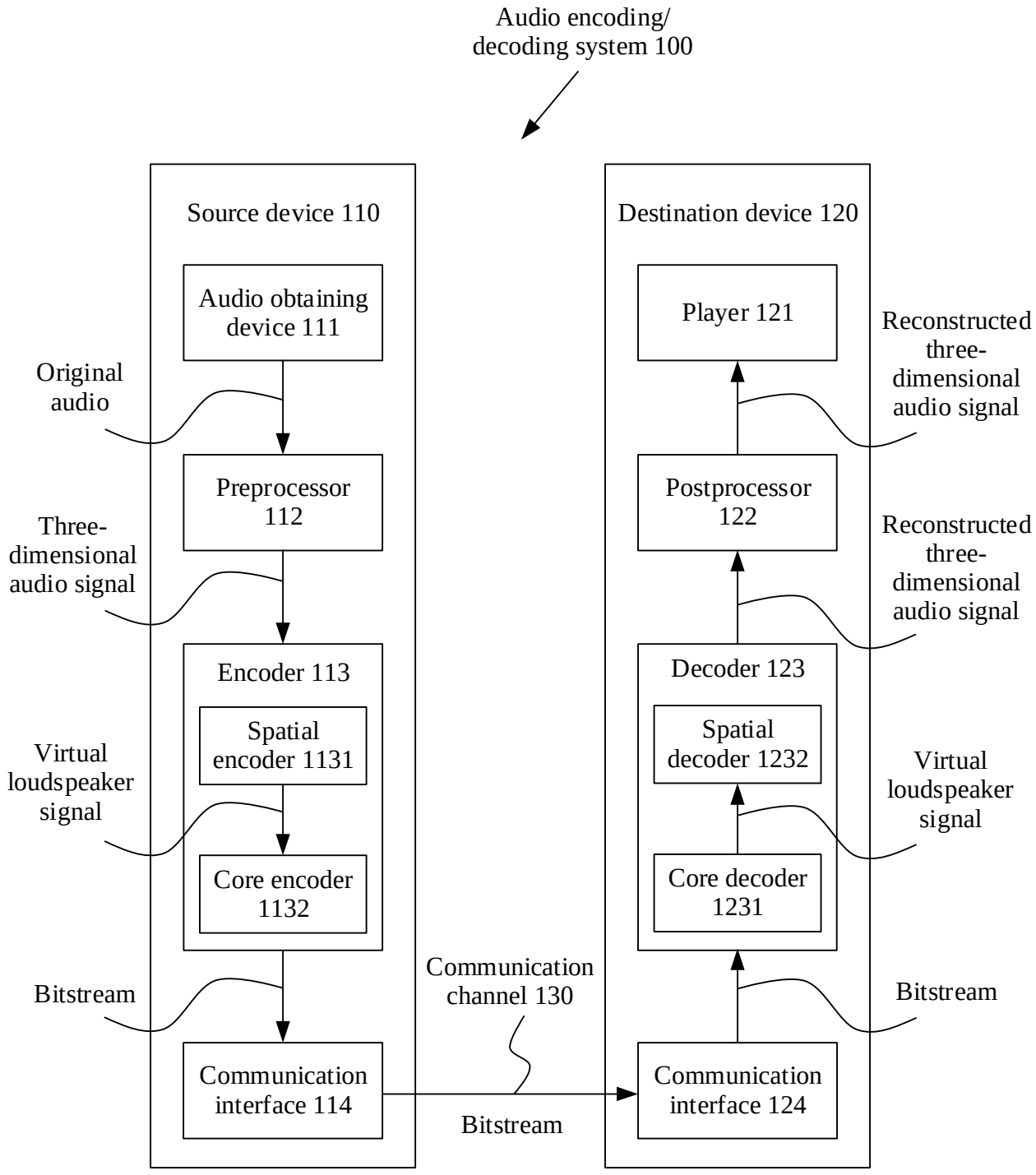
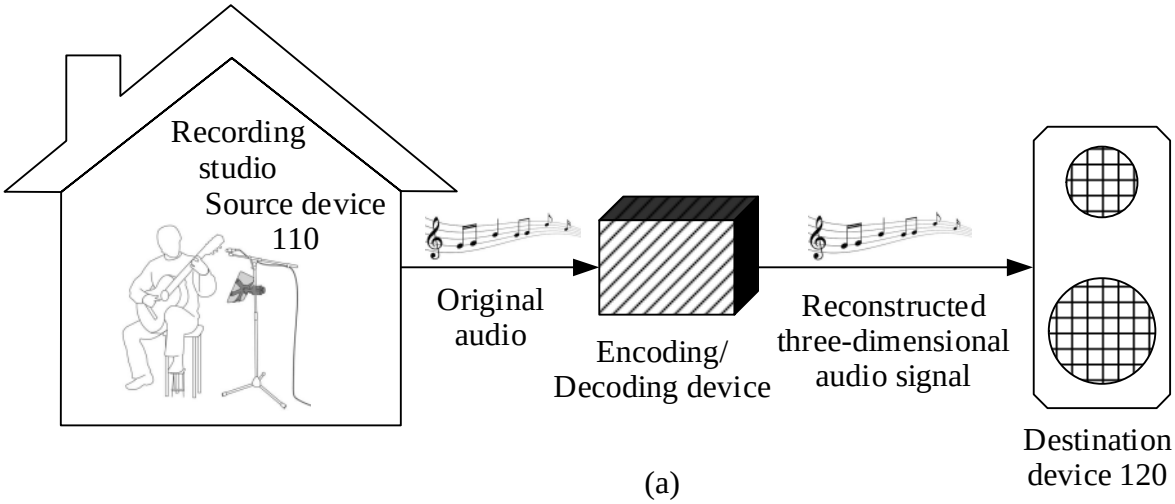
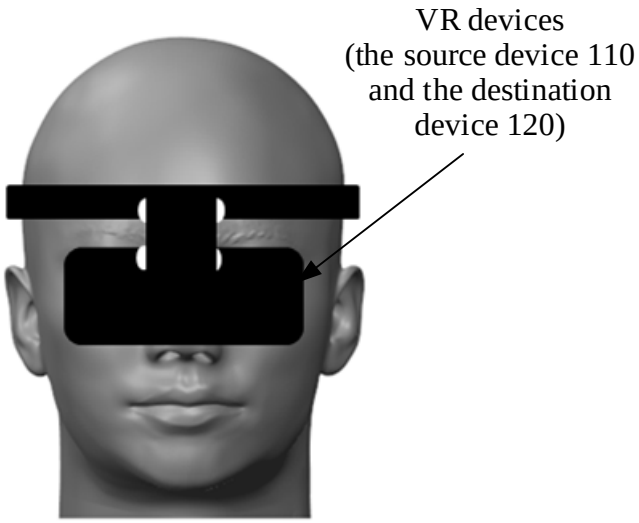

