

DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:	PCT/JP2015/000007
International filing date:	05 January 2015 (05.01.2015)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 61/925,699
	Filing date: 10 January 2014 (10.01.2014)
Date of receipt at the International Bureau:	07 February 2015 (07.02.2015)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

CERTIFICATE OF AVAILABILITY OF A CERTIFIED PATENT DOCUMENT IN A DIGITAL LIBRARY

The International Bureau certifies that a copy of the patent application indicated below has been available to the WIPO Digital Access Service since the date of availability indicated, and that the patent application has been available to the indicated Office(s) as of the date specified following the relevant Office code:

Document details: Country/Office: US

Filing date: 10 Jan 2014 (10.01.2014)

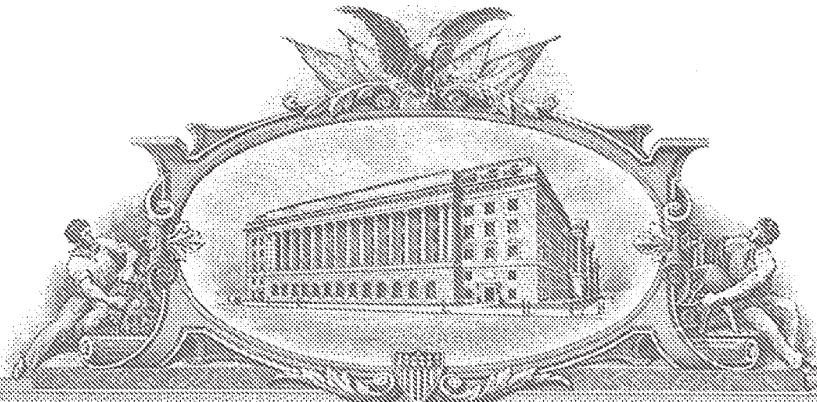
Application number: 61925699

Date of availability of document: 08 Feb 2014 (08.02.2014)

The following Offices can retrieve this document by using the access code:

AU, CN, ES, FI, GB, IB, JP, KR, SE, US, DK

Date of issue of this certificate: 09 Feb 2015 (09.02.2015)



THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

February 09, 2015

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 61/925,699
FILING DATE: *January 10, 2014*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US61/925,699*



Certified by

David J. Kyte

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(e)

INVENTOR(S)		
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)
Tadamasa	TOMA	Osaka, Japan
☐ Additional inventors are being named on the separately numbered sheets attached hereto		
TITLE OF THE INVENTION (280 characters max)		
DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		
CORRESPONDENCE ADDRESS		
Direct all correspondence to: ☐ Customer Number _____ - _____ Type Customer Number here Place Customer Number Bar Code Label here		
OR		
CORRESPONDENCE ADDRESS	CUSTOMER NO. 52349 By: <u>/Charles R Watts/</u> Charles R. Watts Registration No. 33,142 WENDEROTH, LIND & PONACK, L.L.P. 1030 15th Street, N.W., Suite 400 East Washington, D.C. 20005-1503 Phone:(202) 721-8200 Fax:(202) 721-8250 January 10, 2014	
ENCLOSED APPLICATION PARTS (check all that apply)		
☐ Specification	Number of Pages ☐	☐ CD(s), Number _____
☒ Drawings	Number of Sheets [29]	☒ Other, (specify) <u>Application Data Sheet</u>
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISION APPLICATION FOR PATENT (check one)		
☐ Applicant claims small entity status. See 37 CFR 1.27.		
☐ A check or money order is enclosed to cover the filing fees of \$260		
☐ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account No. <u>23-0975</u> . Filing Fee Amount \$260		
☒ Please charge my Credit Card in the amount of \$260 to cover the above fees.		
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. ☒ No. ☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____		

The USPTO is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17, and 1.492, which may be required by this paper and for the entire pendency of the present application to Deposit Account No. 23-0975, except fees for multiple dependent claims.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Tadamasa		TOMA		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Osaka	Country of Residence	JP		
Mailing Address of Inventor:					
Address 1	c/o Panasonic Corporation				
Address 2	1006, Oaza Kadoma, Kadoma-shi				
City	Osaka	State/Province			
Postal Code	571-8501	Country	JP		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add					

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence information of this application.			
Customer Number	52349		
Email Address	wlp@wenderoth.com	Add Email	Remove Email

Application Information:

Title of the Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		
Attorney Docket Number	PR14-0030A	Small Entity Status Claimed	☐
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	29	Suggested Figure for Publication (if any)	

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	52349		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove			
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

- ☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
- NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
Clear			
☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor :			
If the Applicant is an Organization check here. ☒			
Organization Name	Panasonic Corporation		
Mailing Address Information:			
Address 1	1006, Oaza Kadoma, Kadoma-shi		
Address 2			
City	Osaka	State/Province	
Country i	JP	Postal Code	571-8501
Phone Number		Fax Number	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button. Add 			

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.				
Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
				Remove
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				Add

Signature:

Remove					
NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Charles R Watts/			Date (YYYY-MM-DD)	2014-01-10
First Name	Charles	Last Name	Watts	Registration Number	33142
Additional Signature may be generated within this form by selecting the Add button.					Add

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	PR14-0030A
		Application Number	
Title of Invention	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

- The present invention relates to a data multiplexing method, a data reproduction method, and a data conversion method for streams stored on an optical disc.

- Background of the Invention

The file format conventionally used on optical discs employs the MPEG-2 TS format defined by ISO/IEC 13818-1 to multiplex a video stream, an audio stream, and a subtitle stream. In the MPEG-2 TS format, each stream such as video, audio, and subtitles is divided into TS packets of 188 bytes each and then multiplexed for recording. The MPEG-2 TS format is optimized for cases in which data is read and processed sequentially from the beginning, as in broadcasting and optical disc applications, enabling efficient stream reading, decoding, and playback even on consumer devices with relatively small buffer capacities.

In contrast, the file format that has been increasingly adopted for network-based content distribution is the MP4 format defined by ISO/IEC 14496-12. The MP4 format employs an extremely flexible data structure on the premise of application to randomly accessible media such as HDDs and flash memories. In a typical use case, a video stream, an audio stream, and a subtitle stream are each divided into units called fragments of approximately several seconds, and these fragments are then arranged sequentially to form a single file.

As for distribution media for high-quality content such as 4K video, which is expected to become widespread in the future, optical discs are still considered likely to be widely used due to cost-per-bit considerations. On the other hand, smartphones and tablets do not have optical disc drives; however, they are used as terminals for receiving and playing back content distributed over networks, taking advantage of their high portability and the trend toward larger screens and higher resolutions in recent years. For this reason, smartphones and tablets commonly support the MP4 format, while support for the MPEG-2 TS format has not advanced significantly. In this context, when copying MPEG-2 TS format content distributed on optical discs to a smartphone or tablet and converting it to the MP4 format, it is necessary to first decompose the MPEG-2 TS multiplexed content back into a video stream, an audio stream, and a subtitle stream, and then convert the content to the MP4 format. Commercial content distributed on optical discs is generally encrypted; however, conversion has required decrypting the content, converting the format, and then re-encrypting the content. Such decryption and encryption processing not only requires considerable processing time on the conversion device, but also raises security concerns because plaintext content is temporarily generated in the process.

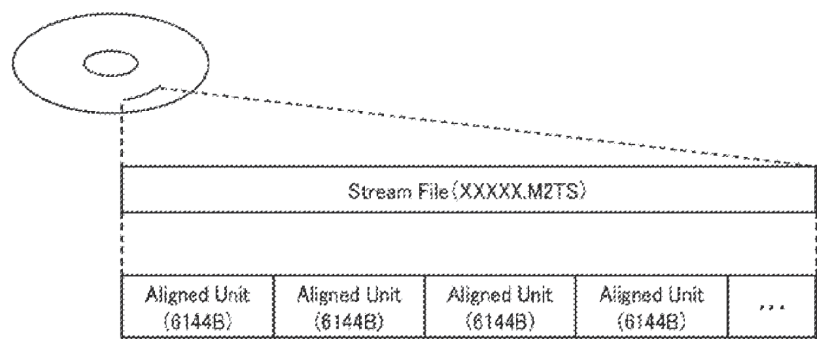
- Brief Summary of the Invention

- When converting from MPEG-2 TS to MP4, auxiliary information for identifying regions to be deleted or regions whose data structure is to be converted within the encoded data is stored in the MPEG-2 TS stream.
- MP4 source data comprising data other than MP4 samples, an MPEG-2 TS stream, and conversion metadata are present, wherein the conversion metadata defines the range of data to be obtained from the MP4 source data and the MPEG-2 TS stream, as well as the storage order of the obtained data, and data generated in accordance with the conversion metadata constitutes an MP4 file.

- Advantageous Effects

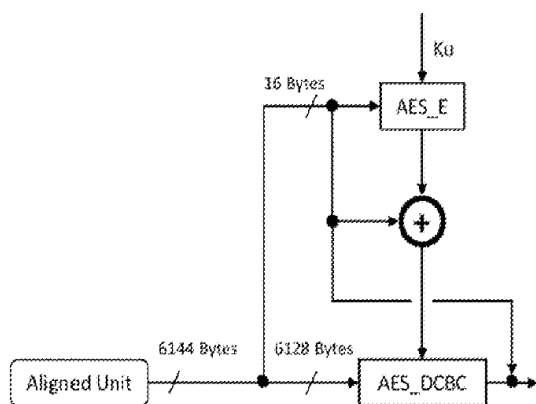
MPEG-2 TS content can be easily converted to MP4 without performing decryption and re-encryption processing.

FIG. 1



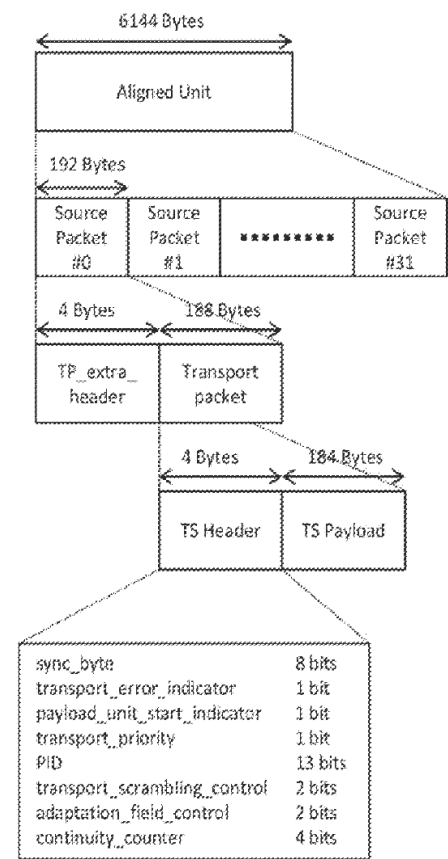
- FIG. 1 schematically illustrates the structure used when storing content on an optical disc in the conventional MPEG-2 TS format. A stream file is stored as content on the optical disc. Although only one stream file is shown in the figure, there may be a plurality of stream files. In this example, the stream file is recorded under the file name XXXXX.M2TS. A number is assigned to XXXXX, enabling individual management when a plurality of pieces of content are stored.
- Each stream file is divided into units called aligned units, each comprising 6,144 bytes. An aligned unit serves as the unit of encryption. Note that the content stored in a stream file may not necessarily be a multiple of 6,144 bytes; in such cases, it is preferable to make the content a multiple of 6,144 bytes by, for example, appending null data at the end.

FIG. 2



- FIG. 2 describes the decryption method for each aligned unit. Content on an optical disc is encrypted using data called a unit key (denoted as Ku in the figure). Each 6,144-byte block of data is separated into the first 16 bytes and the remaining 6,128 bytes. The first 16 bytes are processed using AES_E, which is the decryption process of the AES encryption scheme, with the aforementioned unit key. The data thus obtained is XORed with the first 16 bytes of data, and the result is used as a key to decrypt the remaining 6,128 bytes of data in AES-CBC mode. Plaintext data is thereby obtained, and by appending the first 16 bytes of data thereto, 6,144 bytes of plaintext are obtained.

