ABSTRACT

The invention concerns a method for permanently erasing part of a program recorded on a recording medium, a method for recovering a temporarily erased part of a program recorded on a recording medium and a method for re-using on-the-fly during recording a temporary erased part of a program recorded on a recording medium. In each case, the program consists of a digital data stream that is organised into one or more Stream Objects representing video data or audio data or other digital data information, and representing original navigation data for facilitating management of said digital data stream, wherein said navigation data contains one or more cells that are logically linked with said Stream Objects by stream cell information, and wherein said Stream Objects comprise one or more stream object units.

AUSTRALIA

Patents Act 1990

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COMPLETE SPECIFICATION
STANDARD PATENT
DIVISIONAL

Invention Title:

Method for marking digital data

The following statement is a full description of this invention including
the best method of performing it known to us:-

Title
    Method for marking digital data

Technical Field

5   The invention relates to a method for permanently erasing a part of a program medium. The invention further relates to a method for recovering a temporarily erased part of a program recorded on a recording medium, and a method for re-using on-the-fly during recording a temporarily erased part of a program recorded on a recording medium.

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Background Art

    In bitstream recording one is free to subdivide the bitstream into sub-units of more regular structure. Presentation data in DVDs (digital video or versatile disc) is organised into units called Video Object Unit, denoted VOBU, e.g. in the DVD

15 Specifications for Video Recording. VOBUs have a variable size (data amount measured in number of sectors), but have also a variable duration (measured in number of video fields).

    For data retrieval from the disc the DVD Specifications for Video Recording foresees a 'VOBU map' which is a table where for every VOBU in a recording the

20 length in sectors and the duration in fields is entered.

Summary of the Invention

    Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated

25 element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

    In a first aspect, the present invention is a method for permanently erasing part of a program recorded on a recording medium, which program comprises a digital data stream that is organised into one or more Stream Objects (SOB) representing video data

30 or audio data or other digital data information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contains one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and wherein said Stream Objects (SOB) comprise one or more stream object units (SOBU), and wherein, before

35 permanently erasing, said program part was temporarily erased using the steps of:

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    A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was intended to be temporarily erased, wherein the new navigation data (cell #k, cell #k+1, cell #k+2) were generated such that the corresponding stream cell information (SCI) of

5   said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage

of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing part of said Stream Object (SOB) was changed from displayable to temporarily erased and therefore not displayable;

B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said Stream Object (SOB) was created;

C) Corresponding original navigation data (cell #k) was replaced with said new navigation data (cell #k, cell #k+1, cell #k+2),

said permanently erasing method including the steps of:

- Permanently erasing the cell part which corresponds to said temporarily erased cell part by shifting the cell part following the cell part corresponding to said

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temporarily erased cell part towards the cell part preceding said temporarily erased cell part, wherein to the shifted cell part a new Stream Object (SOB#n+1) is assigned,

- Updating correspondingly a Stream File Information, an Original Program Chain Information and a User Defined Program Chain Information, which
5 Stream File Information, Original Program Chain Information and User Defined Program Chain Information is contained in said navigation data of said recording medium.

In a second aspect, the present invention is a method for recovering a temporarily erased part of a program recorded on a recording medium, which program
10 comprises a digital data stream that is organised into one or more Stream Objects (SOB) representing video data or audio data or other digital data information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contain one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and
15 wherein said Steam Objects (SOB) comprise one or more stream object units (SOBU), and wherein, before recovering, said program part was temporarily erased using the steps of:

A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was
20 intended to be temporarily erased, wherein the new navigation data (cell #k, call #k+1, cell #k+2) were generated such that the corresponding stream cell information (SCI) of said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

25   a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second
30 part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said
35 current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

5   a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (call #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a

10   second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing part of said Stream Object (SOB) was changed from displayable to temporarily erased

15   and therefore not displayable;

B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said Stream Object (SOB) was created;

C) Corresponding original navigation data (cell #k) was replaced with said new navigation. data (cell #k, cell #k+1, cell #k+2),

20   said recovering method including the steps of:

- Combining the cell part corresponding to said temporarily erased cell part and the cell part following the cell part corresponding to said temporarily erased ceil part with the cell part preceding said temporarily erased cell part so as to re-form one cell and to reverse said split,

25   - Updating said navigation data of said recording medium such that following said recovery the corresponding navigation data is completely identical with the state before said temporary erasure.

In a third aspect, the present invention is a method for re-using on-the-fly during recording a temporary erased part of a program recorded on a recording medium, which

30   program comprises a digital data stream that is organised into one or more Stream Objects (SOB) representing video data or audio data or other digital data information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contains one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and

35   wherein said Stream Objects (SOB) comprise one or more stream object units (SOBU),

and wherein, before said re-using, said program part was temporarily erased using steps of:

A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was
5 intended to be temporarily erased, wherein. the new navigation data (cell #k, cell #k+1, cell #k+2) were generated such that the corresponding stream cell information (SCI) of said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

10   a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second
15 part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said
20 current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

25   a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a
30 second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing part of said Stream Object (SOB) was changed from displayable to temporarily erased
35 and therefore not displayable;

B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said Stream Object (SOB) was created;

C) Corresponding original navigation data (cell #k) was replaced with said new navigation data (cell #k, cell #k+1, cell #k+2),

said method of re-using on-the-fly during recording the temporary erased program part including the steps of:

- searching (MAPL) for temporarily erased cell parts for erase application packet arrival time stamps (ERA_S_APAT, ERA_E_APAT) that make the exact position of stream object units locatable;

- permanently erasing and re-using for the recording complete stream object units (SOBU) only of said temporary erased program parts.

It is an advantage of at least one embodiment of the invention to disclose a method for temporarily erasing a part of a program to enable on the fly permanent erasure without any additional view into the streams or complete withdrawal of the temporarily erasure.

