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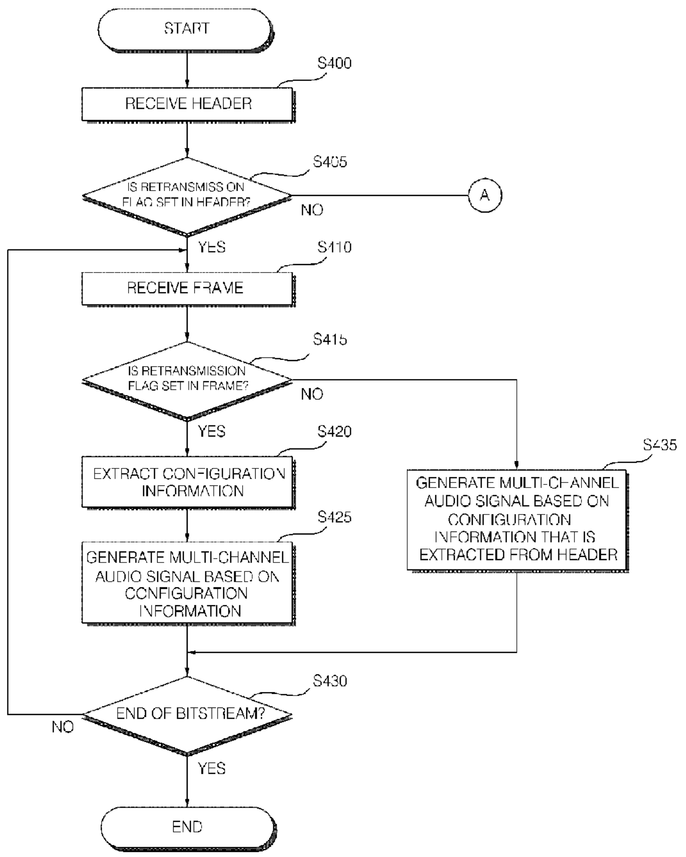
(54) Title: METHOD FOR ENCODING AND DECODING MULTI-CHANNEL AUDIO SIGNAL AND APPARATUS THEREOF



(57) Abstract: Methods and apparatuses for encoding and decoding a multi-channel audio signal are provided. In the encoding method, spatial information that is calculated based on a multi-channel audio signal and a downmix signal is encoded, and additional configuration information is generated based on information that is selected from the encoded spatial information. The downmix signal is encoded, and then, a bitstream is generated by combining the encoded downmix signal with the encoded spatial information. Thereafter, the additional configuration information is inserted into the bitstream. Therefore, it is possible to configure an optimum bitstream according to the circumstances by retransmitting all or part of information included in a header.

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Description

METHOD FOR ENCODING AND DECODING MULTI-CHANNEL AUDIO SIGNAL AND APPARATUS THEREOF

Technical Field

[1] The present invention relates to an encoding method and apparatus and a decoding method and apparatus, and more particularly, to an encoding method and apparatus and a decoding method and apparatus in which a multi-channel audio signal is encoded or decoded so that all or part of information included in a header can be retransmitted.

[2]

Background Art

[3] In a typical method of encoding a multi-channel audio signal, a multi-channel audio signal is downmixed into a mono or stereo signal and the mono or stereo signal is encoded, instead of encoding each channel of the multi-channel audio signal. In this method, a multi-channel audio signal is encoded together with spatial information indicating spatial cues.

[4] FIG. 1 is a diagram for illustrating a bitstream of a multi-channel audio signal generated using a typical method of encoding a multi-channel audio signal. Referring to FIG. 1, a bitstream of a multi-channel audio signal is divided into one or more frames (i.e., frames 1 through 3), and is thus transmitted or decoded in units of the frames. A header is placed ahead of frame 1. The header includes Spatial Audio Coding (SAC) configuration information, and each of frames 1 through 3 includes spatial information of a corresponding frame. The SAC configuration information comprises information that can be commonly applied to frames 1 through 3, i.e., sampling frequency information, frame length information, and tree configuration information specifying a downmix combination of a multi-channel signal .

[5] Conventionally, SAC configuration information is included only in the header of a bitstream. Thus, when the header of a bitstream of a multi-channel audio signal is not received as in a streaming service, information needed to decode the bitstream cannot be obtained.

[6] In addition, since tree configuration information is included only in SAC configuration information, the same downmix combination must be used throughout an entire multi-channel audio signal. Accordingly, it is impossible to perform decoding such that a downmix combination can vary from one frame to another of a multi-channel audio signal obtained by the decoding. Also, it is impossible to perform encoding/decoding such that each frame of a multi-channel audio signal can be encoded/decoded with optimum efficiency.

Disclosure of Invention

Technical Problem

[7] The present invention provides an encoding method and apparatus in which information that is selected from a header can be retransmitted as additional configuration information.

[8] The present invention also provides a decoding method and apparatus in which a bitstream including additional configuration information that is selected from a header can be decoded.

Technical Solution

[9] According to an aspect of the present invention, there is provided an encoding method. The encoding method includes encoding spatial information that is calculated based on a multi-channel audio signal and a downmix signal, generating additional configuration information based on information that is selected from the encoded spatial information, encoding the downmix signal, generating a bitstream by combining the encoded downmix signal with the encoded spatial information, and inserting the additional configuration information into the bitstream.

[10] According to another aspect of the present invention, there is provided an encoding apparatus. The encoding apparatus includes a downmix unit which generates a downmix signal based on a multi-channel audio signal, a core encoder which encodes the down-mix signal, a spatial information generation unit which calculates spatial information of the multi-channel audio signal, a parameter encoder which encodes the spatial information, and a bitstream generation unit which generates a bitstream by combining the encoded spatial information and the encoded down-mix signal and inserts additional configuration information that is selected from the encoded spatial information into the bitstream.