FIG. 3



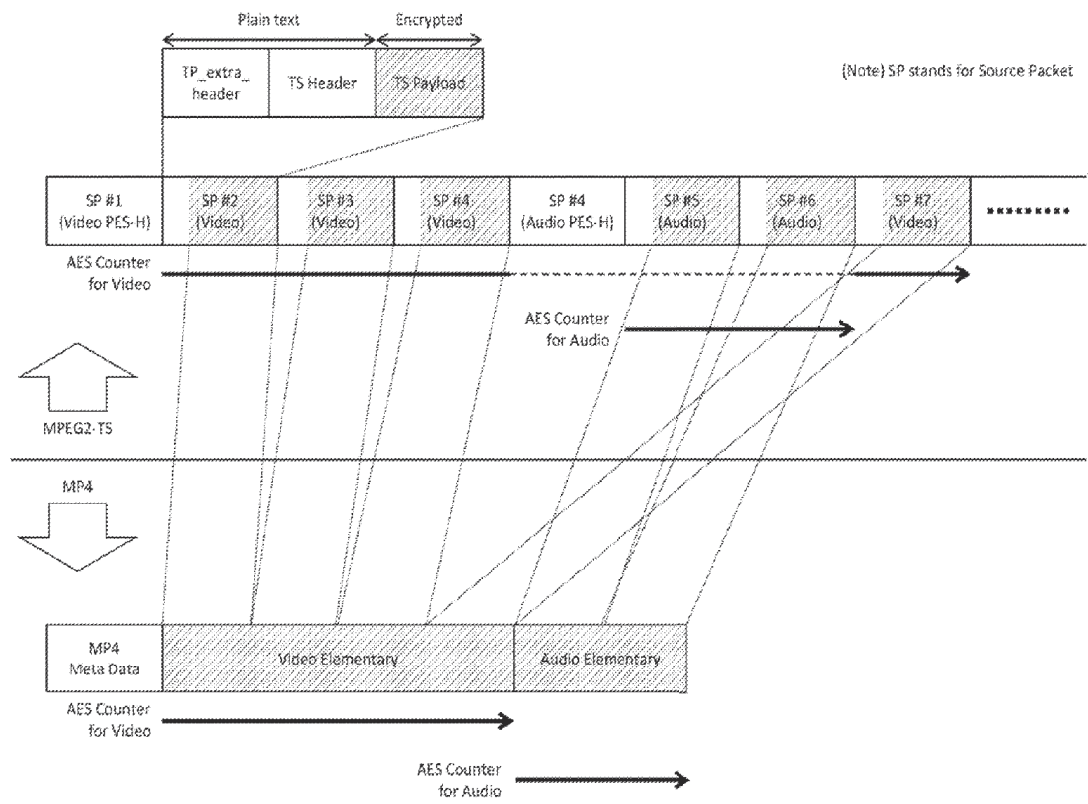
• FIG. 3 describes the internal structure of an aligned unit in the plaintext state. An aligned unit comprises 32 source packets, each comprising 192 bytes. Each source packet comprises a 4-byte header, TP_extra_header, and a 188-byte transport packet. The 188-byte transport packet further comprises a 4-byte TS header and a 184-byte TS payload. The TS header contains information indicating the nature of the TS payload, and comprises sync_byte (8 bits), transport_error_indicator (1 bit), payload_unit_start_indicator (1 bit), transport_priority (1 bit), PID (13 bits), transport_scrambling_control (2 bits), adaptation_field_control (2 bits), and continuity_counter (4 bits). The PID indicates the type of elementary stream stored in the TS payload, and the value thereof enables differentiation between video, audio, and other stream types. The PID also enables differentiation when a plurality of types of audio are recorded.

FIG. 4

TS Payload #1	TS Payload #2	*****	TS Payload #n
PES_Header	Elementary Stream		

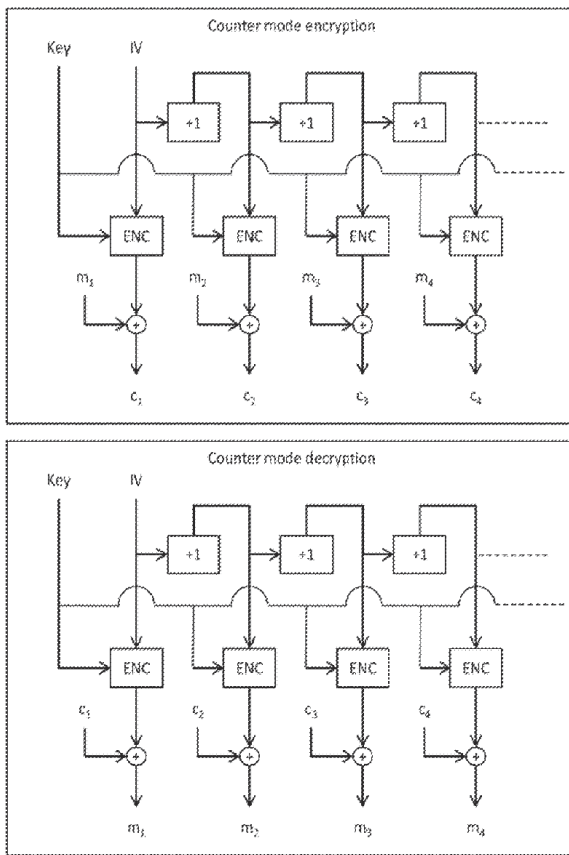
- FIG. 4 describes the method for generating an actual elementary stream from TS payloads. Concatenating a plurality of consecutive TS payloads having the same PID yields a PES header and an elementary stream. In this configuration, the first TS payload is arranged to constitute the PES header.

FIG. 5



- FIG. 5 describes the encryption method for MPEG-2 TS streams and the conversion method to MP4 in the present invention. As previously described, an MPEG-2 TS stream comprises a plurality of source packets. In the figure, a source packet is abbreviated as SP. Only the TS payload portion within each source packet is encrypted. AES-CTR mode is used for the encryption process. The processing in AES-CTR mode is described below. In AES-CTR mode, encryption and decryption are performed using a counter value. In the figure, arrows illustrate how the counter increments. In this configuration, the counter for video and the counter for audio are managed separately, wherein the video counter increments only for video portions and the audio counter increments only for audio portions. With this configuration, it is possible to readily utilize an MP4 file by extracting only the TS payload portions.

FIG. 6



- FIG. 6 describes the encryption and decryption of messages in AES-CTR mode. Encryption uses a key and an initial value, IV (Initial Vector). The ciphertext corresponding to the first 16 bytes is obtained by XORing the first 16 bytes of the message with the value obtained by encrypting the IV using the key. For the next 16-byte block, the IV is incremented by 1 and the same process is performed. By performing such processing continuously, ciphertext can be generated for messages longer than 16 bytes. When the length of the message is not a multiple of 16 bytes, the ciphertext for the trailing block is obtained by performing XOR on a bit-by-bit basis.
- The lower half of FIG. 6 describes the decryption process. The decryption process is identical to the encryption process. It should be noted in particular that ENC processing is performed even though the operation is decryption.

- Because the method of multiplexing access unit data differs in part between MPEG-2 transport streams (TS) and MP4, it is necessary to separate portions of an access unit and store them separately when storing TS content in MP4. The basic concept is as follows: an access unit in TS comprises both initialization information essential for decoding a video picture or an audio frame, and encoded data for each picture or frame; whereas an access unit in MP4 (referred to as a sample in MP4) comprises only the encoded data of a picture or frame, and the initialization information required for decoding is stored separately as MP4 header information.
- The following describes auxiliary information for reducing the processing load associated with conversion when converting encoded data multiplexed by TS to MP4, as well as a method for converting multiplexing formats using the auxiliary information. In particular, when encoded data is encrypted, the processing load for decrypting and re-encrypting the encoded data is substantial; therefore, it is preferable to enable conversion by data copying alone, without decrypting the encoded data. Note that the TS is not limited to a TS defined by the MPEG-2 system, and may be a TS in which a predetermined number of bytes of header information is appended to TS packets, as used in Blu-ray Disc and video distribution applications. The MP4 may be an MP4 using movie fragments or an MP4 not using movie fragments. Furthermore, the format may be CFF (Common File Format) or MPEG-DASH (Dynamic Adaptive Streaming over HTTP) of DECE (Digital Entertainment Content Ecosystem), which are extensions based on MP4.
- FIG. 7(a) illustrates an example of storing an MPEG-4 AAC access unit, as stored in a transport stream, into MP4. An MPEG-4 AAC access unit in a transport stream comprises three types of data: a LATM header, PayloadLengthInfo(), and PayloadMux(). The LATM header contains initialization information required for decoding AAC data, such as the number of channels and the sampling frequency. More specifically, the initialization information is stored in AudioSpecificConfig() within the LATM header. PayloadLengthInfo() stores the size of PayloadMux(). PayloadMux() stores the AAC encoded data. When storing this access unit in MP4, AudioSpecificConfig() within the LATM header is stored in the sample entry of stsd within moov, and PayloadLengthInfo() and PayloadMux() are stored in mdat as sample data. Note that the sample data in mdat is referenced from moov, or from moof when movie fragments are used.
- In MPEG-2 AAC, an ADTS header is used in place of a LATM header, and an access unit comprises an ADTS header and AAC data (referred to as raw_data_block()). In this case as well, the ADTS header is separated from the access unit, and at least adts_fixed_header() is stored in the sample entry. The AAC data is then stored in mdat as sample data.

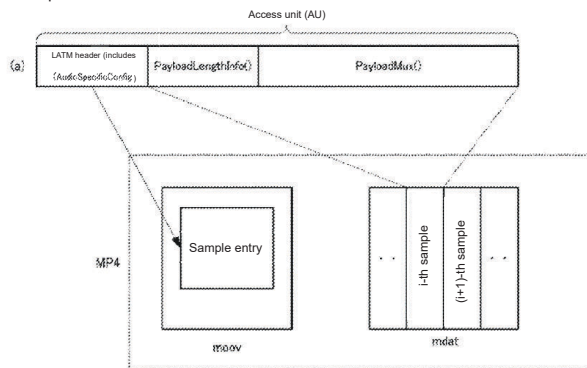


FIG. 7

- FIG. 8(a) illustrates an example of storing an MPEG-4 AVC (Advanced Video Coding) access unit, as stored in a TS, into MP4. As in the case of MPEG-4 AAC, in a TS, initialization information required for decoding, such as a Sequence Parameter Set (SPS) and a Picture Parameter Set (PPS), is stored as part of the access unit; however, in MP4, such initialization information is stored separately as MP4 header information. The example in FIG. 8(a) illustrates the configuration of an IDR (Instantaneous Decoder Refresh) picture, wherein NAL (Network Abstraction Layer) units of SPS and PPS are separated from the access unit and stored as a sample entry of stsd within moov. The remaining data is stored in mdat as sample data.
- Note that in MP4, it is also possible to select a mode that allows initialization information such as SPS and PPS to be included in the sample data of MPEG-4 AVC. The mode is indicated by an identifier in the sample entry. When the identifier is 'avc1' or 'avc2', inclusion of initialization information in the sample data is prohibited; however, when the identifier is 'avc3' or 'avc4', initialization information may be included in the sample data. Therefore, when converting from TS to MP4 and setting the identifier for MPEG-4 AVC data in the converted MP4 to 'avc1' or 'avc2', it is necessary to delete the NAL units of SPS, PPS, and filler data used for stuffing from the access unit in the TS; however, when the identifier is set to 'avc3' or 'avc4', deletion of SPS and PPS is not required. Therefore, whether to delete SPS and PPS may be switched according to the identifier value set in the MP4.
- HEVC (High Efficiency Video Coding), which is a next-generation video coding scheme, has a NAL unit structure similar to that of MPEG-4 AVC and includes initialization information such as SPS and PPS; however, when storing HEVC in MP4, initialization information may be included in the sample data. Therefore, whether to delete initialization information from an access unit during conversion to MP4 may be determined and the operation switched according to the type of coding scheme.