The directory and file structure of DVD Stream Recording is organized in Stream Data and Navigation Data of the DVD Stream Recording as follows:

Any DVD Streamer Device has certain requirements to store its own, Streamer-specific navigation data on the disc. These data are solely for helping the retrieval of recorded data; they need not be understood or even be visible to any outside

5 Application Device.

Any DVD Streamer Device needs to communicate with the Application Device it is connected to. This communication should be straightforward, and as universal as possible, so

10 that the maximum possible range of applications - both today and future - can be connected to the Streamer. The Navigation Data to support such communication must be understandable by the Streamer as well as by the Application Device; they will be called „Common navigation data" in the following.

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The Streamer Device should offer to the connected Application Device a means for storing its own private data of any desired kind. The Streamer needs not to understand any of the content, internal structure, or meaning of this "Application-

20 specific navigation data".

Navigation data is provided to control the recording, playing back, and editing of any bitstreams that are recorded. In DVD Stream Recording, Navigation Data is called "Streamer

25 Information" (STRI). STRI consists of six kinds of information tables, namely Streamer Video Manager Information (STR_VMGI), Stream File Information Table (SFIT), Original Program Chain Information (ORG_PGCI), User Defined Program Chain Information (UD_PGCI), Text Data Manager (TXT_DT_MG),

30 and Application Private Data Manager (APD_MG).

The Stream File Information Table contains the information where on the recording media the stream data are recorded. The Original PGC Information has the function of a play list,

35 which contains all takes which were made. A take is defined as containing the information between a start and a stop

action in the sequence of recording or also called one program of the ORG_PGCI. In addition, a Stream Object (SOB) contains a full take or part of a take. With both tables the data can be retrieved for playback.

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The User Defined PGC Information contains information, which are defined by a user.

In order to address more precisely a program contains one or
10 more cells. A cell points to Stream Object Units (SOBU) and to each SOBU an Incremental Application Packet Arrival Time (IAPAT) is assigned.

According to an embodiment of the invention a temporarily erased flag is
15 introduced in order to indicate a cell to be temporarily erased. In addition necessary time stamps are set in a special way to enable on the fly permanent erasure without any additional view into the streams or quick permanent erasure. Advantageously the temporarily erasure can be
20 withdrawn completely also.

For a permanent erasure of temporarily erased (TE) cells an adaptation of Stream Cell Start Application Packet Arrival Time (SC_S_APAT) and Stream Cell End Application Packet
25 Arrival Time (SC_E_APAT) is needed. In order to realize this during recording a calculation must be performed without any additional views into the stream. This will be realized by following definition of TE cells:
The TE cell covers a part of a SOB. SC_S_APAT and SC_E_APAT
30 of a TE cell are set in a way that only all complete SOBUs, covered by the TE cell, are marked, i.e.
following rules define SC_S_APAT and SC_E_APAT of a TE cell. They must be completely fulfilled:

35 SC_S_APAT is equal to the Application Packet Arrival Time (APAT) of the first application packet of an SOBU and

if the TE cell covers the start of the SOB, then
SC_S_APAT is equal to the APAT of the first application
packet of the first SOBU of the SOB.
In all other cases

5   SC_S_APAT is equal to or greater than the APAT of the first
application packet of the TE part and
SC_S_APAT is as close as possible to the APAT of the first
application packet of the TE part.

10   SC_E_APAT is equal to the APAT of the first application
packet of an SOBU and
if the TE cell covers the end of the SOB, then
SC_E_APAT is equal to the APAT of the first application
packet of the SOBU following immediately the last SOBU of

15   this SOB.
In all other cases
SC_E_APAT is equal to or less than the APAT of the
application packet which follows immediately the last
application packet of the TE part and

20   SC_E_APAT is as close as possible to the APAT of the last
application packet of the TE part.

Note 1: The definition above assumes that an SOBU exists
after the last SOBU of the SOB. This SOBU doesn't exist

25   really.
Therefore, the following rules define the APAT of the first
application packet of the SOBU following immediately the last
SOBU of this SOB:
this APAT is greater than the APAT of the last application

30   packet of this SOB and
the 18 (= MTU_SHFT) least significant bits of this APAT value
are set to zero and
this APAT value is as close as possible to the last
application packet of the SOB.

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Note 2: TE part means all application packets of an SOB which are not part of the normal cells and which are contiguous on the stream, i.e. no breaks via normal cells. The boundaries of TE parts are normal cells or SOB boundaries. Therefore,

5 each TE part contains one TE cell.

Note 3: SC_E_APAT may be less than SC_S_APAT. The TE part contains complete SOBUs only in the case SC_S_APAT < SC_E_APAT.

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Note 4: For small SOBUs the SC_S_APAT and the SC_E_APAT will be set by the definition above, so that the streamer is able to recognize whether the TE part is only inside one SOBU (SC_S_APAT > SC_E_APAT) or the TE part starts in one SOBU and

15 ends in the following SOBU (SC_S_APAT = SC_E_APAT). Only for the (normal) case, that the TE part covers complete SOBUs SC_S_APAT will be less than SC_E_APAT.

As a first alternative it is proposed:

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Stream Cell General Information (SC_GI)

	Contents	Number of Bytes
	reserved	1
(1) C_TY	Cell Type	1
(2) SC_EPI_Ns	Number of Entry Point Information	2
(3) SOB_N	Stream Object number	2
(4) SC_S_APAT	Stream Cell Start APAT	6
(5) SC_E_APAT	Stream Cell End APAT	6
	Total	18

(1) C_TY
Describes the Cell Type of this Stream Cell.

25

C_TY1   ... '010b' shall be described for all Stream Cells.

TE   ... *'0b':*   *This Cell is in the "Normal" state.*

          '1b':   *This Cell is in "Temporarily Erased"*

            state.

Preferably C_TY1 is represented by the first MSBs followed by

5   the TE bits. The remaining LSBs are reserved.

(2) SC_EPI_Ns

Describes the number of Entry Point Information contained in
this SCI.

10   (3) SOB_N

Describes the number of the SOB to which this Cell refers.

(4) SC_S_APAT

Describes the Start Application Packet Arrival Time (Start
APAT) of this Stream Cell in DVD Stream Recording's PAT

15   Describing Format.

If this cell is a TE cell without a previous TE cell of the
same SOB, then this SC_S_APAT describes the APAT of the first
Application Packet of the first SOBU, the beginning of which
is contained in or after the TE Cell.

