INTERNATIONAL STANDARD

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First edition
2005-07

Multimedia home server systems – Interchangeable volume/file structure adaptation for broadcasting receivers –

Part 1: General description and architecture

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Multimedia home server systems – Interchangeable volume/file structure adaptation for broadcasting receivers –

Part 1: General description and architecture

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Международная Электротехническая Комиссия

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MULTIMEDIA HOME SERVER SYSTEMS – INTERCHANGEABLE VOLUME/FILE STRUCTURE ADAPTATION FOR BROADCASTING RECEIVERS –

Part 1: General description and architecture

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The text of this standard is based on the following documents:

FDIS	Report on voting
100/963A/FDIS	100/987/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62328 consists of the following parts, under the general title *Multimedia home server systems – Interchangeable volume/file structure adaptation for broadcasting receivers:*

Part 1: General description and architecture

Part 2: General recording structure

Part 3: Broadcasting system specific recording structure – ISDB

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- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Broadcast data in a transport stream can contain multiple associated objects. When that data is distributed on interchangeable storage media, for example, optical disks, the associated objects should be synchronized. Open distribution of the media requires that the data be adapted to a standardized volume and file structure, which should conform to the existing basic volume and file structure.

MULTIMEDIA HOME SERVER SYSTEMS– INTERCHANGEABLE VOLUME/FILE STRUCTURE ADAPTATION FOR BROADCASTING RECEIVERS –

Part 1: General description and architecture

1 Scope

This part of IEC 62328 defines the volume and file structure required for interchanging multimedia data of a home server/broadcasting receiver, which consists of an AV stream with multiple associated objects.

This part of IEC 62328 specifies references, definitions, abbreviations, notation and bibliography that apply to this and the other three parts. It also specifies requirements, design considerations and content architecture.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62328-2:*Multimedia home server systems – Interchangeable volume/file structure adaptation for broadcasting receivers – General recording structure*

IEC 62328-3:*Multimedia home server systems – Interchangeable volume/file structure adaptation for broadcasting receivers – Broadcasting system specific recording structure – ISDB* [2]

ISO/IEC 13818 (all parts), *Information technology – Generic coding of moving pictures and associated audioinformation*

ISO/IEC 13818-1:2000, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

IEEE 1394:2003, *IEEE standard for a high performance serial bus peer-to-peer data transport protocol (PPDT)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
action
duration from start to end defined by a user or equipment

3.2
AV stream
recorded data in the MainTS stream file of PROGxxxx.PIF in this specification or the general meaning as multiplexed digital audio and video

3.3
event
set of video and/or audio stream data and/or related objects, which together form a broadcasting service in the duration defined by a broadcaster

3.4
partial TS
TS derived from broadcasting TS by modifying PSI/SI and/or removing one or more elementary streams

3.5
programme
recorded TV programmeme compliant with this specification

3.6
programme reference (PGR)
pointer which references all or part of the AV stream in a programme

3.7
programme reference group (PGRG)
set of programme references or programme reference groups

3.8
transport stream (TS)
system stream for broadcasting defined in ISO/IEC 13818-1

3.9
TV programme
logical unit of TV broadcasting (event in digital TV service)

3.10
TVRS partial TS
partial TS recording format, which complies with this specification

4 Abbreviations

For the purposes of this document, the following abbreviations apply.

ACU	Access unit
ALU	Allocation unit
ARIB	Association of radio industries and businesses
ATSC	Advanced television systems committee
CAS	Conditional access system
CBC	Cipher block chaining
CCI	Copy control information
DVB	Digital video broadcasting
EPG	Electronic programme guide

ISDB	Integrated services digital broadcasting
MPEG	Moving picture experts group
PGR	Programme reference
PGRG	Programme reference group
PLL	Phase locked loop
PSI	Programme specific information
RP	Recording packet
SI	Service information
TS	Transport stream
TU	Time unit
TVRS	TV recording format specific
UDF	Universal disk format

5 Notation

5.1 Numerical values

5.1.1 Decimal notation

A decimal number is represented as decimal digits 0 to 9.

6 Requirements

6.1 Overview of digital broadcasting

Conversion from analogue broadcasting to digital broadcasting based on ISO/IEC 13818 (MPEG-2) is in progress in many countries.

From the point of view of contents protection, recording of digital broadcasting contents requires circumspection and caution. A discussion about broadcast services and how to store them onto built-in storage media has begun. Another point of discussion is how other receivers in a house can access contents recorded by one receiver. It is expected that distribution of contents and metadata via communications networks, such as the Internet, will include access control data.

This standard aims at the following recording formats.

- A format which does not need to be conscious of built-in and removable media on the application level in order that removable media can be used as an extension of the built-in storage which has limited capacity.
- A format which records a digital broadcasting programme to a removable medium by one receiver and play the programme by another receiver while protecting a content and keeping compatibility between receivers using secure UDF.
- A format which can record contents distributed via broadcasting networks or removable media.

6.2 Main target contents

The primary target contents of this standard are contents the recording of which is permitted by copy control information but the recording directory to be stored of which is not specified. However, contents whose recording directory is specified can also be recorded into this format with some restrictions.

6.3 Security module

A removable medium, which carries a physical tamper-resistant module for protecting license information, is recommended from the content protection point of view.

7 Design considerations

7.1 Relationship between country-specific CAS and this specification

Digital broadcasting contents, especially on pay per view services, may be scrambled by CAS. Each country defined its own CAS. The CAS defined by one country may not be the same as one defined by another country. According to this recording format, the contents scrambled by CAS shall not be recorded. However, the contents descrambled in a receiver may be encrypted and stored.