[11] According to another aspect of the present invention, there is provided a decoding method. The decoding method includes demultiplexing an encoded down-mix signal and additional information from a current frame of an input bitstream, determining whether additional configuration information has been retransmitted based on the additional information, and generating a multi-channel audio signal corresponding to the current frame based on the additional configuration information if the additional configuration information is determined to have been retransmitted.

[12] According to another aspect of the present invention, there is provided a decoding apparatus. The decoding apparatus includes a demultiplexer which demultiplexes an encoded down-mix signal and additional information from a current frame of an input bitstream, a core decoder which generates a down-mix signal by decoding the encoded down-mix signal, a parameter decoder which determines whether additional con-

figuration information has been retransmitted based on the additional information, and generates spatial information by encoding the additional configuration information if the additional configuration information is determined to have been retransmitted, and a multi-channel synthesization unit which generates a multi-channel audio signal based on the spatial information and the down-mix signal.

[13] According to another aspect of the present invention, there is provided a computer-readable recording medium having recorded thereon a program for executing an encoding method, the encoding method including encoding spatial information that is calculated based on a multi-channel audio signal and a downmix signal; generating additional configuration information based on information that is selected from the encoded spatial information; and encoding the downmix signal, generating a bitstream by combining the encoded downmix signal with the encoded spatial information, and inserting the additional configuration information into the bitstream.

[14] According to another aspect of the present invention, there is provided a computer-readable recording medium having recorded thereon a program for executing a decoding method, the decoding method including demultiplexing an encoded down-mix signal and additional information from a current frame of an input bitstream; determining whether additional configuration information has been retransmitted based on the additional information; and generating a multi-channel audio signal corresponding to the current frame based on the additional configuration information if the additional configuration information is determined to have been retransmitted.

Advantageous Effects

[15] In the encoding method, spatial information that is calculated based on a multi-channel audio signal and a downmix signal is encoded, and additional configuration information is generated based on information that is selected from the encoded spatial information. The downmix signal is encoded, and then, a bitstream is generated by combining the encoded downmix signal with the encoded spatial information. Thereafter, the additional configuration information is inserted into the bitstream. Therefore, it is possible to configure an optimum bitstream according to the circumstances by retransmitting all or part of information included in a header.

Brief Description of the Drawings

[16] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[17] FIG. 1 is a diagram for illustrating a bitstream of a typical multi-channel audio signal;

[18] FIG. 2 is a block diagram of a system for encoding/decoding a multi-channel audio

signal to which encoding and decoding methods according to an embodiment of the present invention are applied; and

[19] FIGS. 3 and 4 present syntax of spatial information used in the present invention;

[20] FIGS. 5 and 6 are flowcharts illustrating a decoding method according to an embodiment of the present invention; and

[21] FIG. 7 is a flowchart illustrating a decoding method according to another embodiment of the present invention.

Best Mode for Carrying Out the Invention

[22] The present invention will now be described more fully with reference to the accompanying drawings in which exemplary embodiments of the invention are shown.

[23] Methods and apparatuses for encoding and decoding a multi-channel audio signal according to the present invention can be applied to the processing of a multi-channel audio signal. However, the present invention is not restricted thereto. In other words, the present invention can also be applied to the processing of a signal other than a multi-channel audio signal.

[24] FIG. 2 is a block diagram of a system for encoding/decoding a multi-channel audio signal to which encoding and decoding methods according to an embodiment of the present invention are applied. Referring to FIG. 2, an encoding apparatus 100 includes a downmix unit 110, a spatial information generation unit 120, a core encoder 130, a parameter encoder 135, and a bitstream generation unit 140. A decoding apparatus 200 includes a demultiplexer 210, a core decoder 220, a parameter decoder 230, and a multi-channel synthesization unit 240.

[25] The downmix unit 110 generates a downmix signal by downmixing a multi-channel audio signals comprising n channels into a mono or stereo signal. The encoding apparatus 100 may use an artistic downmix signal that is processed externally, instead of generating a downmix signal. The spatial information generation unit 120 calculates spatial information regarding a multi-channel audio signal. The core encoder 130 encodes the downmix signal generated by the downmix unit 110. The parameter encoder 135 encodes the spatial information obtained by the spatial information generation unit 120.

[26] The bitstream generation unit 140 generates a bitstream by combining the encoded downmix signal and the encoded spatial information. The bitstream generation unit 140 may insert additional configuration information, if necessary, into the bitstream. The additional configuration information corresponds to all or part of spatial information or other information included in the header of the bitstream. In short, spatial information and additional configuration information can be included in a bitstream generated by the bitstream generation unit 140.

[27] The demultiplexer 210 receives a bitstream input to the decoding apparatus 200, and demultiplexes an encoded downmix signal and encoded additional information from the received bitstream. The core decoder 220 generates a downmix signal by decoding the encoded downmix signal. The parameter decoder 230 generates spatial information by decoding the encoded additional information. If the encoded additional information comprises additional configuration information, the parameter decoder 230 may generate spatial information based on the additional configuration information. The multi-channel synthesization unit 240 generates a multi-channel audio signal based on the spatial information generated by the multi-channel synthesization unit 240 and the downmix signal generated by the core decoder 220.

[28] FIGS. 3 and 4 present syntax of spatial information used in the present invention. Referring to FIG. 3, SpatialSpecificConfig() indicates spatial information included in a header. Referring to FIG. 4, SpatialFrame() indicates frame information which is information corresponding to each frame.