Audio encoding/
decoding system 100
Source device 110
Audio obtaining device 111
Original audio
Preprocessor 112
Three-dimensional audio signal
Encoder 113
Spatial encoder 1131
Virtual loudspeaker signal
Core encoder 1132
Bitstream
Communication interface 114
Communication channel 130
Bitstream
Destination device 120
Player 121
Reconstructed three-dimensional audio signal
Postprocessor 122
Reconstructed three-dimensional audio signal
Decoder 123
Spatial decoder 1232
Virtual loudspeaker signal
Core decoder 1231
Bitstream
Communication interface 124

FIG. 1


Recording
studio
Source device
110
Original
audio
Encoding/
Decoding device
Reconstructed
three-dimensional
audio signal
Destination
device 120

(a)


VR devices
(the source device 110
and the destination
device 120)

(b)

FIG. 2

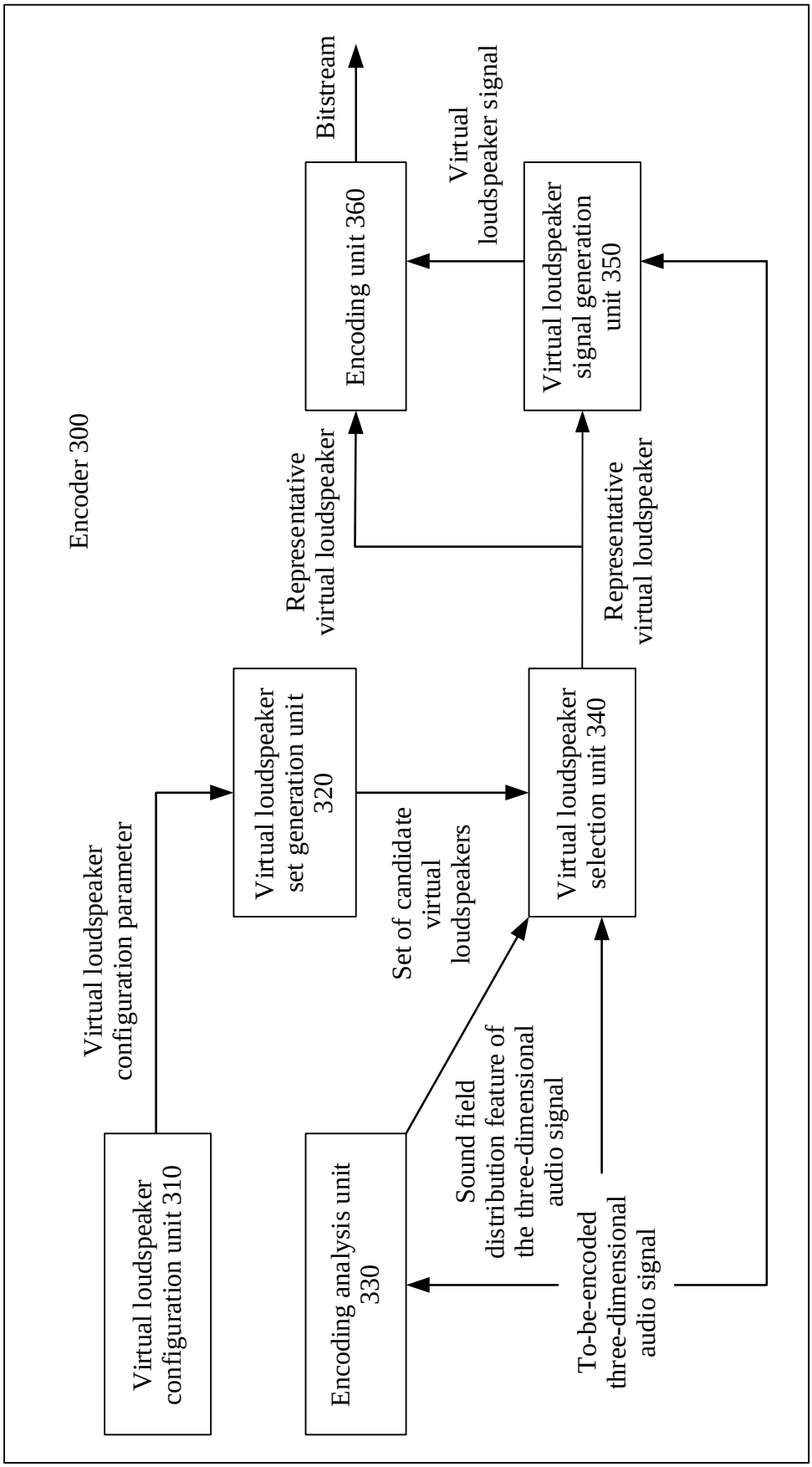

Encoder 300
Virtual loudspeaker configuration unit 310
Virtual loudspeaker configuration parameter
Virtual loudspeaker set generation unit 320
Set of candidate virtual loudspeakers
Encoding analysis unit 330
Sound field distribution feature of the three-dimensional audio signal
Virtual loudspeaker selection unit 340
Representative virtual loudspeaker
Representative virtual loudspeaker
Virtual loudspeaker signal generation unit 350
Virtual loudspeaker signal
Encoding unit 360
Bitstream
To-be-encoded three-dimensional audio signal