7.2 Broadcasting system specific structure

A digital broadcasting system defined by one country may be different from that of another country. The digital broadcasting system in the United States has been developed in the ATSC. In Europe, the digital broadcasting system has been developed in the DVB project. In Japan, the digital broadcasting system, which is called ISDB, has been developed in the ARIB. In this specification, the differences between digital broadcasting systems are absorbed as much as possible. Generic recording structure is specified in IEC 62328-2. The broadcasting system specific structure in Japan is specified in IEC 62328-3. Another broadcasting system specific structure may be specified in the future IEC 62328-4[1].

8 Content architecture

8.1 Basic content architecture

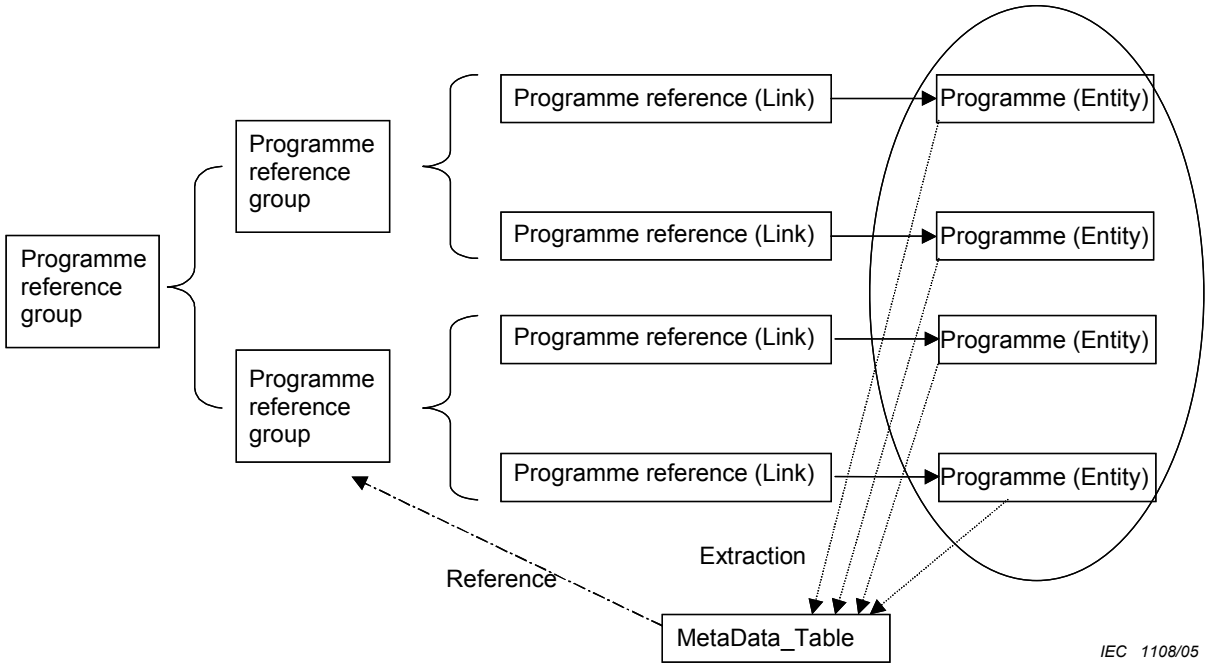


Figure 1 – Basic content architecture

[1] Under consideration.

Figure 1 shows the basic architecture of this specification. A programme (entity) consists of a recorded TVRS partial TS and its related information. A unit of a programme may correspond to a TV programme. Programme reference (link) is a pointer, which references all or a part of TVRS partial TS in a programme. Programme group is a set of programme references or programme reference groups. MetaData_Table is a database which enables users to retrieve desired TV programmes from a storage medium. Metadata in the programme (entity) may be extracted to make a MetaData_Table. MetaData_Table may be used for making a programme reference group. Examples of how to use programme references and programme reference groups are described in Annex A.

8.2 Basic rule and policy

8.2.1 Recording rules

If the concept of event exists in broadcasting/transporting TS, the recording unit which is called programme in this specification shall consist of only one event. Otherwise, partial TS via digital interface may be the case, the recording unit shall be specified by an action which is a certain duration defined by a user or equipment. The format to record the following data and information is specified here.

- TVRS partial TS
- PSI/SI information related to the event if the concept of event exists.
- Time search information
- Index of module change in data carousel, if any
- Licenses, if any
- Correspondence between licenses and TVRS partial TS, if any
- Index information, if any

8.2.2 User access rule

The following rules shall be specified.

- The AV stream shall be accessed from the top of PGRG through PRG.
- Users' edit shall be accepted only through PGR, which indicates a part of the AV stream. The PGRG may be constructed as a group of PGRs. Seamless connection between PGRs may not be guaranteed.
- Editing the programme part of a TS shall not be permitted because of copyright protection.
- Deleting the programme part of a TS shall be performed only for a whole programme not a part of a programme.

8.2.3 Copyright protection policy

The following policies are introduced in this specification.

- The TVRS partial TS may be encrypted.
- The cryptographic algorithm including the key exchange algorithm is out of scope.
- The structure of the application license is out of scope.

