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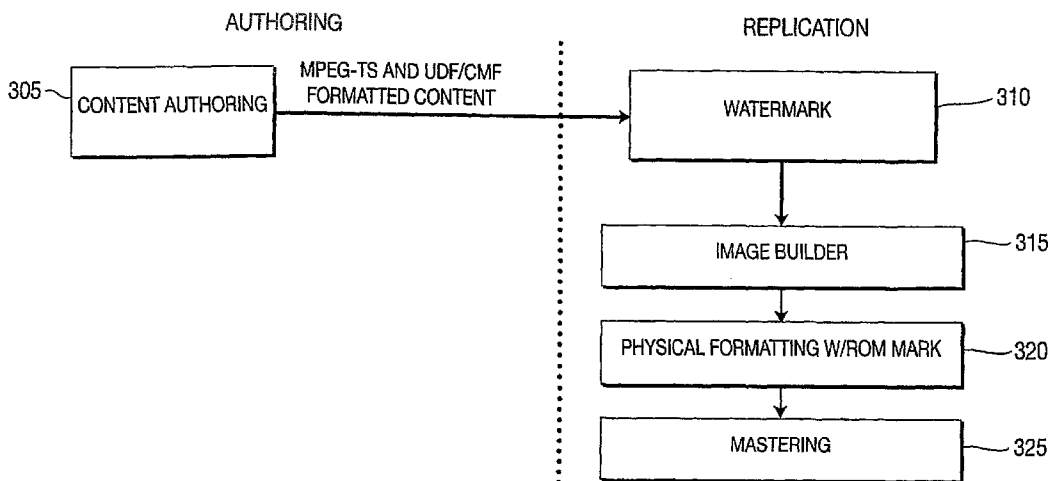
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM AND METHOD FOR PROCESSING CONTENT FOR LATER INSERTION OF DIGITAL WATERMARK AND OTHER DATA



(57) Abstract: A method and system for processing content are described including generating at least one dummy value, inserting the at least one dummy value into the content, selecting at least one position in the content where the at least one dummy value in the content is to be replaced by at least one real value, generating the at least one real value and replacing the at least dummy value with the at least one real value in the content.

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SYSTEM AND METHOD FOR PROCESSING CONTENT FOR LATER INSERTION OF  
DIGITAL WATERMARK AND OTHER DATA

5 FIELD OF THE INVENTION

The present invention relates to digital watermarks and other data and in particular to a method and apparatus for processing content for later insertion of digital watermarks and other data.

10 BACKGROUND OF THE INVENTION

In one prior art approach, additional data are inserted by searching for redundant data in the encoded content and then replacing the redundant data with the real additional data. The prior art describes various ways to locate such redundant data in motion pictures experts group (MPEG) transport streams. Such redundant data are often added by commercial MPEG  
15 encoders and/or multiplexers in MPEG transport streams to control the bit rate.

In another prior art approach, the additional data are inserted by splicing two encoded units of content. The prior art describes a method of splicing two MPEG transport streams without re-multiplexing.

20 SUMMARY OF THE INVENTION

The present invention creates dummy data (or padding data) as "place holders" during content encoding and authoring. At a later stage, these dummy data are replaced by real additional data (watermarks and other data). The real additional data is inserted into the encoded/multiplexed content without re-encoding or re-multiplexing. Thus, the additional data  
25 are inserted into the encoded and multiplexed content with minimal further processing of the content and with minimal impact on the workflow. Content as used herein includes video, audio and any other multimedia content.

A method and system for processing content are described including generating dummy values, multiplexing the dummy values with a transport stream of the content,  
30 selecting at least one position in the content where a value in the content is to be replaced by an alternative value containing a watermark signal, generating at least one alternative value and inserting the at least one alternative value in the content.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is best understood from the following detailed description when read in conjunction with the accompanying drawings. The drawings include the following 5 figures briefly described below where like-numbers on the figures represent similar elements:

Fig. 1 shows encoded content before watermarks and other data are multiplexed.

Fig. 2 shows encoded content with watermarks and other data inserted.

Fig. 3 shows the method of the present invention applied during content authoring and content replication.