FIG. 3

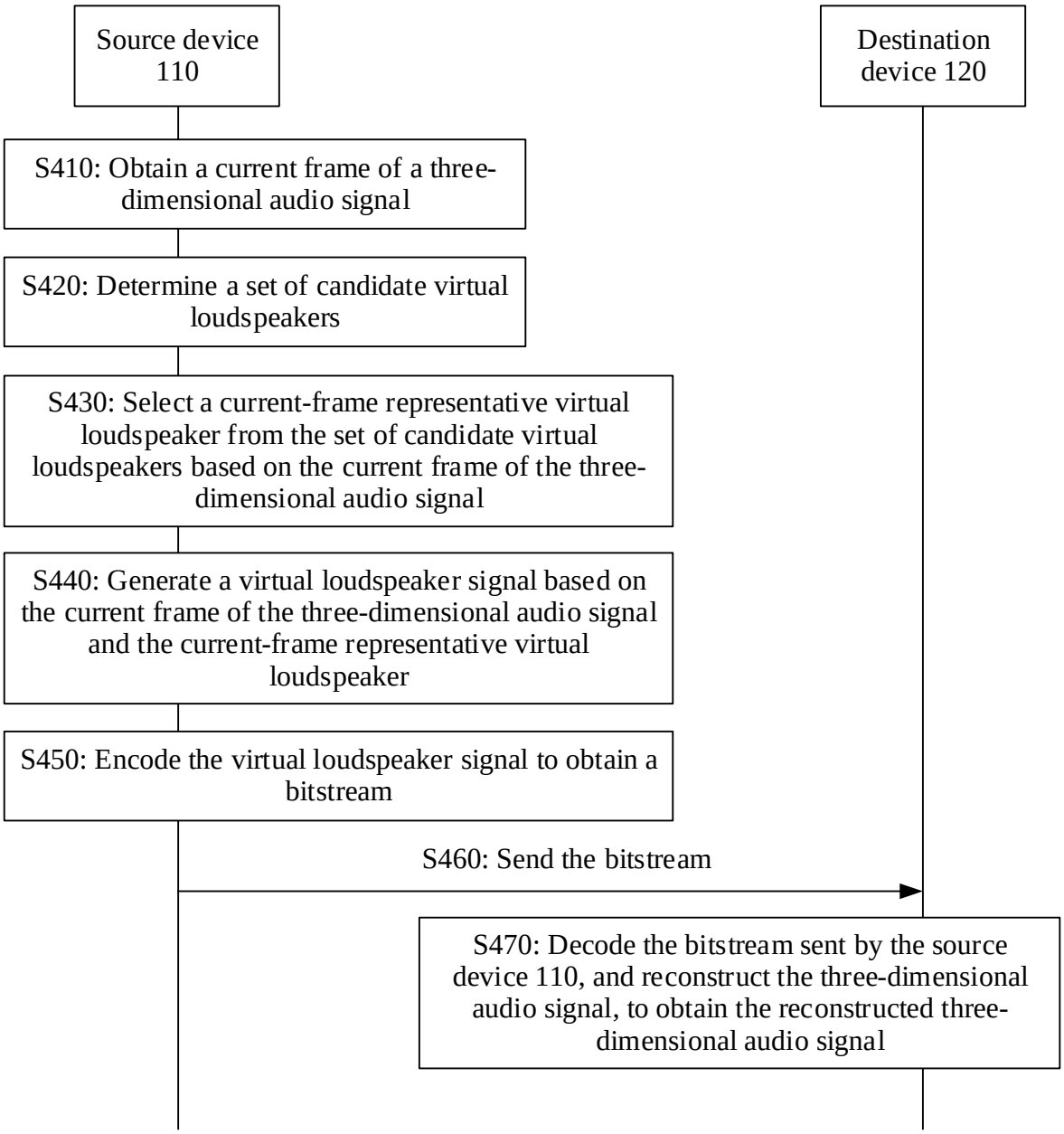

Source device 110
Destination device 120
S410: Obtain a current frame of a three-dimensional audio signal
S420: Determine a set of candidate virtual loudspeakers
S430: Select a current-frame representative virtual loudspeaker from the set of candidate virtual loudspeakers based on the current frame of the three-dimensional audio signal
S440: Generate a virtual loudspeaker signal based on the current frame of the three-dimensional audio signal and the current-frame representative virtual loudspeaker
S450: Encode the virtual loudspeaker signal to obtain a bitstream
S460: Send the bitstream
S470: Decode the bitstream sent by the source device 110, and reconstruct the three-dimensional audio signal, to obtain the reconstructed three-dimensional audio signal