8.3 Basic elements

8.3.1 Thumbnail

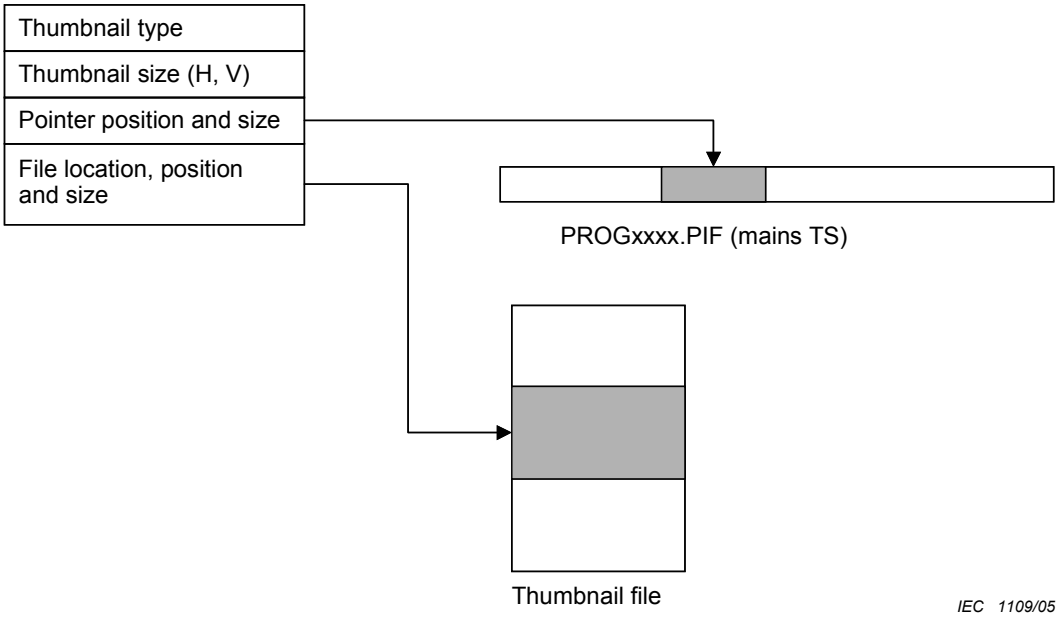


Figure 2 – Thumbnail structure

The general thumbnail pointer format in which two types of thumbnails can be defined is specified. One type of thumbnail is defined as a pointer to the AV stream, the other type is defined as all or part of an external file described in Figure 2.

8.3.2 Hierarchical pointer

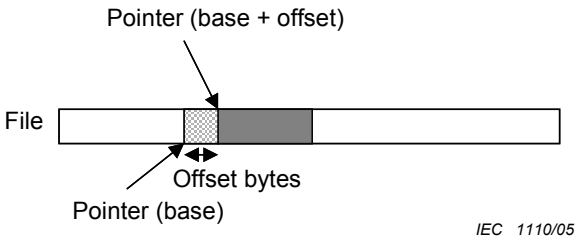


Figure 3 – Hierarchical pointer

The pointer to the TVRS partial TS is pointed by hierarchical two level access. The first level is called pointer (base) and points to the boundary between two blocks. The block assumes the unit of block cipher or CBC. The second level is called pointer (offset) and indicates the byte length between the pointer (base) and the target point.

8.3.3 MarkTable

Two types of marks can be defined in the MarkTable. One is the bookmark, the other is the resume mark. A user or equipment may set these marks.

8.3.4 MetaDataTable

MetaDataTable is a database that enables users to retrieve desired TV programmes from a storage medium. Metadata in a programme may be extracted to make a MetaDataTable.

8.3.5 Time search related table

Three types of time search related table can be defined. One is the access unit table, which is based on an access unit. An access unit may be an MPEG2-I picture. Another is the allocation unit table, which is a set of arrival timestamps based on a predefined allocation unit. The other is the time unit table, which is a set of arrival timestamps based on a predefined time unit.

8.3.5.1 Access unit table

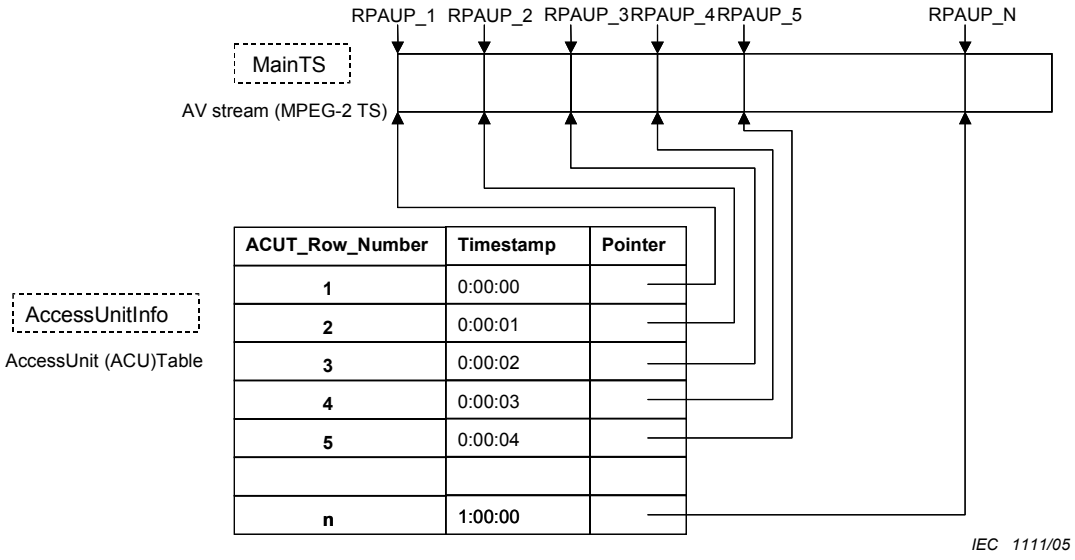
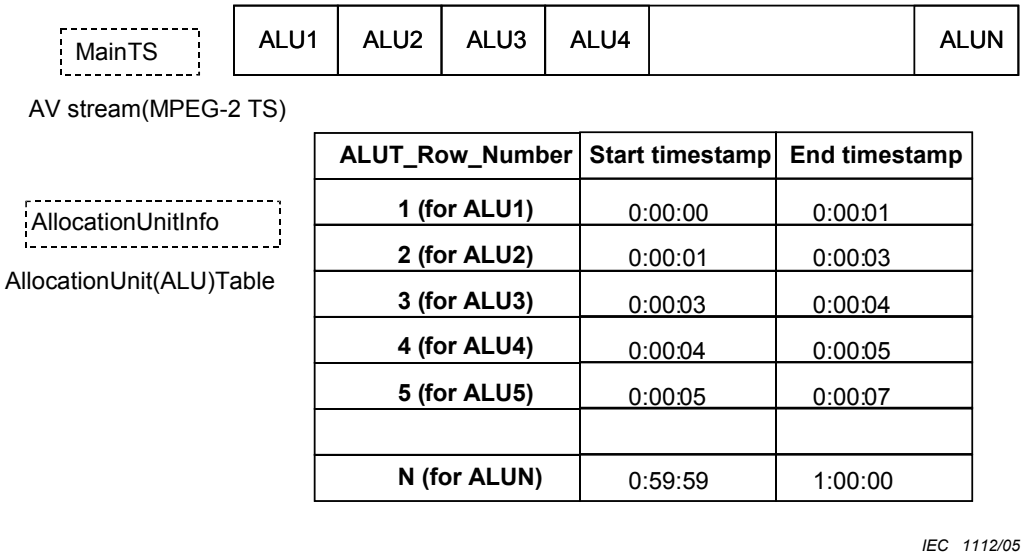