[29] SpatialSpecificConfig() corresponds to SAC configuration information, and particularly, spatial information that can be commonly applied to a number of frames. SpatialSpecificConfig() comprises bsSamplingFrequency which indicates sampling frequency, bsFrameLength which indicates frame length, and bsTreeConfic which indicates information specifying a downmix combination of a multi-channel signal. SpatialFrame() comprises spatial information of each frame such as Framinginfo() which indicates time slot information in connection with the number of parameter sets.

[30] According to the present embodiment, a multi-channel audio signal is encoded so that SpatialSpecficConfig (), which corresponds to all or part of SAC configuration information, can be inserted into either a certain frame or each frame of the bitstream as additional configuration information. In other words, SAC configuration information can be inserted not only into a header of a bitstream but also into either a certain frame or each frame of the bitstream.

[31] In order to decode a bitstream having additional configuration information inserted into a certain frame thereof, a multi-channel audio signal can be encoded in the following manner. First, in order to retransmit additional configuration information corresponding to SpatialSpecificConfig() to a certain frame, a retransmission flag (e.g., bsResendSptialSpecificConficFrame) indicating whether the additional configuration information has been retransmitted may be set in SpatialFrame(). For example, if the retransmission flag bsResendSptialSpecificConficFrame is set in SpatialFrame(), it may be determined, during the decoding of a bitstream, that additional configuration information corresponding to SpatialSpecifigConfig() is inserted into the bitstream.

[32] Also, a retransmission flag bsResendSpatialSpecificConfigHeader may be set in SpatialSpecifigConfig(), which is included into a header of a bitstream. If the re-

transmission flag bsResendSpatialSpecificConfigHeader is set, it may be determined again whether a retransmission flag bsResendSpatialSpecificConficFrame in SpatialFrame() is set, and additional configuration information may be received again according to the result of the determination. If the retransmission flag bsResendSpatialSpecificConfigHeader is not set, it means that a bitstream does not comprise any additional configuration information, and thus, the bitstream can be readily decoded without the need to reexamine the retransmission flag bsResendSpatialSpecificConficFrame.

[33] Additional configuration information may be comprised of SpatialSpecificConfig() or may be comprised of a parameter set SpatialSpecificConfigParam that is selected from SpatialSpecificConfig(). In this case, a retransmission flag bsResendSpatialSpecificConficParamFrame may be inserted into SpatialFrame(). If the retransmission flag bsResendSpatialSpecificConficParamFrame is set, it may be determined that the parameter set SpatialSpecificConfigParam has been retransmitted. In addition, a retransmission flag bsResendSpatialSpecificConfigParamHeader may be included in SpatialSpecifigConfig(). If the retransmission flag bsResendSpatialSpecificConfigParamHeader is set, the retransmission flag bsResendSpatialSpecificConficParamFrame may be reexamined, and additional configuration information may be received again according to the results of the reexamination. On the other hand, if the retransmission flag bsResendSpatialSpecificConfigParamHeader is set, it may be determined that a bitstream does not comprise additional configuration information.

[34] In this manner, it is possible to perform encoding so that all or part of spatial information included in a header of a bitstream can be retransmitted periodically or can be retransmitted, whenever necessary, by being carried on a frame that is selected from among a plurality of the bitstream.

[35] The parameter set SpatialSpecificConfigParam, which corresponds to part of spatial information included in a header of a bitstream, may include at least one of a plurality of pieces of information included in SpatialSpecficConfig().

[36] The definitions of the aforementioned variables in SpatialSpecConfig() are as presented in Table 1.

[37] Table 1

Variables	**Definitions**
bsSamplingFrequency	Define sampling frequency
bsFrameLength	Defines the number of time slots in a spatial frame
bsFreqRes	Defines the number of parameter bands
bsTreeConfig	Defines the tree configuration

bsQuantMode	Defines quantization and CLD energy-dependent quantization (EdQ)
bsOneIcc	Indicates if only a single ICC parameter subset is conveyed common to all OTT boxes.
bsArbitraryDowmix	Indicates the presence of arbitrary downmix gains
bsFixedGainsSur	Defines the gains used for the surround channels
bsFixedGainsLFE	Defines the gains used for the LFE channels
bsFixedGainsDMX	Defines the gains used for the downmix
bsMatrixMode	Indicates if a matrix compatible stereo downmix has been generated in the encoder
bsTempShapeConfig	Indicates operation mode of temporal shaping (TES and/or TP) in the decoder
bsDecorrConfig	Indicates operation mode of the decorrelator in the decoder
bs3DaudioMode	Indicates that the stereo downmix was 3D audio encoded and that inverse HRTF processing is to be applied
bsEnvQuantMode	Defines the quantization mode of the envelope shaping data
bs3DaudioHRTFset	Indicates the set of HRTF parameters

[38] For example, in order to indicate whether bsTreeConfig, which indicates the tree configuration of a multi-channel audio signal, has been retransmitted, a retransmission flag bsResendTreeConfigFrame may be inserted into SpatialFrame(). For example, if the retransmission flag bsResendTreeConfigFrame is set, it is determined that bsTreeConfig has been retransmitted. As described above, a retransmission flag bsResendTreeConfigHeader may be inserted into SpatialSpecifigConfigHeader. If the retransmission flag bsResendTreeConfigHeader is set, the retransmission flag bsResendTreeConfigFrame can be reexamined.