FIG. 4

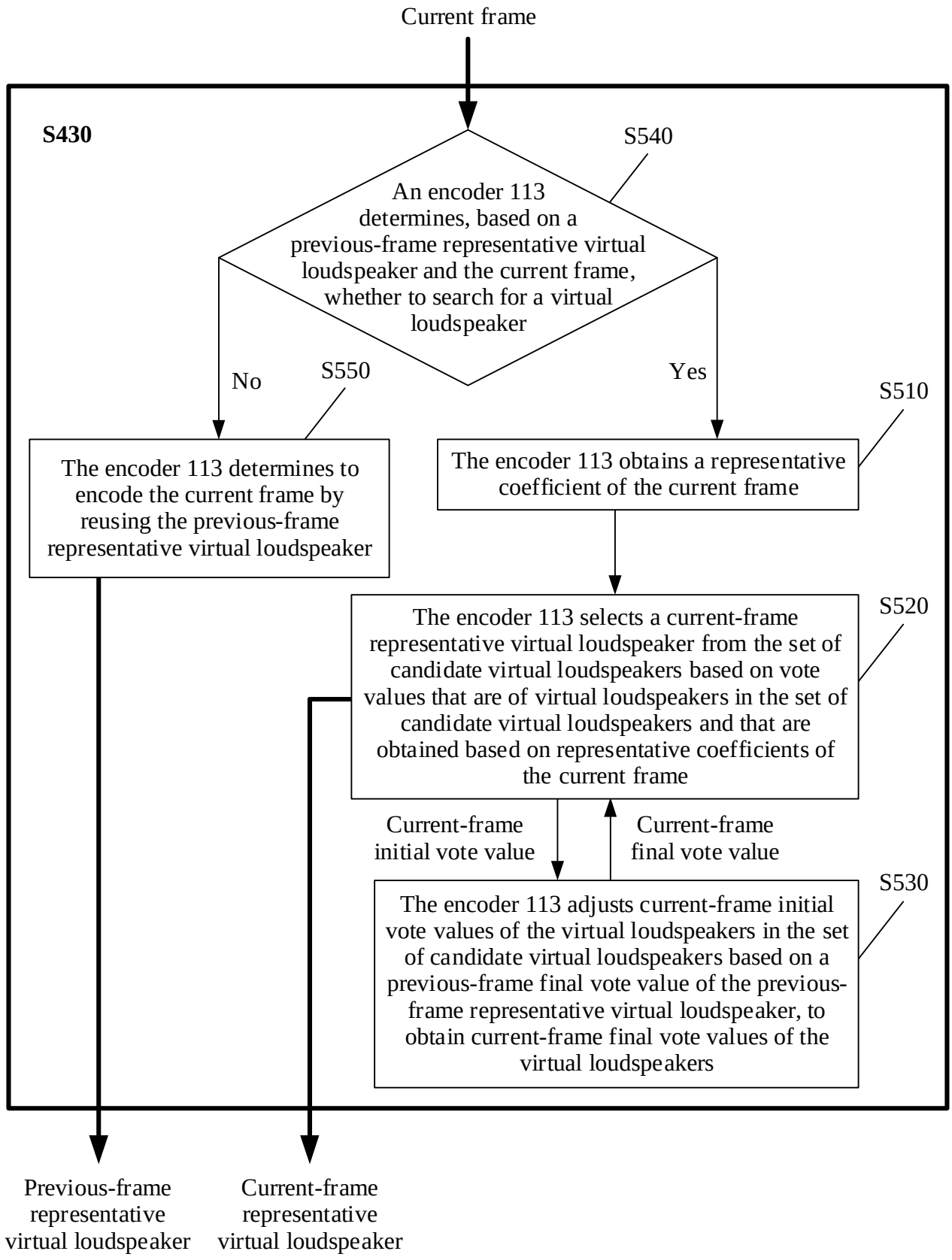

Current frame
S430
S540
An encoder 113 determines, based on a previous-frame representative virtual loudspeaker and the current frame, whether to search for a virtual loudspeaker
No
S550
Yes
S510
The encoder 113 determines to encode the current frame by reusing the previous-frame representative virtual loudspeaker
The encoder 113 obtains a representative coefficient of the current frame
S520
The encoder 113 selects a current-frame representative virtual loudspeaker from the set of candidate virtual loudspeakers based on vote values that are of virtual loudspeakers in the set of candidate virtual loudspeakers and that are obtained based on representative coefficients of the current frame
Current-frame initial vote value
Current-frame final vote value
S530
The encoder 113 adjusts current-frame initial vote values of the virtual loudspeakers in the set of candidate virtual loudspeakers based on a previous-frame final vote value of the previous-frame representative virtual loudspeaker, to obtain current-frame final vote values of the virtual loudspeakers
