed.

TKI_LNK_PTR contains TKIN for a link target TKI. As

shown by arrows TL4, TL5, and TL6 in FIG. 13, the TKI_LNK_PTR for each of TKI#4, TKI#5, TKI#6, and TKI#7 corresponding to the four AOB files forming Track D are set so as to indicate the next TKI.

ISRC contains the ISRC (International Standard Recording Code) in the TKGI.

BIT (block information table) shows which part of a corresponding AOB is valid (AOB_BLOCK). By updating the BIT, is possible to cut the head and end of an AOB.

The following description concerns the constructions of the rec/play PD 3 and the license management apparatus 1 of the second embodiment. The difference between the constructions of the rec/play PD 3 and the license management apparatus 1 of the second embodiment and the rec/play PD 3 and the license management apparatus 1 of the first embodiment is a secure R/W area 26, of which the internal structure is shown in FIG. 17. When the rec/play PD 3 is connected to the SD memory card 2, the secure R/W unit 14 performs AKE processing with the SD memory card 2 using the MKB and media ID and encrypts and decrypts data using a session key Ks. Also, when the license management apparatus 1 is connected to the SD memory card 2, the secure R/W unit 26 performs AKE processing with the SD memory card 2 using the MKB and media

ID and encrypts and decrypts data using a session key Ks.

As shown in Fig. 18, the secure write unit 31 includes an MKB processing unit 41, an ID processing unit 42, an AKE processing unit 43, a Kmu encrypting unit 44, and a Ks encrypting unit 45.

The MKB processing unit 41 reads an MKB stored in the system area of the SD memory card 2, and a device key Kd attached by the manufacturer of the rec/play PD 3 and the license management apparatus 1, and obtains a 56-bit encryption key Km by performing a specific calculation using the MKB and the device key Kd, then outputs the encryption key Km to the ID processing unit 42.

Upon receiving the encryption key Km from the MKB processing unit 41, the ID processing unit 42 reads a media ID from the system area 1 of the SD memory card 2, and performs a specific calculation to obtain a 64-bit calculation result, the lower 56-bits of which are output to the AKE processing unit 43 and the Kmu encrypting unit 44 as the encryption key Kmu.

The AKE processing unit 43 performs AKE processing using the encryption key Kmu calculated by the ID processing unit 42, and the encryption key Kmu on the SD memory card 2. The AKE processing unit 43 then outputs the 56-bit session key Ks resulting from this calculation

to the Ks encrypting unit 45.

The Kmu encryption unit 44 output the TKE included in the AOBSA1.KEY which is to be written into the SD memory card 2 to the Ks encrypting unit 45 using the encryption key Kmu output by the ID processing unit 42.

The Ks encrypting unit 45 further encrypts the TKE included in the AOBSA1.KEY encrypted by the Kmu encrypting unit 44, using the 56 bit session key Ks output from the AKE processing unit 43, and outputs the further encrypted TKE to the SD memory card 2 and has the TKE written into the protected area 103.

The internal structure of the secure read unit 32, as shown in Fig. 19, includes an MKB processing unit 51, an ID processing unit 52, an AKE processing unit 53, a Ks decrypting unit 54, a Kmu decrypting unit 55.

Once the SD memory card 2 is connected to the rec/play PD 3 and the licnese management apparatus 1, the MKB processing unit 51 reads an MKB from the system area 101, and performs a specific calculation using the a device key Kd, thereby obtaining a 56-byte encryption key Km.

The ID processing unit 52 reads a media ID from the system area 101 of the connected SD memory card 2, performs a specific calculation using the encryption key Km calculated by the MKB processing unit 51 and the read media

ID, obtaining a 64-bit calculation result, the lower 56 bits of which it outputs to the AKE processing unit 53 and the Kmu decrypting unit 55 as an encryption key Kmu.

The AKE processing unit 53 performs AKE processing with the AKE processing unit 105 of the SD memory card 2, using the encryption key Kmu output from the Ks decrypting unit 54, and outputs the 56-bit calculation result to the Ks decrypting unit 54 as a session key Ks.

The Ks decrypting unit 54 reads the encrypted AOBSA1.KEY (including the TKE) stored in the protected area 103 of the SD memory card 2, and decrypts the AOBSA1.KEY using the 56-bit session key Ks output from the AKE processing unit 53. Then the Ks decrypting unit 54 outputs the decryption result to the Kmu decrypting unit 55.

The Kmu decrypting unit 55 decrypts the TKE in the AOBSA1.KEY using the 56-bit encryption key Kmu calculated by the ID processing unit 52.

As explained above, access of the proteced area 103 of the SD memory card 2 is accompanied by encryption, decryption, and an AKE procedure, using a section key Ks and a Kmu. This prevents access by an improper device, and means that authentic reading and writing is perfomed only by the recording and playback apparatus 3 and the license management apparatus 1.

Next, an operation example of when the license management apparatus 1 performs migration through the secure R/W unit 22 wil be explained with reference to FIG. 20.

FIG. 20 shows a migration procedure of the eight AOBs and the eight TKEs shown in FIG. 13. If a migration process is performed for the eight TKEs shown in FIG. 13, the AOBs #1 to #3 and #8 shown in FIG. 13 are stored in the local storage 21 as SDMI protected contents A,B,C, and E respectively, as shown by arrows MY1, MY2, MY3, and MY8. AOBs #4 to #7 which correspond to one packaged content are stored in the local storage 21 as an SDMI protected content D, as shown by arrows MY4, MY5, MY6, and MY7. Next, as shown by arrows RY1, RY2, RY3, RY4, and RY5, RMI is generated for the five contents Content. A to Content. E, and a permitted number of check-out times "3" and EKEYs #1 to #5 stored in TKEs #1 to #5 are stored, as shown by arrows ME1, ME2, ME3, ME4, and ME5. The MPF and the AVF of each of the 8 TKEs is set to "0", the content ID is set to "000", and the EKEYs in the TKEs #1 to #5 are overwritten with a random number. In this way AOB #1 to AOB #8 in the SD memory card 2 are put into non-reproduction states.

When an operation to combine tracks is performed, the LCM 23 performs migration in the following way. First,

the LCM 23 finds tracks for which the content ID in the TKE differs, regardless of whether the TKI_BLK_ATR shows a common head of track and end of track for a track. It is considered that regardless of a the content ID being different, tracks for which the TKI_BLK_ATR shows the head of track and end of track of one track are originally separate tracks that have been combined into one or more tracks by editing later.

If the LCM 23 finds a head of track and an end of track which have the same content ID, it puts these tracks back into the original one track before performing migration. Namely, in an example in FIG. 15, the LCM 23 finds the Head of Track C and the End of Track C, which have content IDs 003 and 005 respectively, and makes these back into Track C and Track E before performing migration.

When one track is divided into two or more tracks as shown in FIG. 16, migration is performed in the following way after making the tracks back into the original track. First, the LCM 23 refers to the TKE of each track, and finds tracks which for which the content ID in the TKE is the same, regardless of whether the TKI_BLK_ATR shows different tracks.

It is considered that regardless of the TKI_BLK_ATR showing different tracks, tracks for which the content ID

in the TKE are the same are originally one track that has been divided into two or more tracks by editing later.

When the LCM 23 finds tracks which have the same content ID, it puts these tracks back into the one original track before performing migration. Namely, in the example in FIG. 16, the LCM 23 finds Track C and Track F which have the same Content ID 003, puts these tracks back into one Track C, and performs migration.

According to the BIT settings, when the head of track and the end of track of an AOB have been cut in sections, the LCM 23 puts the BIT settings back to their original state and then performs migration.

The LCM 23 of the present embodiment returns a track back to an equivalent state to the packaged content when combine, divide, or sectional cut operations have been performed on the track. Therefore, the LCM 23 is able to manage a plurality of AOBs, TKEs, and TKIs in the states in FIG. 15 and FIG. 16 in the state shown in FIG. 13, in other words, an equivalent state to that recorded on the CD. According to this, even if editing is performed after a work is written in a PD and before migration is performed by an LCM, the unity of the packaged content is not interfered with.

FIG. 21 shows the structure of a directories and files

in the local storage 21. As shown in FIG. 21, a user area which can be accessed even by a general application program, and a secure area which can only be accessed by the LCM 23 and to which access is prohibited by other application program are provided in the local storage area 21. There is a package directory for storing SDMI protected content in the root directory of the user area. This package directory is a directory in which SDMI protected content is stored, and the five packaged contents shown in FIG. 20 are stored here. Each of the five packages stores a set of SDMI protected content and RMI.

A package management table is located in the user area. The package management table is composed of, for each package, an index number, a file pass showing where the package is stored, and content introduction information showing the artist name and title for the content which corresponds to the package. The user area knows which content is stored in which directory and under which file name by referring to the package management table. The package management table is used when the user interface 20 displays a list of SDMI content stored in the local storage 21.

Next, the secure area will be explained. The secure area stores information that should not be rewritten by

the user, such as billing information, and a check-out history information table which is made up of check-out history information about each content is also stored here. In the state shown in FIG. 21, check-out has not yet been performed, therefore the check-out history information is blank.

Next, an explanation will be given for how check-out is performed on the five SDMI protected contents Content A to Content E. FIG. 22 shows how eight AOBs and eight TKEs are stored in the SD memory card 2, by check-out. Check-out is instructed by the user and Content A, Content B, Content C, and Content E are written into the SD memory card 2 as individual units AOB#1, AOB#2, AOB#3, and AOB#8, as shown by arrows TY1, TY2, TY3, and TY8. Content D is written into the SD memory card 2 as AOB#4 to AOB#7, as shown by arrows TY4, TY5, TY6, and TY7. Then, TKEs #1 to #8 are generated to correspond to AOB#1 to AOB#8 respectively, TKEs #1 to #5, Content IDs 001 to 005, and AVFs are written, with the MPFs remaining at "0". Then the number of permitted check-outs is decremented and set to 2. Check-out history information is generated in correspondence with the Media ID "AA1" and the Content IDs 001 to 005, and stored in the local storage 21. FIG. 23 shows the storage content of the local storage 21 after

check-out has been executed. The difference between FIG. 23 and FIG. 21 is that in FIG. 23 the number of permitted check-outs has been decremented from 3 to 2, and check-out history information A to E has been generated in the secure area.

Next, operations of the license management apparatus 1 of the second embodiment explained above will be explained with reference to a flowchart. FIG. 24 is a flowchart showing the procedures of the LCM 23 of the second embodiment. At step S1 the LCM 23 reads the media ID from the SD memory card 2, and at step S2 refers to the file entry in the SD memory card 2 and displays a list of the plurality of AOBs written in the SD memory card 2. Each AOB written in the SD memory card 2 is displayed in the same way without distinction regardless of whether it is an AOB written according to check-out or whether it is an AOB written by the rec/play PD 3. Please note that it is possible to have the LCM 23 read the MPF and display only AOBs for which migration is permitted. Next, the LCM 23 receives a specification from the user of which of the plurality of AOBs are to be retrieved. If the AOBs to be retrieved into the license management apparatus 1 are specified by, for instance, a drag specification, the LCM 23 proceeds to a loop procedure in which Step S3 and S4

are repeating conditions. The loop procedure is a procedure repeating steps S5 to S25 of the TKEs corresponding to each AOB specified at step S2. The following will focus explaining the procedure for one of the TKEs.

At step S5 the LCM 23 judges whether the content ID in the TKE is 000. If the content ID is 000 there is no AOB corresponding to the TKE, therefore the LCM 23 proceeds to S4 via (A) which is the next TKE to be processed. If the content ID is not 000, it is possible that the TKE is to be migrated. Therefore, the LCM 23 proceeds to step S6 and judges whether the MPF is "1" or "0". A TKE written by the rec/play PD 3 is set to "1", and is clearly distinguishable from a TKE written by the license management apparatus 1, therefore if the MPF is set to "1", the LCM 23 proceeds to step S7. At step S7, the LCM 23 judges whether the AVF is "1" or "0". If the AVF is "1", this means that either the TKE being processed has a one-to-one relationship with the packaged content, or the TKE being processed is the head of track amongst a plurality of TKEs which correspond to one packaged content (TKE #4 in the example in FIG. 13). If the AVF is "1", the LCM 23 proceeds to step S8 and generates a management package which has RMI. Next, at step S9, the LCM 23 reads the AOB

which corresponds to the TKE, and stores the AOB as SDMI protected content in the management package. At step S10, the LCM 23 reads the EKEY from the TKE in the SD memory card 2, and stores the EKEY in the RMI in the management package. At step S11, the LCM 23 stores the number of permitted check-outs, which is set to "3", in the RMI, and encrypts the RMI with a public encryption key. The result of the above-described process is that the AOB written into the SD memory card 2 is put under the management of the license management apparatus 1 as SDMI protected content.

Next, at step 12, the LCM 23 sets the AVF and the MPF in the TKE to "0", and overwrites the content ID with "000". At step S13 the LCM 23 overwrites the EKEY in the TKE with a random number. By overwriting the TKE, the AOB is set in a non-reproduction state.

At step S7, if the LCM 23 judges the AVF to be "0", the LCM 23 considers the TKE which is being processed to be a part of a one of a plurality of TKEs which correspond to one packaged content, excluding the head of track (TKE #5, #6, #7). Therefore, at step S14, the LCM 23 judges whether the content ID in the TKE is the same as the content ID in the directly proceeding TKE. If the judgement is positive, at step S15, the LCM 23 reads and adds the AOB to the management package generated directly before, and

then, at step S16, overwrites the content ID with 000.

When the MPF is set to "0" and migration is not permitted, the LCM 23 proceeds from step S6 to step S17, and judges whether check-out is permitted. Namely, the LCM 23 judges whether check-out information matching the set of the content ID and the media ID exists in the local storage 21. If matching check-out information does not exist, it is clear that the TKE was not written according to check-out by the license management apparatus 1, and the LCM 23 proceeds to step S4 via (A) without performing check-out. If check-out history information does exist, at step S18, the LCM 23 judges whether the AVF is "1". As explained earlier, if the AVF is "1", this means that either the TKE being processed has a one-to-one correspondence to the packaged content, or that the TKE is the head of track TKE amongst a plurality of TKEs that correspond to one packaged content (TKE #4 in the example in FIG. 13). If the TKE being processed is one of these, at step S19, the LCM 23 decrypts the RMI of the SDMI protected content corresponding to the content ID using the public encryption key. At step S20, the LCM 23 increments the permitted number of check-outs included in the RMI, and, at step S21, encrypts the RMI of the SDMI protected content corresponding to the content ID. The LCM 23 deletes the

check-out history information which includes the set of the content ID and the media ID from the check-out history information table at step S22, overwrites the AVF with "0" and the content ID with "000" at step S23, and overwrites the EKEY with a random number at step S24.

At step S18, when the AVF is "0", the TKE is one of a plurality of TKEs which correspond to one package content, excluding the head of track, and only the content ID in this TKE is valid. Therefore, the LCM 23 overwrites the content ID with "000" as step S25.

According to the above-described present embodiment, TKEs are stored in the protected area 103 which cannot be accessed unless the authenticity of a connected device can be proved, therefore tampering with the MPFs is prevented. Consequently, migration of AOBs written by the rec/play PD 3 can be realized while paying thorough consideration to copyright protection of content.

Third Embodiment

In SDMI there is a similar concept to migrate called "move", and the third embodiment relates to improvement when an AOB which is to be moved and an AOB which is to be migrated are both written into the same SD memory card 2. The following is a brief description of the difference

between migration as explained in the first and second embodiments and moving.

Moving is performed on AOBs obtained according to electronic music distribution. Such an AOB has RMI which includes the number of permitted check-outs, and the AOB can be transferred within an SDMI domain in the range of the number of moves permitted.

In contrast, AOBs which are to be migrated have a MPF and may only be transferred once from a PD to an SDMI domain.

Therefore, the decisive difference between an AOB to be migrated and an AOB to be moved is that an AOB to be migrated does not have RMI, and is in a state to be received by the SDMI domain, in other words, a transient state until receiving protection in the SDMI domain. In order to distinguish an AOB to be migrated and an AOB to be moved, in the present embodiment the MPF of an AOB for which RMI is already written into the SD memory card 2 is also set to "0". FIG. 25 shows a setting example for the MPF in the third embodiment.