[39] In this manner, it is possible to retransmit bsTreeConfig periodically or whenever necessary. In addition, it is possible to effectively store and transmit signals by setting bsTreeConfig differently for each frame. For example, assume that a multi-channel audio signal with five channels comprises a portion whose quality is maintained even after the multi-channel audio signal is downmixed mono and a portion that must be compressed as stereo. In this case, according to the prior art, the multi-channel audio signal must be encoded as stereo in order to maintain the quality of the multi-channel audio signal. On the other hand, according to the present invention, only portions of

the multi-channel audio signal that need to be compressed as stereo can be selectively encoded as stereo. In addition, according to the present invention, the mode of encoding can be changed according to the type of signals during the encoding of signals as mono signals, thus obtaining signals with better quality than in the prior art at a given bitrate.

[40] According to the present embodiment, bsTreeConfig can be divided into three bits, i.e., bsTreeExt, bsTreeCh, and bsTreeCfg, and bsTreeExt, bsTreeCh, and bsTreeCfg can be used, instead of retransmitting bsTreeConfig. In this case, if bsTreeExt=1 and bsTreeConfig=15, then TreeDescription may be received through extended signaling. If bsTreeExt=0 and bsTreeCh=0, a 515 format may be used. If bsTreeExt=0 and bsTesCh=1, a 525 format may be used. If bsTreeExt=0, bsTreeCh=0, and bsTreeCfg=0, a 5151 format may be used. If bsTreeExt=0, bsTreeCh=0, and bsTreeCfg=1, a 5152 format may be used. In this manner, it is possible to represent bsTreeConfig with only two bits and thus reduce the number of bits used.

[41] FIGS. 5 and 6 are flowcharts illustrating a decoding method according to an embodiment of the present invention. Referring to FIG. 5, in operation S400, a header of an input bitstream is received. In operation S405, it is determined whether a retransmission flag (bsResendSpatialSpecificConfigHeader) in the header is set. If it is determined in operation S405 that the retransmission flag (bsResendSpatialSpecificConfigHeader) in the header is not set, it means that the header does not include any additional configuration information, and thus, a multi-channel audio signal is generated using configuration information included in the header as spatial information in operations S440 through S450 illustrated in FIG. 6.

[42] On the other hand, if it is determined in operation S405 that the retransmission flag (bsResendSpatialSpecificConfigHeader) in the header is set, it means that additional configuration information has been retransmitted. Then, in operation S410, a frame (hereinafter referred to as the current frame) of the input bitstream is received. In operation S415, it is determined whether a retransmission flag (bsResendSpatialSpecificConficFrame) in the current frame is set. In operation S420, if it is determined in operation S415 that the retransmission flag (bsResendSpatialSpecificConficFrame) in the current frame is set, additional configuration information is extracted. The additional configuration information may be included in the current frame or a previous frame.

[43] In operation S420, once the additional configuration information is extracted, a multi-channel audio signal is generated based on a downmix signal according to the additional configuration information. In detail, an encoded downmix signal and frame information are demultiplexed from the current frame, spatial information is generated based on the additional configuration information and the frame information, and a

multi-channel audio signal is generated based on the spatial information and the encoded downmix signal. If the additional configuration information is part of the spatial information included in the header, other information that is needed to generate spatial information may be obtained from spatial information that is extracted from the header . Then, in operation S435, if it is determined in operation S415 that the retransmission flag (bsResendSpatialSpecificConficFrame) in the current frame is not set, a multi-channel audio signal is generated based on the configuration information included in the header. Operations S400 through S425, S435, and S440 through S450 are repeatedly performed until the end of the input bitstream is encountered .

[44] FIG. 7 is a flowchart illustrating a decoding method according to another embodiment of the present invention. Referring to the decoding method illustrated in FIG. 7, a retransmission flag is included, not in a header but in a frame. Referring to FIG. 7, in operation S500, a frame of an input bitstream is received. In operation S505, it is determined whether a retransmission flag in the frame is set. In operation S510, if it is determined in operation S505 that the retransmission flag in the frame is set, additional configuration information is extracted (from the frame?). In operation S515, a multi-channel audio signal is generated based on the additional configuration information. In detail, spatial information is generated based on the additional configuration information and frame information, and then, a multi-channel audio signal is generated based on the spatial information and a downmix signal.

[45] On the other hand, in operation S525, if it is determined in operation S505 that the retransmission flag in the frame is not set, spatial information is generated based on the frame information and configuration information that is extracted from a header of the input bitstream, and a multi-channel audio signal is generated based on the spatial information and the downmix signal.

[46] According to the present embodiment, additional configuration information is inserted into a certain frame of a bitstream, thereby enabling the generation of a multi-channel audio signal even when the header of the bitstream is not received as in a streaming service .

[47] The present invention can be realized as computer-readable code written on a computer-readable recording medium. The computer-readable recording medium may be any type of recording device in which data is stored in a computer-readable manner. Examples of the computer-readable recording medium include a ROM, a RAM, a CD-ROM, a magnetic tape, a floppy disc, an optical data storage, and a carrier wave (e.g., data transmission through the Internet). The computer-readable recording medium can be distributed over a plurality of computer systems connected to a network so that computer-readable code is written thereto and executed therefrom in a decentralized manner. Functional programs, code, and code segments needed for realizing the

present invention can be easily construed by one of ordinary skill in the art.

[48] According to the present invention, a multi-channel audio signal is encoded so that all or part of information included in a header can also be included in a predetermined frame. Thus, the present invention can be applied to streaming services. In addition, according to the present invention, a multi-channel audio signal is encoded or decoded so that configuration can vary from one frame to another. Thus, it is possible to generate an optimum bitstream according to the circumstances.