Figure 4 – Relationship between access unit table and AV stream

The relationship between the access unit table and the AV stream is described in Figure 4. The access unit table contains the timestamp corresponding to RPAUP and pointer to the AV stream. The explanation of RPAUP is given in Annex C of IEC 62328-2. The ACUT_Row_Number is defined as the row number of the table.

8.3.5.2 Allocation unit table

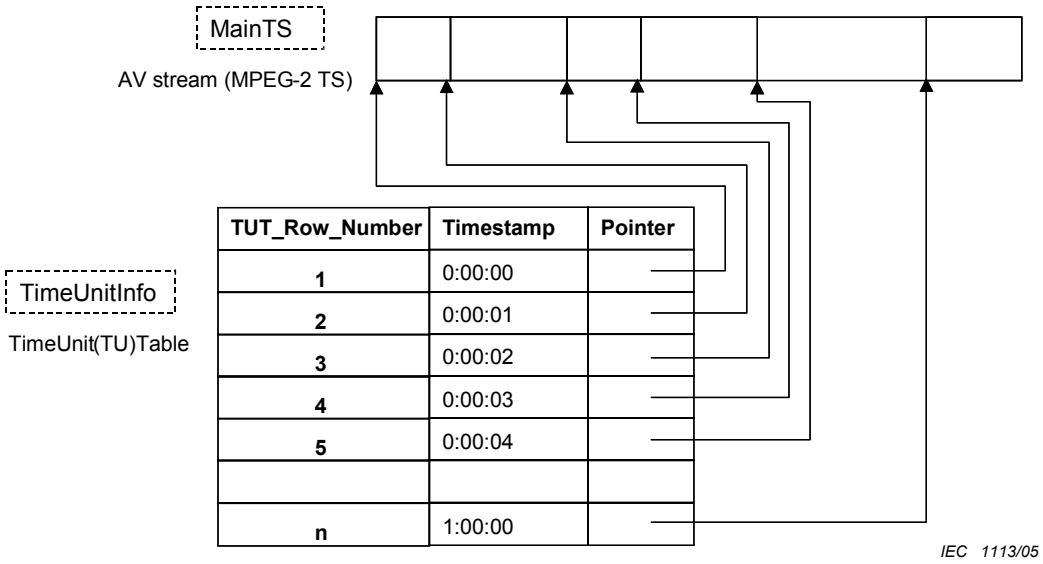


ALUT_Row_Number	Start timestamp	End timestamp
1 (for ALU1)	0:00:00	0:00:01
2 (for ALU2)	0:00:01	0:00:03
3 (for ALU3)	0:00:03	0:00:04
4 (for ALU4)	0:00:04	0:00:05
5 (for ALU5)	0:00:05	0:00:07
N (for ALUN)	0:59:59	1:00:00

Figure 5 – Relationship between allocation unit table and AV stream

The relationship between the allocation unit table and the AV stream is described in Figure 5. The allocation unit is the fixed number of bytes for allocation defined in advance. The allocation unit table contains the start timestamp, which is defined as the arrival timestamp of the first byte of ALU, and the end timestamp, which is defined as the arrival timestamp of the last byte of ALU. The ALUT_Row_Number is defined as the row number of the table.

8.3.5.3 Time unit table



TUT_Row_Number	Timestamp	Pointer
1	0:00:00	
2	0:00:01	
3	0:00:02	
4	0:00:03	
5	0:00:04	
n	1:00:00	

Figure 6 – Relationship between time unit table and AV stream

The relationship between the time unit table and the AV stream is described in Figure 6. The time unit is the fixed time interval defined in advance. The time unit table contains the pointer to the AV stream corresponding to the timestamp in the unit of the time interval. The TUT_Row_Number is defined as the row number of the table.

8.3.6 Index table

The index table is used for vendor-defined index information. This table shall NOT be used in TV recording. This table may be used in video distribution services. It is NOT used for indexes that a user or equipment defines. A user or equipment should use the mark table instead of the index table.

Figure 7 shows the relationship between the index table and the AV stream. Each index field has a timestamp and the pointer to the AV stream. Each index may have a thumbnail.