20   (5) SC_E_APAT

For a "Normal" Cell, this describes the End Application
Packet Arrival Time (End APAT) of this Stream Cell in DVD
Stream Recording's PAT Describing Format.

For a "Temporarily Erased" Cell, this describes the APAT of

25   *the first Application Packet of that SOBU which contains the*
Application Packet immediately following the TE Cell.

The requirements for the temporary erasure:

1. Any TE part of a stream shall be completely

30   reconstructable.

2. The start and end location marks of the TE parts shall be
   time based with APAT precision (note: the consumer doesn't
   know anything about SOBs, SOBUs or MAPLs).

3. During a recording the TE parts shall be permanently
   erasable without any view into the stream (real time
   recycling).

The realization of these requirements is done by a TE flag
5 inside the cells of the original PGCs. This flag indicates
   cells which are temporarily erased.

A TE process changes the ORG_PGCI. The UD_PGCI and the SFI
content won't be changed. The main action is done inside the
10 program #j. The temporary erasure will be done by separating
   the cells of the program #j into the parts which covers the
   normal stream part (not erased) and the TE part.

After the reconstruction the complete Nav. Data is completely
identical with the state before the temporary erasure.
15

Rules for SC_S_APAT and SC_E_APAT for normal Cells

The normal cells point into its assigned SOB, i.e. if
SC_E_APAT is equal to SOB_E_APAT of its assigned SOB, then
this cell ends with the last application packet of its
20 assigned SOB.

The nomenclature to define SC_S_APAT and SC_E_APAT is as
follows:

1. cell #k shall denote the normal cell

2. $SC\_S\_APAT_k$ and $SC\_E\_APAT_k$ shall denote the start and end
25 time of cell #k

3. SOB_N(k) shall denote the assigned SOB number of cell #k.

The definition of SC_S_APAT and SC_E_APAT of normal cells:

1. $SOB\_S\_APAT_{SOB\_N(k)} \leq SC\_S\_APAT_k \leq SC\_E\_APAT_k \leq SOB\_E\_APAT_{SOB\_N(k)}$

30 2. $SC\_S\_APAT_k$ is equal to the APAT of the application packet
   inside SOB #SOB_N(k) which represents the first application
   packet of cell #k

3.$SC\_E\_APAT_k$ is equal to the APAT of the application packet inside SOB #SOB_N(k) which represents the last application packet of cell #k

5 Rules for SC_S_APAT and SC_E_APAT for TE Cells

The information stored in the TE cells shall be defined in a way

* that the original state of the program is 100% reconstructable and

10 * that the by the TE part completely covered SOBUs are indicated (this is demanded in order to be able to reuse complete SOBUs of TE parts on the fly during recording, i.e. without any view into the stream)

The nomenclature to define SC_S_APAT and SC_E_APAT is as
15 follows:

* cell #k shall denote the TE cell

* $SC\_S\_APAT_k$ and $SC\_E\_APAT_k$ shall denote the start and end time of cell #k

* SOB_N(k) shall denote the assigned SOB number of cell #k.
20

The definition of SC_S_APAT and SC_E_APAT of TE cells:

1.   if the TE part starts with the first Application Packet of a SOBU or the TE part contains the start of the SOB,
25   then SC_S_APAT is the APAT of the first Application Packet of that SOBU which contains the first Application Packet of the TE part.

2.   In all other cases:

2.1 If k>1 and cell #k-1 is a TE cell of the SOB
30   #SOB_N(k), then

SC_S_APAT$_k$ is the APAT of the first Application Packet of this TE part.

2.2 In all other cases: SC_S_APAT$_k$ is equal to the APAT of the first Application Packet of that SOBU which follows immediately the SOBU containing the first Application Packet of the TE part.

3. SC_E_APAT$_k$ is equal to the APAT of the first Application Packet of that SOBU which contains the Application Packet immediately following the TE part.

Note 1: The definition above for SC_S_APAT and SC_E_APAT assumes that an Application Packet exists after the last Application Packet of the SOB. This Application Packet doesn't exist really. Therefore, the following rules define the APAT of the Application Packet following immediately the last Application Packet of this SOB:

- this APAT is an integer multiple of the IAPAT Time Unit and

- this APAT is greater than the APAT of the last Application Packet of this SOB and

- this APAT is as close as possible to the last Application Packet of the SOB and

- this APAT is an APAT of the first Application Packet of a SOBU

Note 2: TE part means all application packets of an SOB which are not part of the normal cells and which are contiguous on the stream, i.e. no breaks via normal cells. The boundaries of TE parts are either normal cells, other TE cells or SOB boundaries. Therefore, each TE part contains one TE cell.

Note 3: SC_E_APAT may be less than SC_S_APAT. The TE part contains complete SOBUs only in the case SC_S_APAT < SC_E_APAT. The 3 possible cases of SC_S_APAT and SC_E_APAT of an TE cell:

1) SC_S_APAT < SC_E_APAT

There is at least one complete SOBU inside the TE part of this TE cell. All complete SOBUs of this TE part can be permanently erased (e.g. during recording).

2) SC_S_APAT = SC_E_APAT

There is no complete SOBU inside the TE part of this TE cell. But the TE part has Application Packets in 2 SOBUs. A permanent erasure would split the assigned SOB between these 2 SOBUs into 2 SOBs. I.e. the resulting 2 SOBs doesn't share any SOBU.

3) SC_S_APAT > SC_E_APAT

There is no complete SOBU inside the TE part of this TE cell. The TE part has Application Packets only in 1 SOBU. A permanent erasure would split the assigned SOB inside one SOBU into 2 SOBs. I.e. the resulting 2 SOBs share a common SOBU.

So, each state is unambiguous and contains a lot of information about the location of the cells inside the stream.