[49] Moreover, according to the present invention, spatial information can be selectively transmitted only to a few frames. Thus, it is possible to effectively reduce the amount of data to be transmitted while maintaining the quality of signals.

[50] The present invention can be applied to the encoding/decoding of a multi-channel audio signal and can enable retransmission of all or part of information included in a header.

[51] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

Industrial Applicability

[52] The present invention is used to an encoding method and apparatus and a decoding method and apparatus in which a multi-channel audio signal is encoded or decoded so that all or part of information included in a header can be retransmitted.

Claims

[1] An encoding method comprising:
encoding spatial information that is calculated based on a multi-channel audio signal and a downmix signal;
generating additional configuration information based on information that is selected from the encoded spatial information; and
encoding the downmix signal, generating a bitstream by combining the encoded downmix signal with the encoded spatial information, and inserting the additional configuration information into the bitstream.

[2] The encoding method of claim 1, wherein the inserting comprises inserting the additional configuration information into each of a plurality of frames of the bitstream

[3] The encoding method of claim 1, wherein the inserting comprises inserting the additional configuration information only into a frame that is selected from among a plurality of frames of the bitstream.

[4] The encoding method of claim 1, further comprising inserting a retransmission flag in the bitstream to indicate whether the additional configuration information is inserted into the bitstream and setting the retransmission flag according to whether the additional configuration information is inserted into the bitstream.

[5] The encoding method of claim 1, wherein the additional configuration information is selected from configuration information included in a header of the bitstream.

[6] The encoding method of claim 1, wherein the additional configuration information comprises information that is selected from Spatial Audio Coding (SAC) configuration information.

[7] An encoding apparatus comprising:
a downmix unit which generates a down-mix signal based on a multi-channel audio signal;
a core encoder which encodes the down-mix signal;
a spatial information generation unit which calculates spatial information of the multi-channel audio signal;
a parameter encoder which encodes the spatial information; and
a bitstream generation unit which generates a bitstream by combining the encoded spatial information and the encoded down-mix signal and inserts additional configuration information that is selected from the encoded spatial information into the bitstream.

[8] The encoding apparatus of claim 7, wherein the bitstream generation unit inserts

the additional configuration information into each of a plurality of frames of the bitstream.

[9] The encoding apparatus of claim 7, wherein the bitstream generation unit inserts the additional configuration information only into a frame that is selected from among a plurality of frames of the bitstream.

[10] The encoding apparatus of claim 7, wherein the bitstream generation unit inserts a retransmission flag in the bitstream to indicate whether the additional configuration information is inserted into the bitstream, and sets the retransmission flag according to whether the additional configuration information is inserted into the bitstream.

[11] A decoding method comprising:
demultiplexing an encoded down-mix signal and additional information from a current frame of an input bitstream;
determining whether additional configuration information has been retransmitted based on the additional information; and
generating a multi-channel audio signal corresponding to the current frame based on the additional configuration information if the additional configuration information is determined to have been retransmitted.

[12] The decoding method of claim 11, further comprising generating a multi-channel audio signal corresponding to the current frame based on spatial information that is extracted from a header of the input bitstream if the additional configuration information is determined not to have been retransmitted.

[13] The decoding method of claim 11, wherein the additional configuration information is included either in the current frame or in a previous frame.

[14] The decoding method of claim 11, wherein the determining comprises determining whether the additional configuration information has been retransmitted according to whether a retransmission flag included in the additional information is set.

[15] The decoding method of claim 11, wherein the generating comprises:
generating a down-mix signal by decoding the encoded down-mix signal; and
generating spatial information based on the additional configuration information, and generating a multi-channel audio signal based on the spatial information and the down-mix signal.

[16] The decoding method of claim 11, wherein the additional configuration information comprises information that is selected from configuration information included in a header of the input bitstream.

[17] A decoding apparatus comprising:
a demultiplexer which demultiplexes an encoded down-mix signal and additional

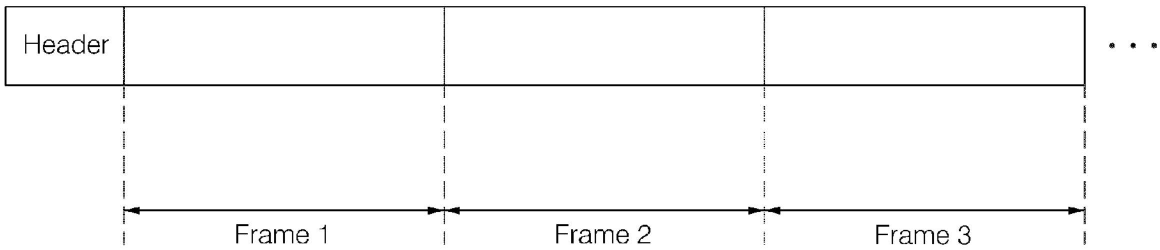
information from a current frame of an input bitstream;
a core decoder which generates a down-mix signal by decoding the encoded down-mix signal;
a parameter decoder which determines whether additional configuration information has been retransmitted based on the additional information, and generates spatial information by encoding the additional configuration information if the additional configuration information is determined to have been retransmitted; and
a multi-channel synthesization unit which generates a multi-channel audio signal based on the spatial information and the down-mix signal.

[18] The decoding apparatus of claim 17, wherein the parameter decoder generates spatial information by decoding configuration information that is extracted from a header of the input bitstream if the additional configuration information is determined not to have been retransmitted.