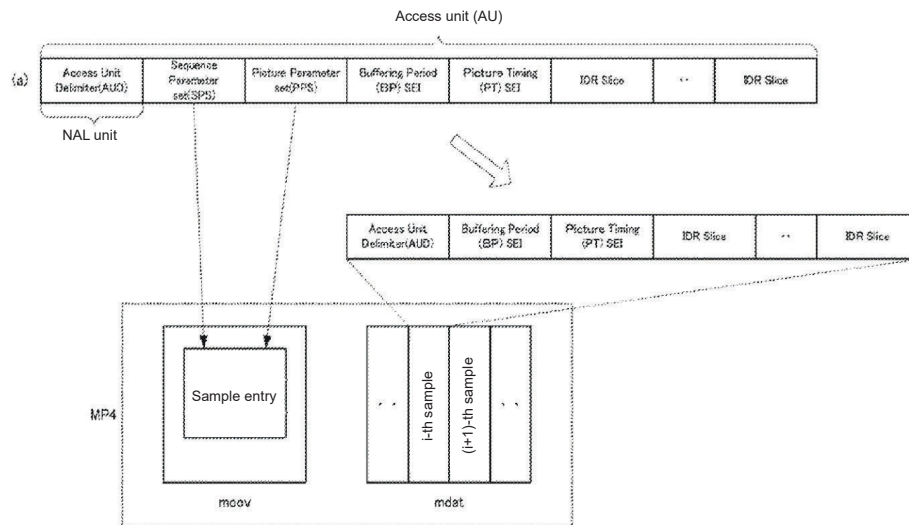


FIG. 8

- When storing MPEG-4 AAC encoded data in MP4, the LATM header is separated, and only PayloadLengthInfo() and PayloadMux() (hereinafter, PayloadLengthInfo() and PayloadMux()) are collectively referred to as the LATM payload) are stored as sample data. Therefore, when storing an MPEG-4 AAC access unit in TS packets, the LATM header can be readily separated by storing the LATM header and the LATM payload in separate TS packets. FIG. 9(a) illustrates an example of storing the LATM header and the LATM payload in TS packets. Stuffing is applied as necessary so that the LATM header and the LATM payload do not coexist within the payload of the same TS packet. For example, the LATM header of access unit 1 is stored in the payload of the first TS packet; however, because the size of the LATM header does not fill the TS packet payload size, the remaining area of the TS payload is stuffed. Note that although PES packets are not shown in this example, in practice, access unit data is stored in the payload of a PES packet, and the PES packet data is stored in the payload of a TS packet.
- Next, the method for identifying a TS packet storing the LATM header and a TS packet storing the LATM payload is described. When storing one access unit as a single PES packet, the payload_unit_start_indicator of the TS header is set to 1 in the TS packet containing the first data of the PES packet. By ensuring that the payload of a TS packet in which payload_unit_start_indicator is set to 1 contains the LATM header, it is possible to determine whether a LATM header is contained in a TS packet based on the value of payload_unit_start_indicator. When storing a plurality of access units in a single PES packet, an AU_info table comprising the number of access units contained in the payload and the sizes of the LATM header and LATM payload for each access unit may be placed at the beginning of the PES packet payload. FIG. 9(b) illustrates a syntax example of the AU_info table. AU_info_identification_code is a bit string unique to the AU_info table, and whether an AU_info table is present can be determined by searching for this code. Alternatively, a data structure combining a box data size and a box type, as in the MP4 box structure, may be used. However, when the presence of the AU_info table is signaled in a TS descriptor or in auxiliary data prepared separately from the TS for MP4 conversion, this code may be omitted. The AU_info table may also be used when storing a single access unit in a single PES packet.
- The method of identifying data to be separated during conversion to MP4 by indicating the sizes of components within an access unit and data offsets is also applicable when separating SPS and PPS NAL units when storing MPEG-4 AVC encoded data. FIG. 9(c) illustrates a syntax example of an AU_info table for indicating, for each component within an access unit, whether the component needs to be excluded from MP4 sample data. Num_of_data_unit indicates the number of data units, and size_of_data_unit indicates the size of a data unit. conversion_mode is a field indicating how a data unit is to be handled during MP4 conversion; a value of 0 indicates that the data unit is to be copied to MP4 sample data, and a value of 1 indicates that the data unit is to be excluded from the sample data. When the value is 1, the handling after exclusion, such as storing in a sample entry after exclusion from the sample data, may also be indicated. Information for each data unit is stored in decoding order. For example, when storing a single MPEG-4 AVC access unit as a single PES packet, a data unit corresponds to a NAL unit, and the number of NAL units constituting the access unit is indicated in num_of_data_unit. conversion_mode is then set to 1 for the SPS and PPS NAL units. The approach is also applicable to MPEG-4 AAC by treating the LATM header and the LATM payload each as a data unit and setting conversion_mode to 1 for the data unit corresponding to the LATM header. When a plurality of access units are stored in a single PES packet, num_of_data_unit indicates the total number of data units contained in all access units.
- The AU_info table may be stored in the adaptation field of the TS packet header at which a PES packet begins, or may be stored as part of encoded data such as a NAL unit in MPEG-4 AVC or HEVC, or an SEI message. When stored as part of encoded data, it may be stored per access unit or per random access unit. When stored in TS packets or PES packets, the AU_info table may be stored per PES packet, or alternatively only in PES packets containing the access unit that is the first in a random access unit at the time of decoding. When stored per random access unit, the AU_info table stores information pertaining to all access units constituting the random access unit.

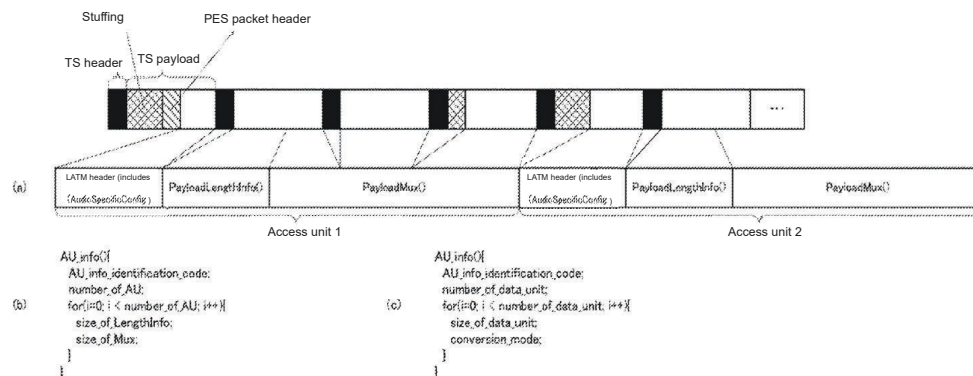


FIG. 9

- It was noted that TS and MP4 differ in whether initialization information required for decoding is included within an access unit when storing audio and video encoded data. Furthermore, because the storage format of NAL units in MPEG-4 AVC and HEVC differs between TS and MP4, conversion of the storage format is required when converting from TS to MP4. FIG. 10(a) through FIG. 10(c) illustrate the storage format of NAL units in TS and MP4. FIG. 10(a) illustrates the structure of a NAL unit. A NAL unit comprises a header and a payload, wherein the header stores type information indicating the type of data stored in the payload. FIG. 10(b) illustrates an example of the storage format of NAL units in TS. In TS, a unique bit string called a start code is prepended to identify NAL unit boundaries (hereinafter referred to as start code format). In a decoding device or the like, a desired NAL unit can be separated by searching for the start code and the type information of the NAL unit data stored in the header. FIG. 10(c) illustrates an example of the storage format of NAL units in MP4, wherein a field indicating the data size of the NAL unit is prepended to identify NAL unit boundaries (hereinafter referred to as NAL size format). The field length of the field indicating the data size is stored in the AVCDecoderConfigurationRecord, which stores initialization information and the like for decoding in the sample entry. In a decoding device or the like, NAL units can be separated based on the size of the NAL unit. As described above, TS and MP4 also differ in whether the identification information indicating NAL unit boundaries is in start code format or NAL size format. Therefore, when converting from TS to MP4, it is necessary to convert the identification information indicating NAL unit boundaries.
- Because the storage format of an access unit is defined for each coding scheme, the operation may be switched by referencing the audio or video coding scheme during conversion to MP4.