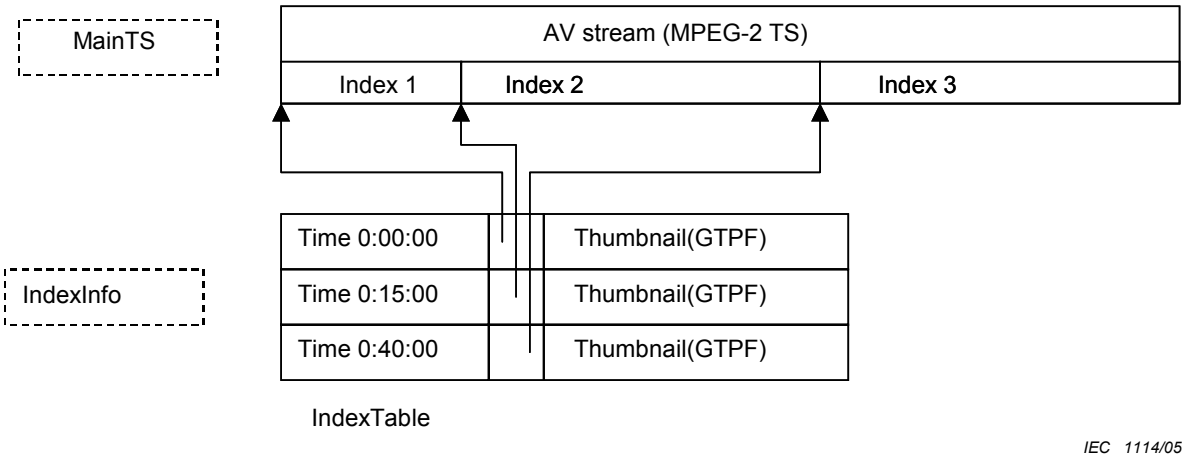


Figure 7 – Relationship between index table and AV stream

8.3.7 Change data carousel table

The change data carousel table is a list of pointers to data streams. The pointer indicates a position where the content of the data carousel is changed. This table may be useful for viewing the data stream after recording. The relationship between the change data carousel table and the data stream is shown in Figure 8.

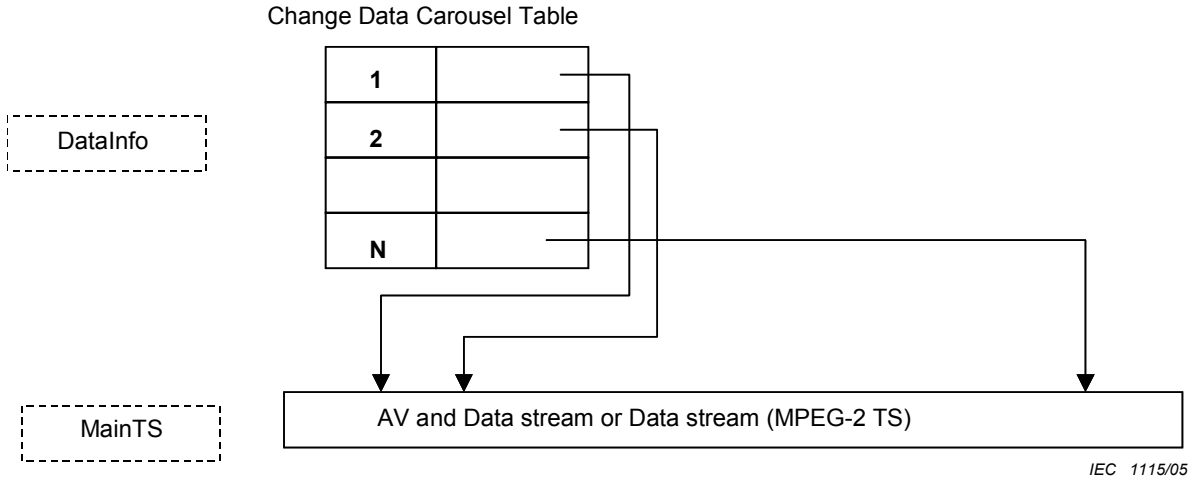


Figure 8 – Relationship between change data carousel table and data stream

8.3.8 Cipher information and licenses

The copyright protection policy in this specification is described in 8.2.3. AV streams may be encrypted. The decrypt key and usage rules such as copy control information are stored in the license. If multiple licenses are used in an encrypted AV stream, the correspondence between each license and part of the encrypted AV stream is described in the cipher information shown in Figure 9. A TV programme is stored as encrypted AV stream. Two licenses, which have a decrypt key and CCI, are stored in the license file. CCI of License 1 is “copy never” which corresponds to the content of the TV programme. CCI of License 2 is “copy free” which corresponds to the commercials of the TV programme. The correspondence between the AV stream and the licenses is stored as cipher information.