According to the present embodiment, an AOB to be moved can be prevented from being migrated, by setting the MPF to "0".

Details of the data structures and various processing

disclosed in the first to the third embodiments are described in international patent publications listed below, which may be referred to for further technical details.

WO 0065602 (November 2, 2000)

WO 0074054 (December 7, 2000)

WO 0074059 (December 7, 2000)

WO 0074060 (December 7, 2000)

WO 0116821 (March 8, 2001)

Furthermore, it should be obvious that the present invention is not limited to the examples described above. Further representative variations (A)-(G) are described below.

(A) An explanation was given for audio data obtained by code compressing packaged content recorded on a CD, but audio data may be obtained by code compressing packaged content recorded on, for instance, a DVD-Audio or a cassette tape.

Furthermore, "1" being "on" and meaning that migration is permitted, and "0" being "off" and meaning that migration is not permitted is an example of settings, and "0" may be "on" and mean that migration is permitted and "1" may be "off" and mean that migration is not permitted.

(B) The rec/play PD 3 has a screening unit 10 and performs code compression of packaged content, but the code compression of the packaged content may be performed by the license management apparatus 1 itself.

(C) The rec/play PD 3 may be realized as a component stereo, a mobile telephone, or a PDA (Personal Digital Assistant). Furthermore, the rec/play PD 3 may be a component type recording and playback PD in which the rec/play PD 3 is integrated with a playback apparatus which reproduces, for instance, CDs or DVD-Audio. The license management apparatus 1 is realized on a personal computer, but may be, for instance, a radio/cassette, a component stereo, or an STB (Set Top Box), that has an internal storage apparatus.

(D) In the first and second embodiments, an encryption key and a number of permitted check-outs are stored in the RMI, but other information may be stored. Such information may be, for instance, information showing whether playback of SDMI protected content in the personal computer (license management apparatus 1) is permitted (PC playback permission information), or information limiting the number of playbacks.

(E) In the embodiments the procedures explained using function blocks and the procedure explained using a flow

chart (FIG. 24) may be realized according to an executable program, and this program may be recorded on a recording medium and sold or distributed. This kind of recording medium may be, for instance, an IC card, an optical disk, or a floppy disk, and the machine language program thereon used by being installed on a general-purpose computer. The general-purpose computer successively executes the installed machine language program, and realizes the license management apparatus 1 and the recording and playback apparatus of the first and second embodiments.

(F) In the first and second embodiments data that is to be migrated is audio data, but the data may be other stream data such as moving images. In such a case, when a PD obtains moving image stream data from, for instance, a moving picture distribution service, the stream data may be written on the SD memory card 2 with a MPF set to "1". The license management apparatus 1 may perform migration after confirming that the MPF is set to "1". According to this, the stream data is managed in the license management apparatus 1 with the RMI. Then, when check-out of the stream data is performed, the license management apparatus 1 writes the MPF which has been set to "0", and the stream data on the SD memory card 2.

(G) The watermark detector 12 in the first

embodiment removes a watermark from audio data when it detects a watermark, but the watermark may be rewritten. Namely, the watermark detector 12, when it detects a watermark, may decipher the watermark. If the result of this deciphering is "copying permitted", the watermark detector rewrites the watermark as "copying prohibited", and outputs to the encrypting unit 15.

INDUSTRIAL USE

In one SDMI system amongst a plurality of SDMI systems for protecting copyright, a PD performs code compression of a packaged content recorded on a CD, and the license management apparatus 1 can retrieve the code compressed packaged content safely, allowing for increased user convenience without sacrificing the profits to the copyright holder. Therefore, various manufacturers involved in making the license management apparatus 1 and the rec/play PD 3 make significant contributions to the device manufacturing industry by manufacturing and introducing into the market the license management apparatus 1, the SD memory card 2, and the rec/play PD 3, the value of which is high as products for increased user convenience without sacrificing the profits to copyright holder.

Although the present invention has been fully described by way of example with reference to accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless such changes and modifications depart form the scope of the present invention, they should be construed as being included therein.

CLAIMS

1. A recording medium for use with a plurality of apparatuses, the following being recorded thereon:

an audio object, and

a flag which is (a) set to off, when right management information for the audio object has been generated by any of the plurality of apparatuses, to show an instruction that a migration procedure is not permitted, and (b) set to on, when right management information is yet to be generated, to show an instruction that the migration procedure is permitted,

wherein the migration procedure is one of the plurality of apparatuses retrieving the audio object from the recording medium and generating the right management information for the audio object.

2. The recording medium of Claim 1,

wherein the recording medium is a semiconductor memory card comprising:

an authentication circuit for verifying, when the semiconductor memory card is connected to one of the plurality of apparatuses, whether the apparatus is authentic, and

a protected area which is accessed only when the authentication circuit verifies that the apparatus is authentic, and in which the flag is recorded.

3. The recording medium of Claim 2, wherein

an encryption key is recorded on the protected area with the flag, and

the audio object is audio data that has been encrypted using the encryption key.

4. A license management apparatus comprising:

a connecting unit operable to connect to a recording medium on which an audio object and a flag in correspondence have been recorded,

a first judgement unit operable to judge whether a migration procedure of the audio object is permitted, by referring to a set value of the flag,

a storage unit, and

a migration procedure unit operable to perform the migration procedure only when the migration procedure is permitted,

wherein the migration procedure is retrieving the audio object from the recording medium, generating right management information about the audio object, and writing

the audio object and the right management information in correspondence into the storage unit.

5. The license management apparatus of Claim 4 comprising:

a second judgement unit operable to judge, when the migration process is not permitted, whether right management information for the audio object has been generated by the license management apparatus in the past, and

a check-in unit operable to perform check-in, by incrementing a number of permitted check-outs in the right management information, and setting the audio object into a non-reproduction state when judgement by the second judgement unit is affirmative.

6. A recording and playback apparatus for use with a license management apparatus, and for performing reading from and writing to a recording medium on which (a) a first audio object for which corresponding right management information has been generated by the license management apparatus, and (b) a flag set to off, are recorded, the recording and playback apparatus comprising:

a playback unit operable to reproduce the first audio

object when a playback instruction is performed by the user,

a signal receiving unit operable to receive an external audio signal when a recording instruction is performed by the user,

an encoding unit operable to encode the audio signal to obtain a second audio object, and

a writing unit operable to write the second audio object and the flag set to on into the recording medium,

wherein the flag shows (c) by being set to on, that a migration procedure is permitted, and (d) by being set to off, that the migration procedure is not permitted, the migration procedure being the license management apparatus retrieving the second audio object and generating right management information about the second audio object.

7. The recording and playback apparatus of Claim 6 being used with a playback apparatus which reproduces packaged content recorded on another recording medium, wherein

the signal receiving unit, when the record instruction is performed, receives an audio signal obtained by reproducing the packaged content, and

the encoding unit obtains the second audio object by encoding the input audio signal.

8. A computer-readable recording medium on which a license management program is recorded, the program realizing on a computer which has a connecting unit operable to connect to a recording medium on which an audio object and a flag corresponding to the audio object are recorded, and a storage unit:

a first judgement step for judging whether a migration procedure of the audio object is permitted, by referring to a set value of the flag, and

a migration procedure step for performing the migration procedure only when the migration procedure is permitted,

wherein the migration procedure is retrieving the audio object from the recording medium, generating right management information about the audio object, and writing the audio object and the right management information in correspondence into the storage unit.

9. The recording medium of Claim 8, wherein the license management program includes:

a second judgement step for judging, when the migration process is not permitted, whether right management information for the audio object has been

generated by the computer in the past, and

a check-in step for performing check-in, by incrementing a number of permitted check-outs in the right management information, and setting the audio object into a non-reproduction state when judgement by the second judgement unit is affirmative.

10. A method of management for performing license management in a computer which has a connecting unit operable to connect to a recording medium on which an audio object and a flag corresponding to the audio object are recorded, and a storage unit, the method including:

a first judgement step for judging whether a migration procedure of the audio object is permitted, by referring to a set value of the flag, and

a migration procedure step for performing the migration procedure only when the migration procedure is permitted,

wherein the migration procedure is retrieving the audio object from the recording medium, generating right management information about the audio object, and writing the audio object and the right management information in correspondence into the storage unit.

11. The method of Claim 10, wherein the license management method includes:

a second judgement step for judging, when the migration process is not permitted, whether right management information for the audio object has been generated by the license management apparatus in the past, and

a check-in step for performing check-in, by incrementing a number of permitted check-outs in the right management information, and setting the audio object into a non-reproduction state when judgement by the second judgement unit is affirmative.

12. A recording medium for use with a plurality of apparatuses, the following being recorded thereon:

stream data, and

a flag which is (a) set to off, when right management information for the stream data has been generated by any of the plurality of apparatuses, to show an instruction that a migration procedure is not permitted, and (b) set to on, when right management information is yet to be generated, to show an instruction that the migration procedure is permitted,

wherein the migration procedure is one of the

plurality of apparatuses retrieving the stream from the recording medium and generating the right management information for the stream data.

13. A license management apparatus comprising:

a connecting unit operable to connect to a recording medium on which stream and a flag in correspondence have been recorded,

a first judgement unit operable to judge whether a migration procedure of the stream data is permitted, by referring to a set value of the flag,

a storage unit, and

a migration procedure unit operable to perform the migration procedure only when the migration procedure is permitted,

wherein the migration procedure is retrieving the stream from the recording medium, generating right management information about the stream data, and writing the stream data and the right management information in correspondence into the storage unit.

14. A recording and playback apparatus for use with a license management apparatus, and for performing reading and writing of a recording medium on which (a) a first piece

of stream data for which corresponding right management information has been generated by the license management apparatus, and (b) a flag set to off, have been recorded, the recording and playback apparatus comprising:

a playback unit operable to reproduce the first piece of stream data when a playback instruction is performed by the user,

a signal receiving unit operable to receive an external piece of stream data when a recording instruction is performed by the user,

an encoding unit operable to encode the received external piece of stream data to obtain a second piece of stream data, and

a writing unit operable to write the second piece of stream data and the flag set to on into the recording medium,

wherein the flag shows (c) by being set to on, that a migration procedure is permitted, and (d) by being set to off, that the migration procedure is not permitted, the migration procedure being the license management apparatus retrieving the second piece of stream data and generating right management information about the second piece of stream data.

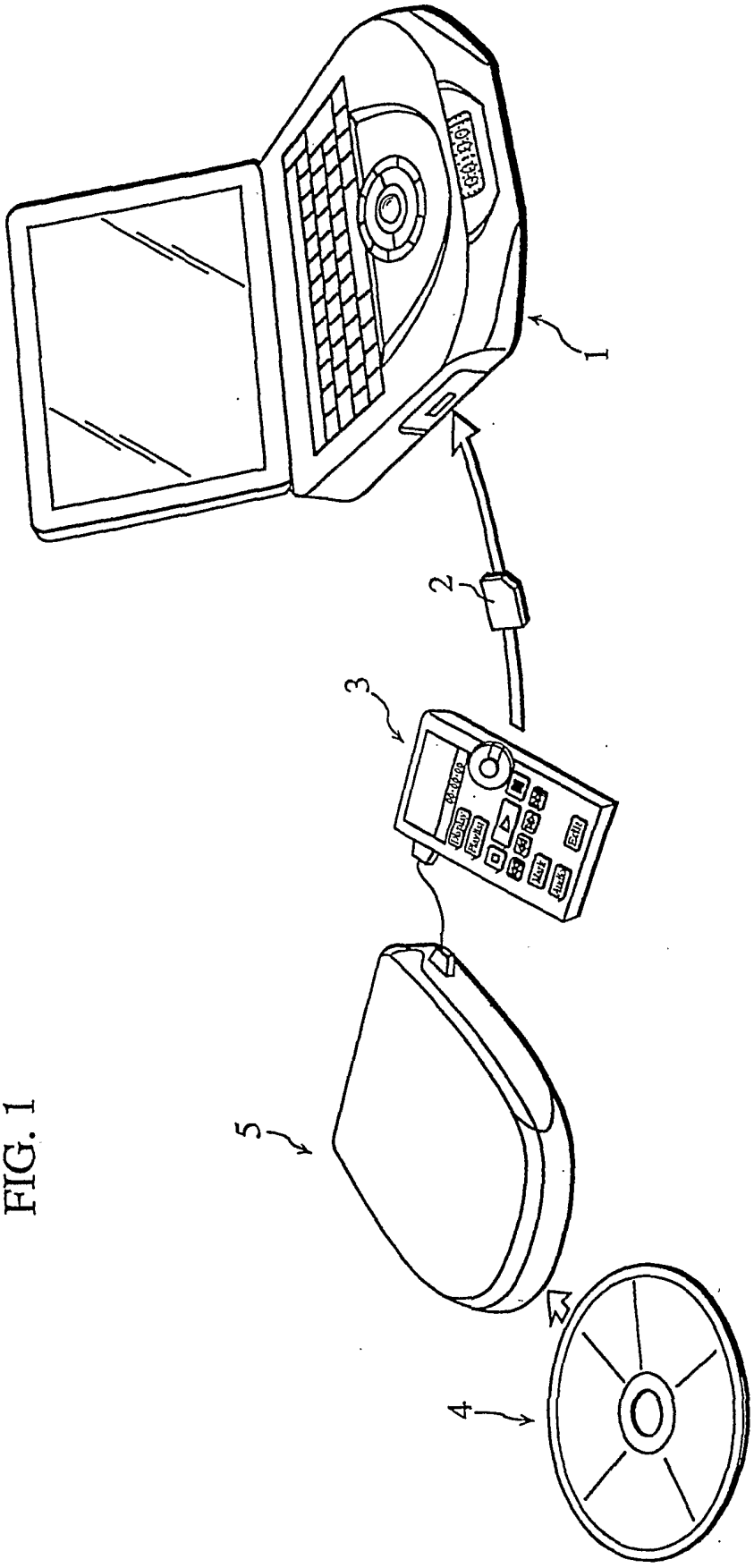
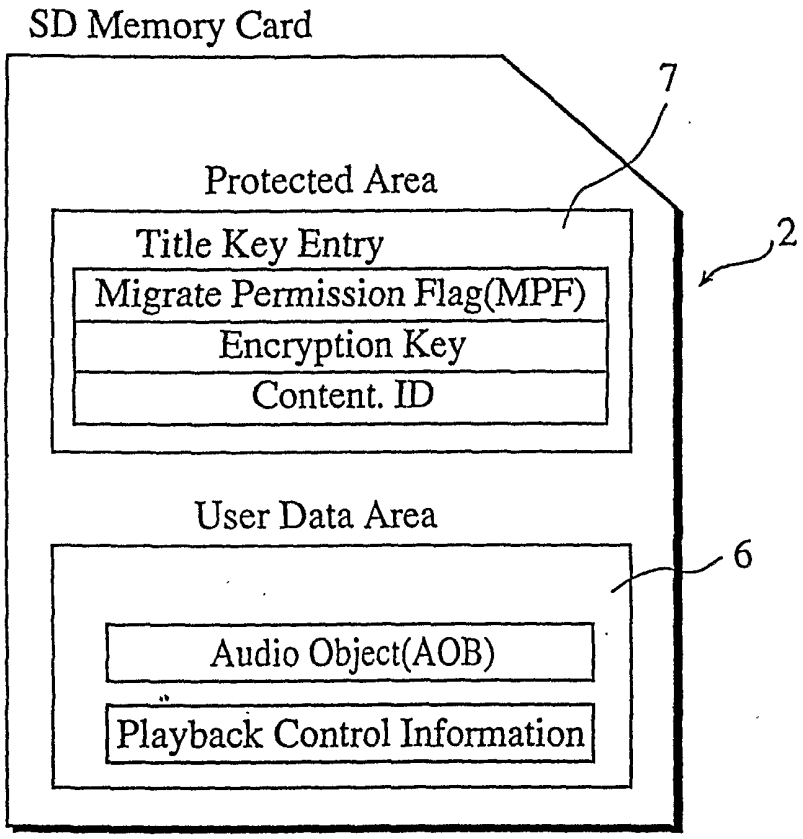