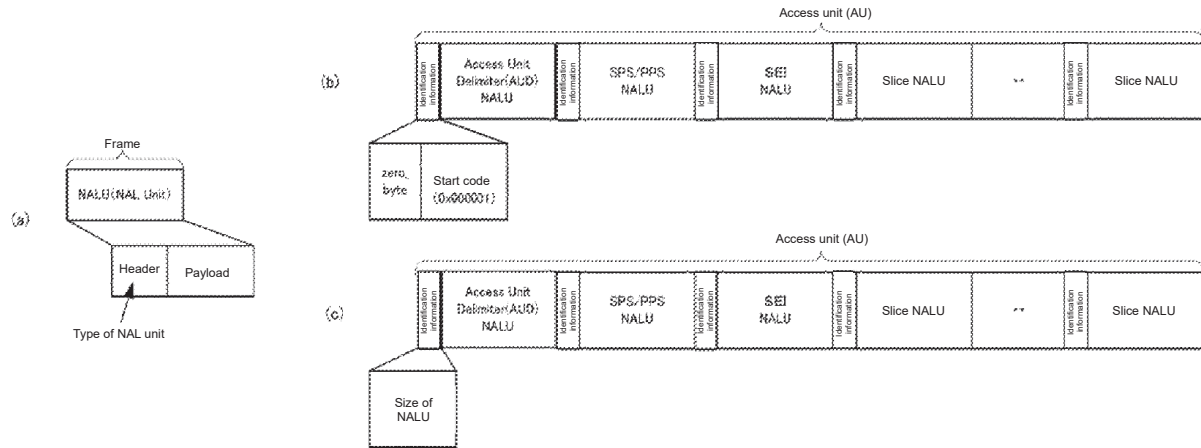


FIG. 10

- When handling encoded data of a coding scheme that uses NAL size format upon conversion to MP4, the size of NAL units is required; therefore, it is preferable that the size of each NAL unit constituting an access unit be obtainable in advance. This reduces the processing load involved in determining NAL unit sizes by searching for start codes in a start code format access unit and detecting NAL unit boundaries. FIG. 11(a) illustrates an example in which the sizes of the NAL units constituting an access unit multiplexed in a TS are stored at the beginning of the access unit. In this example, the sizes are stored using a newly defined size information NAL unit. Among the NAL unit types, values available for private use or user data use exist, and one such type is selected for use as the size information NAL unit. Because size information does not need to be encrypted, this NAL unit is stored in plaintext. FIG. 11(b) illustrates a syntax example of size information in the size information NAL unit. number_of_nalu indicates the number of NAL units constituting the access unit, and nal_size indicates the size of each NAL unit. Because the size information NAL unit is not stored in MP4, the size of the size information NAL unit itself need not be indicated. Note that in this example, the size information NAL unit is placed before the NAL unit for signaling the beginning of an access unit, called the Access Unit Delimiter (AUD); however, it may also be placed immediately after the AUD. When placed immediately after the AUD, the size information NAL unit indicates the sizes of the NAL units following the AUD, and the size of the AUD itself is not indicated; however, because the size of the AUD is fixed, it may be stored in advance. The size information NAL unit may also be placed at the beginning of the PES packet payload, as with the AU_info table. Furthermore, in TS, a variable-length code such as a zero byte may be included before a NAL unit in addition to the start code. Therefore, as illustrated in FIG. 11(c), the size of the identification information of a NAL unit comprising the start code may be stored separately. If the size of the identification information is fixed, it may be stored separately as a TS descriptor or as auxiliary data for MP4 conversion. Furthermore, the field length of the field indicating the NAL unit size in the NAL size format after MP4 conversion may also be indicated separately.
- The identification information may also be treated as a data unit, and the content of the Nal_size_info may be indicated by the AU_info table. In this case, setting conversion_mode to multiple deletes the data unit. In addition to the two operations of deletion and retention as-is, a mode for converting the data structure of the data unit may also be added. Furthermore, identification information for identifying the type of data unit may be added to the AU_info table. For example, the identification information may be used to identify the NAL unit type, such as SPS or PPS of MPEG-4 AVC or HEVC, or a slice NAL unit, or to identify the LATM header or LATM payload of MPEG-4 AAC. Furthermore, a separate field indicating whether a data unit is encrypted may also be provided.
- Data units with different conversion_mode values may be stored in different TS packets. Additionally, a data unit with conversion_mode set to 2, which is to be stored as header information such as a sample entry, may be stored in plaintext.
- Regarding encryption, only the NAL units of slice data may be encrypted, with all other portions stored in plaintext. Because encryption is performed on a per-TS-packet basis, plaintext and encrypted portions cannot coexist within the payload of a TS packet; this is because data such as AUD has a small data size, and storing it as an independent packet would increase stuffing and reduce multiplexing efficiency. Furthermore, when the boundary of the NAL unit data of an encrypted slice is not aligned to the end of the TS packet payload, stuffing is required. When stuffing is required, either the adaptation field of the TS packet header may be used, or a filler data NAL unit or an SEI for filler data may be inserted into the encoded data. When using the adaptation field of the TS packet header, the adaptation field must be stored in plaintext; however, switching between encryption and non-encryption for a variable-length region imposes a high processing load. Therefore, when stuffing, it is preferable to use the stuffing data structure within the encoded data to align the NAL unit data boundary to the end of the TS packet payload.
- Size information may be stored in the adaptation field of a TS packet or by inserting a user data unregistered SEI into the access unit. When converting to MP4, conversion from start code format to NAL size format can be performed based on the NAL unit size information stored by one or more of these methods.
- Information indicating whether size information is stored may also be stored using a descriptor in the TS.

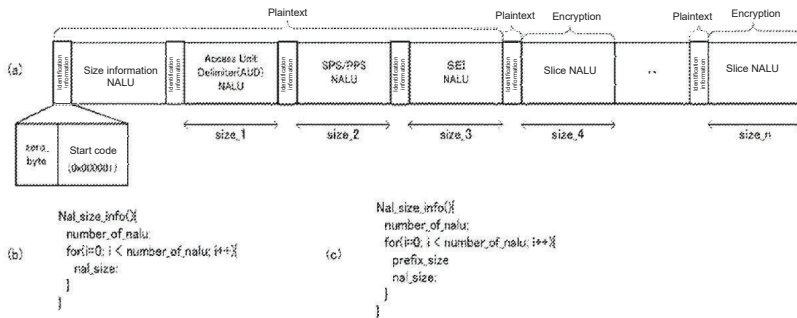


FIG. 11

- FIG. 12(a) is a flowchart illustrating an example of the operation when the data conversion method of the present invention is realized by referencing the AU_info table. In step 101, the AU_info table placed at the beginning of the PES packet payload or elsewhere is searched, and in step 102, a determination is made as to whether an AU_info table is present. If an AU_info table is present, the process proceeds to step 103. If not present, the access unit separated from the PES packet is treated as a data unit, and the process proceeds to step 105. When a single access unit is stored in a single PES packet, the PES packet payload may be treated as one access unit's worth of data and separated; however, when a plurality of access units are stored in a single PES packet, or when an access unit is fragmented and stored across PES packets, access unit boundaries within the encoded data are searched to separate the access units. In step 103, the size and conversion mode of the data unit are obtained, and in steps 104 through 108, conversion processing is performed according to the conversion mode. If the conversion mode is 0, the data unit is copied as sample data in step 105. If the conversion mode is 1, the data structure of the data unit is converted and stored as sample data in step 107. For example, the identification information of NAL unit boundaries is converted from start code format to NAL size format. If the conversion mode is 2, at least a portion of the data unit data is stored in a sample entry in step 108. For example, SPS and PPS NAL units in MPEG-4 AVC are stored in a sample entry, or AudioSpecificConfig() is separated from the LATM header of MPEG-4 AAC and stored in a sample entry. The portion of the data unit data to be stored in the sample entry is defined in advance by the coding scheme; however, auxiliary information for identifying the portion to be stored in the sample entry may also be separately indicated in the AU_info table.
- FIG. 12(b) is a block diagram illustrating the configuration of a data conversion apparatus that realizes the operation of the flowchart shown in FIG. 12(a).

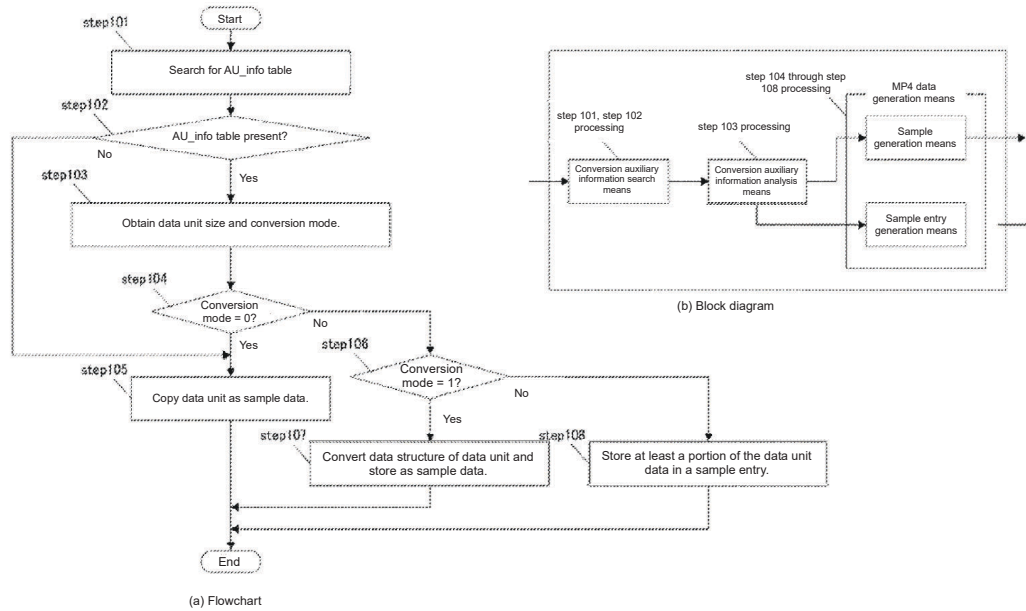
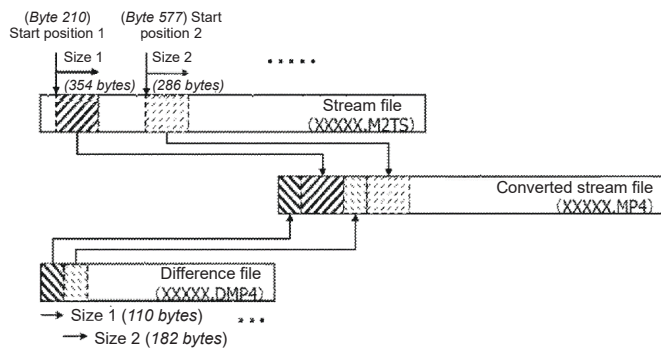


FIG. 12



Copy manifest file (XXXXXX.CMNF)

Input File A: XXXXX.DMP4
 Input File B: XXXXX.M2TS
 Output File: XXXXX.MP4
 Output File Size: 1234567890 bytes
 ATTRIBUTE: HEVC 4K, AAC 5.1ch (English)
 MP4 DECODER BUFFER SIZE: 234567 bytes
 COPY MANIFEST:
 110, 210-354, 182, 577-286, ...

FIG. 13

When converting a stream file (XXXXX, M2FS) to another stream file (XXXXX.MP4), it is desirable that the stream file can be easily converted to a different format without decoding the audio or video elementary streams (such as HE-AAC or MPEG-4 AVC), and, if encryption has been applied, without decrypting that encryption either. However, this has required numerous complex processes, and the only method available has been to first demultiplex the stream, parse the elementary streams, select only the necessary elementary streams, and then multiplex them to obtain another system stream. One embodiment disclosed herein is described with reference to FIG. 13. In this embodiment, a stream file (XXXXX.M2TS), a copy manifest file (XXXXX.CMNF) describing conversion rules specifying how the M2TS file is to be processed and converted to an MP4 file, and a difference file (XXXXX.DMP4) storing the difference data required for conversion to the MP4 file are recorded on a Blu-ray Disc. When converting the stream file (XXXXX.M2TS), the converted stream file (XXXXX.MP4) is generated by alternately combining the stream file (XXXXX.M2TS) and the difference file (XXXXX.DMP4) in accordance with the description in the corresponding copy manifest file (XXXXX.CMNF). The copy manifest file (XXXXX.CMNF) contains the following information. The names of the two input files are described as Input File A and Input File B, and the actual conversion processing begins with copying the beginning portion of Input File A. The name of the output file is specified by Output File. The data size of the output file is described with byte precision as Output File Size, which can be checked prior to conversion processing to determine whether sufficient free space is available on the destination recording medium. If the destination recording medium or device does not have sufficient free space, the output may be omitted, or only as much data as can be output may be output. Alternatively, only as much data as can be output may first be output, and after the user has viewed that portion, the data may be deleted and the remaining portion of the data output. In this case, the data size already output is stored in the conversion processing device or the destination recording medium or device. Furthermore, the data size of the unoutput portion may be stored at the output destination so that, after deleting data or performing similar operations, a determination can be made as to whether sufficient free space is available to output the remaining unoutput portion.

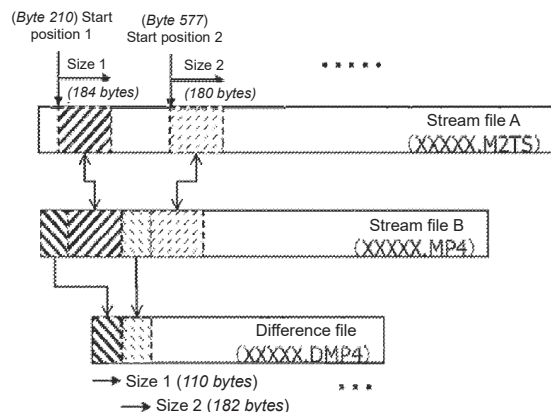
Which elementary streams are converted and what type of file is generated are described in ATTRIBUTE. In this example, it is described that the converted MP4 file contains video compressed in HEVC and 5.1-channel English audio encoded in AAC. This enables confirmation, prior to conversion processing, of what type of file will be obtained when conversion is performed in accordance with the copy manifest file. The data structure of the MP4 file and similar information may also be indicated, and the MP4 brand stored in ftyp may be described within the MP4 file. The decoder resources (memory and data transfer rate) required to playback the converted stream file may also be described. In this example, the minimum buffer size required to playback the converted stream file (XXXXX.MP4) is described as MP4_DECODER_BUFFER_SIZE. This is a quantity that depends on the multiplexing rules used in the converted MP4 for multiplexing video, audio, and other data. Finally, the copy start positions and copy sizes for generating the output file by alternately copying portions from Input File A, Input File B, and Input File A are described in order in COPY MANIFEST. Because the difference file (XXXXX.DMP4) is copied sequentially from the beginning of the file in specified size increments, there is no need to specify a copy start position, and a single size value describes one conversion operation (copy operation). Because the stream file (XXXXX.M2TS) contains data that is not needed in the converted stream file (XXXXX.MP4), the stream file is described in the pattern of copy start position (byte offset from the beginning of the file) and copy size (byte size) in order to specify only particular regions. By alternately copying specified regions from two input files in accordance with the copy manifest file, the same converted stream file (XXXXX.MP4) can be generated regardless of which device performs the conversion. This facilitates playback of the converted stream file on any device without errors.