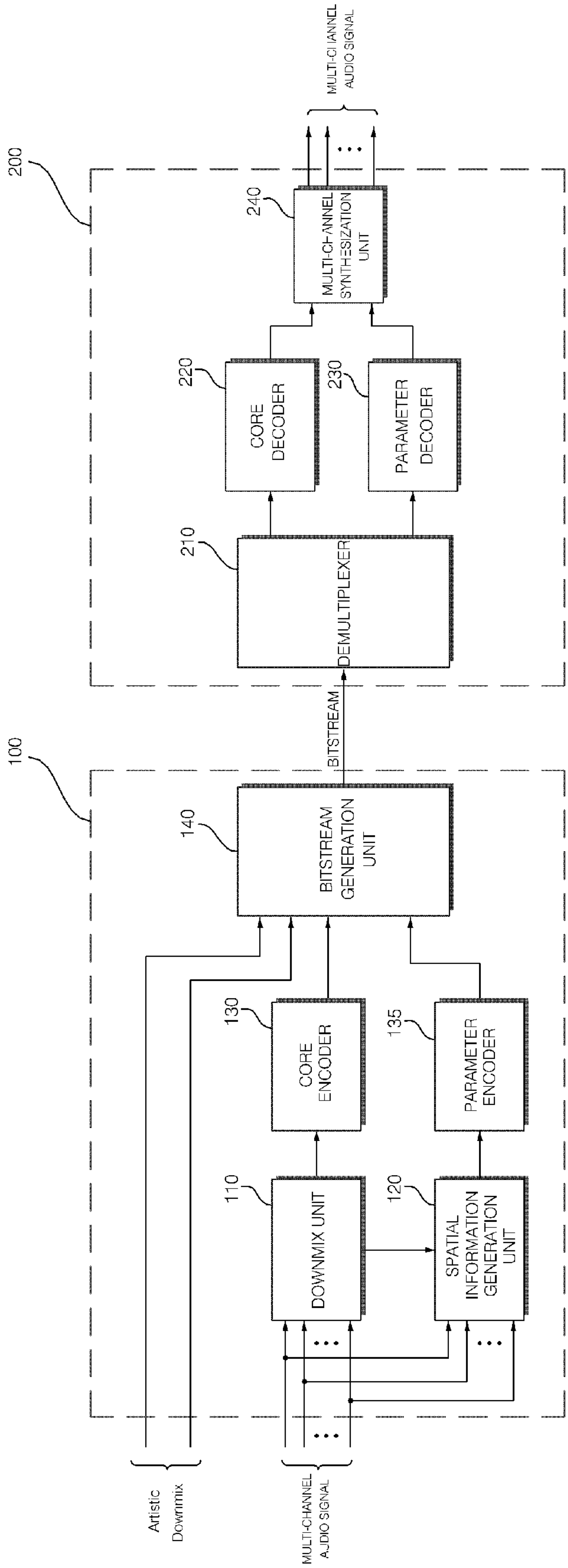
[19] A computer-readable recording medium having recorded thereon a program for executing an encoding method, the encoding method comprising:
encoding spatial information that is calculated based on a multi-channel audio signal and a downmix signal;
generating additional configuration information based on information that is selected from the encoded spatial information; and
encoding the downmix signal, generating a bitstream by combining the encoded downmix signal with the encoded spatial information, and inserting the additional configuration information into the bitstream.

[20] A computer-readable recording medium having recorded thereon a program for executing a decoding method, the decoding method comprising:
demultiplexing an encoded down-mix signal and additional information from a current frame of an input bitstream;
determining whether additional configuration information has been retransmitted based on the additional information; and
generating a multi-channel audio signal corresponding to the current frame based on the additional configuration information if the additional configuration information is determined to have been retransmitted.

[Fig. 1]



[Fig. 2]


MULTI-CHANNEL AUDIO SIGNAL
200
240
MULTI-CHANNEL SYNTHESIZATION UNIT
220
CORE DECODER
230
PARAMETER DECODER
210
DEMULTIPLEXER
BITSTREAM
100
140
BITSTREAM GENERATION UNIT
130
CORE ENCODER
135
PARAMETER ENCODER
110
DOWNMIX UNIT
120
SPATIAL INFORMATION GENERATION UNIT
Artistic Downmix
MULTI-CHANNEL AUDIO SIGNAL

[Fig. 3]

Syntax of SpatialSpecificConfig()