FIG. 1

FIG. 2



MPF : 0
Migration Prohibited
(Right Management Information corresponding to AOB already generated)

MPF : 1
Migration Permitted
(Right Management Information corresponding to AOB not yet generated)

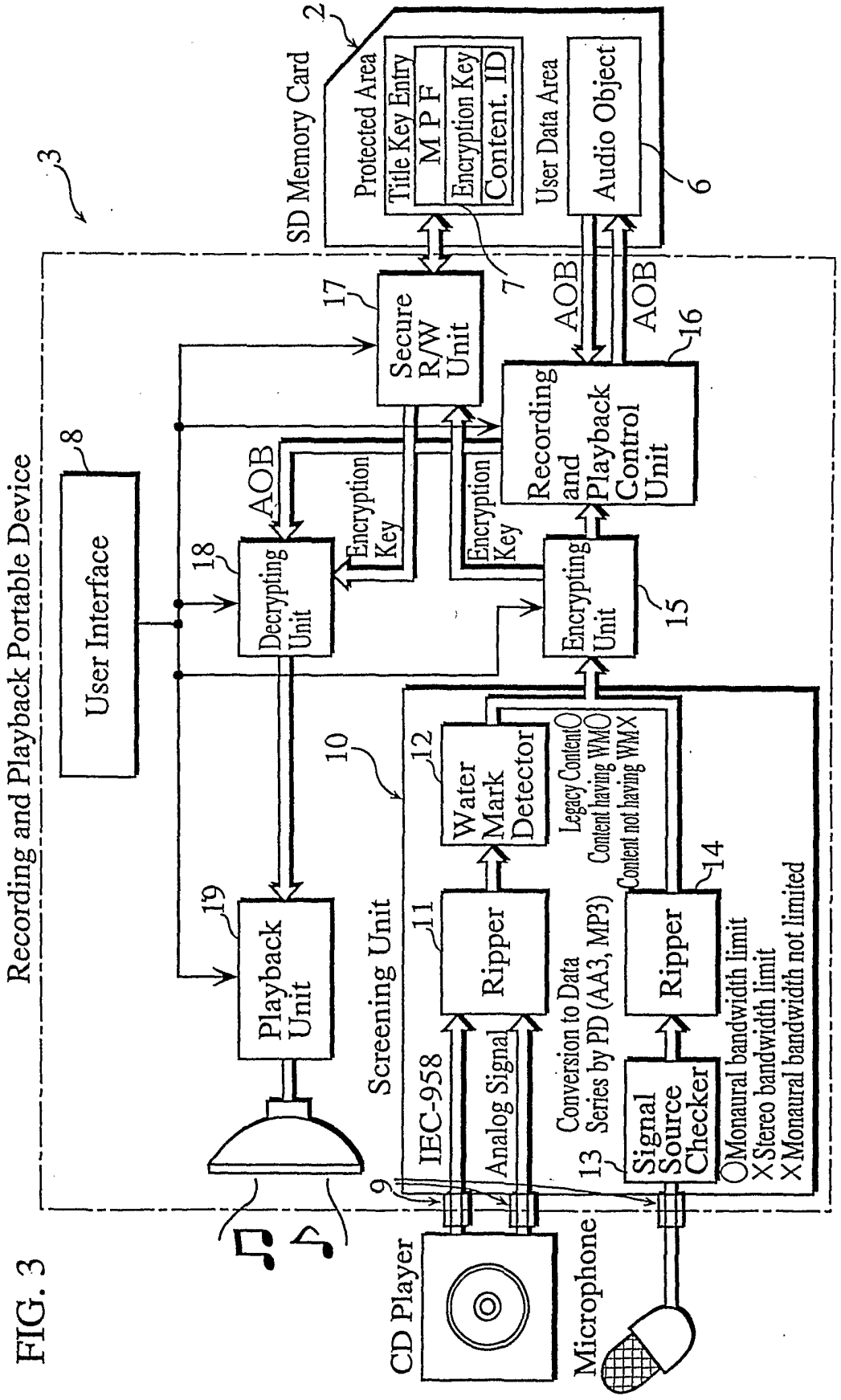

Recording and Playback Portable Device
3
SD Memory Card
2
Protected Area
Title Key Entry
M P F
Encryption Key
Content. ID
User Data Area
Audio Object
6
7
Secure R/W Unit
17
AOB
AOB
16
Recording and Playback Control Unit
User Interface
8
AOB
Encryption Key
Encryption Key
18
Decrypting Unit
Encrypting Unit
15
10
12
Water Mark Detector
Legacy Content○
Content having WM○
Content not having WM×
19
Playback Unit
11
Ripper
14
Ripper
Screening Unit
IEC-958
Analog Signal
Conversion to Data Series by PD (AA3, MP3)
13
Signal Source Checker
○Monaural bandwidth limit
×Stereo bandwidth limit
×Monaural bandwidth not limited
9
CD Player
Microphone

FIG. 3

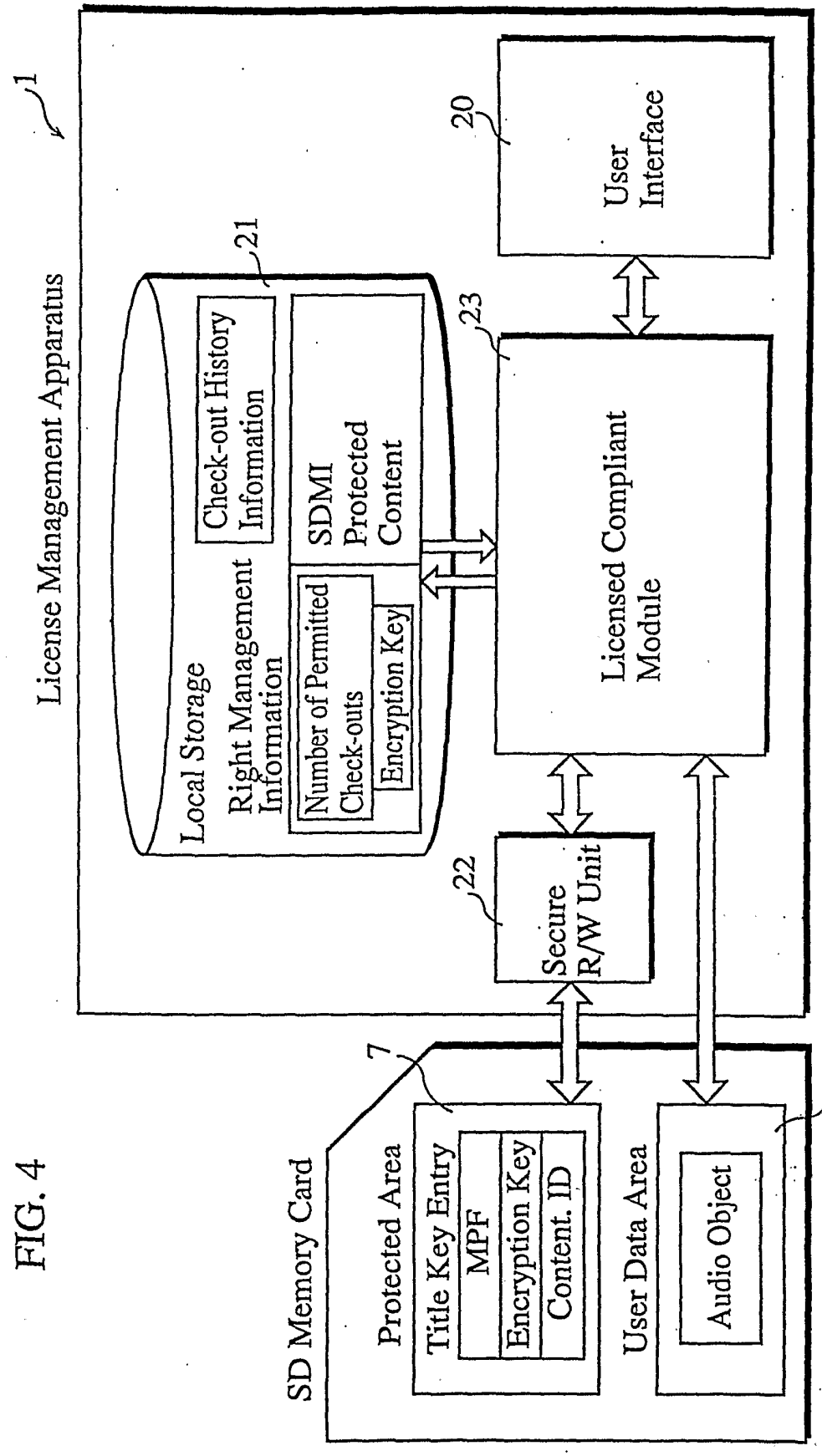

License Management Apparatus
1
20
User Interface
21
Local Storage
Right Management Information
Number of Permitted Check-outs
Encryption Key
Check-out History Information
SDMI Protected Content
23
Licensed Compliant Module
22
Secure R/W Unit
7
SD Memory Card
Protected Area
Title Key Entry
MPF
Encryption Key
Content. ID
User Data Area
Audio Object
6

FIG. 4

FIG. 5

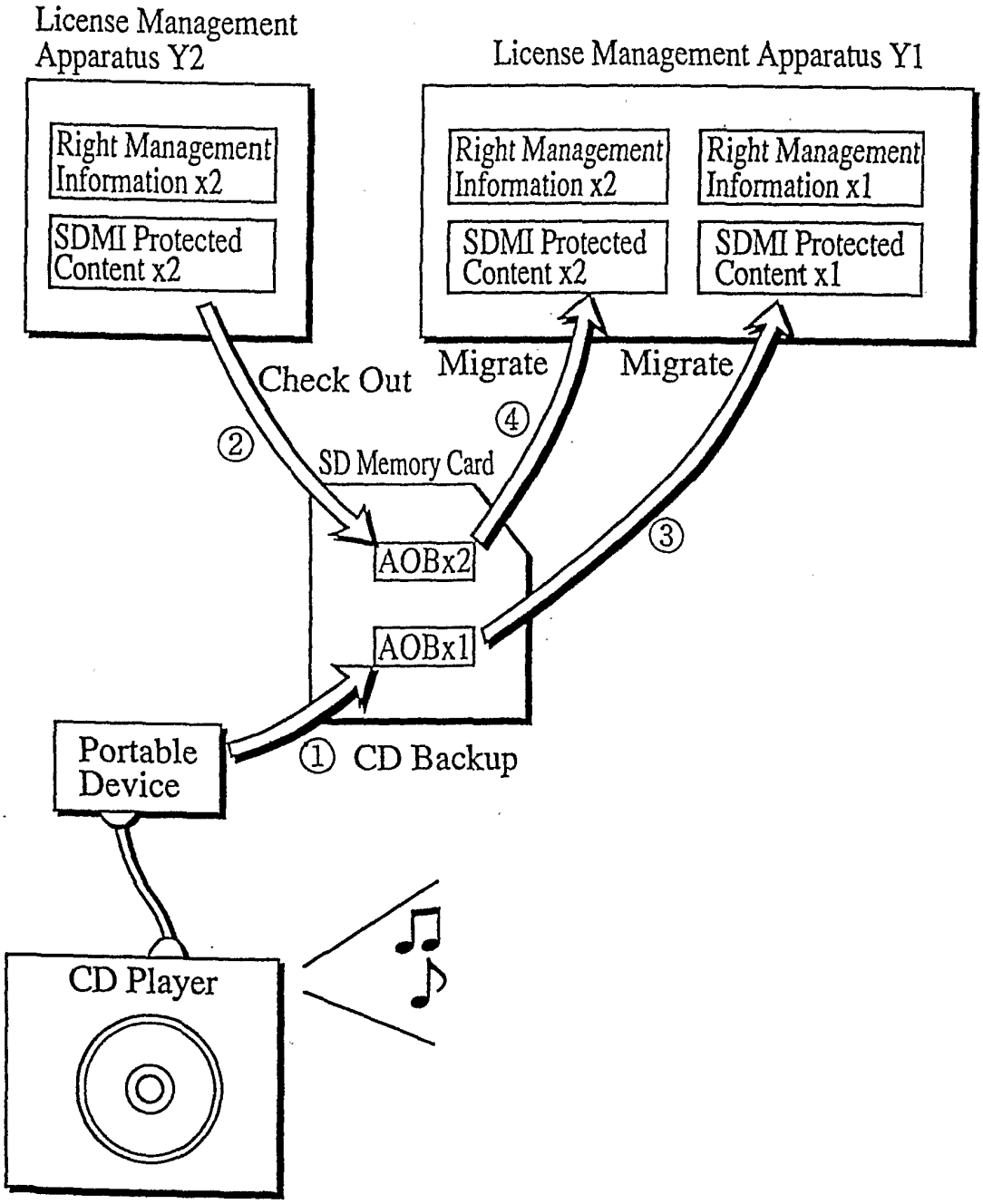

License Management Apparatus Y2
Right Management Information x2
SDMI Protected Content x2
License Management Apparatus Y1
Right Management Information x2
SDMI Protected Content x2
Right Management Information x1
SDMI Protected Content x1
Check Out
Migrate
Migrate
②
④
③
SD Memory Card
AOBx2
AOBx1
Portable Device
① CD Backup
CD Player