Note that while the difference file (XXXXX.DMP4) and the copy manifest file (XXXXX.CMNF) are described herein as being recorded on a Blu-ray Disc, either or both of these files may alternatively be obtained via the Internet. In this case, it becomes possible to present users with various options, such as converting to the latest file format or to an MP4 file containing different audio and video content, without requiring any particular modification to the conversion device.

The foregoing describes operation when processing the stream file in its encrypted state; however, it is also possible to decrypt the M2TS file and then perform conversion to MP4, followed by re-encrypting the generated MP4. In this case, XXXXX.M2TS may be in plaintext. Note that because the difference file comprises header information, encryption is not required. However, when XXXXX.M2TS or XXXXX.MP4 is in plaintext, operations such as expanding the entire file into memory or temporarily saving it to a hard disk may not be permitted from a security standpoint. Therefore, plaintext data of XXXXX.M2TS may be deleted sequentially starting from regions where conversion to MP4 has been completed, and XXXXX.MP4 may be encrypted each time a movie fragment or a predetermined number of MP4 samples are generated. If an encryption scheme in which the data size does not change before and after encryption is used, the region of data to be copied does not change regardless of whether encryption is applied. Furthermore, information indicating whether XXXXX.M2TS is encrypted, or whether encoded data multiplexed in the M2TS file is to be processed while remaining encrypted or is to be converted to plaintext before being converted to MP4 and then re-encrypted, may be indicated in the copy manifest file.

In addition, while the BD-ROM standard does not support AAC or HE-AAC encoded audio in MPEG-2 or MPEG-4, AAC and HE-AAC are widely used in mobile devices such as smartphones and tablets that playback converted files. Therefore, in order to enable the audio coding scheme in the converted MP4 file to be AAC or similar, an AAC encoded stream corresponding to the audio data stored in the M2TS prior to conversion may be stored in the difference file. In this case, the converted MP4 file can be generated from the difference file and the encoded video stream data multiplexed in the M2TS. Alternatively, an AAC encoded stream may be prepared as an independent file, and the manifest file may specify that the video encoded data is to be referenced and copied from the M2TS, while the audio encoded data is to be referenced and copied from the AAC encoded stream.

FIG. 14



Copy manifest file (XXXXX.CMNF)

```

Input File A: XXXXX.DMP4
Input File B: XXXXX.M2TS
Output File: XXXXX.MP4
Output File Size: 1234567890 bytes
ATTRIBUTE: HEVC 4K, AAC 5.1ch (English)
MP4 DECODER BUFFER SIZE: 234567 bytes
MIN COPY SIZE: 8 bytes
COPY MANIFEST:
110, 210-184, 182, 577-180, ...

```

The difference file (XXXXX.DMP4) and the copy manifest file (XXXXX.CMNF) can be generated as follows. At the authoring stage, both stream file A (XXXXX.M2TS) and stream file B (XXXXX.MP4), which is a format-converted version of stream file A, are generated. A search is performed to identify a pair of sub-intervals, one from stream file A and one from stream file B, such that the data of the sub-interval of stream file A matches the data of the sub-interval of stream file B and the data size of the matching sub-interval is maximized. Once the matching intervals have been identified, all sub-intervals of the stream files excluding the matching intervals are concatenated in order of occurrence as the difference file, and the correlation result of the files is recorded in the copy manifest file in COPY MANIFEST format.

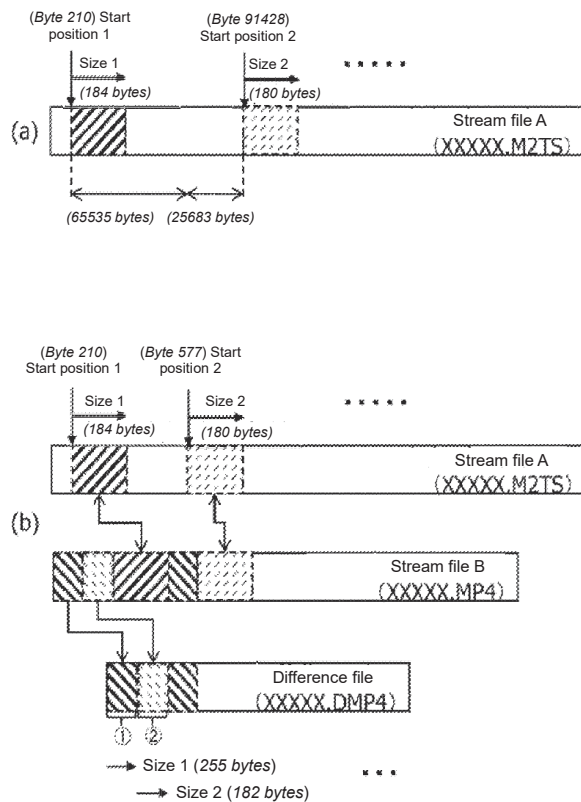
Note that the matching interval search may be performed so that it proceeds forward from the beginning of stream file A and stream file B without backtracking. This enables sequential and continuous processing during conversion (copy processing), thereby achieving higher speed and reduced memory usage.

Note that when multiplexing video in TS, video picture data for a given PTS may be multiplexed earlier in time relative to audio frames with the same PTS, in order to prevent underflow of data for pictures with large coded sizes such as I-pictures. On the other hand, in MP4, when generating movie fragments, it is generally the case that multiplexing is performed such that the PTS of the first picture of a movie fragment is the same as, or close to, the PTS of the corresponding audio. As described above, when the multiplexing units for AV or text differ between stream file A and stream file B, conversion cannot be performed sequentially, and conversion may require moving the read or write pointer backward and forward. Whether conversion processing can be performed continuously, or, if not continuously, the maximum size requiring backtracking, may be registered in the manifest file.

Note that if matching intervals are identified at too granular a data unit level, the data size of the copy manifest file will increase and conversion processing will become complex; therefore, a specific threshold value may be set such that only matching intervals of, for example, 8 bytes or more are registered in the copy manifest file, while matching intervals below that threshold are treated as non-matching and stored in the difference file. This threshold may also be described in the copy manifest file as "MIN_COPY_SIZE: 8 bytes" or similar.

The copy manifest file specifies the copy source and destination for data; however, a conversion manifest file may be used instead of a difference file, wherein the conversion manifest file indicates the multiplexing units in the output MP4 file. For example, assume that audio, video, and text are each multiplexed as separate movie fragments. In this case, the DTS and PTS of the audio frames and video pictures that are first and last in decoding order within each movie fragment, or the byte offset values from the beginning of the input TS file, may be registered together with the media identifier. The registration order of movie fragments shall match the order of appearance of movie fragments in the MP4.

FIG. 15



In the copy manifest file, the address of the copy start position in the stream file may be expressed not as an absolute value from the beginning of the file, but as a difference value from the start address of the immediately preceding entry. For example, the second entry corresponding to the stream file in FIG. 15 may be described as (367, 180) rather than (577, 180).

The copy start address and copy size may be described in the following three ways, for example.

Mode 1: Data is copied alternately from the stream file and the difference file.

Description example: (address, size)

Example bit lengths for each field: (int32, int8).

Mode 2: When the copy size is 0, the copy is skipped. Because data can be copied continuously from the same file, the data length of the address field can be made shorter compared to Mode 1.

Description example: (address, size)

Example bit lengths for each field: (int16, int8).

Mode 3: In Mode 2, rather than explicitly indicating the copy size, data is copied up to the last data of the payload in the TS packet indicated by the address, and the copy size field is omitted. Instead of specifying an address, the difference value of the TS packet index number in the stream file may be used.

Description example: (packet number, copy mode)

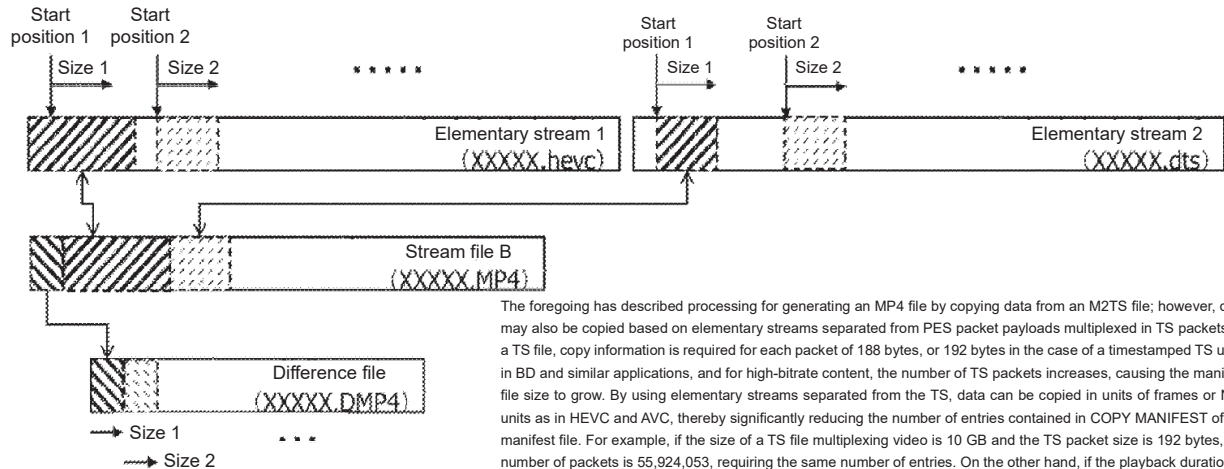
Example bit lengths for each field: (int7, int1).

The copy mode indicates whether the copy is to be skipped.

A specific example of address specification using Mode 2 is given below. In FIG. 16(a), start position 1 and start position 2 are at byte 210 and byte 91,428, respectively. If the field length of the address difference value is 16 bits, the maximum field value is 65,535; therefore, the jump from start position 1 to start position 2 cannot be expressed in a single entry, and two entries, (65535, 0) and (25683, 180), are used. This enables jumping to start position 2 and then obtaining 180 bytes of data. FIG. 16(b) illustrates an example of reading a continuous region that exceeds the upper limit of the copy size. In this case, by describing the entries as (255, (0, 0), and (182), regions 1 and 2 of the difference file can be copied continuously.

Note that the start address and copy size may be described in units of 4 bytes rather than 1 byte. Furthermore, by separately providing identification information in each entry indicating whether data is to be copied from the difference file or the stream file, entries for one file may be described consecutively rather than alternating entries for the two files.

FIG. 16



The foregoing has described processing for generating an MP4 file by copying data from an M2TS file; however, data may also be copied based on elementary streams separated from PES packet payloads multiplexed in TS packets. In a TS file, copy information is required for each packet of 188 bytes, or 192 bytes in the case of a timestamped TS used in BD and similar applications, and for high-bitrate content, the number of TS packets increases, causing the manifest file size to grow. By using elementary streams separated from the TS, data can be copied in units of frames or NAL units as in HEVC and AVC, thereby significantly reducing the number of entries contained in COPY MANIFEST of the manifest file. For example, if the size of a TS file multiplexing video is 10 GB and the TS packet size is 192 bytes, the number of packets is 55,924,053, requiring the same number of entries. On the other hand, if the playback duration of the video is 2 hours and the frame rate is 30 Hz, the total number of frames is 216,000, representing a significant reduction in the number of entries compared to generating one entry per packet. Furthermore, even in cases where the M2TS is doubly encrypted, such as with AACS and BD+, and data is interleaved and rearranged by BD+, the order of data constituting the encoded stream can be uniquely determined after decryption and data separation, enabling the copy operation by this method.