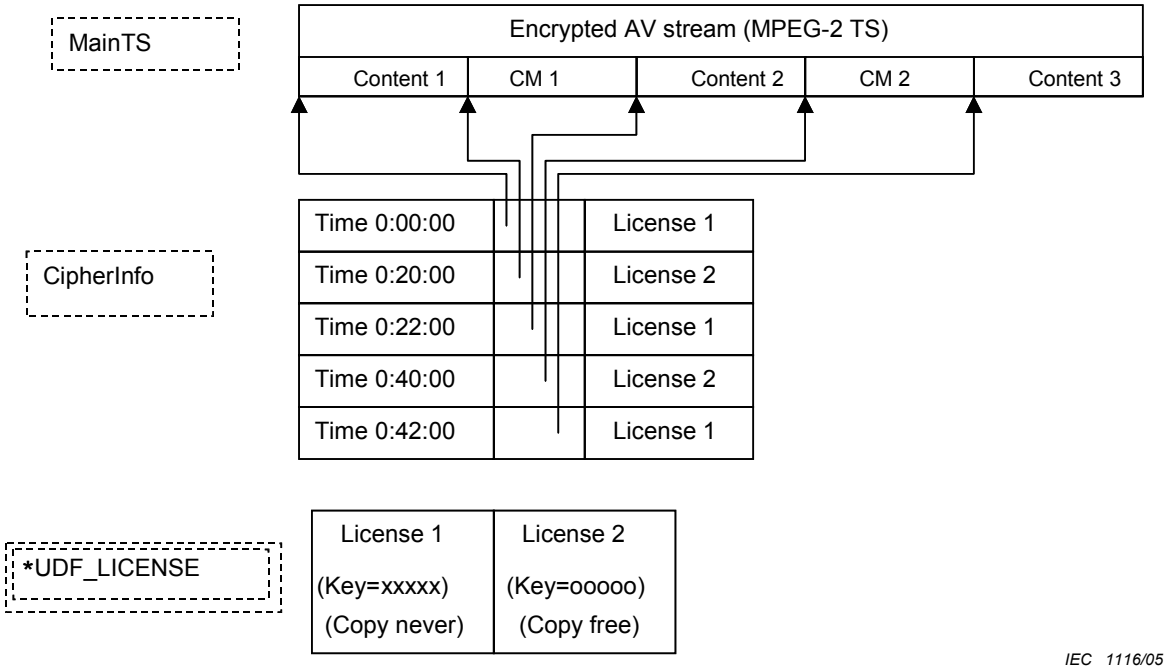


Figure 9 – Relationship between license and encrypted AV stream

8.4 Recording model

8.4.1 Digital TV recording model

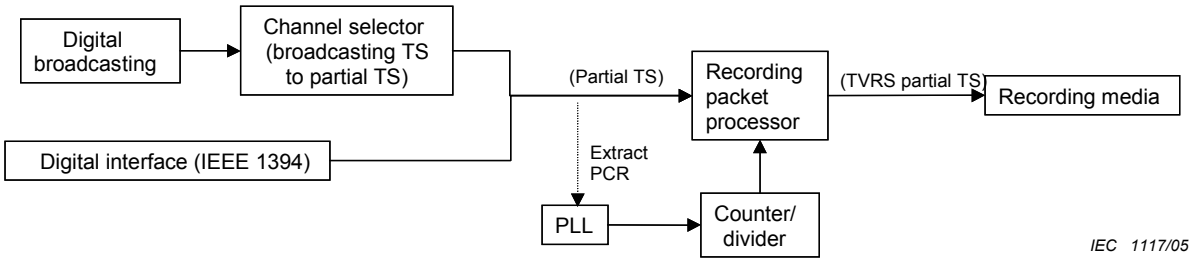


Figure 10 – Digital TV recording model

Figure 10 shows a digital TV recording model. Two kinds of input (one is digital broadcasting; the other is digital interface such as IEEE 1394) are assumed. If the input is digital broadcasting, the channel selector module processes broadcasting TS to partial TS. The recording packet processor adds the recording header including the arrival timestamp to each TS packet for storing to recording media. The final stream is named as “TVRS partial TS” in this specification.

8.4.2 Analogue TV recording model

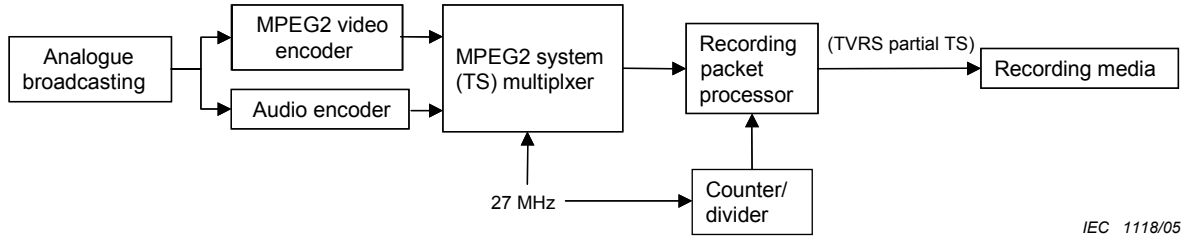


Figure 11 – Analogue TV recording model

Figure 11 shows the analogue TV recording model. In the case of analogue broadcasting, the equipment needs to encode video and audio streams to be able to store them. These streams are multiplexed in MPEG2 system (TS) multiplexer. The recording packet processor adds the recording header to each TS packet.

8.4.3 Decoding model

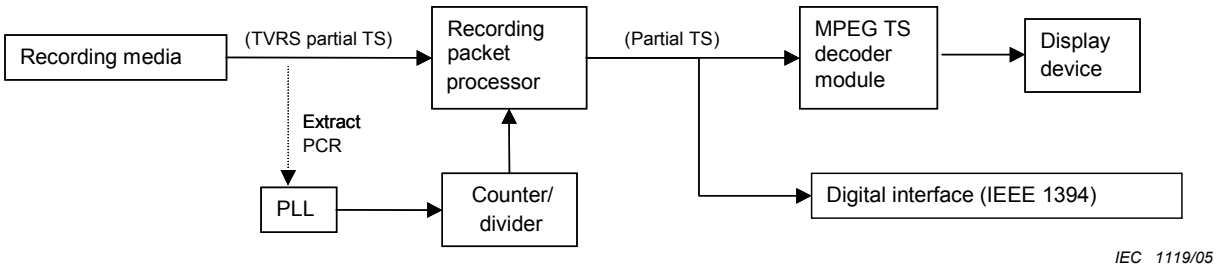


Figure 12 – Decoding model

Figure 12 shows the decoding model. Recorded TVRS partial TS is read from the recording media. In the recording packet processor, the arrival timestamp in the RP header is referred and the time interval between two adjacent TS packets is restored. Two kinds of output (one is the display device through the MPEG TS decoder module; the other is the digital interface such as IEEE 1394) are assumed.