As a second alternative it is proposed:

Stream Cell General Information (SC_GI)

	Contents	Number of Bytes
	reserved	1
(1) C_TY	Cell Type	1
(2) SC_EPI_Ns	Number of Entry Point Informations	2
(3) SOB_N	Stream Object number	2
(4) SC_S_APAT	Stream Cell Start APAT	6
(5) SC_E_APAT	Stream Cell End APAT	6
if (TE=='10b') {		
(6) ERA_S_APAT	Erase Start APAT	6
(7) ERA_E_APAT	Erase End APAT	6

		Total	18 or 30

with:

(1) C_TY

5 Describes the Cell Type of this Stream Cell.

C_TY1 ... '010b' shall be described for all Stream Cells.

TE ... '00b': This Cell is in the "Normal" state.

10 '01b': This Cell is in "Temporarily Erased" state; and this Cell starts after the first Application Packet of a SOBU and ends before the last Application Packet of the same SOBU.

15 '10b': This Cell is in "Temporarily Erased" state; and this Cell contains at least one SOBU border (first or last Application Packet of a SOBU). ERA_S_APAT and ERA_E_APAT exist for this Cell.

20 (2) SC_EPI_Ns
Describes the number of Entry Point Information contained in this SCI.

(3) SOB_N
Describes the number of the SOB to which this Cell refers.

25 (4) SC_S_APAT
Describes the Start Application Packet Arrival Time (Start APAT) of this Stream Cell in DVD Stream Recording's PAT Describing Format.

(5) SC_E_APAT
30 Describes the End Application Packet Arrival Time (End APAT) of this Stream Cell in DVD Stream Recording's PAT Describing Format.

(6) ERA_S_APAT

For a "Temporarily Erased" Cell, this describes the APAT of the first Application Packet of the first SOBU, the beginning of which is contained in the TE Cell or after that Cell.

5 *(7) ERA_E_APAT*

For a "Temporarily Erased" Cell, this describes the APAT of the first Application Packet of that SOBU which contains the Application Packet immediately following the TE Cell.

10 The SCI definition of the ORG_PGCI contains a TE flag inside C_TY (Cell Type) of its SC_GI. This TE flag indicates whether this is an TE cell (TE flag is set) or a normal cell (TE flag is cleared).

15 <u>Drawings</u>

Embodiments of the invention are described with reference to the accompanying drawing, which shows in:

Fig. 1 TE and Permanent Erasure seen from SOBU level;
20 Fig. 2 The principle of temporary erasure including reconstruction;
Fig. 3 principle of a permanent erasure of a TE part;
Fig. 4 Temporary erasure and subsequent permanent erasure;
Fig. 5 TE and subsequent further TE and reconstruction of
25 the first TE cell.

<u>Exemplary embodiments</u>

Exemplary embodiments of the invention are explained in more
30 detail in the following description.

In figure 1 TE and Permanent Erasure seen from SOBU level is shown. In the upper part of the drawing labeled 'original program" a program #j contains one cell #k with one SC_S_APAT
35 and one SC_E_APAT. The cell #k contains several SOBUs from

SOBU #1 to SOBU #6. To each SOBU an Incremental Application
Packet Arrival Time (IAPAT) is assigned.

5   In the middle part labeled 'after TE" the gray marked part of
program #j is marked for example by a user or based on given
parameter as being temporarily erased. The program #j contain
now 3 cells from cell #k to cell #k+2. Cell #k and cell #k+2
can be played back, while on cell #k+1 an erased flag is set.
Cell #k+1 contains a TE part, which was decided to be erased
10   and a smaller TE cell, which can be used for later recording.

To cell #k a new SC_E_APAT and to cell #k+2 a new SC_S_APAT
are assigned. To enable on-the-fly erasure SC_E_APAT
SC_S_APAT for cell #k+1 have to be calculated by the
15   following rules:

SC_S_APAT is equal to the Application Packet Arrival Time
(APAT) of the first application packet of an SOBU and
if the TE cell covers the start of the SOB, then
20   SC_S_APAT is equal to the APAT of the first application
packet of the first SOBU of the SOB.
In all other cases
SC_S_APAT is equal to or greater than the APAT of the first
application packet of the TE part and
25   SC_S_APAT is as close as possible to the APAT of the first
application packet of the TE part.

SC_E_APAT is equal to the APAT of the first application
packet of an SOBU and
30   if the TE cell covers the end of the SOB, then
SC_E_APAT is equal to the APAT of the first application
packet of the SOBU following immediately the last SOBU of
this SOB.
In all other cases

SC_E_APAT is equal to or less than the APAT of the
application packet which follows immediately the last
application packet of the TE part and
SC_E_APAT is as close as possible to the APAT of the last
5. application packet of the TE part.

The program #j contains now 3 cells from cell #k to cell
#k+2. Cell #k and cell #k+2 can be played back, while on cell
#k+1 an erased flag is set.
10

In the lower part labeled "after permanent erasure" the
program #j contains only two cells, that are cell #k and cell
#k+1 (former cell #k+2), while the TE cell of the former cell
#k+1 was erased.
15

The SOBUs of each cell #k and cell #k+1 have been renumbered
and also the assigned IAPATs. As shown in this example a
small area marked in gray remains in the bit stream, which
cannot be used for recording of further data.
20

After permanent erasure the Stream File Information, the
Original PGC Information and the User Defined PGC Information
are updated.

25 Description and requirements for User Operations related to
Temporary Erasure.

The invention handles two kinds of erasure. The first one is
to permanently erase parts of a stream. The other one is to
30 temporarily erase (TE) parts of a stream. Fig. 2 shows the
principle of temporary erasure including reconstruction.

The requirements for the temporary erasure:

1.Any TE part of a stream shall be completely
reconstructable.

2. The start and end location marks of the TE parts shall be time based with APAT precision because the consumer doesn't know anything about SOBs, SOBUs or MAPLs.

3. During a recording the TE parts shall be permanently
5   erasable without any view into the stream that means real time recycling.

The realization of these requirements is done by a TE flag inside the cells of the original PGCs. This flag indicates cells which are temporarily erased.
10

Fig. 3 shows the principle of a permanent erasure of a TE part.

A TE process changes the ORG_PGCI. The UD_PGCI and the SFI content won't be changed. The main action is done inside the
15   program #j. The temporary erasure will be done by separating the cells of the program #j into the parts which covers the normal stream part - not erased - and the TE part.