When copying from elementary streams, because a plurality of elementary streams exist, identification information for each is required. For COPY MANIFEST, the following description examples are possible corresponding to Mode 1 and Mode 2 in FIG. 16, wherein the start address represents a difference value from the immediately preceding entry.

Mode 1: Comprises (file ID, address, size). Example bit lengths for each field: (int4, int22 in 1-byte units, int22).

The file ID is identification information for the file from which data is to be copied; for example, 0 is assigned to the difference file and values of 1 or greater are assigned to elementary stream files.

For HEVC and AVC encoded data at 4K resolution, assuming a Minimum Compression Ratio of 4, the maximum size of one frame is approximately 4 MB.

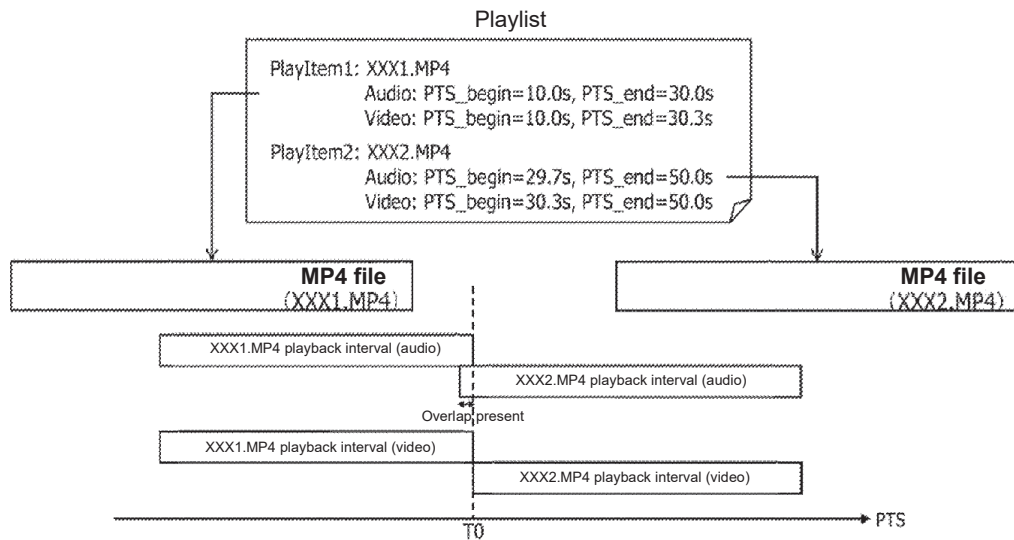
When copying data from an encoded stream, the maximum difference value of the start address may be set to the maximum size of one frame; 4 MB can be expressed in 22 bits.

The copy size field is also set to 22 bits to express the maximum size of one frame.

Mode 2: Comprises (file ID, address, size). Example bit lengths for each field: (int4, int12 in 1-byte units, int16).

Note that in AVC and HEVC, because it is necessary to convert the NAL unit header from start code format to NAL size format and to copy data in units of NAL unit payloads, a start address field is provided; however, when the elementary stream within the TS can be copied as-is, the start address field may be omitted. Alternatively, a single entry may represent an entire NAL unit, and the NAL unit header may be converted to NAL size format after copying. In this case as well, because data can be read continuously, a start address is not required.

FIG. 17



In the BD-ROM standard, a plurality of M2TS files can be referenced from a playlist for continuous playback, and stream constraints at file boundaries are also defined. For example, when a plurality of files or playback intervals are seamlessly connected, the playback intervals of two audio streams to be connected may overlap.

In MP4 as well, it is possible to specify a plurality of MP4 files for continuous playback using a playlist, and similar constraints are expected to apply. FIG. 18 illustrates an example of audio and video playback intervals in two consecutively played MP4 files, wherein the audio playback intervals overlap. However, DTS and PTS in MP4 are expressed as relative times with reference to the DTS of the first sample in the file (=0), and absolute times cannot be expressed. Therefore, when two MP4 files with overlapping playback intervals (XXX1.MP4 and XXX2.MP4) are played back consecutively, the first sample of XXX2.MP4 is played back immediately after the last sample of XXX1.MP4, resulting in the overlapping portion being played back twice. For this reason, information indicating whether the playback intervals of XXX1.MP4 and XXX2.MP4 overlap, or information indicating the overlapping playback intervals, may be stored in the playlist or in the MP4 files. In this example, the PTS of the first audio and video samples and the playback end time of the last sample in the MP4 file referenced by each play item in the playlist are described. Alternatively, the absolute DTS or PTS of the first sample of the MP4 file may be stored in moov of the MP4 file, or the absolute DTS or PTS of the first sample of a movie fragment or the first sample of each track within a movie fragment may be stored in moov or traf. For example, if it is guaranteed that the video playback intervals of XXX1.MP4 and XXX2.MP4 have neither overlap nor gap and that PTS values are continuous, information regarding the overlap need only be indicated for audio or text. If the PTS of the first video sample of XXX2.MP4 is T0, the offset value between the PTS of the first audio sample of XXX2.MP4 and T0, or the offset value between the playback end time of the last audio sample of XXX1.MP4 and T0, may be stored. Additionally, the offset value between the playback end time of the last audio sample of XXX1.MP4 and the PTS of the first sample of XXX2.MP4 may be stored in XXX2.MP4. A playback device selects and synthesizes audio samples to be output based on this overlap information.

Note that the video playback intervals may also be overlapped, or gaps may be provided instead of overlapping the audio or video playback intervals.

FIG. 18

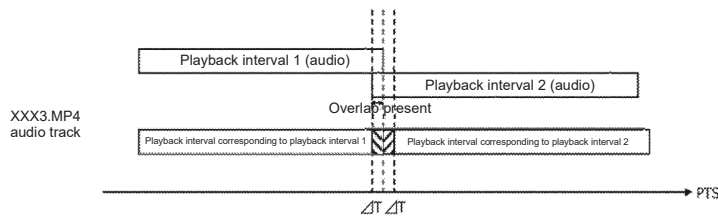


FIG. 18 described the case of continuously playing back a plurality of files using a playlist; however, continuously played playback intervals may also be integrated into a single MP4 file. For example, in FIG. 19, playback interval 1 and playback interval 2 are integrated to generate XXX3.MP4, wherein the audio of playback interval 1 comprises 100 samples from sample 1-1 through sample 1-100, and the audio of playback interval 2 comprises 100 samples from sample 2-1 through sample 2-100. The following describes audio as an example. First, if there is neither overlap nor gap between playback interval 1 and playback interval 2, the audio track of XXX3.MP4 stores samples 1-1 through 1-100 followed by samples 2-1 through 2-100, and each sample is played back in order during playback. Next, consider the case where the playback intervals of sample 1-100 and sample 2-1 overlap. If the playback intervals (start time: PTS, end time: PTS + playback duration) of sample 1-100 and sample 2-1 are identical, the overlap between samples can be resolved by deleting sample 2-1 and constructing the audio track of XXX3.MP4. The same applies when the playback intervals of a plurality of samples overlap. On the other hand, if the playback intervals of sample 1-100 and sample 2-1 overlap but are not identical, deletion of samples alone cannot resolve the issue; both sample 1-100 and sample 2-1 are stored in the audio track of XXX3.MP4, and information indicating the overlapping playback interval is stored separately. If the duration of the overlapping portion is ΔT , for example, the last sample of playback interval 1 and the first sample of playback interval 2 may be placed in separate movie fragments, and ΔT may be stored in traf of moof or similar to indicate that the interval of ΔT from the beginning of the audio track in the movie fragment containing playback interval 2 overlaps with the playback interval of the audio track of the immediately preceding movie fragment. When a gap is present, it can be addressed by using the edit list feature of MP4 or by setting the duration-is-empty flag in a movie fragment to generate a non-playback interval corresponding to the gap interval. Overlap intervals and gap intervals may also be indicated separately in MP4 metadata or in an external file. Note that an MP4 containing a gap interval has greater compatibility with conventional MP4 than an MP4 containing an overlap interval. Therefore, when integrating playback intervals containing mutual overlap intervals to generate an MP4 file, samples containing the overlap interval in, for example, playback interval 2 in FIG. 19 are deleted. If a gap results, it is addressed by generating a non-playback interval. This method is applicable not only to audio but also to video and subtitles. Furthermore, information indicating whether deletion is necessary, which samples require deletion, and the duration of the gap resulting from the deletion may be separately stored as auxiliary information such as a copy manifest. When playing back such an MP4 file, if an overlap interval is present, the decoding results of audio samples in the overlap interval may be synthesized for output, based on information such as the overlap interval contained in the MP4 file. Furthermore, when integrating continuously played playback intervals, it is necessary to identify whether overlap intervals or gap intervals exist in the playback intervals to be integrated; however, information indicating the presence or absence of overlap intervals and the like, as well as their durations, may be separately obtainable as auxiliary information from within the optical disc or via the Internet.

FIG. 19

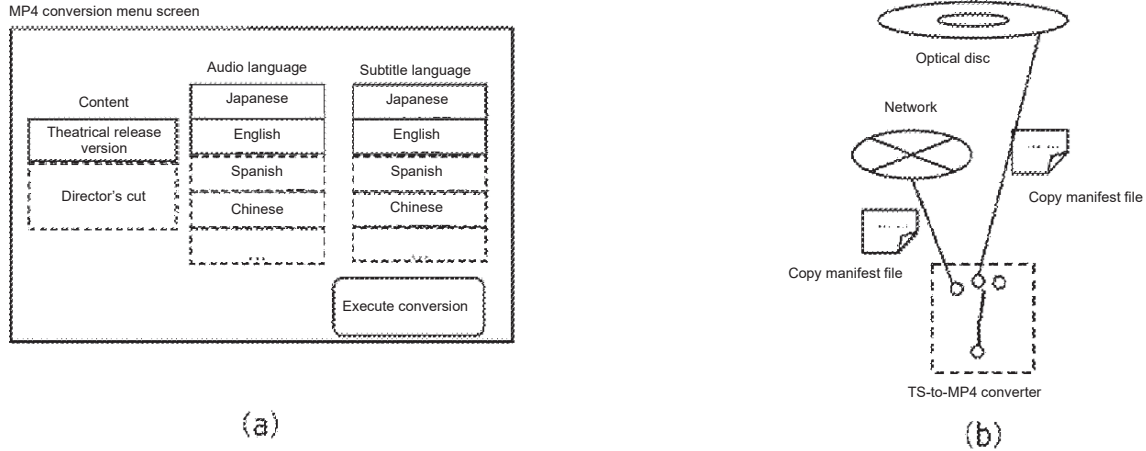
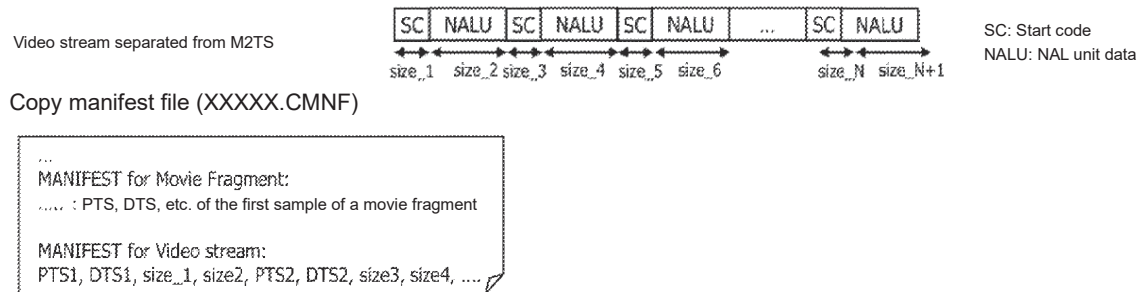


FIG. 20(a) illustrates an example of a menu screen for generating an MP4 from content stored on an optical disc. The disc stores audio and subtitles in a plurality of languages, and the language to be stored in the MP4 can be selected at the time of MP4 generation. In this example, Japanese and English are selected for both audio and subtitles from among Japanese, English, Spanish, and Chinese stored on the disc. Here, if the sample sizes of audio or subtitles differ by language, the content of the copy manifest file depends on the sample sizes, and the number of copy manifest file variants increases in proportion to the combinations of selected languages for audio and subtitles. Therefore, the MP4 file may always store audio and subtitle data for all languages, with information indicating the language selected by the user stored separately, enabling the user-selected language to be chosen during playback. In this way, the copy manifest file can be made identical regardless of the selected language. Alternatively, copy manifest files corresponding to two cases may be prepared: one in which only one language is stored, and one in which all languages are stored. Furthermore, the audio coding scheme, such as AAC or AC3, may also be made selectable according to whether the scheme is supported by the device playing back the MP4 file, or audio data in all coding schemes may be stored in the MP4. When audio data in all coding schemes is stored, the coding scheme may be selected during playback based on the user's selection or the capability information of the playback device.