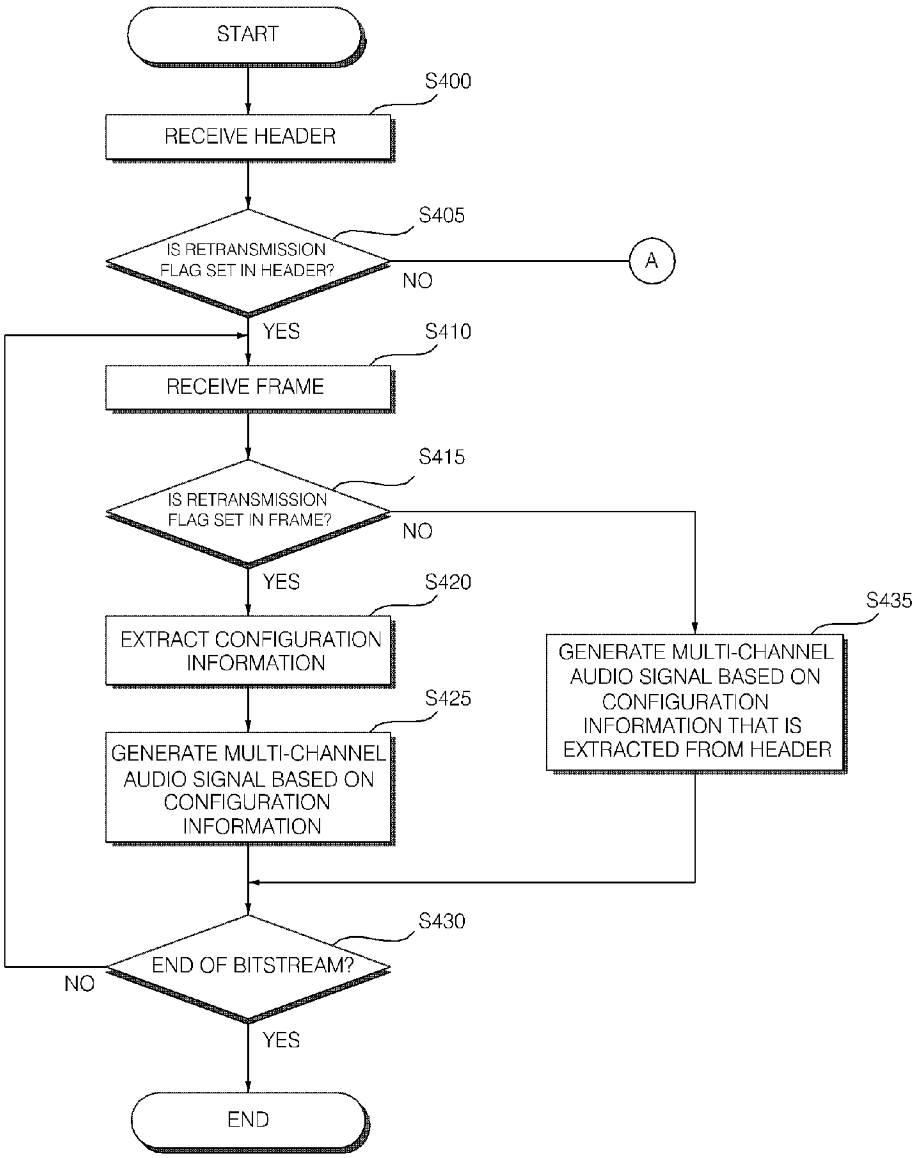
Syntax	No. of bits	Mnemonic
SpatialSpecificConfig()		
{		
bsSamplingFrequencyIndex;	**4**	**uimsbf**
if (bsSamplingFrequencyIndex == 0xf) {		
bsSamplingFrequency;	**24**	**uimsbf**
}		
bsFrameLength;	**7**	**uimsbf**
bsFreqRes;	**3**	**uimsbf**
bsTreeConfig;	**4**	**uimsbf**
bsQuantMode;	**3**	**uimsbf**
bsOneIcc;	**1**	**uimsbf**
bsArbitraryDowmix;	**1**	**uimsbf**
bsFixedGainSur;	**3**	**uimsbf**
bsFixedGainLFE;	**3**	**uimsbf**
bsFixedGainDMX;	**3**	**uimsbf**
bsMatrixMode;	**1**	**uimsbf**
bsTempShapeConfig;	**4**	**uimsbf**
bsDecorrConfig;	**4**	**uimsbf**
bs3DaudioMode;	**1**	**uimsbf**
for (i=0; i<numOttBoxes; i++) {		Note 1
OttConfig(i);		
}		
for (i=0; i<numTttBoxes; i++) {		Note 1
TttConfig(i);		
}		
if ((bsTempShapeConfig>=4) && (bsTempShapeConfig<8)) {		
bsEnvQuantMode	**3**	**uimsbf**
}		
if (bs3DaudioMode) {		
bs3DaudioHRTFset;	**2**	**uimsbf**
if (bs3DaudioHRTFset==0) {		
ParamHRTFset();		
}		
}		
SpatialExtensionConfig();		
}		

[Fig. 4]

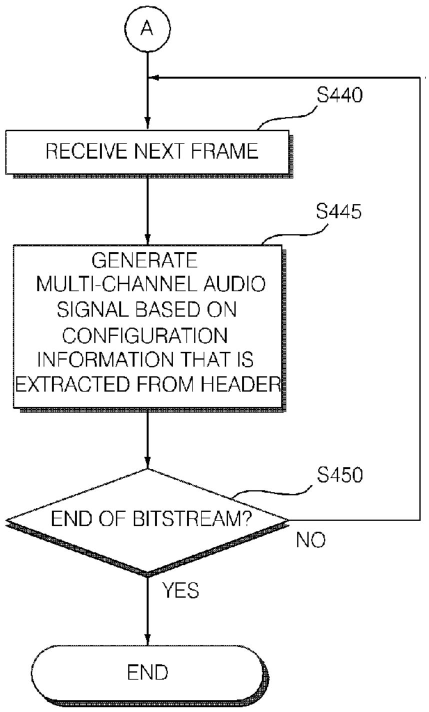
Syntax of SpatialFrame()

Syntax	No. of bits	Mnemonic
SpatialFrame()		
{		
FramingInfo();		
bsIndependencyFlag;	**1**	**uimsbf**
OttData();		
TttData();		
SmgData();		
TempShapeData();		
if (bsArbitraryDownmix != 0) {		
ArbitraryDownmixData();		
}		
SpatialExtensionFrame();		
}		