Annex A
(informative)

Examples of PGR_Group

A.1 Example of PGRG_Base stream file and the relationship between this stream file and other stream files

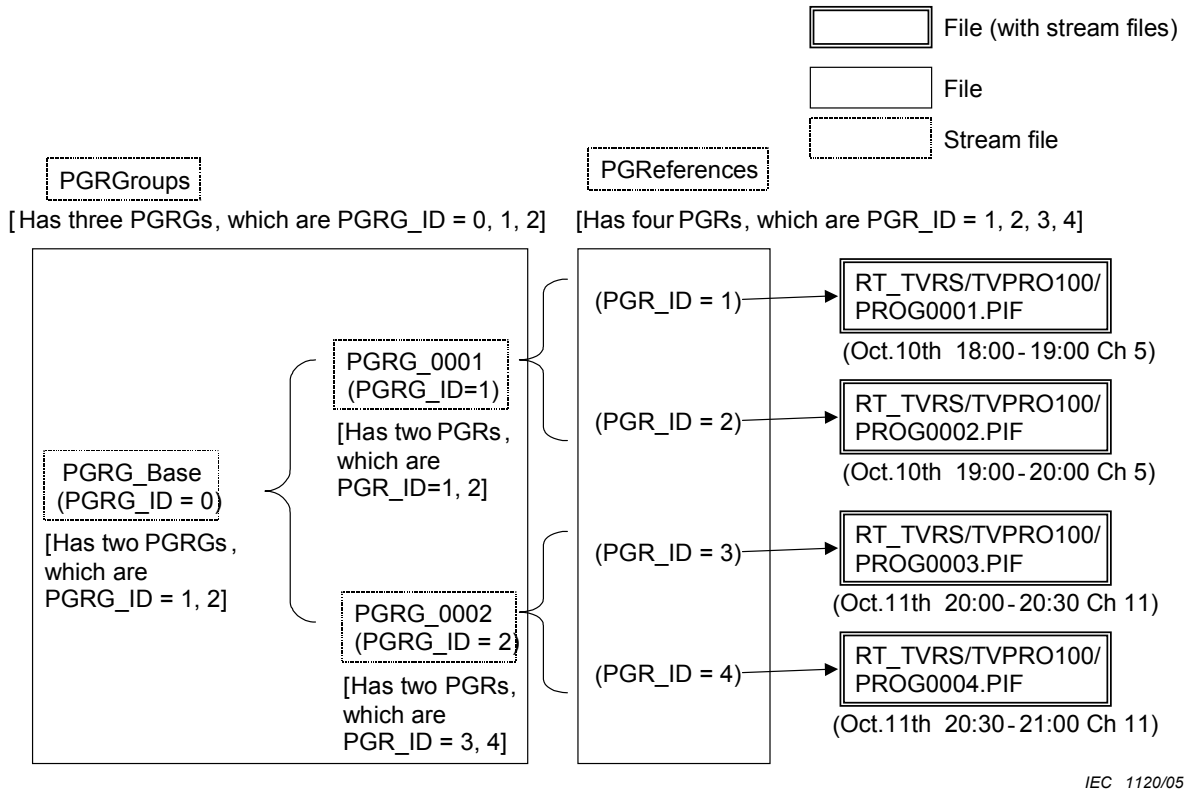


Figure A.1 – Example of PGRG_Base

The PRRG_Base stream file manages all recorded programmes in recorded time order. There are two kinds of recording methods – one records a certain TV programme, the other records a certain channel between one time and another, in the case of recording TV. In this specification, the recorded programme on a storage media is recommended to consist of one TV programme. When a user selects recording a certain channel between one time and another including plural TV programmes, the plural recorded programmes, which consist of one TV programme each, are recommended to be created using EPG to separate a series of TV programmes. The recorded start time and the duration are managed by group of recorded programmes.

Figure A.1 shows the example of the PRGR_Base stream file and related files. In this example, a user records channel 5 from 18:00 to 20:00 on October 10th including two TV programmes. Two recorded programmes, whose file names are "PT_TVRS/TVPRO100/PROG0001.PIF" and "PT_TVRS/TVPRO100/PROG0002.PIF", are stored. Then two PGRs, which correspond to each recorded programme, are created. These PGR_IDs are equal to 1 and 2 each. Then a PGRG, which is equal to 1. The PGRG manages the recorded start time and the duration input by a user. The PGRG_0001 is an element of PGRG_Base. In the same way, a user records channel 11 from 20:00 to 21:00 on October 11th including two TV programmes. Two recorded programmes, whose file names are

"PT_TVRS/TVPRO100/PROG0003.PIF" and "PT_TVRS/TVPRO100/PROG0004.PIF", are stored. Then two PGRs, which correspond to each recorded programme, are created. These PGR_IDs are equal to 3 and 4 each. Then a PGRG, which consists of two PGRs, is created. The stream file name is "PGRG_0002" and the PGRG_ID is equal to 2. The PGRG_0002 is also an element of PGRG_Base. At the moment, the PGRG_Base manages two PGRGs whose PGRG_IDs are equal to 1 and 2 each.