Alternatively, audio and subtitles in all languages may be stored without language selection at the time of MP4 generation, with the user making a selection during playback. Furthermore, if the copy manifest file can be obtained via a network, there is no need to store the copy manifest file on the optical disc; this is particularly effective when the number of copy manifest files increases, such as when any language can be selected. Only the copy manifest file corresponding to the default language combination may be stored on the optical disc, with copy manifest files corresponding to other combinations downloaded from a server. Additionally, the languages of audio and subtitles obtainable from the optical disc or network and those of audio and subtitles contained in the MP4 file may each be obtained separately, enabling the user to select and obtain languages not contained in the MP4 file that are obtainable externally. Alternatively, a list of externally obtainable audio may be stored in the MP4 file or similar, and when the playback device cannot decode the audio coding scheme in the MP4 file during playback, the playback device may select and externally obtain audio in a coding scheme it supports. In this case, the externally obtained data may be encoded data containing only subtitles or audio, or an MP4 file, and during playback, the video and other content in the original MP4 file and the newly obtained data are played back in synchronization. Alternatively, a complete MP4 file containing all of video, audio, and subtitles may be obtained externally.

Furthermore, while the content stored on the optical disc may be in MP4 format rather than M2TS format, in this case the MP4 data stored on the optical disc may be copied or exported as-is to a device-bound or media-bound recording medium or device without performing conversion processing. The key used to encrypt the content may be changed at the time of copying or exporting. A device that generates MP4, such as a BD player, may determine whether conversion to MP4 is necessary based on identification information of the data format or similar, to determine whether the content on the optical disc is in M2TS format or MP4 format, and then generate the MP4 data accordingly. Alternatively, information indicating whether conversion to MP4 is necessary may be indicated in auxiliary information such as a copy manifest file. Furthermore, even when the content stored on the optical disc is in MP4 format, the user may select a specific language of audio or subtitles within the content, or a version type such as a theatrical release or director's cut, and only the selected data may be extracted from the MP4 data on the optical disc based on the selection result to generate an MP4 file.

FIG. 20

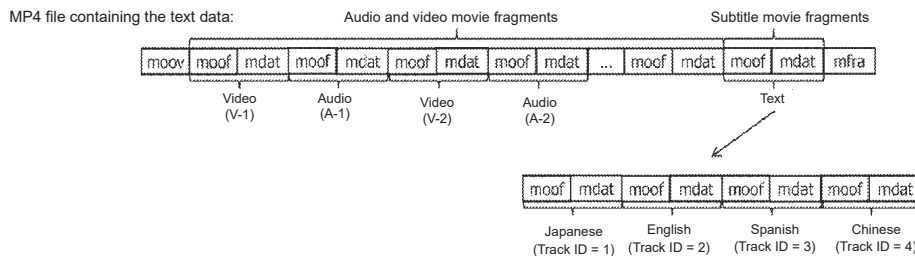


As described in FIG. 15, the file size can also be reduced by indicating in the copy manifest file information for identifying the multiplexing units in the output MP4 file, which is effective when the copy manifest file has a large number of entries. In this case, information that can uniquely determine the movie fragment units in the MP4 file and that is language-independent may be used as copy manifest information, such as the PTS or DTS of the sample that is first in a movie fragment, and the identification information of the M2TS file from which sample data is obtained. Among the MP4 file header information, boxes contained in stbl within moov, and trun within moof, differ in content when sample sizes differ; therefore, header information of the MP4 file cannot be included in a copy manifest file that is to be used commonly for different languages. Therefore, when converting to MP4, the movie fragment units are determined based on the copy manifest file, and the MP4 header information is separately generated based on the PTS or DTS of each sample, or the sample sizes.

When obtaining the PTS, DTS, or size of each sample, processing such as searching for access unit boundaries in audio, video, subtitle, and other data multiplexed in the M2TS or stored separately in a different region without multiplexing, or analyzing PES packet headers, is required, and the processing load is high for high-bitrate video. Therefore, for at least video, information indicating the sizes of NAL units constituting an access unit (corresponding to a sample in MP4) and the PTS and DTS may be stored in the copy manifest. This information can significantly reduce the processing required to search the video stream, and also has the advantage of enabling conversion from start code format in M2TS to NAL size format in MP4 using the size information. The size information may separately indicate the size of the start code portion and the data of the NAL unit portion, and by making the byte length of the field indicating the NAL unit size the same as the byte length of the size portion in the NAL size format, conversion to NAL size format can be achieved by replacing the start code portion data with data indicating the size of the NAL unit portion. When the sizes of all start code portions are identical, only a default value need be set. Furthermore, for PTS and DTS, the data format used in the MP4 header may be used rather than the PTS and DTS values in the PES header of the M2TS. For example, for DTS, the difference value between the DTS values of two consecutive samples in decoding order may be indicated, and for PTS, the difference value between DTS and PTS may be indicated. The timescale of this information may be converted to the timescale used in MP4. Furthermore, information indicating the absolute values of the PTS and DTS of the first sample may be stored separately. Information for identifying NAL units to be deleted during MP4 conversion may also be added. When storing similar auxiliary information for an AAC encoded stream, header information such as ADTS and LATM headers is deleted from the sample data; however, if the sizes of these headers are fixed, only one of either the sum of the sizes of the header information and payload data, or the size of the payload data alone, need be indicated. Furthermore, for audio, because the frame rate is fixed, only a default value need be used for DTS information.

Note that when the audio coding scheme differs, the playback duration of each sample may also differ. As a result, because the PTS and DTS of each sample also differ, a copy manifest file may be prepared for each audio coding scheme.

FIG. 21



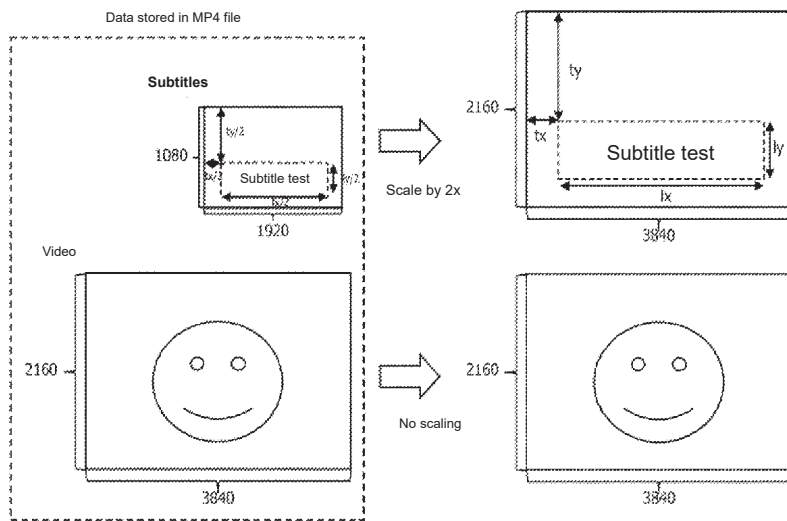
When storing subtitle data in an MP4 file, by storing all subtitle data together at the end of the file, the movie fragments of AV data remain identical even when the language of the subtitle data is changed. On the other hand, when video and audio movie fragments and subtitle movie fragments are stored interleaved, a change in the size of the subtitle data causes the positions of the AV data movie fragments to shift, consequently requiring the content of moov to be changed. Furthermore, because subtitle data is smaller in size compared to AV data, it is also possible to expand all subtitle data contained in the entire content or in units such as chapters into memory at once for playback. In this case, there is also the advantage that data is easier to obtain when it is stored together at the end of the file. The subtitle data may be based on text fonts or may be image data such as PNG format. Because image data has a larger data size than text format, a run may be generated for each unit such as a chapter to improve accessibility to the subtitle data contained in a given unit. Alternatively, trun may be generated such that the size of the subtitle data constituting a run does not exceed the buffer size, according to the buffer size for holding text data during playback.

Furthermore, when storing subtitle data in a plurality of languages, subtitle data for a specific language can be readily obtained by storing each language in a separate movie fragment. In this case, information for identifying the language stored in each movie fragment is required; this can be addressed by, for example, treating each language as a separate track and associating track IDs with languages. Track IDs are indicated by a box within traf. Note that information associating track IDs with languages may be stored in a box for metadata storage in MP4 or may be managed as management information separate from the MP4 file. The association between languages and movie fragments is also applicable to audio.

Randomly accessible samples in video, audio, or subtitles are indicated by mfra. For video and audio, when the playback intervals of consecutive video and audio movie fragments are aligned, it is sufficient to indicate only the video random access points, and audio samples with the same PTS, or the immediately preceding or following PTS, can be obtained from the immediately following movie fragment. For example, in FIG. 22, the PTS of the first sample of V-1 and the PTS of the first sample of A-1 are aligned. On the other hand, when text is stored at the end of the file, random access points must be indicated independently for text.

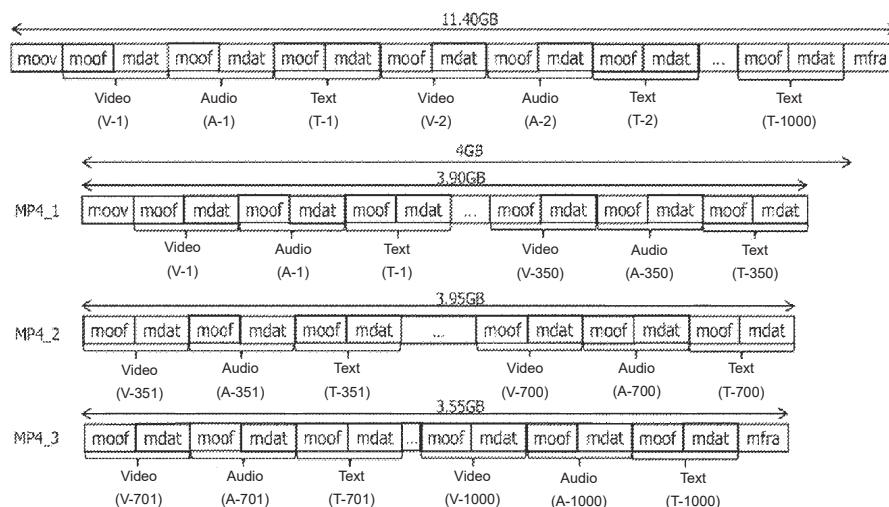
Furthermore, when audio and subtitle data in all languages of the optical disc content are stored in the MP4 file, if the user has selected a desired language at the time of MP4 file generation, random access points in mfra need only be indicated for the track corresponding to the selected language.