After the reconstruction the complete Navigation Data is completely identical with the state before the temporary
20   erasure.

Rules for SC_S_APAT and SC_E_APAT for Cells

The normal and the TE cells point into its assigned SOB, i.e. if SC_E_APAT is equal to SOB_E_APAT of its assigned SOB, then
25   this cell ends with the last application packet of its assigned SOB.

The nomenclature to define SC_S_APAT and SC_E_APAT is as follows:

1. cell #k shall denote the normal or TE cell

30   2. $SC\_S\_APAT_k$ and $SC\_E\_APAT_k$ shall denote the start and end time of cell #k

3. SOB_N(k) shall denote the assigned SOB number of cell #k.

The definition of SC_S_APAT and SC_E_APAT of normal and TE cells:

1. $SOB\_S\_APAT_{SOB\_N(k)} \leq SC\_S\_APAT_k \leq SC\_E\_APAT_k \leq SOB\_E\_APAT_{SOB\_N(k)}$

2. $SC\_S\_APAT_k$ is equal to the APAT of the application packet
   inside SOB #SOB_N(k) which represents the first application
   packet of cell #k

3. $SC\_E\_APAT_k$ is equal to the APAT of the application packet
   inside SOB #SOB_N(k) which represents the last application
   packet of cell #k

Rules for ERA_S_APAT and ERA_E_APAT for TE Cells

Only when a TE cell covers at least one SOBU border - start
or end application packet of a SOBU -, then this TE cell
contains ERA_S_APAT and ERA_E_APAT. These two APATs mark the
SOBUs which are completely covered by a TE cell. This
information is useful to reuse the TE SOBUs on-the-fly, i.e.
without any view into the stream.

The definition of ERA_S_APAT and ERA_E_APAT:

1. if SC_S_APAT is the first Application Packet of a SOBU or
   the TE Cell contains the start of the SOB, then
   ERA_S_APAT is equal to the APAT of the first Application
   Packet of that SOBU which contains the Application Packet
   with the APAT SC_S_APAT.

2. In all other cases
   ERA_S_APAT is equal to the APAT of the first Application
   Packet of that SOBU which follows immediately the SOBU
   containing the Application Packet with the APAT SC_S_APAT.

3. ERA_E_APAT is equal to the APAT of the first Application
   Packet of that SOBU which contains the Application Packet
   immediately following the TE Cell

Note 1: The definitions above for ERA_S_APAT and ERA_E_APAT
assume that an Application Packet exists after the last
Application Packet of the SOB. This Application Packet

doesn't exist really. Therefore, the following rules define the APAT of the Application Packet following immediately the last Application Packet of this SOB:

- this APAT is an integer multiple of the IAPAT Time Unit
5 and

- this APAT is greater than the APAT of the last Application Packet of this SOB and

- this APAT is as close as possible to the last Application Packet of the SOB and

10 - this APAT is an APAT of the first Application Packet of a SOBU

Note 2: ERA_S_APAT may be equal to ERA_E_APAT, i.e. no complete SOBU is covered by the TE cell. The TE cell contains
15 complete SOBUs only for the case ERA_S_APAT < ERA_E_APAT. If even ERA_S_APAT is equal to ERA_E_APAT inside each TE cell of a TE cell chain, then between the TE cells are complete SOBUs.

Note 3: TE cells which start after the first application
20 packet of a SOBU and ends before the last application packet of the same SOBU will have no ERA_S_APAT and no ERA_E_APAT.

Following figures shall explain the definition of TE cells. Fig. 4 shows a temporary erasure with a subsequent permanent erasure of the just temporarily erased part. Fig. 5 shows a
25 temporary erasure with a subsequent second temporary erasure behind the just temporarily erased part. After that, a reconstruction of the first TE part is shown.

The gray parts mark the not presentable (TE) parts of the stream. The dark gray parts mark the temporarily erased
30 complete SOBUs.

Re-use of TE cells on-the-fly during recording

The TE cells contain 2 special APATs: ERA_S_APAT and
ERA_E_APAT. The actual intention of these 2 APATs is to allow
to reuse TE SOBUs during recording, i.e. when the disc
becomes full during recording, then the streamer shall be
5 able to permanently erase TE cells, in order to get new free
SOBUs to continue the recording without any break. The APATs
SC_S_APAT and SC_E_APAT of the TE cell aren't exact enough
for this purpose, because a search via the MAPL results in 2
possible positions of the assigned SOBU (SOBU #m or SOBU
10 #m+1). A search via the MAPL would require an additional
search inside the stream. That's not possible in realtime.
But, with ERA_S_APAT and ERA_E_APAT the exact SOBU position
is locateable via the MAPL without any view into the stream.

15

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for permanently erasing part of a program recorded on a recording medium, which program comprises a digital data stream that is organised into one or more Stream Objects (SOB) representing video data or audio data or other digital data

5 information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contains one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and wherein said Stream Objects (SOB) comprise one or more stream object units (SOBU), and wherein, before permanently erasing, said program

10 part was temporarily erased using the steps of:

A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was intended to be temporarily erased, wherein the new navigation data (cell #k, cell #k+1, cell #k+2) were generated such that the corresponding stream cell information (SCI) of

15 said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said

20 current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream

25 Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream

30 Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (cell #k), then said

35 current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

5   a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing part of said Stream Object (SOB) was changed from displayable to temporarily erased and therefore not displayable;

B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said
10   Stream Object (SOB) was created;

C) Corresponding original navigation data (cell #k) was replaced with said new navigation data (cell #k, cell #k+1, cell #k+2),

said permanently erasing method including the steps of:

- Permanently erasing the cell part which corresponds to said temporarily
15   erased cell part by shifting the cell part following the cell part corresponding to said temporarily erased cell part towards the cell part preceding said temporarily erased cell part, wherein to the shifted cell part a new Stream Object (SOB#n+1) is assigned,

- Updating correspondingly a Stream File Information, an Original Program Chain Information and a User Defined Program Chain Information, which
20   Stream File Information, Original Program Chain Information and User Defined Program Chain Information is contained in said navigation data of said recording medium.