A.2 Example of users' editing and its representation

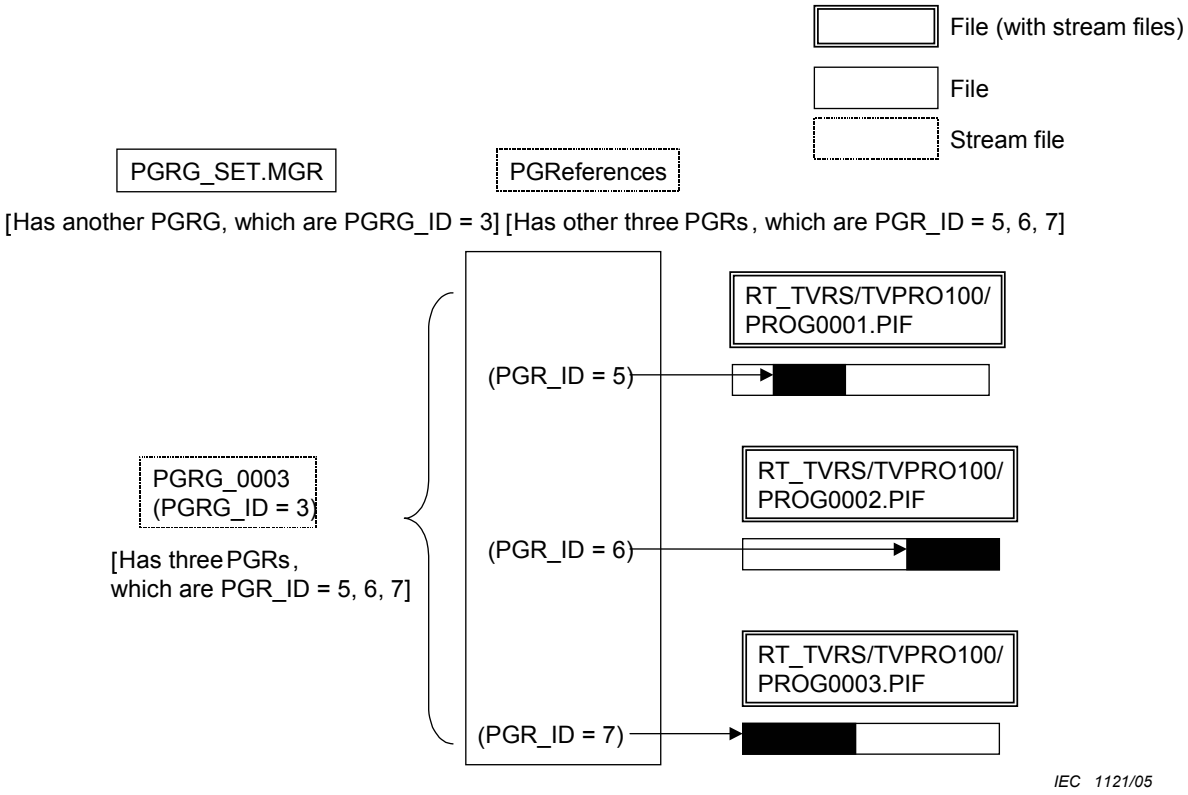


Figure A.2 – Example of users' editing

PGRG is also used in users' editing. Figure A.2 gives an example. At first, a user wants to extract part of the AV stream in "RT_TVRS/TVPRO100/PROG0001.PIF". In this case, a PGR which points a part of the AV stream is created. The PGR_ID is 5. In the same manner, PGRs whose PGR_IDs are equal to 6 and 7 each is created. Then a PGRG, which consists of three PGRs, is created. The stream file name is "PGRG_0003" and the PGRG_ID is equal to 3. The PGRG represents a digest version of three TV programmes.

Bibliography

The following documents have served as references in the preparation of this standard.

Universal Disk Format (UDF) Specification, Revision 2.01, OSTA, 2000-03
<http://www.osta.org/specs/pdf/udf201.pdf>

Secure UDF Specification, Revision 1.00, OSTA, 2002-2
<http://www.osta.org/specs/pdf/SecureUDF_1_00.pdf>

JIS/TR X 0040:2001 Security Extension to Universal Disk Format (UDF)

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A Prioritaire

RÉPONSE PAYÉE

SUISSE

Customer Service Centre (CSC)
International Electrotechnical Commission
3, rue de Varembé
1211 GENEVA 20
Switzerland

Q1 Please report on **ONE STANDARD** and **ONE STANDARD ONLY**. Enter the exact number of the standard: *(e.g. 60601-1-1)*

.....

Q2 Please tell us in what capacity(ies) you bought the standard *(tick all that apply).* I am the/a:

purchasing agent ❑
librarian ❑
researcher ❑
design engineer ❑
safety engineer ❑
testing engineer ❑
marketing specialist ❑
other.....

Q3 I work for/in/as a: *(tick all that apply)*

manufacturing ❑
consultant ❑
government ❑
test/certification facility ❑
public utility ❑
education ❑
military ❑
other.....

Q4 This standard will be used for: *(tick all that apply)*

general reference ❑
product research ❑
product design/development ❑
specifications ❑
tenders ❑
quality assessment ❑
certification ❑
technical documentation ❑
thesis ❑
manufacturing ❑
other.....

Q5 This standard meets my needs: *(tick one)*

not at all ❑
nearly ❑
fairly well ❑
exactly ❑

Q6 If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date ❑
standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

Q7 Please assess the standard in the following categories, using the numbers:
(1) unacceptable,
(2) below average,
(3) average,
(4) above average,
(5) exceptional,
(6) not applicable

timeliness.....
quality of writing.....
technical contents.....
logic of arrangement of contents .....
tables, charts, graphs, figures.....
other .....

Q8 I read/use the: *(tick one)*

French text only ❑
English text only ❑
both English and French texts ❑

Q9 Please share any comment on any aspect of the IEC that you would like us to know:

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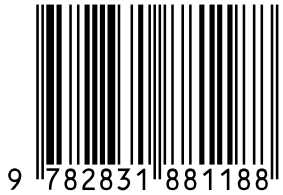

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