Previous-frame representative virtual loudspeaker
Current-frame representative virtual loudspeaker

FIG. 5

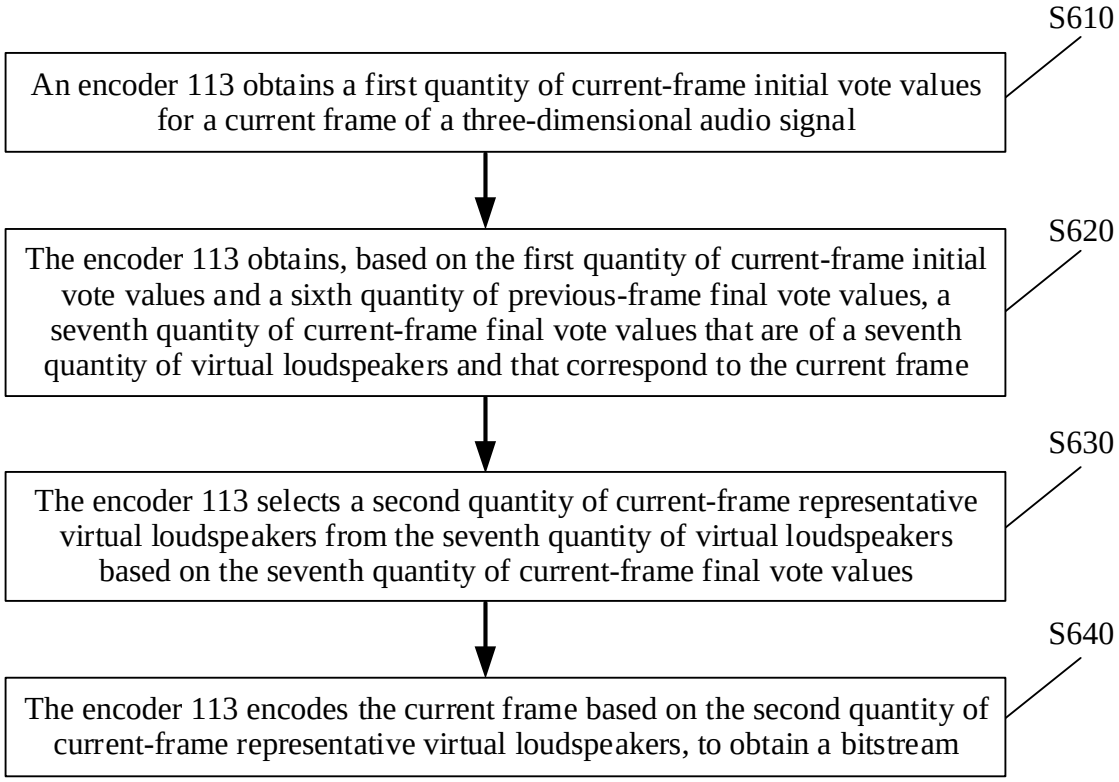

S610
An encoder 113 obtains a first quantity of current-frame initial vote values for a current frame of a three-dimensional audio signal
S620
The encoder 113 obtains, based on the first quantity of current-frame initial vote values and a sixth quantity of previous-frame final vote values, a seventh quantity of current-frame final vote values that are of a seventh quantity of virtual loudspeakers and that correspond to the current frame
S630
The encoder 113 selects a second quantity of current-frame representative virtual loudspeakers from the seventh quantity of virtual loudspeakers based on the seventh quantity of current-frame final vote values
S640
The encoder 113 encodes the current frame based on the second quantity of current-frame representative virtual loudspeakers, to obtain a bitstream