10 Fig. 4 depicts the insertion of dummy Advanced Access Content System data during the content authoring phase and the subsequent substitution of Advanced Access Content System keys and files for the dummy files during the replication phase.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 As described in PCT application "Watermarking Encoded Content" (PCT/05/43895, filed December 5, 2005), the process to watermark an encoded content consists of three separate steps:

- Location selection, which is the selection of the position where the value in the encoded content can be replaced by alternative values containing watermark signals.
- 20 • Calculation of alternative values, which is the determination of the alternative values so that the alternative values have the same number of bits as the value the alternative values are to replace in the encoded content and such substitution will not cause perceptual changes to the content. Moreover, these alternative values contain watermark and other data signals.
- 25 • Watermark embedding/insertion, which is the actual replacement/substitution of the value in the encoded content by one of the alternative values containing watermark signals.

The first two steps can be pre-processed before the playback of the content. As a result of the pre-processing, a set of watermark units (WUs) are produced. WUs contain all 30 information for actually embedding/inserting a watermark and other data. Each WU may include the following fields:

- P – the position of the watermark signal in the encoded content. This can be a global byte offset from a known position in the encoded content;
- L – the number of bits occupied by the original value. The start position of the original value is specified by P.
- 5 • V – the original value.
- V1, V2, ...Vn – the valid alternative values containing watermark signals of V. In other words, the replacement of V by any of these alternative values in the encoded content result in neither corruption of the content format nor perceptual artefacts. Each of these alternatives may contain a different watermark signal.

10 The watermark pre-processor takes an encoded content as the input and a watermark key, and outputs a sequence of watermark units. As disclosed in PCT/05/43895, filed December 5, 2005, these watermark units are integrated into the final content as meta-data of the encoded content, as a separate channel multiplexed with the content, as steganographic data hidden in the syntax elements or in the content, or as a separate file stored in the physical  
15 media (optical disc, tape, hard driver, etc.) or transmitted over network (TCP/IP, satellite, etc.).

If WUs are multiplexed with the encoded content, the global position P in each WU in the final multiplexed content must be re-calculated and adjusted because of the insertion of WUs. In one example, assume  $WU1=(P1, 40, V1, V1a)$  and  $WU2=(P2, 40, V2, V2a)$  are two  
20 WUs where V1 and V2 are the original values, and V1a and V2a are the alternative values for each WU, respectively.

Fig. 1 shows the encoded content before these two WUs are multiplexed with encoded content. Fig. 2 shows the encoded content after the encoded content is multiplexed with the WUs. As shown in Fig. 2, the global positions P1 in WU1 and P2 in WU2 become P1' and  
25 P2' after the insertion of  $WU1'=(P1', 40, V1, V1a)$  and  $WU2'=(P2', 40, V2, V2a)$  in the encoded content.

To avoid such re-calculation and adjustment of global positions in WUs, the present invention adds “dummy” WUs in the encoded content before the watermark pre-processing phase (which produces real WUs) during one of the content preparation phases. The content  
30 preparation phases encode, author and multiplexing multiple components of the content.

These “dummy” WUs are identical in size to the real WUs and are inserted in the appropriate places of the encoded content.

Fig. 3 shows the method of the present invention applied during content authoring and replication. Replication is the copying of the processed content (including watermark and/or film marks, which are both herein called watermarks) onto storage media for distribution through/to retail channels including theaters, broadcast media, retail sales/rental outlets etc. Storage media include, but are not limited to, physical media such as optical disks, compact discs (CDs), DVDs, VHS or other tapes. During the content authoring, which is performed by a Content Authoring module 305, the maximum number of dummy WUs are multiplexed with the MPEG-TS (transport stream). The MPEG-TS is further formatted to UDF/CMF files for replication. CMF (Cutting Master Format) is a standardized way of communicating and transferring data between DVD title authoring workstations and DVD glass master cutting systems. UDF (Universal Disk Format) is a specification enabling the file interchange among various platforms and is optimized for large contiguous files. The dummy WU values that are generated can be added to the UDF files, which are then formatted as CMF files or the dummy WU values can be added directly to the CMF files.