FIG. 6

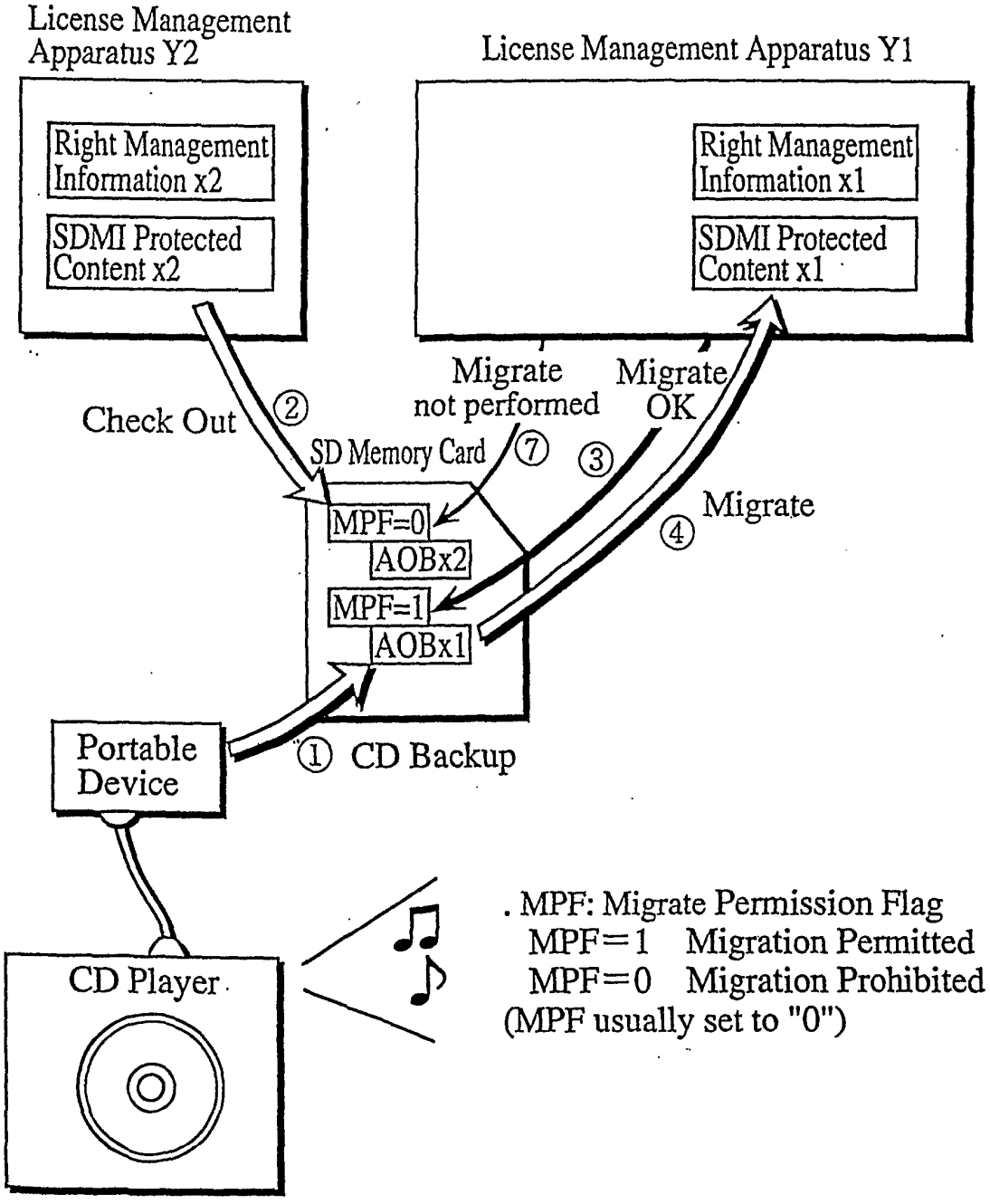
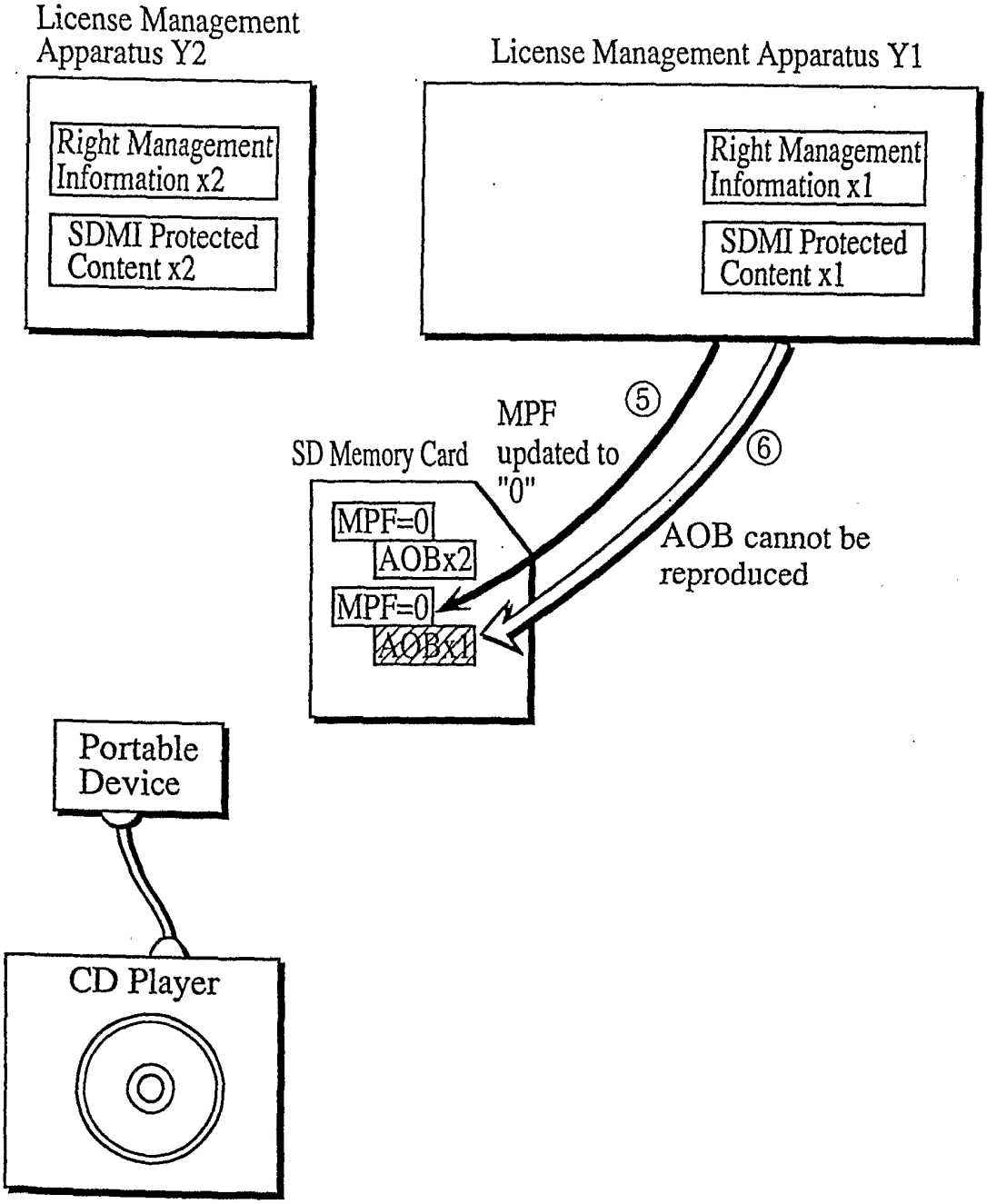

License Management Apparatus Y2
License Management Apparatus Y1
Right Management Information x2
SDMI Protected Content x2
Right Management Information x1
SDMI Protected Content x1
Check Out
②
Migrate not performed
Migrate OK
SD Memory Card
⑦
③
Migrate
④
MPF=0
AOBx2
MPF=1
AOBx1
Portable Device
① CD Backup
CD Player
. MPF: Migrate Permission Flag
MPF=1 Migration Permitted
MPF=0 Migration Prohibited
(MPF usually set to "0")

FIG. 7


License Management Apparatus Y2
Right Management Information x2
SDMI Protected Content x2
License Management Apparatus Y1
Right Management Information x1
SDMI Protected Content x1
⑤
MPF updated to "0"
⑥
SD Memory Card
MPF=0
AOBx2
MPF=0
AOBx1
AOB cannot be reproduced
Portable Device
CD Player

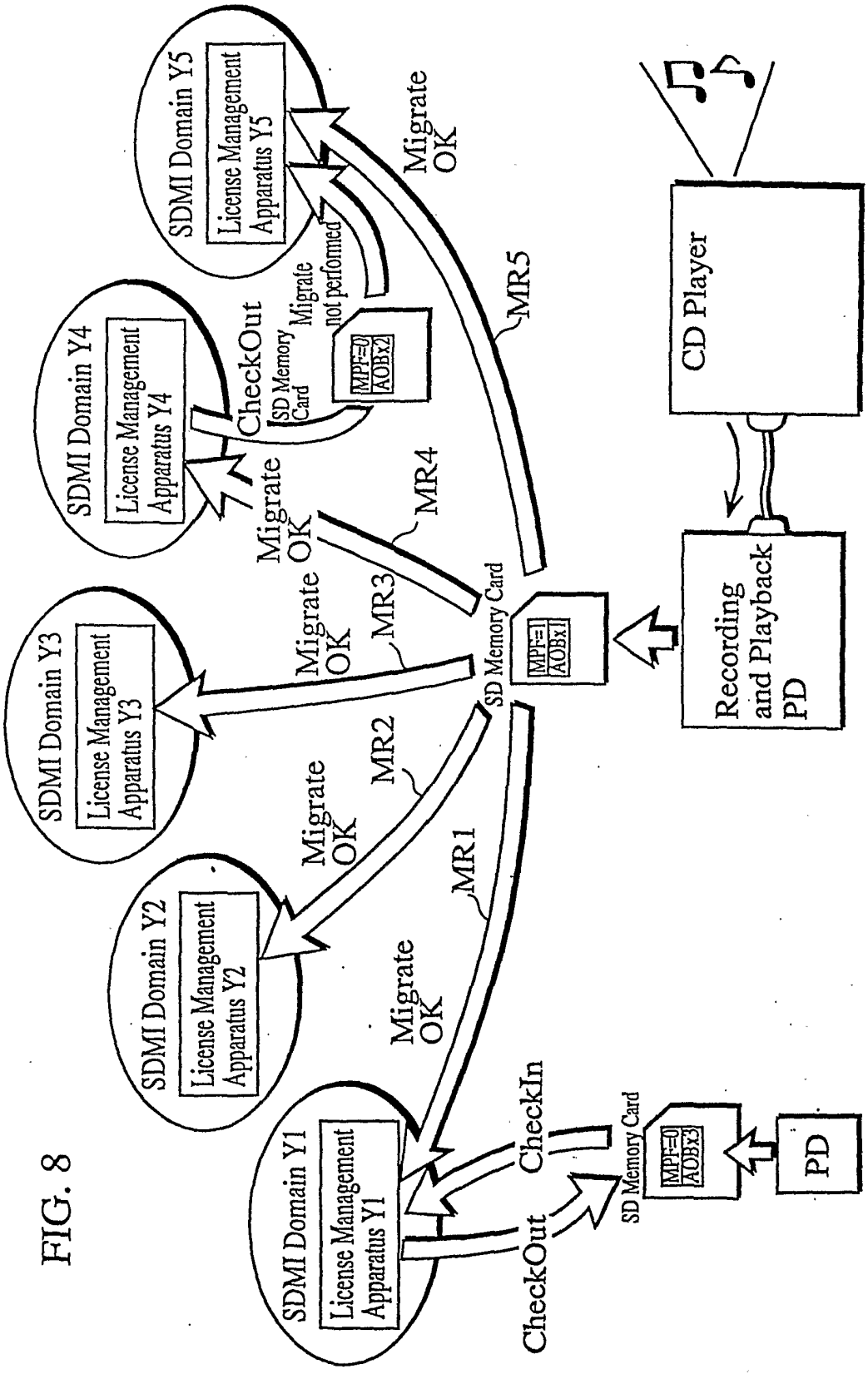
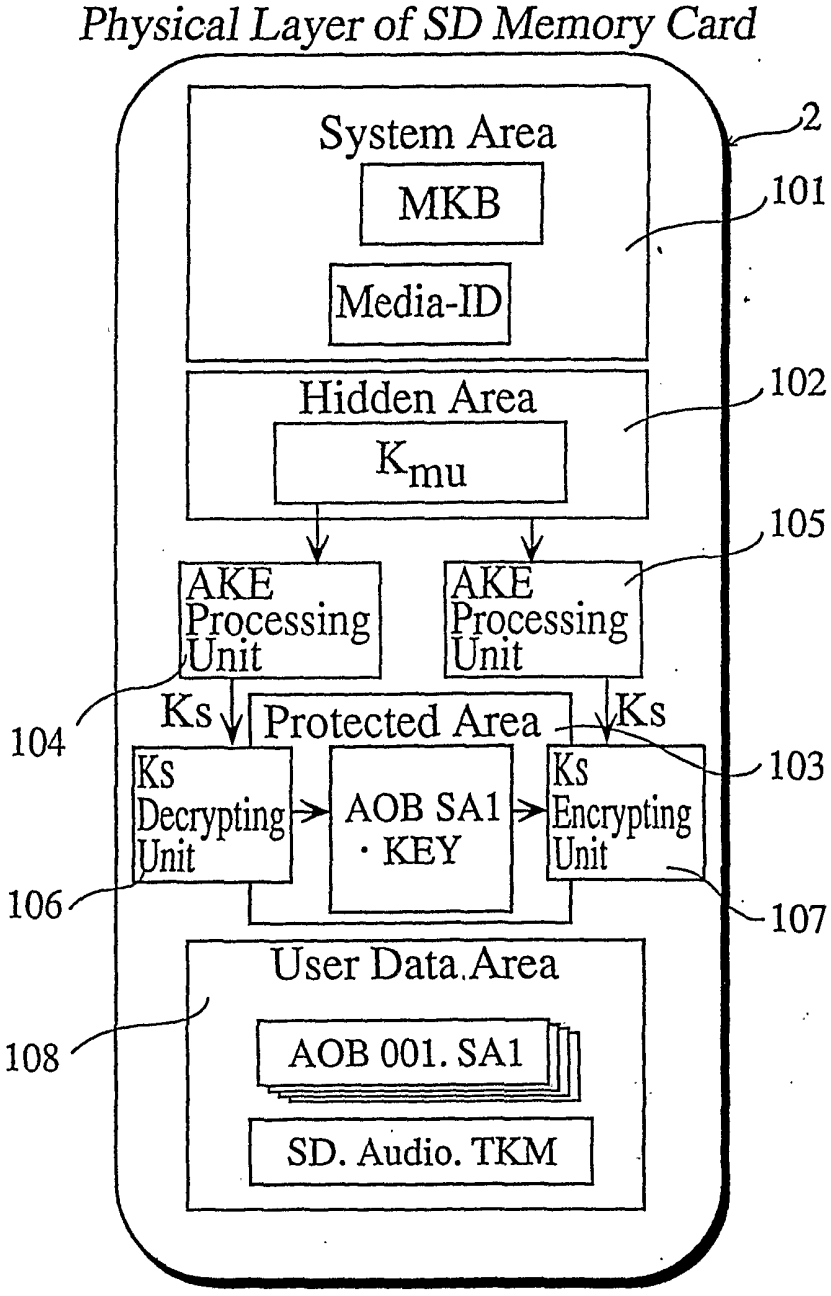

SDMI Domain Y5
License Management Apparatus Y5
SDMI Domain Y4
License Management Apparatus Y4
SDMI Domain Y3
License Management Apparatus Y3
SDMI Domain Y2
License Management Apparatus Y2
SDMI Domain Y1
License Management Apparatus Y1
Migrate OK
Migrate not performed
CheckOut
SD Memory Card
MPF=0 AOBx2
MR5
MR4
MR3
MR2
MR1
SD Memory Card
MPF=1 AOBx1
CD Player
Recording and Playback PD
CheckIn
CheckOut
SD Memory Card
MPF=0 AOBx3
PD

FIG. 8

FIG. 9


Physical Layer of SD Memory Card
System Area
MKB
Media-ID
Hidden Area
Kmu
AKE Processing Unit
AKE Processing Unit
Ks
Protected Area
Ks
Ks Decrypting Unit
AOB SA1 · KEY
Ks Encrypting Unit
User Data Area
AOB 001. SA1
SD. Audio. TKM
2
101
102
105
104
103
106
107
108