FIG. 6

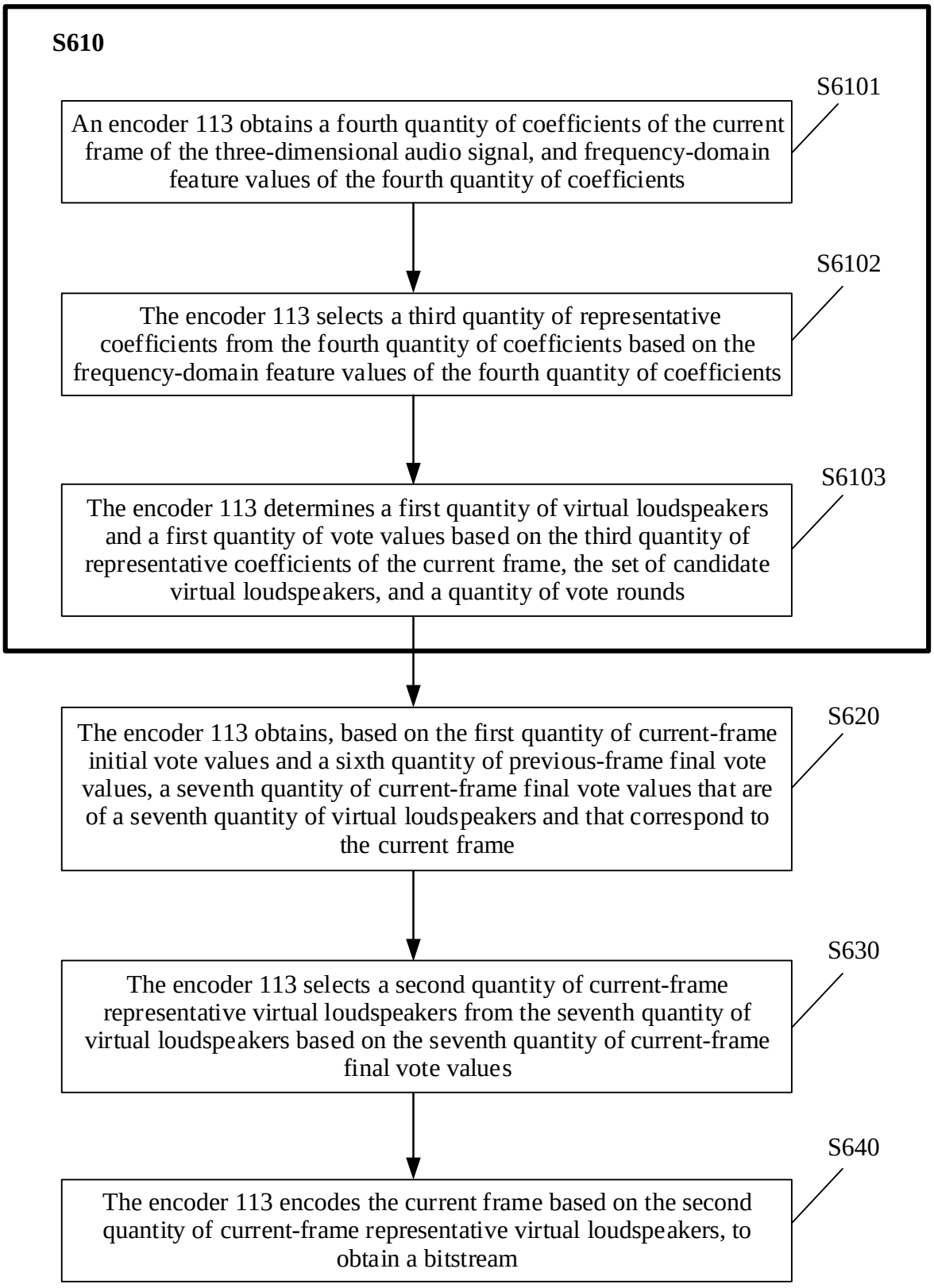

S610
S6101
An encoder 113 obtains a fourth quantity of coefficients of the current frame of the three-dimensional audio signal, and frequency-domain feature values of the fourth quantity of coefficients
S6102
The encoder 113 selects a third quantity of representative coefficients from the fourth quantity of coefficients based on the frequency-domain feature values of the fourth quantity of coefficients
S6103
The encoder 113 determines a first quantity of virtual loudspeakers and a first quantity of vote values based on the third quantity of representative coefficients of the current frame, the set of candidate virtual loudspeakers, and a quantity of vote rounds
S620
The encoder 113 obtains, based on the first quantity of current-frame initial vote values and a sixth quantity of previous-frame final vote values, a seventh quantity of current-frame final vote values that are of a seventh quantity of virtual loudspeakers and that correspond to the current frame
S630
The encoder 113 selects a second quantity of current-frame representative virtual loudspeakers from the seventh quantity of virtual loudspeakers based on the seventh quantity of current-frame final vote values
S640
The encoder 113 encodes the current frame based on the second quantity of current-frame representative virtual loudspeakers, to obtain a bitstream