In the replication stage, the watermark pre-processor module 310 first parses the UDF/CMF formatted files and extracts the MPEG-TS. Then the watermark pre-processor 310 performs steps 1 and 2 as described above to select locations and calculate alternative values. After WUs are produced, the dummy WUs in MPEG-TS are located and replaced with the real WUs by the watermark pre-processor module 310. If the number of dummy WUs are greater than the number of real WUs, the remaining/excess dummy WUs can remain in the content or be replaced by NULL or redundant data. After the content image is built by the Image Builder module 315, the content is physically formatted by the Physical Formatting Module 320. The physically formatted content is then mastered by the Mastering Module 325.

In another embodiment of the present invention, AACS (Advanced Access Content System) files are inserted during the replication stage. AACS defines an advanced, robust and renewable method for protecting entertainment content including high-definition audio-visual content. In a typical workflow, the encoded content is prepared and formatted as CMF files during authoring, and then such CMF files are transferred to replicator for making discs. However, various AACS keys and other files are only obtained by a disc replicator from an AACS Licensing Agency after receiving CMF files from an authoring phase. Thus, using the method of the present invention dummy data are created and added during UDF formatting

and carried in the CMF files during authoring. At the replication stage, the dummy data are replaced by these AACCS keys and files.

Fig. 4 illustrates the method of the present invention whereby the AACCS files are applied to an optical disc. The AACCS PreProcess module 405 of the authoring stage creates dummy AACCS data. The dummy AACCS data are included in the UDF formatted files and/or CMF formatted files. The content is UDF formatted by a UDF Formatting module 410. The AACCS parameters are generated by the AACCS Parameter module 415. Together the UDF formatted files and the AACCS parameters are input to the CMF Formatting module 420, which generates CMF formatted files. The CMF formatted files are transferred to a replicator by a CMF for Disc module 425 to make discs in the replication phase/stage.

In the replication stage, these dummy AACCS data are replaced by real AACCS keys and files received from AACCS LA (Licensing Agency). Specifically, the AACCS PostProcess module 430 accepts real AACCS keys and files from an AACCS Licensing agency via the AACCS Data from AACCS LA module 435. The AACCS PostProcess module 430 locates the previously inserted dummy values and replaces the dummy values with the real AACCS keys and files. The AACCS Post Process module 430 provides input to the Image Builder module 440. The Image Builder module 440 also accepts input from the Signing Content Certificate/Providing Revocation List by AACCS LA module 455, which allows the Image Builder module to sign the content certificate. After the content image is built by the Image Builder module 440, the content is physically formatted by the Physical Formatting Module 445. The physically formatted content is then mastered by the Mastering Module 450.

It is to be understood that the present invention may be applied to any system in a content production/distribution workflow where dummy "placeholders" are first created and inserted into an encoded content, and then these placeholders are replaced or filled with real value at a later stage of the workflow.

It is to be understood that the present invention may be implemented in various forms of hardware, software, firmware, special purpose processors, or a combination thereof. Preferably, the present invention is implemented as a combination of hardware and software. Moreover, the software is preferably implemented as an application program tangibly embodied on a program storage device. The application program may be uploaded to, and executed by, a machine comprising any suitable architecture. Preferably, the machine is implemented on a computer platform having hardware such as one or more central processing units (CPU), a random access memory (RAM), and input/output (I/O) interface(s). The computer platform also includes an operating system and microinstruction code. The various

processes and functions described herein may either be part of the microinstruction code or part of the application program (or a combination thereof), which is executed via the operating system. In addition, various other peripheral devices may be connected to the computer platform such as an additional data storage device and a printing device.

5           It is to be further understood that, because some of the constituent system components and method steps depicted in the accompanying figures are preferably implemented in software, the actual connections between the system components (or the process steps) may differ depending upon the manner in which the present invention is programmed. Given the teachings herein, one of ordinary skill in the related art will be able to contemplate these and  
10 similar implementations or configurations of the present invention.

## CLAIMS:

1. A method for processing content, said method comprising:
  - generating at least one dummy value;
  - inserting said at least one dummy value into said content;
  - 5 selecting at least one position in said content where said at least one dummy value in said content is to be replaced by at least one real value;
  - generating said at least one said real value; and
  - replacing said at least dummy value with said at least one real value in said content.
- 10 2. The method according to claim 1, wherein said content is a motion picture experts group formatted transport stream.
3. The method according to claim 2, wherein said dummy values are inserted into said  
15 motion picture experts group transport stream by multiplexing said dummy values with said motion picture experts group transport stream.
4. The method according to claim 1, wherein said dummy values are inserted into  
20 universal disk format files.
5. The method according to claim 1, wherein said dummy values are inserted into cutting master format files.
6. The method according to claim 1, wherein said at least one real value is an  
25 alternative value containing watermark signals.
7. The method according to claim 1, wherein said at least one real value is an AAC3 key and related data.
- 30 8. The method according to claim 1, wherein any excess dummy values in said content after inserting said at least one real value are replaced by null values.
9. The method according to claim 1, wherein any excess dummy values in said content after inserting said at least one real value are replaced by redundant values.