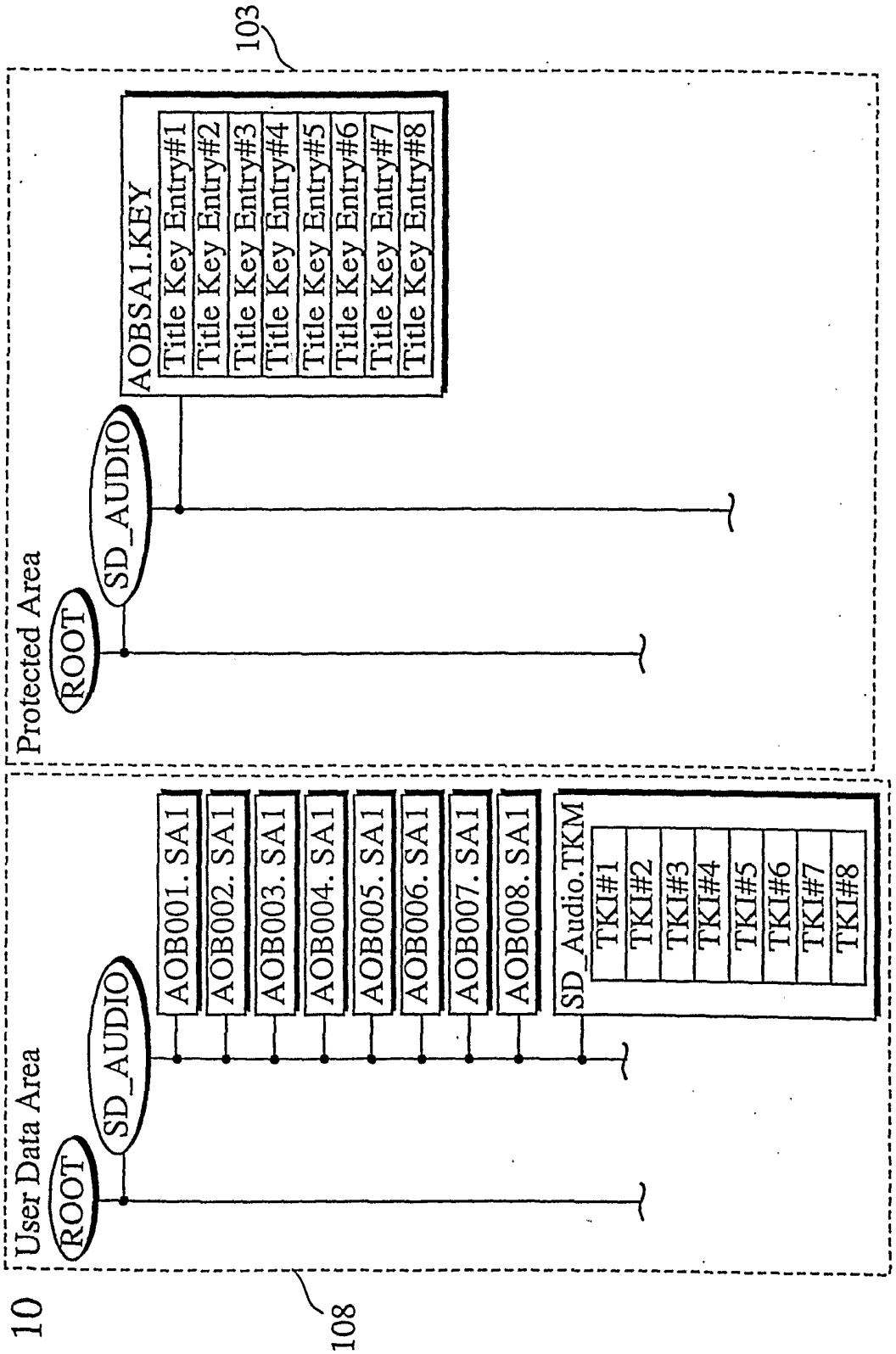

103
Protected Area
ROOT
SD_AUDIO
AOBSA1.KEY
Title Key Entry#1
Title Key Entry#2
Title Key Entry#3
Title Key Entry#4
Title Key Entry#5
Title Key Entry#6
Title Key Entry#7
Title Key Entry#8
User Data Area
ROOT
SD_AUDIO
AOB001.SA1
AOB002.SA1
AOB003.SA1
AOB004.SA1
AOB005.SA1
AOB006.SA1
AOB007.SA1
AOB008.SA1
SD_Audio.TKM
TKI#1
TKI#2
TKI#3
TKI#4
TKI#5
TKI#6
TKI#7
TKI#8
108

FIG. 10

FIG. 11

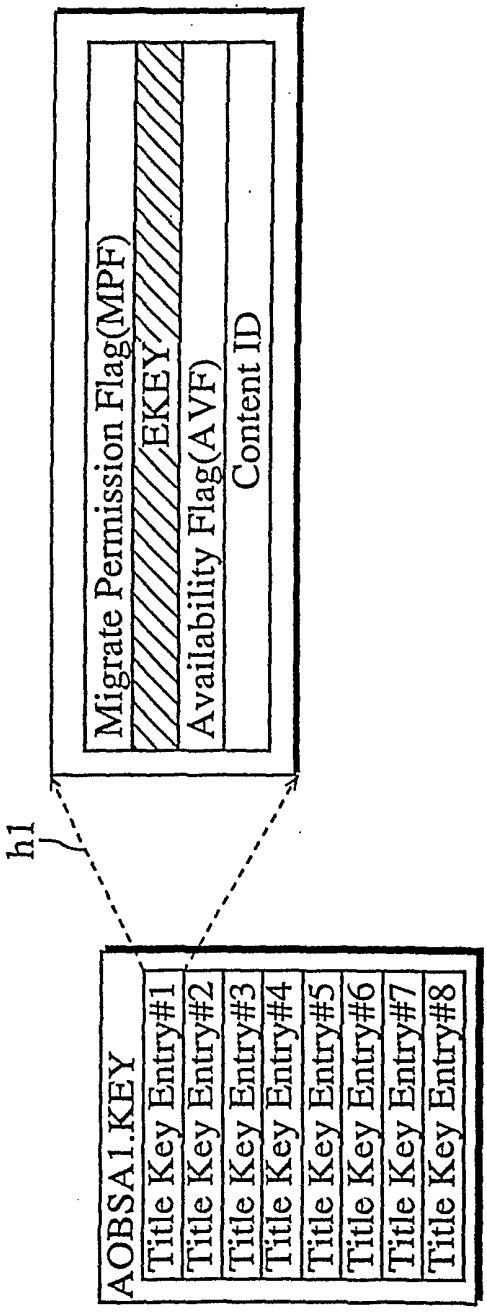

h1
Migrate Permission Flag(MPF)
EKEY
Availability Flag(AVF)
Content ID
AOBSA1.KEY
Title Key Entry#1
Title Key Entry#2
Title Key Entry#3
Title Key Entry#4
Title Key Entry#5
Title Key Entry#6
Title Key Entry#7
Title Key Entry#8

FIG. 12

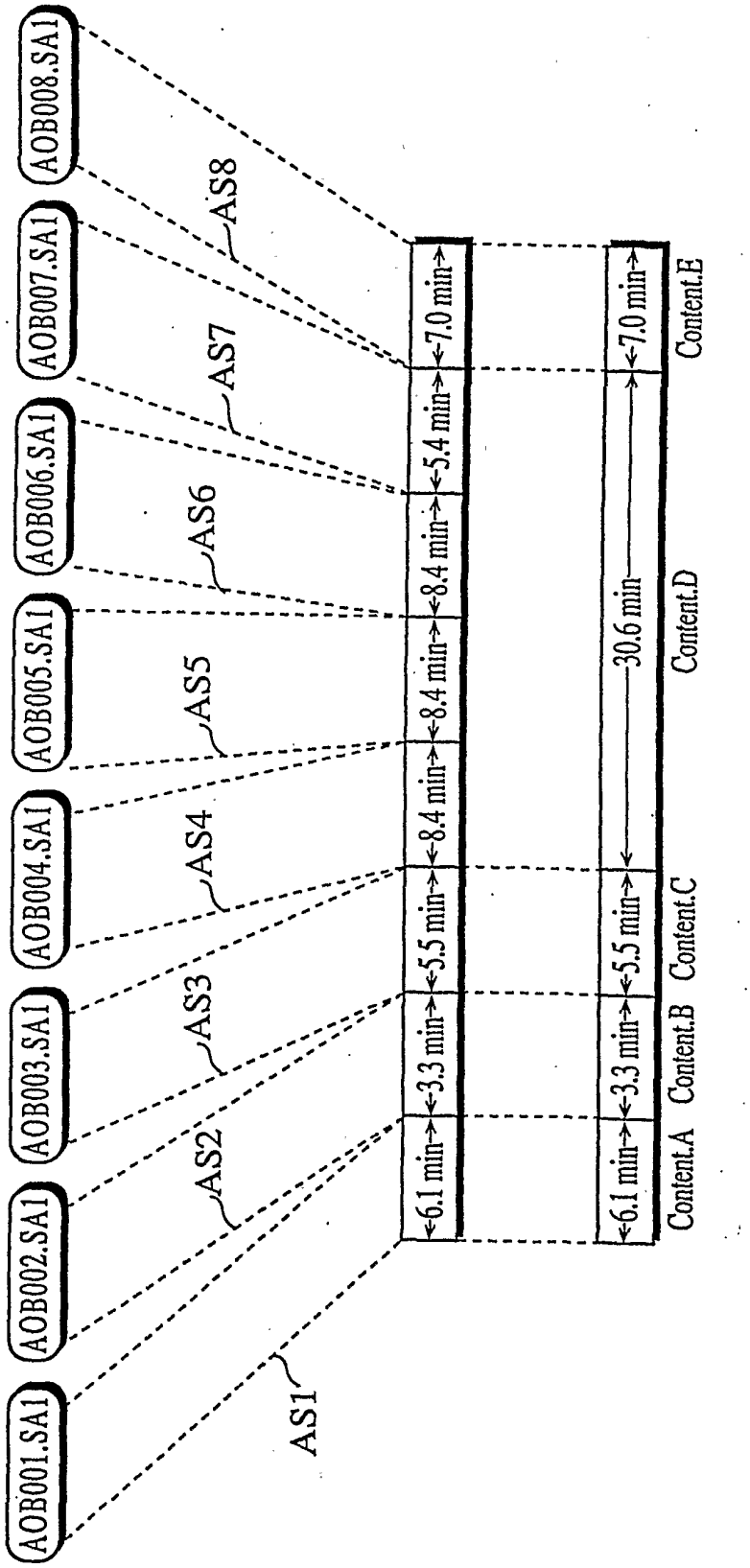

AOB001.SA1
AOB002.SA1
AOB003.SA1
AOB004.SA1
AOB005.SA1
AOB006.SA1
AOB007.SA1
AOB008.SA1
AS1
AS2
AS3
AS4
AS5
AS6
AS7
AS8
6.1 min
3.3 min
5.5 min
8.4 min
8.4 min
8.4 min
5.4 min
7.0 min
Content.A
Content.B
Content.C
Content.D
Content.E
30.6 min

FIG. 13

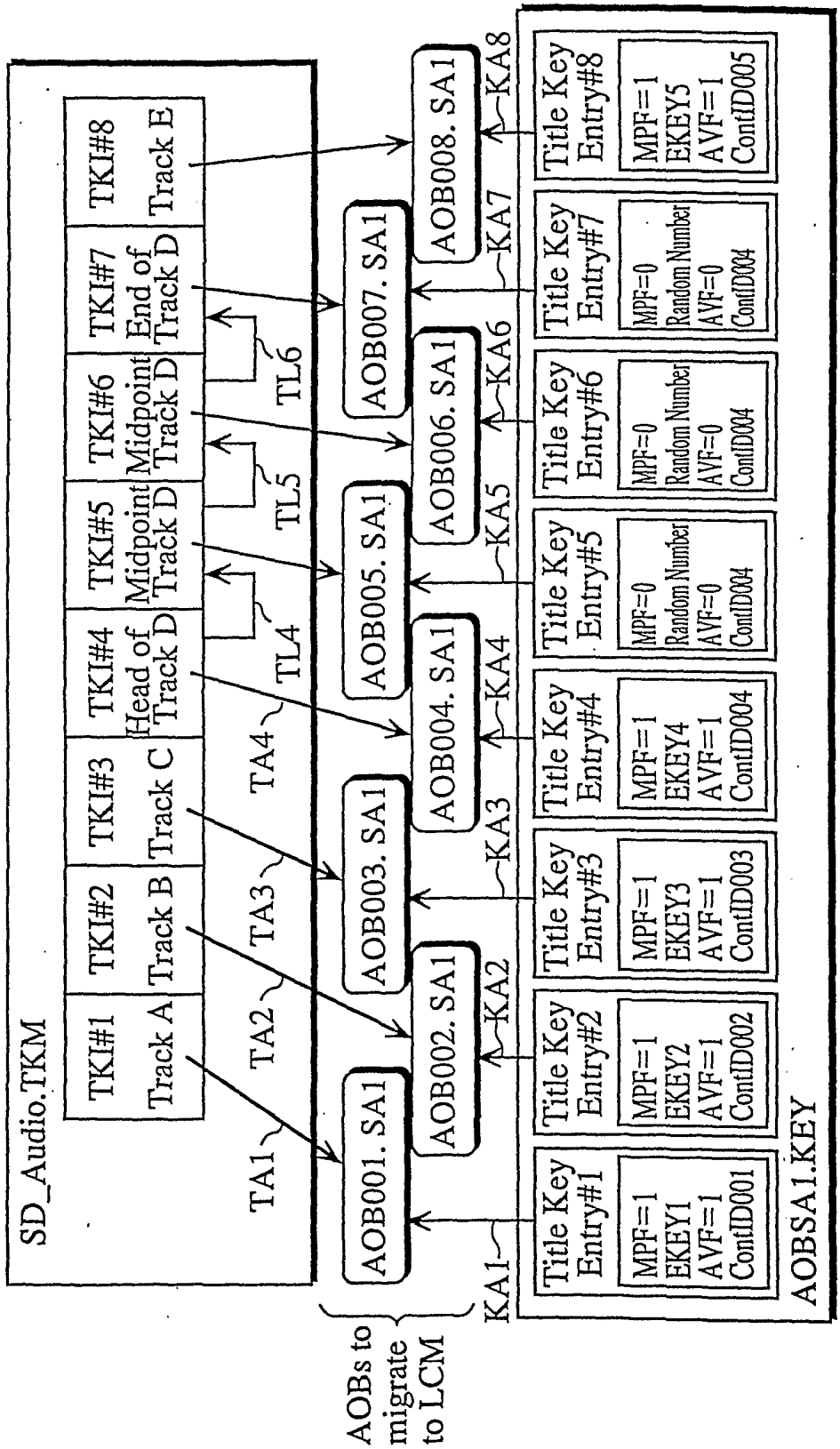

SD_Audio.TKM
TKI#1 Track A
TKI#2 Track B
TKI#3 Track C
TKI#4 Head of Track D
TKI#5 Midpoint Track D
TKI#6 Midpoint Track D
TKI#7 End of Track D
TKI#8 Track E
TA1
TA2
TA3
TA4
TL4
TL5
TL6
AOB001. SA1
AOB002. SA1
AOB003. SA1
AOB004. SA1
AOB005. SA1
AOB006. SA1
AOB007. SA1
AOB008. SA1
KA1
KA2
KA3
KA4
KA5
KA6
KA7
KA8
AOBs to migrate to LCM
AOBSA1.KEY
Title Key Entry#1
MPF=1 EKEY1 AVF=1 ContID001
Title Key Entry#2
MPF=1 EKEY2 AVF=1 ContID002
Title Key Entry#3
MPF=1 EKEY3 AVF=1 ContID003
Title Key Entry#4
MPF=1 EKEY4 AVF=1 ContID004
Title Key Entry#5
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#6
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#7
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#8
MPF=1 EKEY5 AVF=1 ContID005

FIG. 14

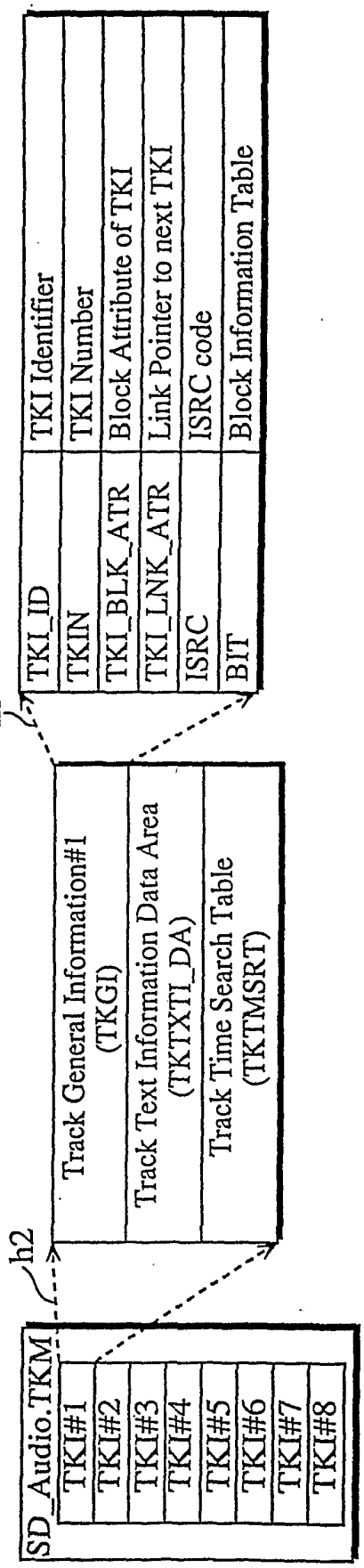

SD_Audio.TKM
TKI#1
TKI#2
TKI#3
TKI#4
TKI#5
TKI#6
TKI#7
TKI#8
h2
Track General Information#1 (TKGI)
Track Text Information Data Area (TKTXTI_DA)
Track Time Search Table (TKTMSRT)
h3
TKI_ID
TKIN
TKI_BLK_ATR
TKI_LNK_ATR
ISRC
BIT
TKI Identifier
TKI Number
Block Attribute of TKI
Link Pointer to next TKI
ISRC code
Block Information Table