FIG. 7

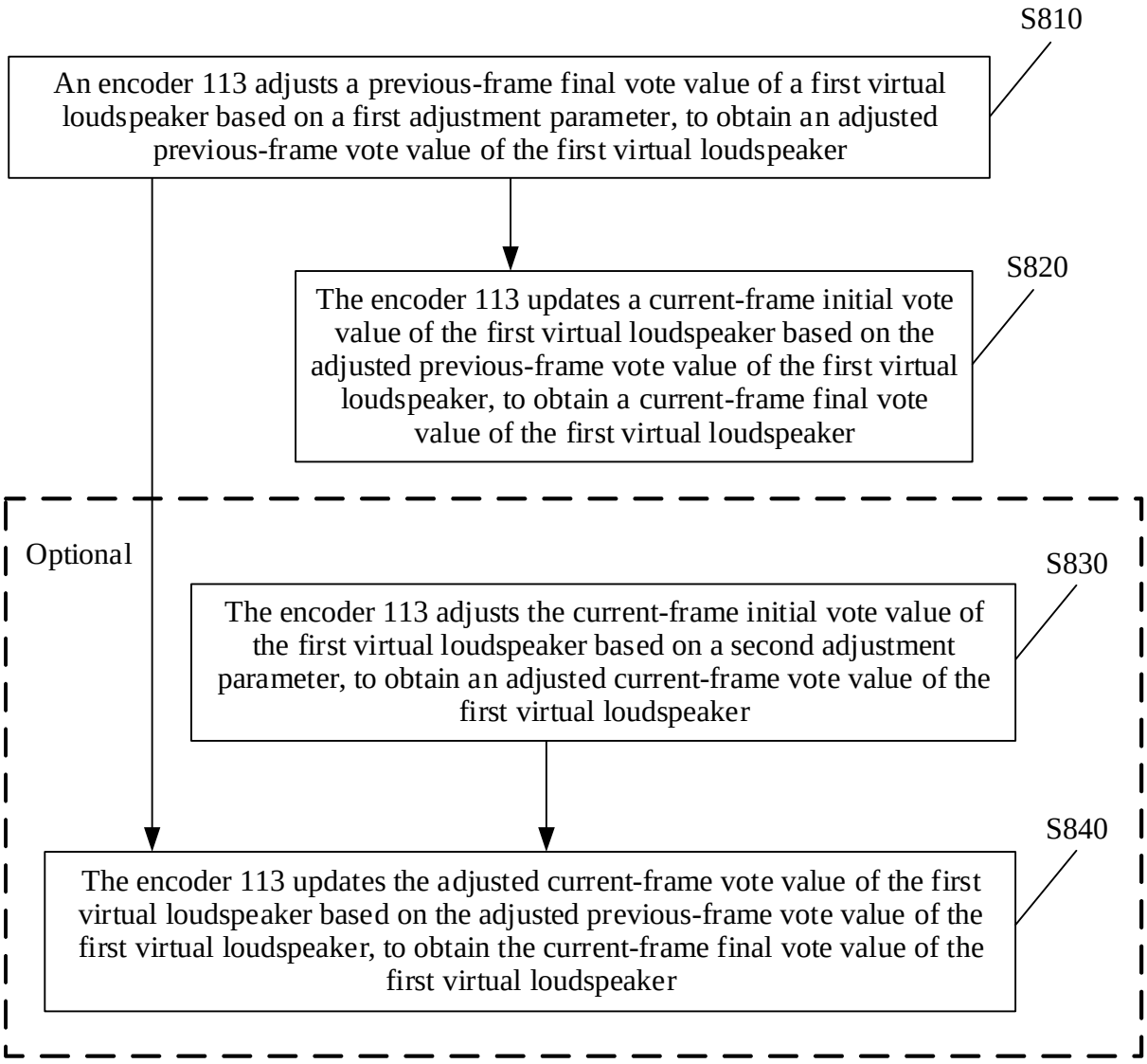

S810
An encoder 113 adjusts a previous-frame final vote value of a first virtual loudspeaker based on a first adjustment parameter, to obtain an adjusted previous-frame vote value of the first virtual loudspeaker
S820
The encoder 113 updates a current-frame initial vote value of the first virtual loudspeaker based on the adjusted previous-frame vote value of the first virtual loudspeaker, to obtain a current-frame final vote value of the first virtual loudspeaker
Optional
S830
The encoder 113 adjusts the current-frame initial vote value of the first virtual loudspeaker based on a second adjustment parameter, to obtain an adjusted current-frame vote value of the first virtual loudspeaker
S840
The encoder 113 updates the adjusted current-frame vote value of the first virtual loudspeaker based on the adjusted previous-frame vote value of the first virtual loudspeaker, to obtain the current-frame final vote value of the first virtual loudspeaker