10. The method according to claim 1, wherein any excess dummy values in said content after inserting said at least one real value remain in said content.

5 11. The method according to claim 1, wherein said first generating step and said inserting step are performed during content authoring.

12. The method according to claim 1, wherein said selecting step, said second generating step and said replacing step are performed during content replication.

10 13. The method according to claim 1, further comprising:  
building a content image; and  
mastering said content image for replication of said content image onto a storage medium.

15 14. A system for processing content, comprising:  
means for generating at least one dummy value;  
means for inserting said at least one dummy value into said content;  
means for selecting at least one position in said content where said at least one  
20 dummy value in said content is to be replaced by at least one real value;  
means for generating said at least one said real value; and  
means for replacing said at least dummy value with said at least one real value  
in said content.

25 15. The system according to claim 14, wherein said content is a motion picture experts group formatted transport stream.

16. The system according to claim 15, wherein said dummy values are inserted into said motion picture experts group transport stream by multiplexing said dummy values  
30 with said motion picture experts group transport stream.

17. The system according to claim 14, wherein said dummy values are inserted into universal disk format files.

18. The system according to claim 14, wherein said dummy values are inserted into cutting master format files.

5 19. The system according to claim 14, wherein said at least one real value is an alternative value containing watermark signals.

20. The system according to claim 14, wherein said at least one real value is an AAC3 key and related data.

10 21. The system according to claim 14, wherein any excess dummy values in said content after inserting said at least one real value are replaced by null values.

22. The system according to claim 14, wherein any excess dummy values in said content after inserting said at least one real value are replaced by redundant values.

15 23. The system according to claim 14, wherein any excess dummy values in said content after inserting said at least one real value remain in said content.

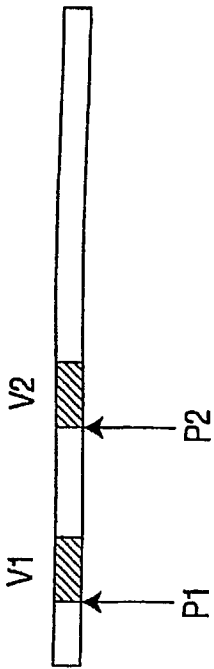
20 24. The system according to claim 14, wherein said first means for generating and said means for inserting are performed during content authoring.

25 25. The system according to claim 14, wherein said means for selecting, said second means for generating and said means for replacing are performed during content replication.

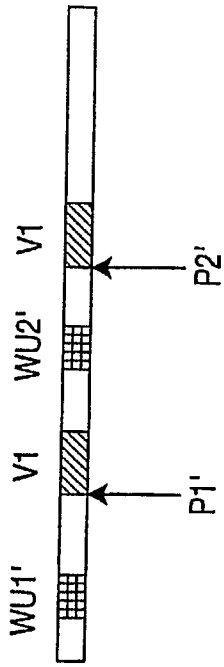
26. The system according to claim 14, further comprising:

means for building a content image; and

means for mastering said content image for replication of said content image onto a storage medium.