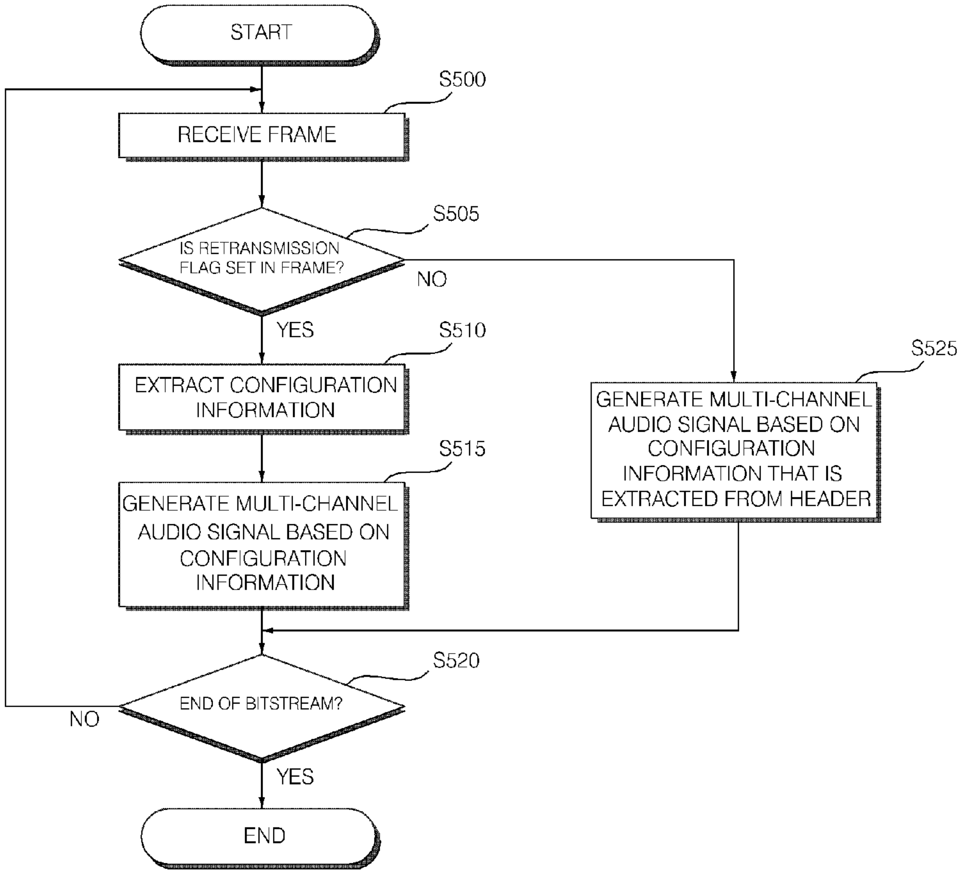
[Fig. 5]


START
S400
RECEIVE HEADER
S405
IS RETRANSMISSION FLAG SET IN HEADER?
NO
A
YES
S410
RECEIVE FRAME
S415
IS RETRANSMISSION FLAG SET IN FRAME?
NO
YES
S420
EXTRACT CONFIGURATION INFORMATION
S435
GENERATE MULTI-CHANNEL AUDIO SIGNAL BASED ON CONFIGURATION INFORMATION THAT IS EXTRACTED FROM HEADER
S425
GENERATE MULTI-CHANNEL AUDIO SIGNAL BASED ON CONFIGURATION INFORMATION
S430
END OF BITSTREAM?
NO
YES
END

[Fig. 6]


A
S440
RECEIVE NEXT FRAME
S445
GENERATE MULTI-CHANNEL AUDIO SIGNAL BASED ON CONFIGURATION INFORMATION THAT IS EXTRACTED FROM HEADER
S450
END OF BITSTREAM?
NO
YES
END

[Fig. 7]


START
S500
RECEIVE FRAME
S505
IS RETRANSMISSION FLAG SET IN FRAME?
NO
YES
S510
EXTRACT CONFIGURATION INFORMATION
S515
GENERATE MULTI-CHANNEL AUDIO SIGNAL BASED ON CONFIGURATION INFORMATION
S525
GENERATE MULTI-CHANNEL AUDIO SIGNAL BASED ON CONFIGURATION INFORMATION THAT IS EXTRACTED FROM HEADER
S520
END OF BITSTREAM?
NO
YES
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/004286

A. CLASSIFICATION OF SUBJECT MATTER

G10L 19/00(2006.01)i

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)
IPC 8 : G10L 19/00, G10L 19/04, G11B 20/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for inventions since 1975
Utility models and applications for Utility Models since 1975
Japanese Utility Models and application for Utility Models since 1975

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

eKIPASS(KIPO internal) "audio, channel, multi, cod*, spatial, spa*, SAC, downmix, down-mix, flag"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 03/090208 A1 (KONINKLIJKE PHILIPS ELECTRONICS N.V.) 30 OCTOBER 2003 See the abstract, pages 10-13, figure 2, claims	1-20
A	US 6,774,820 B2 (CRAVEN P. et al.) 10 AUGUST 2004 See the abstract, claims	1-20
A	Beack S. et al., "An Efficient Representation Method for ICLD with Robustness to Spectral Distortion" ETRI Journal, June 2005, VOL.27,NO.3,pp.330-333 See the abstract, Introduction, page 330 right column	1-20
A	US 5682461 A (SILZLE A. et al.) 28 October 1997 See the abstract, claims	1-20
A	US 2005/0177360 A1 (SCHUIJERS E. et al.) 11 Aug. 2005 See the abstract, claims	1-20

☐ 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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Date of the actual completion of the international search	Date of mailing of the international search report
24 JANUARY 2007 (24.01.2007)	**24 JANUARY 2007 (24.01.2007)**

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Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
KYUNG, Youn Jeong
Telephone No. 82-42-481-8536

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/004286

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