2.   A method for recovering a temporarily erased part of a program recorded on a recording medium, which program comprises a digital data stream that is organised into
25   one or more Stream Objects (SOB) representing video data or audio data or other digital data information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contain one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and wherein said Steam Objects (SOB) comprise one or
30   more stream object units (SOBU), and wherein, before recovering, said program part was temporarily erased using the steps of:

A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was intended to be temporarily erased, wherein the new navigation data (cell #k, call #k+1,
35   cell #k+2) were generated such that the corresponding stream cell information (SCI) of said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage

of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said 5 current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream 10 Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream 15 Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (call #k), then said 20 current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

25 a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing part of said Stream Object (S0B) was changed from displayable to temporarily erased and therefore not displayable;

B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said 30 Stream Object (SOB) was created;

C) Corresponding original navigation data (cell #k) was replaced with said new navigation. data (cell #k, cell #k+1, cell #k+2),

said recovering method including the steps of:

- Combining the cell part corresponding to said temporarily erased cell 35 part and the cell part following the cell part corresponding to said temporarily erased

ceil part with the cell part preceding said temporarily erased cell part so as to re-form one cell and to reverse said split,

- Updating said navigation data of said recording medium such that following said recovery the corresponding navigation data is completely identical with the state before said temporary erasure.

3. A method for re-using on-the-fly during recording a temporary erased part of a program recorded on a recording medium, which program comprises a digital data stream that is organised into one or more Stream Objects (SOB) representing video data or audio data or other digital data information, and representing original navigation data (cell #k) for facilitating management of said digital data stream, wherein said navigation data contains one or more cells that are logically linked with said Stream Objects (SOB) by stream cell information (SCI), and wherein said Stream Objects (SOB) comprise one or more stream object units (SOBU), and wherein, before said re-using, said program part was temporarily erased using steps of:

A) New navigation data (cell #k, cell #k+1, cell #k+2) of a corresponding Stream Object (SOB) was generated in case part of said Stream Object (SOB) was intended to be temporarily erased, wherein. the new navigation data (cell #k, cell #k+1, cell #k+2) were generated such that the corresponding stream cell information (SCI) of said navigation data (cell #k, cell #k+1, cell #k+2) was split depending on the coverage of said intended-to-be-deleted part of said Stream Object (SOB) according to the following rules:

a1) If the program part that was to be temporarily erased covered neither the start of a current cell (cell #k) nor the end of said current cell (cell #k), then said current cell (cell #k) was split into three parts,

wherein a first part (cell #k) was assigned to a first part of the Stream Object (SOB) that was displayable, a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a third part (cell #k+2) was assigned to a third part of said Stream Object (SOB) that was displayable;

a2) If the program part that was to be temporarily erased covered the start of said current cell (cell #k) but not the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

wherein a first part (cell #k) was assigned to a first part of said Stream Object (SOB) that was temporarily erased and therefore not displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was displayable;

a3) If the program part that was to be temporarily erased did not cover the start of said current cell (cell #k) but the end of said current cell (cell #k), then said current cell (cell #k) was split into two parts,

    wherein a first part (cell #k) was assigned to a first part of said Stream

5 Object (SOB) that was displayable, and a second part (cell #k+1) was assigned to a second part of said Stream Object (SOB) that was temporarily erased and therefore not displayable;

    a4) If the program part that was to be temporarily erased covered the start and the end of said current cell (cell #k), then said current cell (cell #k) representing

10 part of said Stream Object (SOB) was changed from displayable to temporarily erased and therefore not displayable;

    B) A link of said new navigation data (cell #k, cell #k+1, cell #k+2) with said Stream Object (SOB) was created;

    C) Corresponding original navigation data (cell #k) was replaced with said new

15 navigation data (cell #k, cell #k+1, cell #k+2),

    said method of re-using on-the-fly during recording the temporary erased program part including the steps of:

    - searching (MAPL) for temporarily erased cell parts for erase application packet arrival time stamps (ERA_S_APAT, ERA_E_APAT) that make the exact

20 position of stream object units locatable;

    - permanently erasing and re-using for the recording complete stream object units (SOBU) only of said temporary erased program parts.

4.   The method according to any one of claims 1 to 3, wherein within the generated navigation data (cell #k, cell #k+1, cell #k+2) for temporarily erased (TE) cells a

25 Stream Cell Start Application Packet Arrival Time (SC_S_APAT) and a Stream Cell End Application Packet Arrival Time (SC_E_APAT) was set, and wherein said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) is equal to an Application Packet Arrival Time (APAT) of the first application packet of a Stream Object Unit (SOBU).

30 5.   The method according to claim 4, wherein said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) was set according to the following rules:

    - If the part of said Stream Object (SOB), which is temporarily erased, covers the start of the Stream Object (SOB), then said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) is equal to the Application Packet Arrival Time (APAT)

35 of the first application packet of the first Stream Object Unit (SOBU) of the Stream Object (SOB);

- If the part of said Stream Object (SOB), which is temporarily erased, does not cover the start of the Stream Object (SOB), then said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) is equal to or greater than the Application Packet Arrival Time (APAT) of the first application packet of the temporarily erased cell, and

5 said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) is as close as possible to the Application Packet Arrival Time (APAT) of the first application packet of the temporarily erased cell;

- Said Stream Cell End Application Packet Arrival Time (SC_E_APAT) is equal to the Application Packet Arrival Time (APAT) of the first application packet of a

10 Stream Object Unit (SOBU);

- If the part of said Stream Object (SOB), which is temporarily erased, covers the end of the Stream Object (SOB), then said Stream Cell End Application Packet Arrival Time (SC_E_APAT) is equal to the Application Packet Arrival Time (APAT) of the first application packet of the Stream Object Unit (SOBU) following immediately the last Stream Object Unit (SOBU) of this Stream Object (SOB);

- If the part of said Stream Object (SOB), which is temporarily erased, does not cover the end of the Stream Object (SOB), then said Stream Cell End Application Packet Arrival Time (SC_E_APAT) is equal to or less than the Application Packet Arrival Time (APAT) of the application packet which follows immediately the last

20 application packet of the temporarily erased cell,

and said Stream Cell End Application Packet Arrival Time (SC_E_APAT) is as close as possible to the Application Packet Arrival Time (APAT) of the last application packet of the temporarily erased cell.