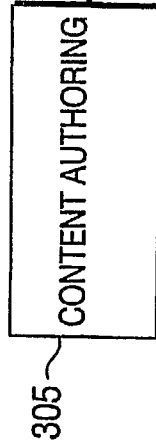
**FIG. 1**



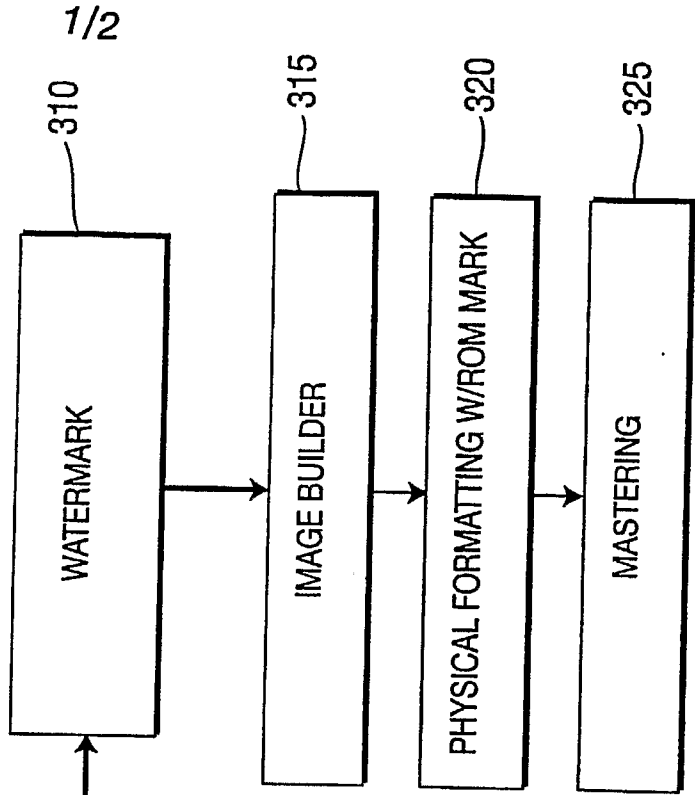
**FIG. 2**

AUTHORING

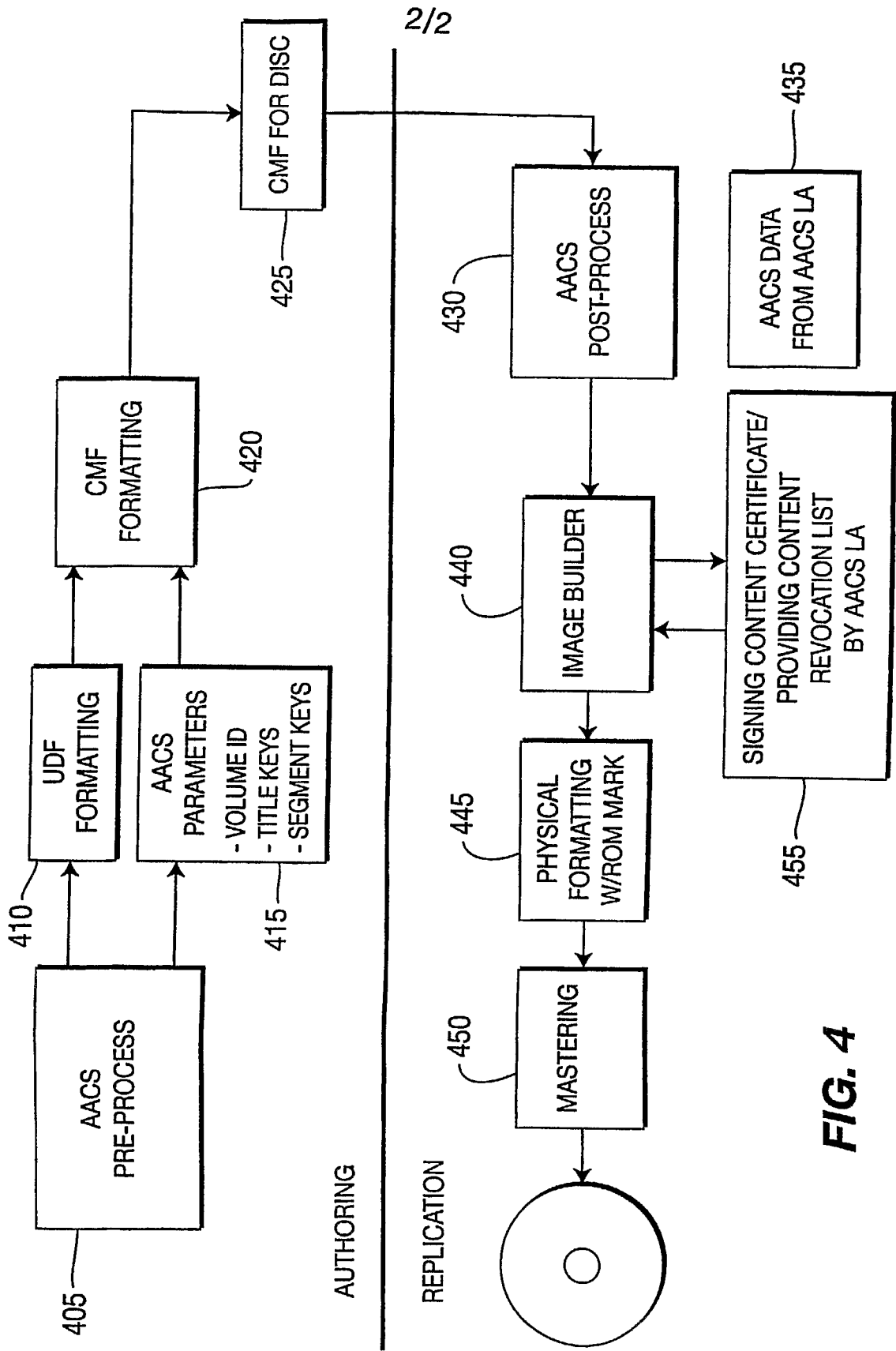
MPEG-TS AND UDF/CMF  
FORMATTED CONTENT



REPLICATION



**FIG. 3**



2/2

FIG. 4



# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2006/009992

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. H04N7/52

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
H04N

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

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

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 555 826 A (SAMSUNG ELECTRONICS CO LTD [KR]) 20 July 2005 (2005-07-20)	1-3, 10, 11, 14-16, 23, 24
Y	abstract  paragraphs [0001], [0002], [0006], [0008], [0012], [0015], [0016], [0019] - [0021], [0026], [0027], [0030], [0032], [0041], [0042] claims 1, 7, 10, 17 figures 2, 3, 6  ----- -/--	4, 5, 7, 12, 13, 17, 18, 20, 25, 26

Further documents are listed in the continuation of Box C.

See patent family annex.

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- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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25 October 2006

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## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/009992