FIG. 15

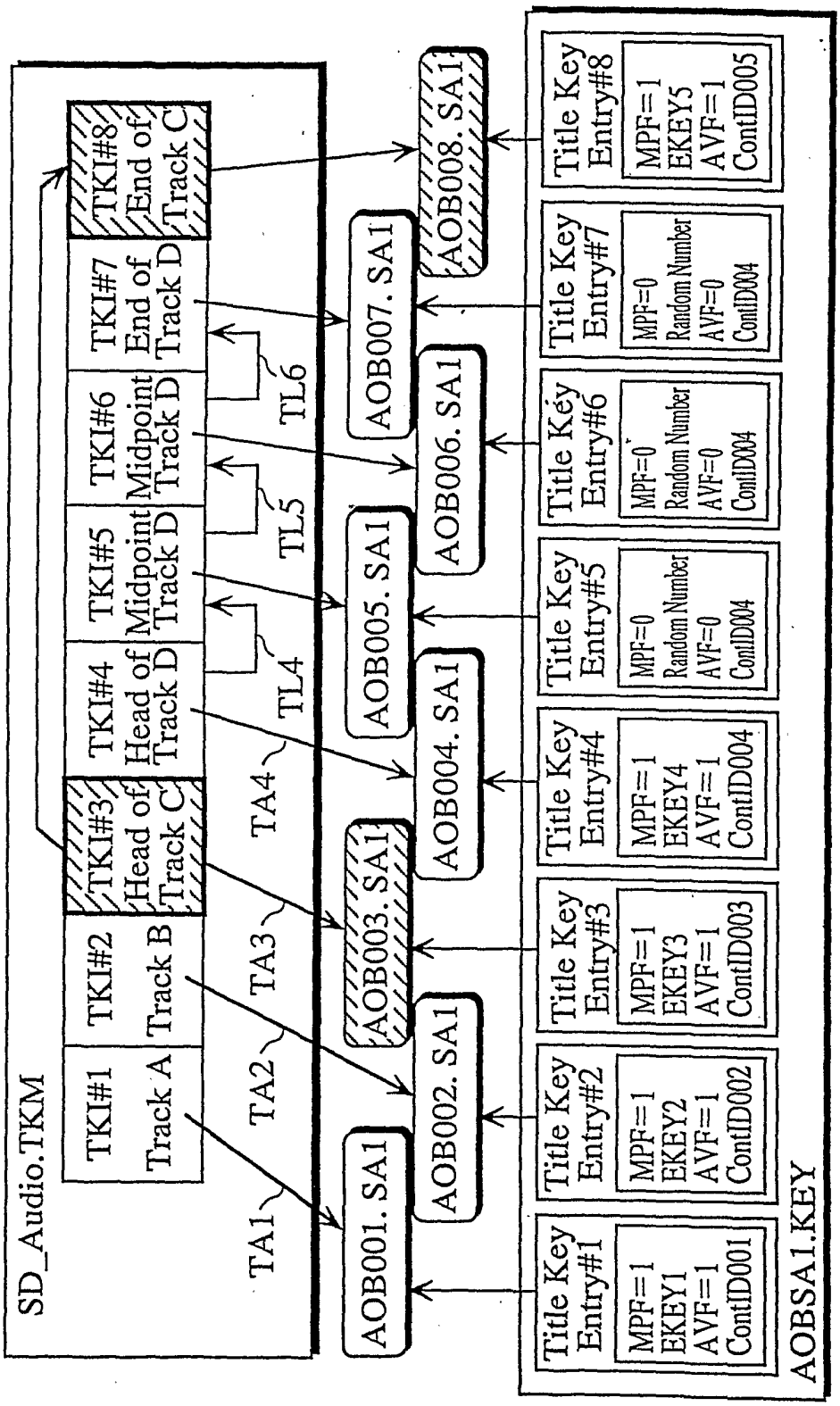

Combining Tracks C, E into Track C
SD_Audio.TKM
TKI#1 Track A
TKI#2 Track B
TKI#3 Head of Track C
TKI#4 Head of Track D
TKI#5 Midpoint Track D
TKI#6 Midpoint Track D
TKI#7 End of Track D
TKI#8 End of Track C
TA1
TA2
TA3
TA4
TL4
TL5
TL6
AOB001. SA1
AOB002. SA1
AOB003. SA1
AOB004. SA1
AOB005. SA1
AOB006. SA1
AOB007. SA1
AOB008. SA1
Title Key Entry#1
MPF=1 EKEY1 AVF=1 ContID001
Title Key Entry#2
MPF=1 EKEY2 AVF=1 ContID002
Title Key Entry#3
MPF=1 EKEY3 AVF=1 ContID003
Title Key Entry#4
MPF=1 EKEY4 AVF=1 ContID004
Title Key Entry#5
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#6
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#7
MPF=0 Random Number AVF=0 ContID004
Title Key Entry#8
MPF=1 EKEY5 AVF=1 ContID005
AOBSA1.KEY

FIG. 16

Dividing Track C into Track C,F

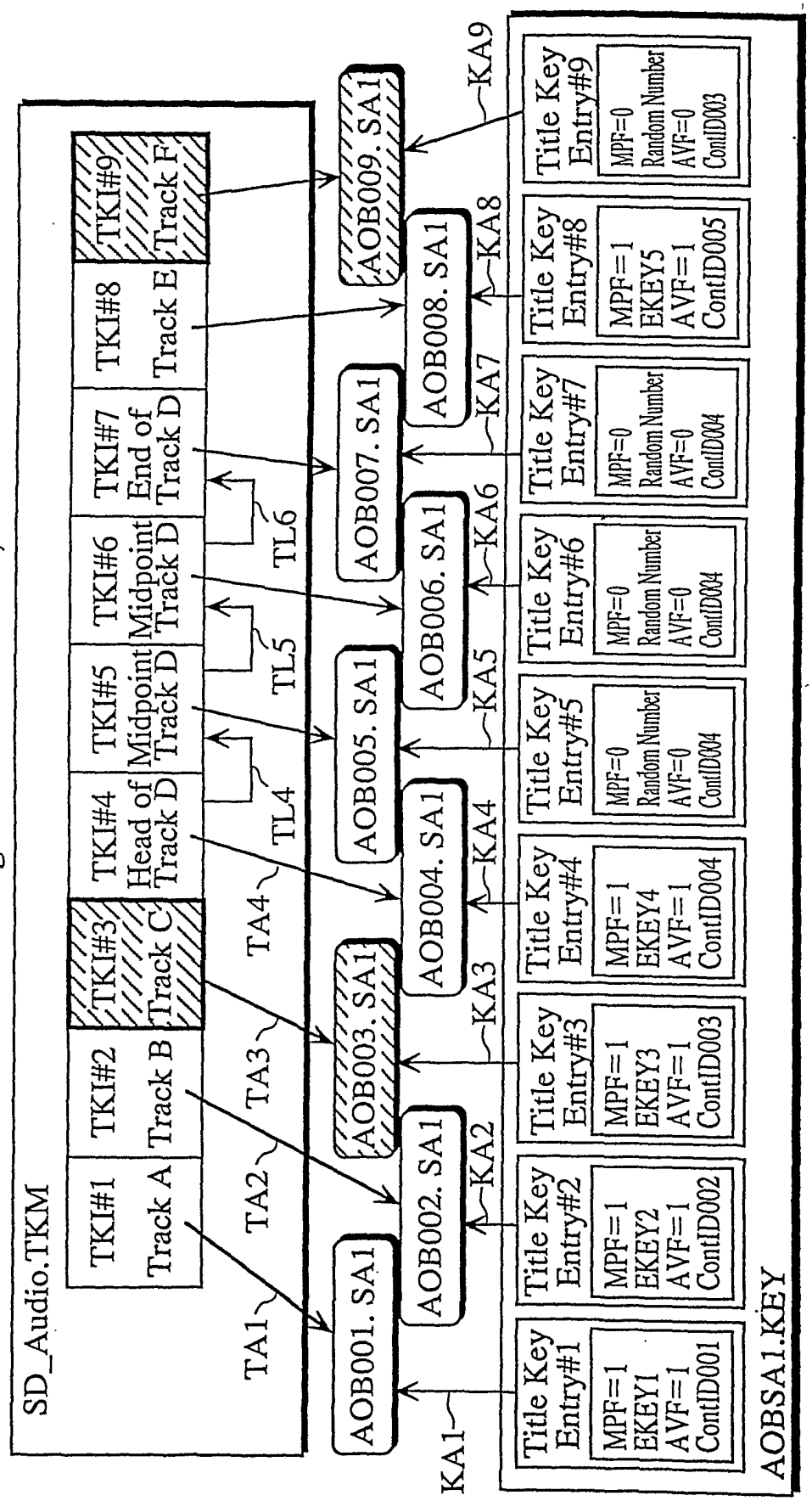
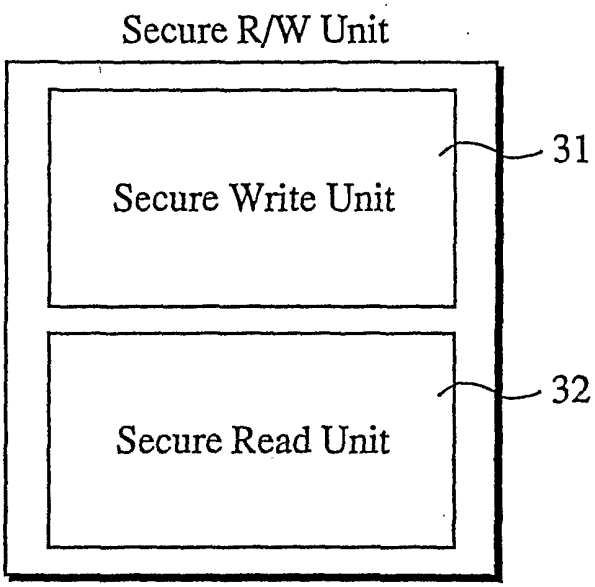


FIG. 17



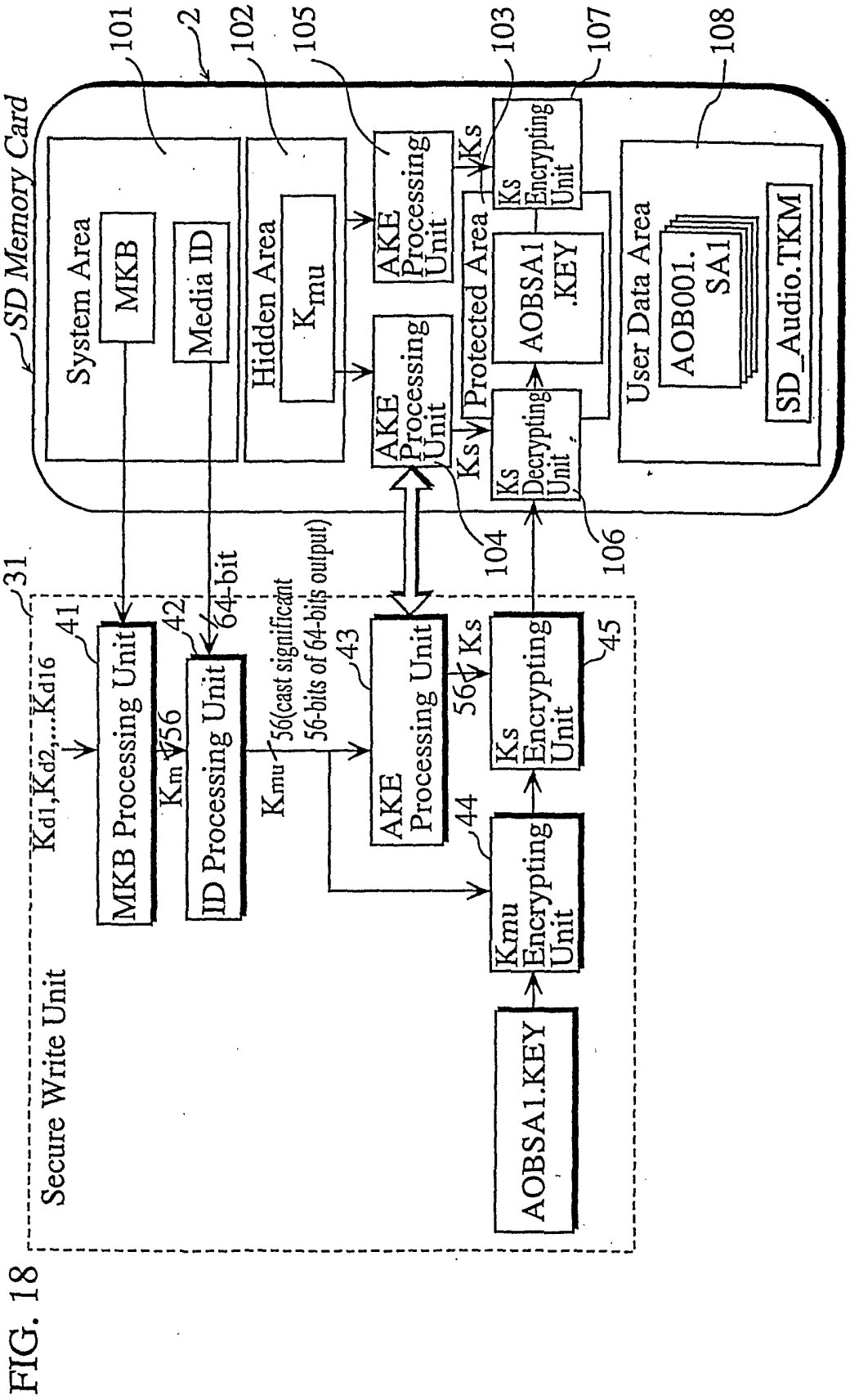

SD Memory Card
101
2
102
105
103
107
108
System Area
MKB
Media ID
Hidden Area
Kmu
AKE Processing Unit
AKE Processing Unit
Ks
Ks Encrypting Unit
Protected Area
AOBSA1 .KEY
Ks Decrypting Unit
User Data Area
AOB001. SA1
SD_Audio.TKM
104
106
31
Secure Write Unit
41
42
43
44
45
Kd1,Kd2,...Kd16
MKB Processing Unit
Km 56
ID Processing Unit
64-bit
Kmu
56(cast significant 56-bits of 64-bits output)
AKE Processing Unit
56 Ks
Ks Encrypting Unit
Kmu Encrypting Unit
AOBSA1.KEY