6. The method according to any one of claims 1 to 5, wherein within the generated

25 navigation data (cell #k, cell #k+1, cell #k+2) for a part of said Stream Object (SOB), which is temporarily erased, an Erase Start Application Packet Arrival Time (ERA_S_APAT) was set,

and wherein said Erase Start Application Packet Arrival Time (ERA_S_APAT) is equal to an Application Packet Arrival Time (APAT) of the first application packet

30 of a Stream Object Unit (SOBU).

7. The method according to claim 6, wherein within the generated navigation data (cell #k, cell #k+1, cell #k+2) for a part of said Stream Object (SOB), which was temporarily erased, an Erase End Application Packet Arrival Time (ERA_E_APAT) was set, wherein said Erase End Application Packet Arrival Time (ERA_E_APAT) is

35 equal to the Application Packet Arrival Time (APAT) of the first application packet of a Stream Object Unit (SOBU).

8. The method according to claim 6 or claim 7, wherein said Erase Start Application Packet Arrival Time (ERA_S_APAT) was set according to the following rules:

   - Said Erase Start Application Packet Arrival Time (ERA_S_APAT) is equal to
5 the Application Packet Arrival Time (APAT) of the first application packet of a Stream Object Unit (SOBU);

   - If the part of said Stream Object (SOB), which was temporarily erased, covers the start of the Stream Object (SOB), then said Erase Start Application Packet Arrival Time (ERA_S_APAT) is equal to the Application Packet Arrival Time (APAT) of the
10 first application packet of the first Stream Object Unit (SOBU) of said Stream Object (SOB);

   - If the part of said Stream Object (SOB), which was temporarily erased, does not cover the start of the Stream Object (SOB), then said Erase Start Application Packet Arrival Time (ERA_S_APAT) is equal to or greater than the Application Packet
15 Arrival Time (APAT) of first application packet of the part of said Stream Object (SOB) that was temporarily erased,

   and said Erase Start Application Packet Arrival Time (ERA_S_APAT) is as close as possible to the Application Packet Arrival Time (APAT) of the first application packet of the part of said Stream Object (SOB) that was temporarily erased;
20   - Said Erase End Application Packet Arrival Time (ERA_E_APAT) is equal to the Application Packet Arrival Time (APAT) of the first application packet of a Stream Object Unit (SOBU);

   - If the part of said Stream Object (SOB), which was temporarily erased, covers the end of the Stream Object (SOB), then said Erase End Application Packet Arrival
25 Time (ERA_E_APAT) is equal to the Application Packet Arrival Time (APAT) of the first application packet of the Stream Object Unit (SOBU) following immediately the last Stream Object Unit (SOBU) of this Stream Object (SOB);

   - If the part of said Stream Object (SOB), which was temporarily erased, does not cover the end of the Stream Object (SOB), then said Erase End Application Packet
30 Arrival Time (ERA_E_APAT) is equal to or less than the Application Packet Arrival Time (APAT) of the application packet which follows immediately the last application packet of the part or said Stream Object (SOB) that was temporarily erased.

9. The method according to claim 8, wherein said Erase End Application Packet Arrival Time (ERA_E_APAT) was set as close as possible to the Application Packet
35 Arrival Time (APAT) of the last application packet of the part of said Stream Object (SOB) that was temporarily erased.

32

10. The method according to claim 6, wherein within the generated navigation data (cell #k, cell #k+1, cell #k+2) for a part of said Stream Object (SOB), which was temporarily erased, a Stream Cell Start Application Packet Arrival Time (SC_S_APAT) and a Stream Cell End Application Packet Arrival Time (SC_E_APAT)

5 was set,

and wherein said Stream Cell Start Application Packet Arrival Time (SC_S_APAT) is equal to the Application Packet Arrival Time (APAT) of the first application packet of the part of said Stream Object (SOB) that was temporarily erased,

and wherein said Stream Cell End Application Packet Arrival Time

10 (SC_E_APAT) is equal to the Application Packet Arrival Time (APAT) of the last application packet of the part of said Stream Object (SOB) that was temporarily erased.

11. The method according to any one of claim 3, 8 or 9 wherein, only in case a temporarily erased cell part covers at least one start or end application packet of a stream object unit (SOBU), this temporarily erased cell part contains said Erase Start

15 Application Packet Arrival Time (ERA_S_APAT) and said Erase End Application Packet Arrival Time (ERA_E_APAT).

12. A method for permanently erasing part of a program recorded on a recording medium as claimed in claim 1, substantially as herein described with reference to the accompanying drawings.

20 13. A method for recovering a temporarily erased part of a program recorded on a recording medium as claimed in claim 2, substantially as herein described with reference to the accompanying drawings.

14. A method for re-using on-the-fly during recording a temporarily erased part of a program as claimed in claim 3, substantially as herein described with reference to the

25 accompanying drawings.