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>WO 00/59204 A (DIVA SYSTEMS CORP [US]) 5 October 2000 (2000-10-05)</p> <p>abstract page 2, line 30 - page 3, line 9 page 4, line 25 - page 5, line 4 page 5, line 24 - page 6, line 2 page 6, line 29 - line 34 page 8, line 5 - line 8 page 9, line 24 - page 10, line 17 page 11, line 5 - line 23 page 12, line 17 - line 22 page 13, line 4 - line 11 page 13, line 23 - line 29 page 14, line 1 - line 17 claims 1,2,6-8,11,12,14 figures 1-3</p>	<p>1-3, 8-11, 14-16, 21-24</p>
X	<p>US 2003/167397 A1 (MANGOLD RICHARD P [US] ET AL) 4 September 2003 (2003-09-04)</p> <p>abstract paragraphs [0010] - [0013], [0018], [0021], [0023]</p>	<p>1,6,10, 11,14, 19,23,24</p>
Y	<p>AUGER, BOB: "HD DVD in Europe: Background and Update" MEDIA-TECH SHOWCASE &amp; CONFERENCE, [Online] 5 October 2005 (2005-10-05), pages 1-33, XP002404360 Retrieved from the Internet: URL:<a href="http://showcase.mediatech-expo.net/2005/admin/dateien/sicher/phpGKUYa6_keynote_day2_auger.pdf">http://showcase.mediatech-expo.net/2005/admin/dateien/sicher/phpGKUYa6_keynote_day2_auger.pdf</a> page 21 - page 23 page 25</p>	<p>4,5,7, 12,13, 17,18, 20,25,26</p>
P,A	<p>JIM TAYLOR: "Generating the Next Generation" SVP &amp; GM, ADVANCED TECHNOLOGY GROUP, SONIC SOLUTIONS, [Online] 11 October 2006 (2006-10-11), pages 1-23, XP002404361 Retrieved from the Internet: URL:<a href="http://www.media-tech.net/fileadmin/templates/resources/sc06/mtc06_keynote_day2_taylor.pdf">http://www.media-tech.net/fileadmin/templates/resources/sc06/mtc06_keynote_day2_taylor.pdf</a> page 13 - page 14</p>	<p>4,5,7, 12,13, 17,18, 20,25,26</p>

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No  
PCT/US2006/009992

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