FIG. 22



In content stored on an optical disc, it is anticipated that the resolutions of video and graphics may differ. For example, the video resolution may be 4K, while the resolution of graphics such as subtitles may be 2K in order to reduce the processing load. FIG. 23 illustrates a case in which subtitles at 2K resolution are scaled to 4K for display. When displaying subtitles, information for specifying the subtitle display area is required in addition to the subtitle data and its resolution. The display area is specified using, for example, the rectangular size of the display area and the display position of the rectangle. For example, as information indicating the resolution of each track, it can be indicated that the subtitle track is 2K and the video track is 4K. Regarding the display area, in the case of SMPTE or W3C Timed Text, it may be described as part of the XML data constituting the Timed Text, or stored in a box indicating metadata within the MP4. When playing back an MP4 file, the resolutions of the video and subtitles are obtained, and if the two resolutions differ, the subtitles are scaled to match the video resolution for display. In this case, if the subtitle data is image data, the image data is enlarged; if it is text data, a size consistent with the video resolution is selected. The display area is also calculated and determined according to the scaling factor and similar parameters. Note that the information indicating the display area may store the information after scaling to match the video resolution.

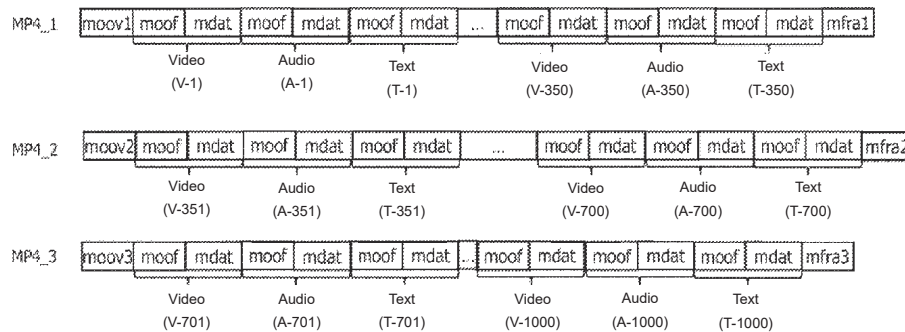
FIG. 23



An MP4 file generated from data such as M2TS is recorded on the destination recording device to which the MP4 file is to be transferred, such as removable media like an SD card, or an HDD in a smartphone or tablet. In this case, the upper limit of the file size that can be handled is restricted depending on the file system of the recording device. For example, the limit is 4 GB for an SD card and 32 GB for an SDHC card. Therefore, when the size of the MP4 file corresponding to the entire content exceeds the upper limit of the file system of the recording device, the MP4 file must be divided. FIG. 23 illustrates an example in which an MP4 file with a size of 11.40 GB corresponding to the entire content is divided into three files of 4 GB or less for recording on an SD card. In MP4 using movie fragments, it is preferable that movie fragments with the same or adjacent playback intervals in audio, video, or subtitles be stored in the same file. When audio and video data with the same playback interval are stored in different files, it is necessary to access the data of two MP4 files simultaneously during playback, and depending on the data read speed and seek speed of the recording device, there are issues such as the need to buffer extra data before playback compared to playing back from a single file. Therefore, MP4 files are generated such that movie fragments of audio, video, and subtitles with the same or adjacent playback intervals are contained in the same MP4 file and the file size does not exceed 4 GB. By storing as many movie fragments as possible in the same file while keeping the file size at 4 GB or less, the number of generated files can be minimized.

Note that because the data sizes of audio and subtitles are smaller than that of video, a longer duration of data can be buffered. Therefore, rather than storing all movie fragments of different media with the same playback interval in the same file, at least the video movie fragments may be divided such that they are contained in the same file. For media other than video as well, dividing the data of the same movie fragment across different files may be prohibited.

FIG. 24



As in the example of FIG. 24, when the data of an original MP4 file is divided as-is, moov is absent in the second and subsequent files, and it is necessary to reference the first file in order to obtain the initialization information required for decoding each medium stored in the sample entry. Furthermore, because mfra is contained only in the final file, it is necessary to reference the mfra stored in the final MP4 file when performing random access to MP4 files other than the final file, and self-contained playback of each MP4 file cannot be performed. Therefore, moov or mfra may be appended to each file. Regarding moov, because the sample entry of the original MP4 file contains all initialization information required for the entire content, the content of stsd need not be changed. Other boxes also basically require no changes; however, tkhd for each track and mvhd store the playback duration for each track and for the entire file, respectively. Therefore, these playback durations may be changed to correspond to the playback duration of the divided MP4 file. Alternatively, if it is indicated by some auxiliary information that the file is a divided file, changing the playback duration may also be deemed unnecessary. Similarly, the content of mfra may also be changed to indicate the random access points within each MP4 file. The random access information of mfra indicates the offset from the beginning of the file of moov to which the sample serving as a random access point belongs. If the content of mfra is not changed, the offset values correspond to the original MP4 file and therefore do not correspond to the offset values of the divided files. Therefore, when searching for random access points in a divided file, the total size of the MP4 files preceding the file in playback order is added for the second and subsequent files to reproduce the file offset value of the original MP4 file, thereby obtaining the sample data serving as the random access point.

When the sizes of moov and mfra in the original MP4 file are updated as a result of changing the content of moov or mfra in each divided file, the files are divided such that the updated file size does not exceed the maximum size in the file system.

Note that the playback order of the divided files shall be identifiable by the file name or by content management information storing information indicating the playback order of the files.

Furthermore, as in the example of FIG. 22, when subtitle data is stored together at the end of an MP4 file without interleaving, information for identifying the divided file containing the subtitle data is included in the content management information or similar. During playback, the divided file storing the subtitle data is accessed to obtain the subtitle data. In general, because subtitle data is small in size, it is preferable that all subtitle data be contained in the same file. Note that initialization information for decoding subtitle data is stored in moov, as with audio and video.

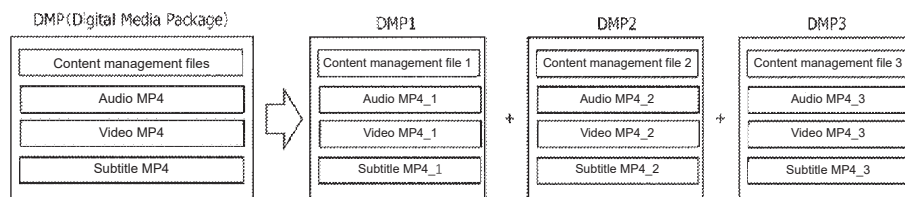
FIG. 25

When generating an MP4 file, it is necessary to obtain in advance the upper limit of the file size in the file system of the output destination. Therefore, when the output destination is another device such as a tablet, communication is performed with the destination device using some communication means; and when the output destination is a recording medium such as an SD card or HDD connected to the same device as the device containing the optical disc, such as a BD player, communication is performed within the device using some communication means, to obtain information indicating the maximum file size of the output destination file system or information indicating whether the original MP4 file needs to be divided. For example, prior to generating the MP4 file, the MP4 generation module may take the initiative in obtaining this information, such as by issuing a request to obtain information indicating the maximum file size in the file system of the output destination recording medium. Alternatively, it is also possible to notify the output destination device of the original MP4 file, and when division is necessary, have the output destination device transmit information indicating the maximum file size to the MP4 generation module.

When another device obtains an MP4 file via a communication network, it is possible to first obtain a metafile describing content metadata such as selectable languages, the URL of the MP4 file acquisition source, and the URL of a DRM (Digital Rights Management) management server, and then issue an MP4 file acquisition request based on the analysis results of the metafile. In such cases, information indicating the maximum file size may be described in the MP4 file acquisition request message or command.

It may also be possible to accommodate updates to these metafiles. The default metafile is obtained from within the optical disc, and if an update is available, the updated metafile is obtained via a network. The URL of the management server that the playback device accesses first may be described in the metafile, and the management server may determine whether the metafile is the latest version based on the version number of the metafile on the optical disc or similar, and if not the latest, notify the playback device of the acquisition source of the latest metafile. Furthermore, the DRM and content acquisition sources described in the default metafile, or the content itself, may differ depending on the country or region, and these can similarly be processed by the management server based on identification information of the country or region in which the playback device is located, in the same manner as metafile updates. The same applies when the content of metafile updates differs by country or region.

FIG. 26



When generating an MP4 file, it is common practice to multiplex data of different media such as audio, video, and subtitles into the same file; however, there is also a format in which a separate independent MP4 file is created for each medium. This format is called DMP (Digital Media Package), and during playback, media data obtained from a plurality of MP4 files is played back in synchronization. In DMP, MP4 files and content management files are archived in ZIP format or similar; however, if the archived file exceeds the maximum file size of the output destination file system, division is necessary. When dividing, the same division method as described in FIG. 24 through FIG. 26 can be applied. That is, the playback intervals of the MP4 files of each medium constituting the same DMP are divided such that they are the same or adjacent. Alternatively, in the MP4 file of each medium, a single movie fragment may be prohibited from being stored across a plurality of DMPs. The handling of moov and mfra is the same. Furthermore, because audio and subtitles have smaller data sizes than video, only the video may be divided across a plurality of files, with all audio and subtitle data stored in the first divided file.

Regarding the content of the content management file, attribute information pertaining to the entire content can be stored in the content management file contained in the first DMP after division. Furthermore, the content management file stored in the first DMP may store identification information of the subsequent divided DMP files and information indicating the playback order. The content management file in a subsequent DMP may describe archive information of the files within the DMP or identification information of the DMP, without describing information pertaining to the entire content. Note that rather than generating a plurality of DMPs, the data of a single DMP may be divided into a plurality of files.

Note that in DMP as well, as described in FIG. 18 and FIG. 19, it is possible to continuously play back MP4 files constituting a plurality of playback intervals by referencing them via a playlist or similar. When multiplexing a plurality of media into the same file, the connection destination and connection source are each a single file; however, in DMP, the connection destination and connection source are each a plurality of files, and the identification information of those plurality of files is described in the playlist. Audio gaps and overlaps at the connection points of consecutively played files can also be handled in the same manner by the aforementioned processing.

FIG. 27

Electronic Acknowledgement Receipt	
EFS ID:	17875375
Application Number:	61925699
International Application Number:	
Confirmation Number:	4101
Title of Invention:	DATA REPRODUCING APPARATUS AND DATA REPRODUCING METHOD
First Named Inventor/Applicant Name:	Tadamasa TOMA
Customer Number:	52349
Filer:	Charles R. Watts/pam veazey
Filer Authorized By:	Charles R. Watts
Attorney Docket Number:	PR14-0030A
Receipt Date:	10-JAN-2014
Filing Date:	
Time Stamp:	10:39:39
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$ 260
RAM confirmation Number	9414
Deposit Account	230975
Authorized User	WATTS, CHARLES R.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)					
Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)					
Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)					
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	AttachA1_TRN_P664469-01.pdf	325163	no	1
			8f9abb217d474770141f704d96df3dd9a095d7cd		
Warnings:					
The PDF file has been signed with a digital signature and the legal effect of the document will be based on the contents of the file not the digital signature.					
Information:					
2	Application Data Sheet	AttachA2_ADS_P664469-01.pdf	1560698	no	7
			56111ce76095d3cbc2e2be4f5ab1018c67435db		
Warnings:					
Information:					
3	Drawings-only black and white line drawings	AttachB_DRW_P664469-01.pdf	5062301	no	29
			f89c401e3cab547e4c78405a72378768a10a aa38		
Warnings:					
The PDF file has been signed with a digital signature and the legal effect of the document will be based on the contents of the file not the digital signature.					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	29637	no	2
			c2b28308c7c28234fd5df5301c09ea9e0092a761		
Warnings:					
Information:					
Total Files Size (in bytes):			6977799		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

TRANSLATOR CERTIFICATION

Date: June 21, 2026

To whom it may concern:

I, Shenal C., a translator fluent in the Japanese and English languages, on behalf of Morningside Translations, do solemnly and sincerely declare that the following is, to the best of my knowledge and belief, a true and correct translation of the documents listed below in a form that reflects the intention and meaning of the original text.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

The document is designated as:

- **Toma-446 provisional 1 - 61925699.pdf**



Signature

Shenal C.

Print

Questel Confidential: Limited External Use

4001 S 700 East, Suite 500 #B17
Salt Lake City, UT 84107