FIG. 18

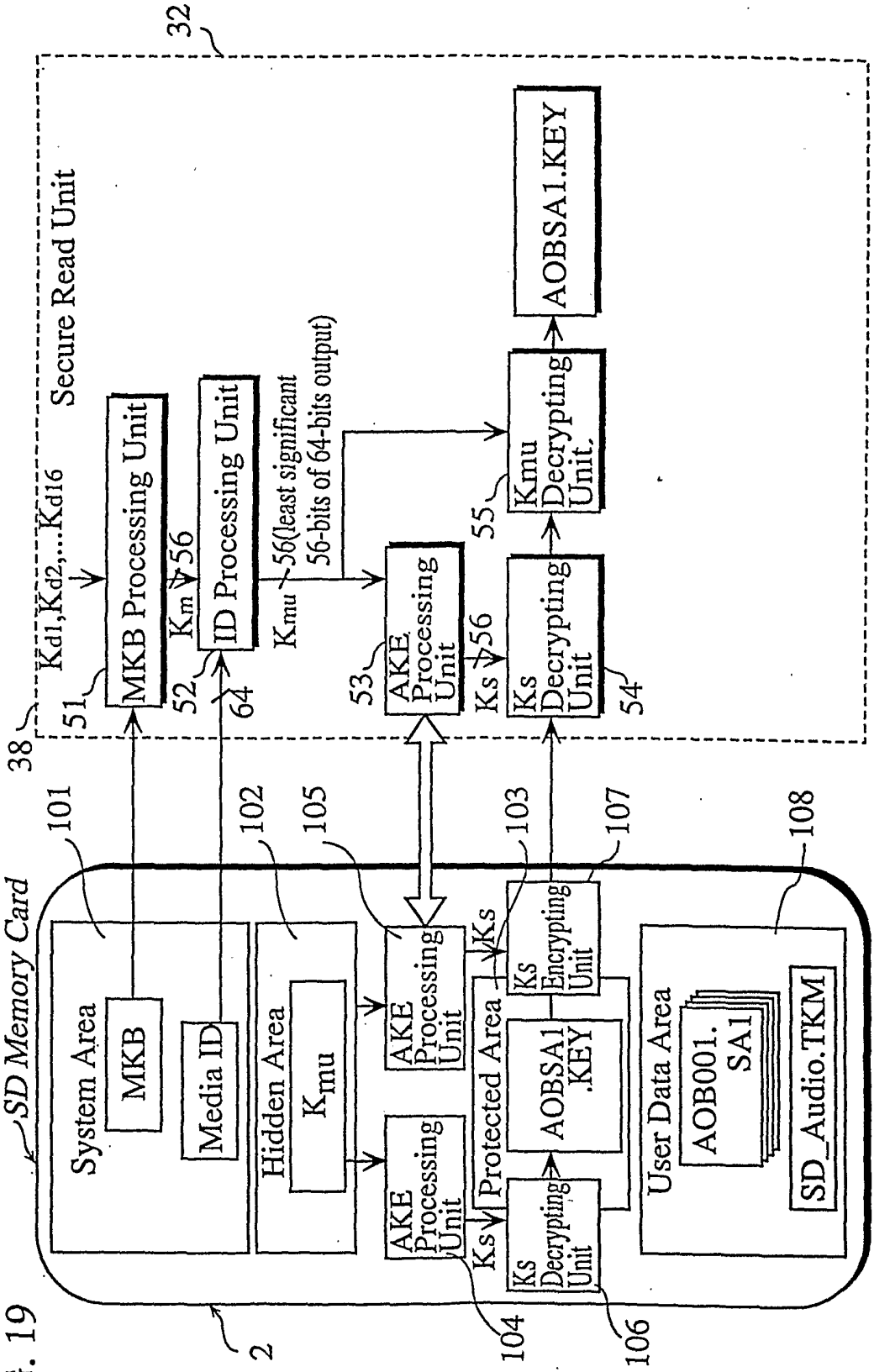

32
Secure Read Unit
Kd1,Kd2,...Kd16
MKB Processing Unit
51
Km 56
ID Processing Unit
52
64
56(least significant 56-bits of 64-bits output)
Kmu
AKE Processing Unit
53
Ks 56
Ks Decrypting Unit
54
Kmu Decrypting Unit
55
AOBSA1.KEY
38
SD Memory Card
101
System Area
MKB
Media ID
102
Hidden Area
Kmu
105
AKE Processing Unit
AKE Processing Unit
103
Protected Area
AOBSA1 .KEY
Ks Encrypting Unit
107
Ks
Ks
Ks Decrypting Unit
104
106
108
User Data Area
AOB001. SA1
SD_Audio.TKM
2

FIG. 19

FIG. 20

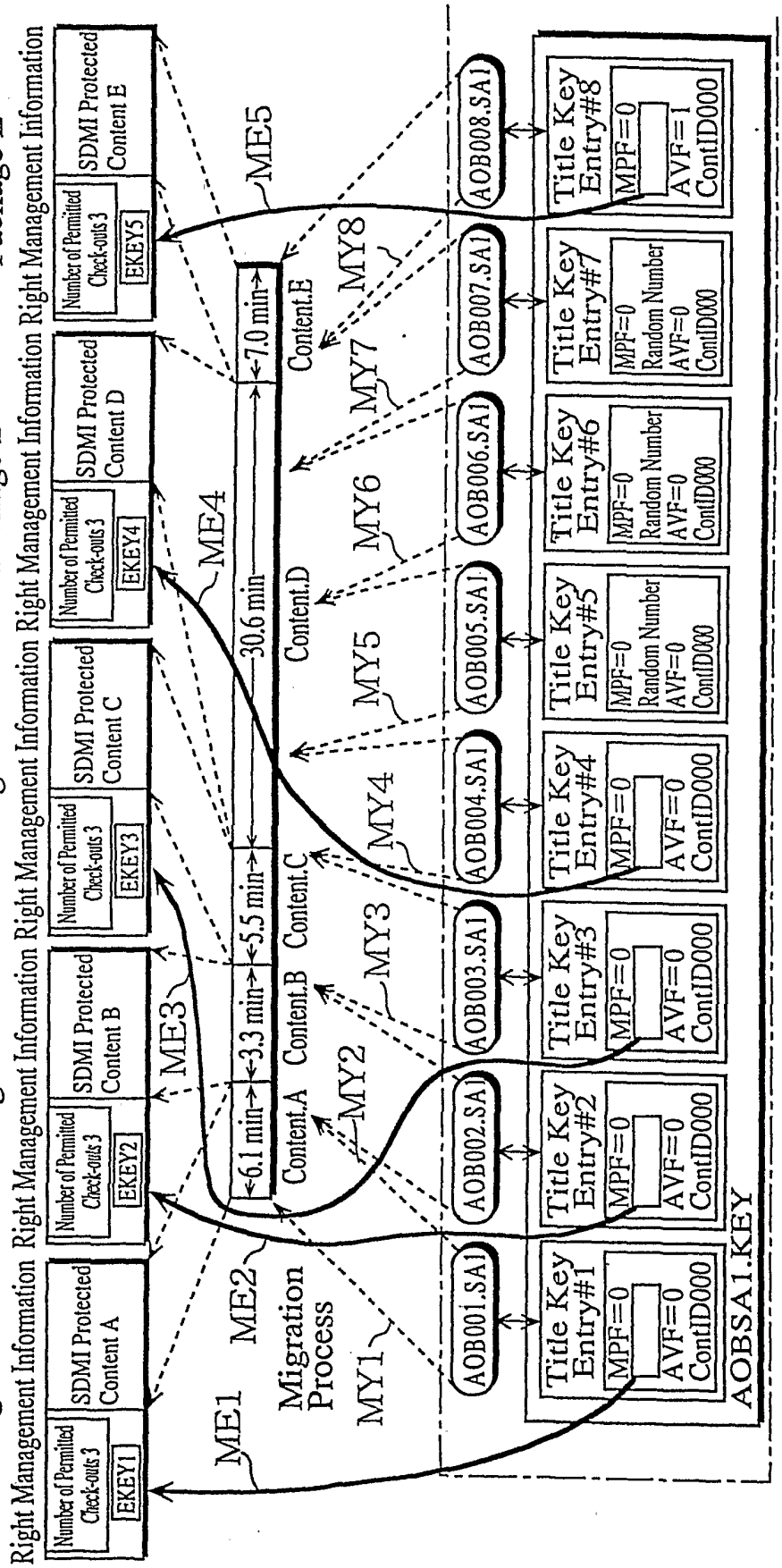
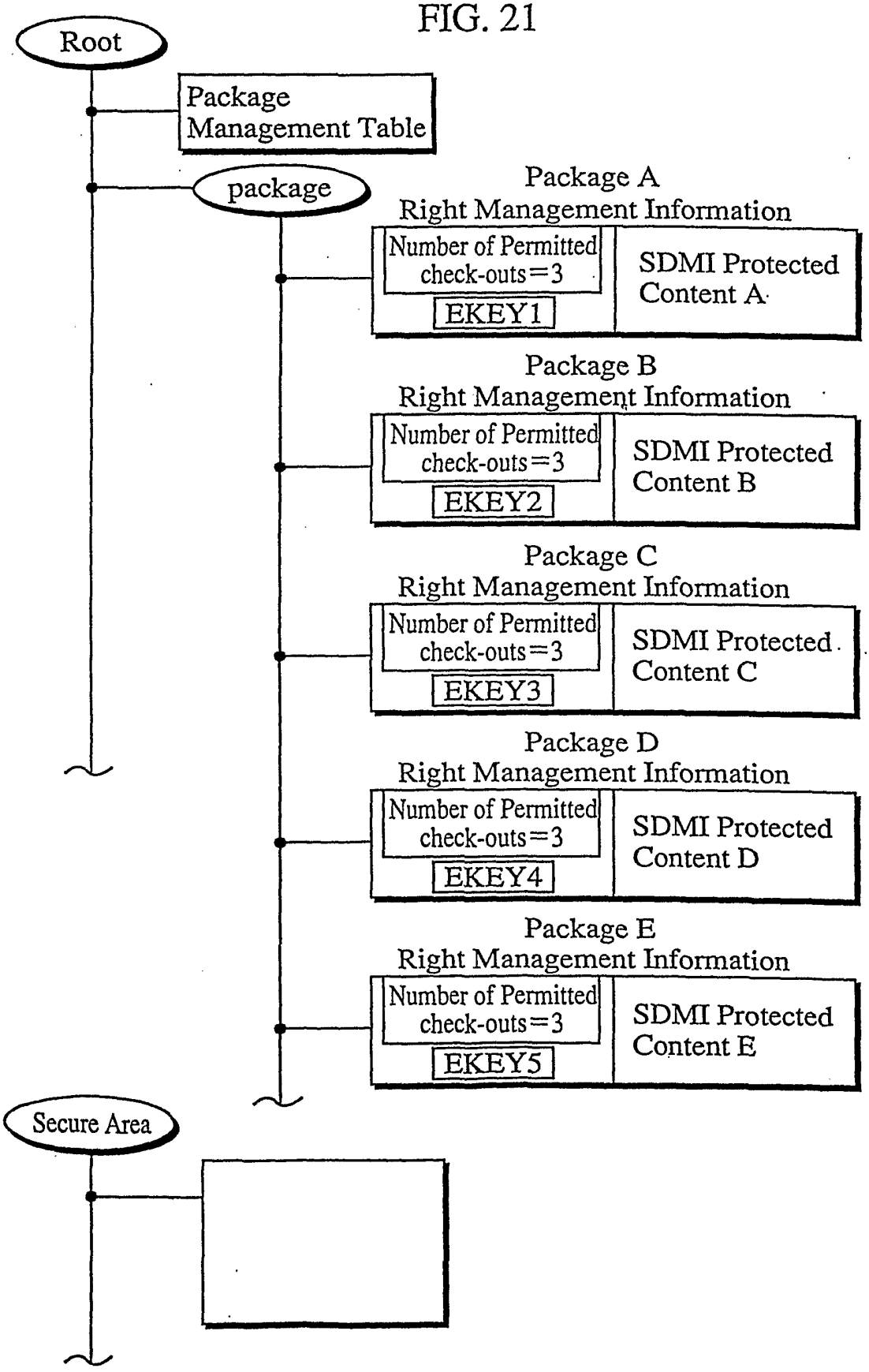

RY1
Package A
Right Management Information
Number of Permitted Check-outs 3
EKEY1
SDMI Protected Content A
RY2
Package B
Right Management Information
Number of Permitted Check-outs 3
EKEY2
SDMI Protected Content B
RY3
Package C
Right Management Information
Number of Permitted Check-outs 3
EKEY3
SDMI Protected Content C
RY4
Package D
Right Management Information
Number of Permitted Check-outs 3
EKEY4
SDMI Protected Content D
RY5
Package E
Right Management Information
Number of Permitted Check-outs 3
EKEY5
SDMI Protected Content E
ME1
ME2
Migration Process
MY1
ME3
MY2
MY3
ME4
MY4
MY5
MY6
MY7
MY8
ME5
6.1 min
3.3 min
5.5 min
30.6 min
7.0 min
Content.A
Content.B
Content.C
Content.D
Content.E
AOBSA1.KEY
AOB001.SA1
AOB002.SA1
AOB003.SA1
AOB004.SA1
AOB005.SA1
AOB006.SA1
AOB007.SA1
AOB008.SA1
Title Key Entry#1
MPF=0
AVF=0
ContID000
Title Key Entry#2
MPF=0
AVF=0
ContID000
Title Key Entry#3
MPF=0
AVF=0
ContID000
Title Key Entry#4
MPF=0
AVF=0
ContID000
Title Key Entry#5
MPF=0
Random Number
AVF=0
ContID000
Title Key Entry#6
MPF=0
Random Number
AVF=0
ContID000
Title Key Entry#7
MPF=0
Random Number
AVF=0
ContID000
Title Key Entry#8
MPF=0
AVF=1
ContID000

FIG. 21


Root
Package Management Table
package
Package A
Right Management Information
Number of Permitted check-outs=3
EKEY1
SDMI Protected Content A
Package B
Right Management Information
Number of Permitted check-outs=3
EKEY2
SDMI Protected Content B
Package C
Right Management Information
Number of Permitted check-outs=3
EKEY3
SDMI Protected Content C
Package D
Right Management Information
Number of Permitted check-outs=3
EKEY4
SDMI Protected Content D
Package E
Right Management Information
Number of Permitted check-outs=3
EKEY5
SDMI Protected Content E
Secure Area