Dated this seventh day of December 2005

Deutsche Thomson-Brandt GmbH;
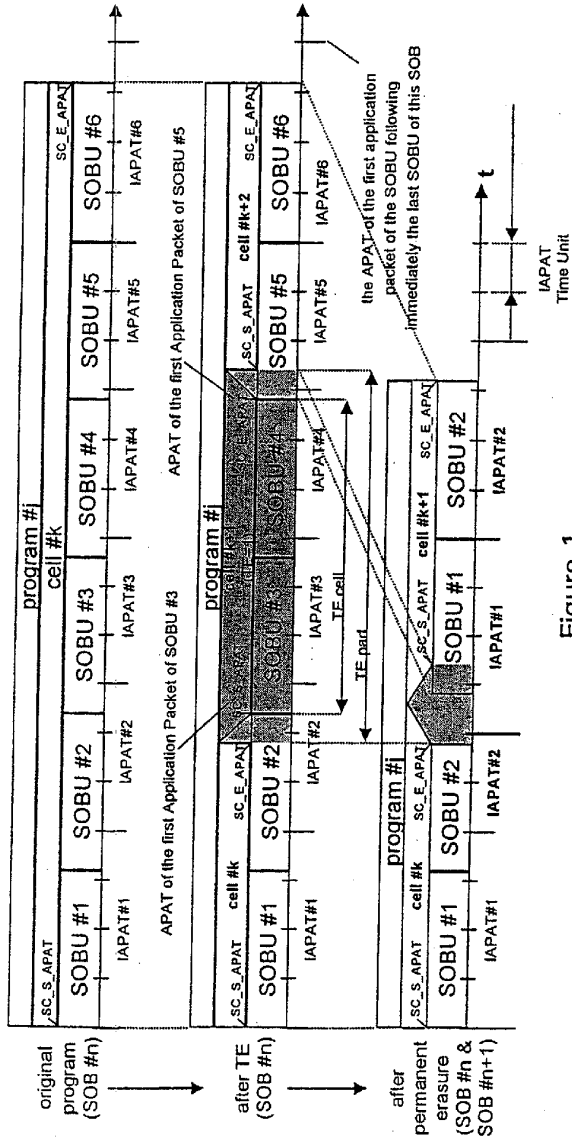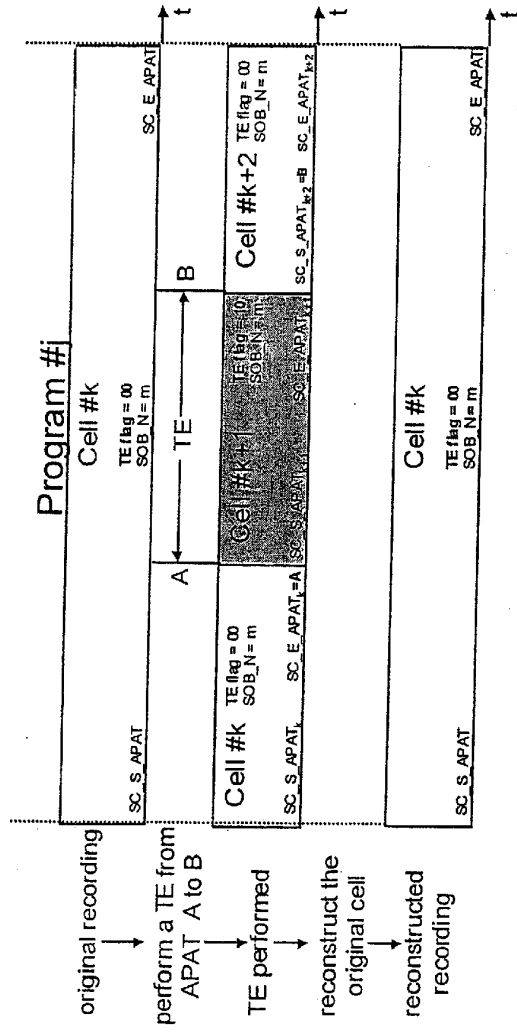Samsung Electronics Co., Ltd.
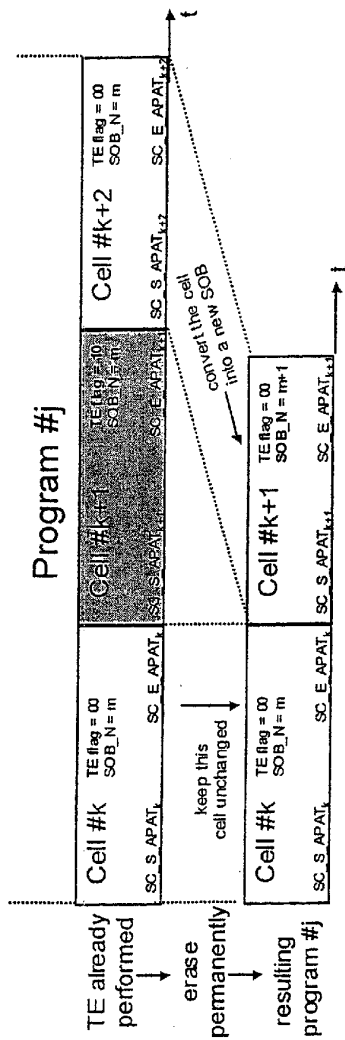Patent Attorneys for the Applicant:

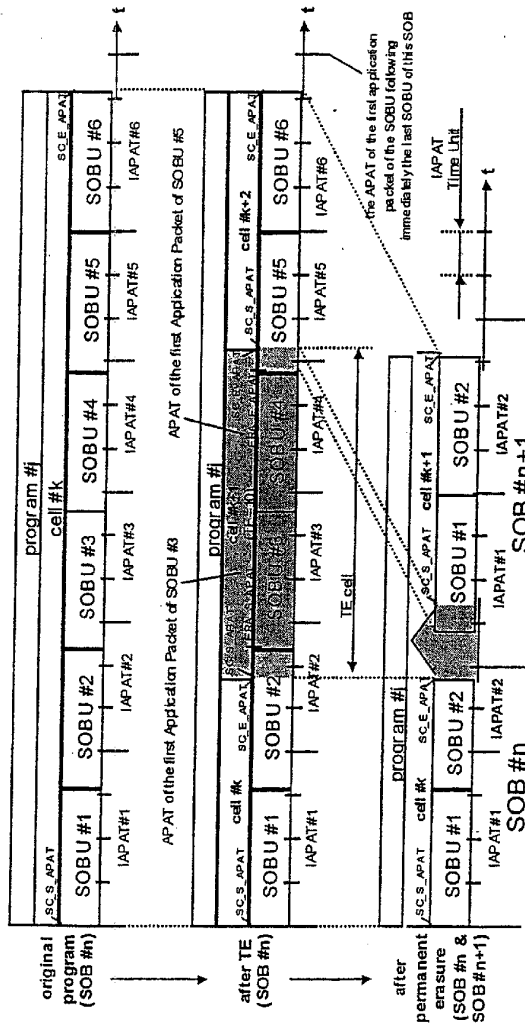F B RICE & CO

Figure 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5