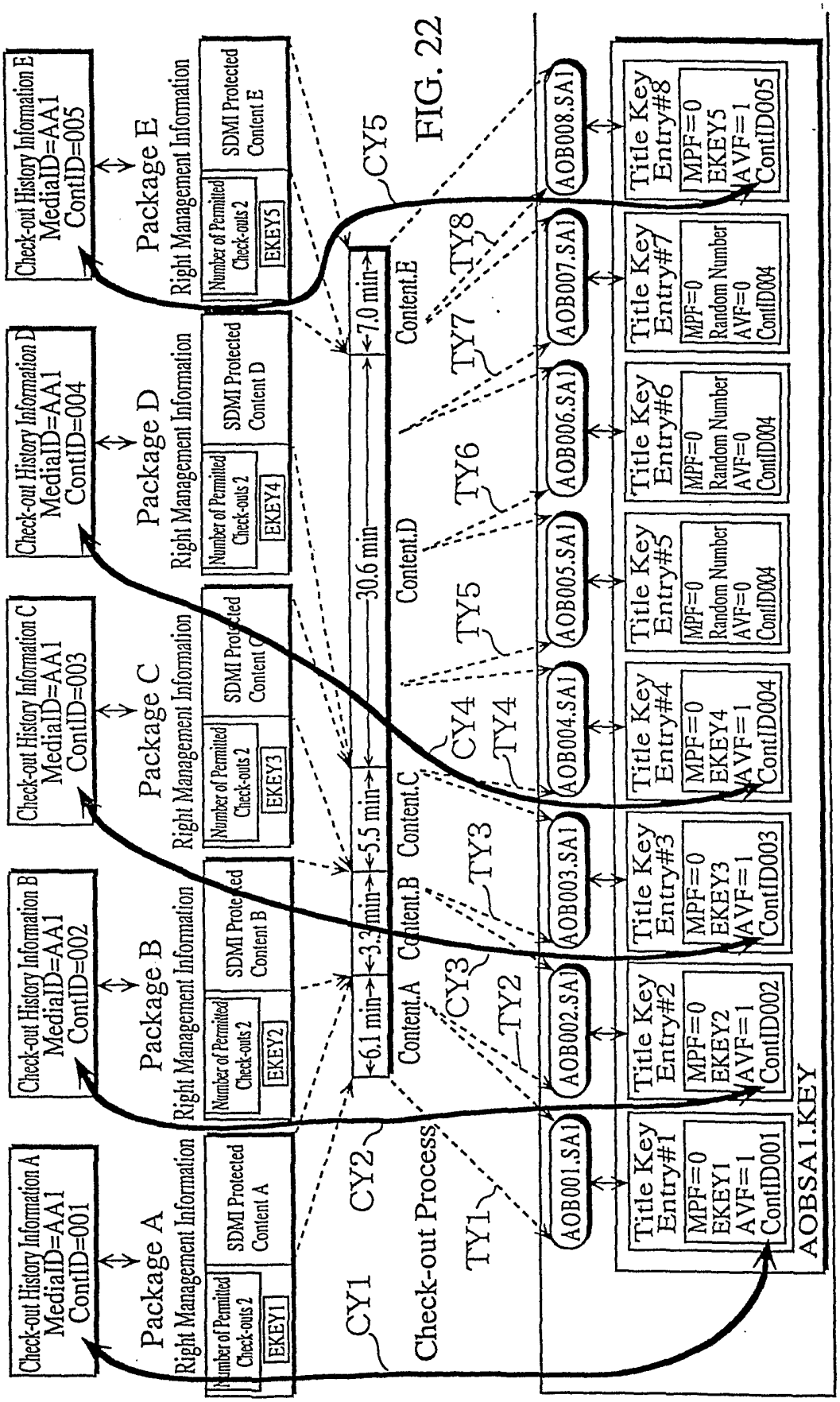

Check-out History Information A
MediaID=AA1
ContID=001
Package A
Right Management Information
Number of Permitted Check-outs 2
EKEY1
SDMI Protected Content A
Check-out History Information B
MediaID=AA1
ContID=002
Package B
Right Management Information
Number of Permitted Check-outs 2
EKEY2
SDMI Protected Content B
Check-out History Information C
MediaID=AA1
ContID=003
Package C
Right Management Information
Number of Permitted Check-outs 2
EKEY3
SDMI Protected Content C
Check-out History Information D
MediaID=AA1
ContID=004
Package D
Right Management Information
Number of Permitted Check-outs 2
EKEY4
SDMI Protected Content D
Check-out History Information E
MediaID=AA1
ContID=005
Package E
Right Management Information
Number of Permitted Check-outs 2
EKEY5
SDMI Protected Content E
Check-out Process
CY1
CY2
CY3
CY4
CY5
TY1
TY2
TY3
TY4
TY5
TY6
TY7
TY8
6.1 min
3.3 min
5.5 min
30.6 min
7.0 min
Content.A
Content.B
Content.C
Content.D
Content.E
AOB001.SA1
AOB002.SA1
AOB003.SA1
AOB004.SA1
AOB005.SA1
AOB006.SA1
AOB007.SA1
AOB008.SA1
Title Key Entry#1
MPF=0
EKEY1
AVF=1
ContID001
Title Key Entry#2
MPF=0
EKEY2
AVF=1
ContID002
Title Key Entry#3
MPF=0
EKEY3
AVF=1
ContID003
Title Key Entry#4
MPF=0
EKEY4
AVF=1
ContID004
Title Key Entry#5
MPF=0
Random Number
AVF=0
ContID004
Title Key Entry#6
MPF=0
Random Number
AVF=0
ContID004
Title Key Entry#7
MPF=0
Random Number
AVF=0
ContID004
Title Key Entry#8
MPF=0
EKEY5
AVF=1
ContID005
AOBSA1.KEY

FIG. 22

FIG. 23

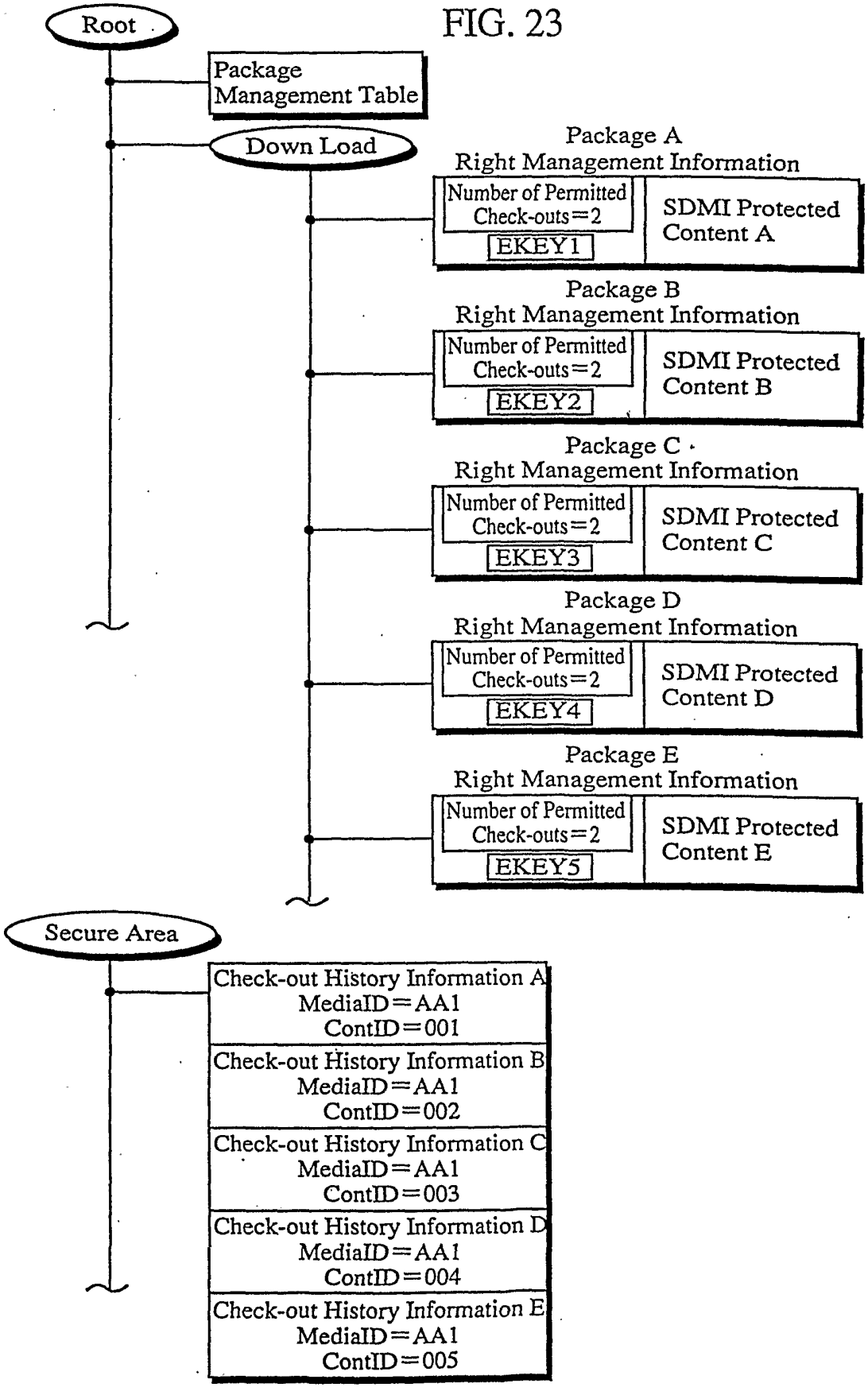

Root
Package Management Table
Down Load
Package A
Right Management Information
Number of Permitted Check-outs=2
EKEY1
SDMI Protected Content A
Package B
Right Management Information
Number of Permitted Check-outs=2
EKEY2
SDMI Protected Content B
Package C
Right Management Information
Number of Permitted Check-outs=2
EKEY3
SDMI Protected Content C
Package D
Right Management Information
Number of Permitted Check-outs=2
EKEY4
SDMI Protected Content D
Package E
Right Management Information
Number of Permitted Check-outs=2
EKEY5
SDMI Protected Content E
Secure Area
Check-out History Information A
MediaID=AA1
ContID=001
Check-out History Information B
MediaID=AA1
ContID=002
Check-out History Information C
MediaID=AA1
ContID=003
Check-out History Information D
MediaID=AA1
ContID=004
Check-out History Information E
MediaID=AA1
ContID=005

FIG. 24

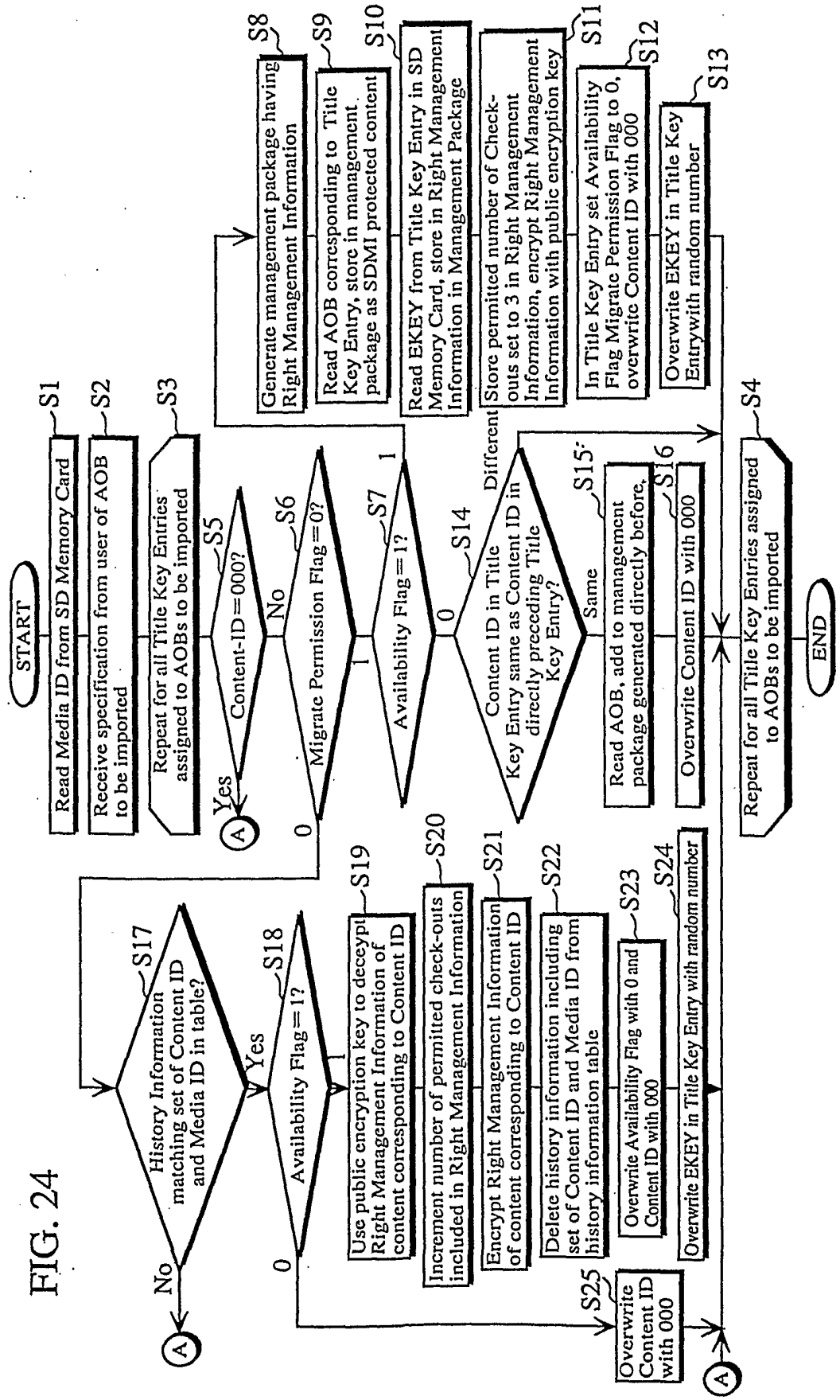
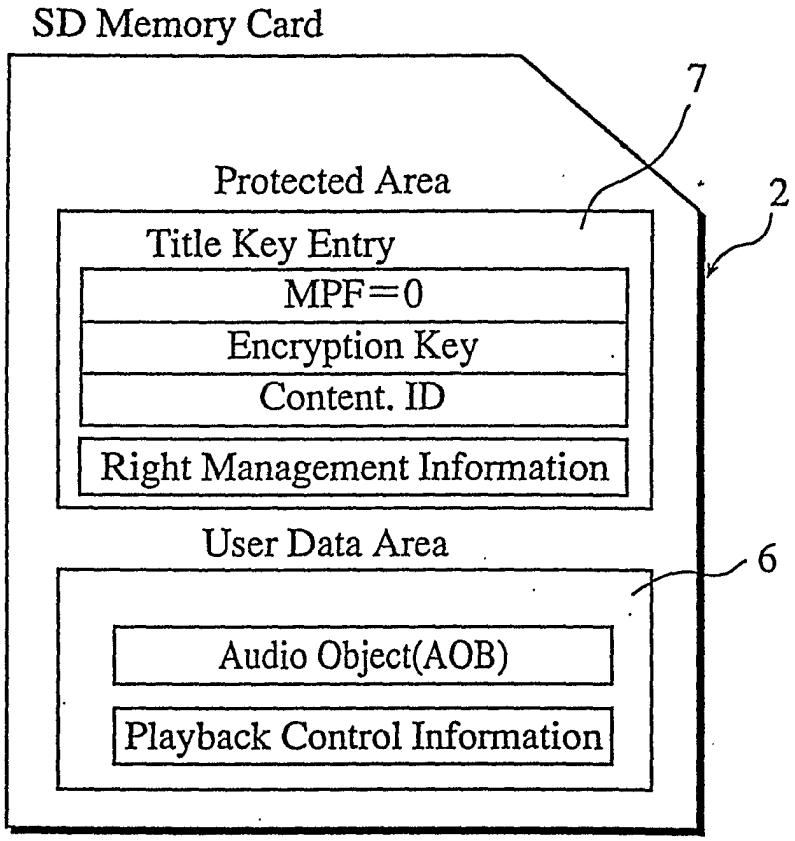

START
Read Media ID from SD Memory Card
S1
Receive specification from user of AOB to be imported
S2
Repeat for all Title Key Entries assigned to AOBs to be imported
S3
Content-ID=000?
S5
Yes
No
Migrate Permission Flag=0?
S6
0
1
Availability Flag=1?
S7
1
0
Content ID in Title Key Entry same as Content ID in directly preceding Title Key Entry?
S14
Different
Same
Read AOB, add to management package generated directly before.
S15
Overwrite Content ID with 000
S16
Repeat for all Title Key Entries assigned to AOBs to be imported
S4
END
Generate management package having Right Management Information
S8
Read AOB corresponding to Title Key Entry, store in management package as SDMI protected content
S9
Read EKEY from Title Key Entry in SD Memory Card, store in Right Management Information in Management Package
S10
Store permitted number of Check-outs set to 3 in Right Management Information, encrypt Right Management Information with public encryption key
S11
In Title Key Entry set Availability Flag Migrate Permission Flag to 0, overwrite Content ID with 000
S12
Overwrite EKEY in Title Key Entry with random number
S13
History Information matching set of Content ID and Media ID in table?
S17
No
Yes
Availability Flag=1?
S18
0
1
Use public encryption key to decrypt Right Management Information of content corresponding to Content ID
S19
Increment number of permitted check-outs included in Right Management Information
S20
Encrypt Right Management Information of content corresponding to Content ID
S21
Delete history information including set of Content ID and Media ID from history information table
S22
Overwrite Availability Flag with 0 and Content ID with 000
S23
Overwrite EKEY in Title Key Entry with random number
S24
Overwrite Content ID with 000
S25

FIG. 25



MPF : 0
Migration Prohibited
(Right Management Information corresponding to AOB already generated)

MPF : 1
Migration Permitted
(Right Management Information corresponding to AOB not yet generated)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/17291

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) :G06F 17/60
US CL :705/59
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 705/59

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, P	US 6,240,185 B1 (VAN WIE et al) 29 May 2001, figure 11	1-14
A, P	US 6,226,618 B1 (DOWNS et al) 01 May 2001, figure 5.	1-14
A, P	US 6,073,124 A (KRISHNAN et al) 06 June 2000, figure 11.	1-14
A	5,940,504 A (GRISWOLD) 17 August 1999, figure 6.	1-14
A	US 5,553,143 A (ROSS et al) 03 September 1996, figure 5A.	1-14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 11 SEPTEMBER 2001	Date of mailing of the international search report 02 NOV 2001
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer THOMAS DIXON Peggy Harwood Telephone No. (703) 308-3900

Form PCT/ISA/210 (second sheet) (July 1998) ★