FIG. 8

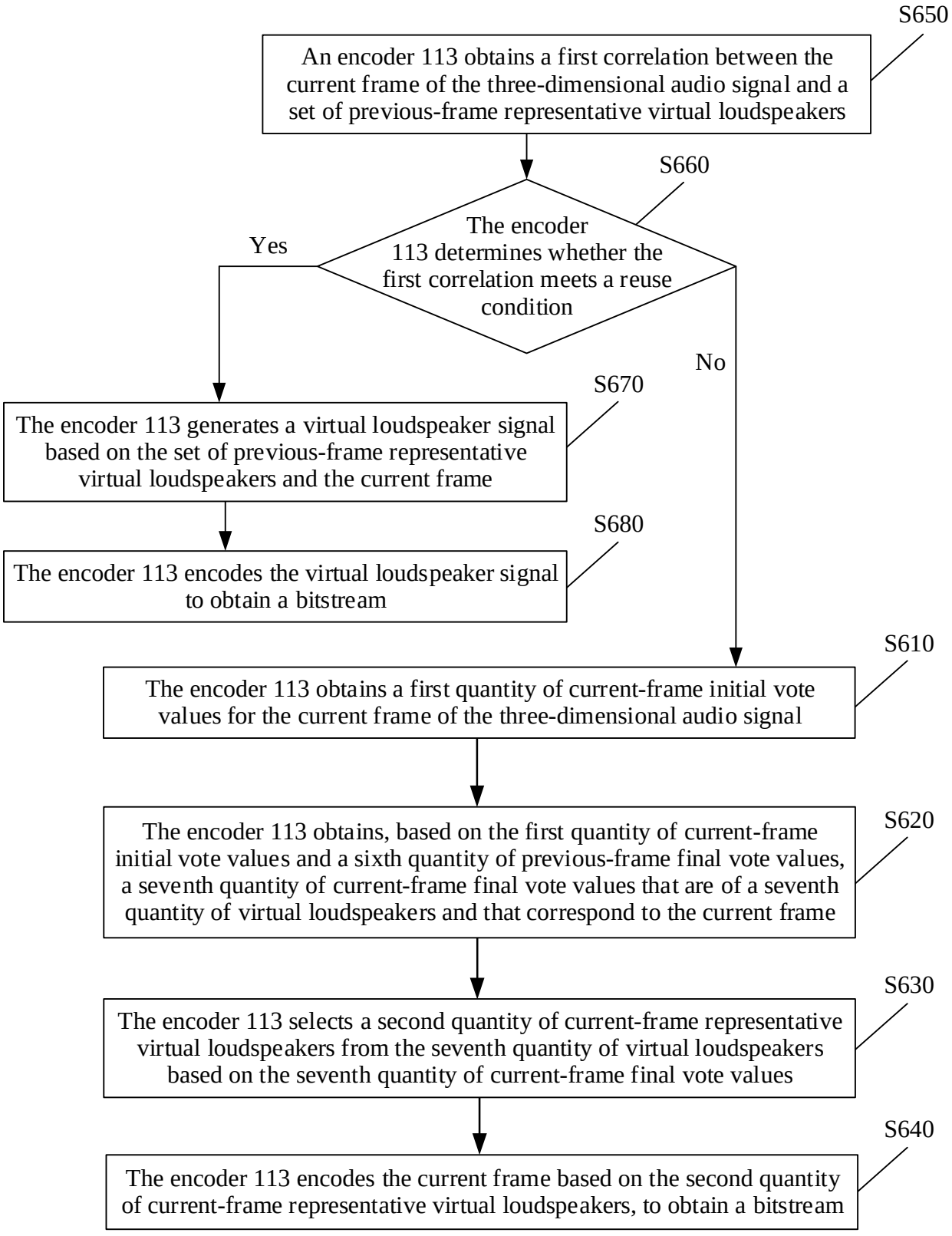

S650
An encoder 113 obtains a first correlation between the current frame of the three-dimensional audio signal and a set of previous-frame representative virtual loudspeakers
S660
The encoder 113 determines whether the first correlation meets a reuse condition
Yes
No
S670
The encoder 113 generates a virtual loudspeaker signal based on the set of previous-frame representative virtual loudspeakers and the current frame
S680
The encoder 113 encodes the virtual loudspeaker signal to obtain a bitstream
S610
The encoder 113 obtains a first quantity of current-frame initial vote values for the current frame of the three-dimensional audio signal
S620
The encoder 113 obtains, based on the first quantity of current-frame initial vote values and a sixth quantity of previous-frame final vote values, a seventh quantity of current-frame final vote values that are of a seventh quantity of virtual loudspeakers and that correspond to the current frame
S630
The encoder 113 selects a second quantity of current-frame representative virtual loudspeakers from the seventh quantity of virtual loudspeakers based on the seventh quantity of current-frame final vote values
S640
The encoder 113 encodes the current frame based on the second quantity of current-frame representative virtual loudspeakers, to obtain a bitstream

FIG. 9

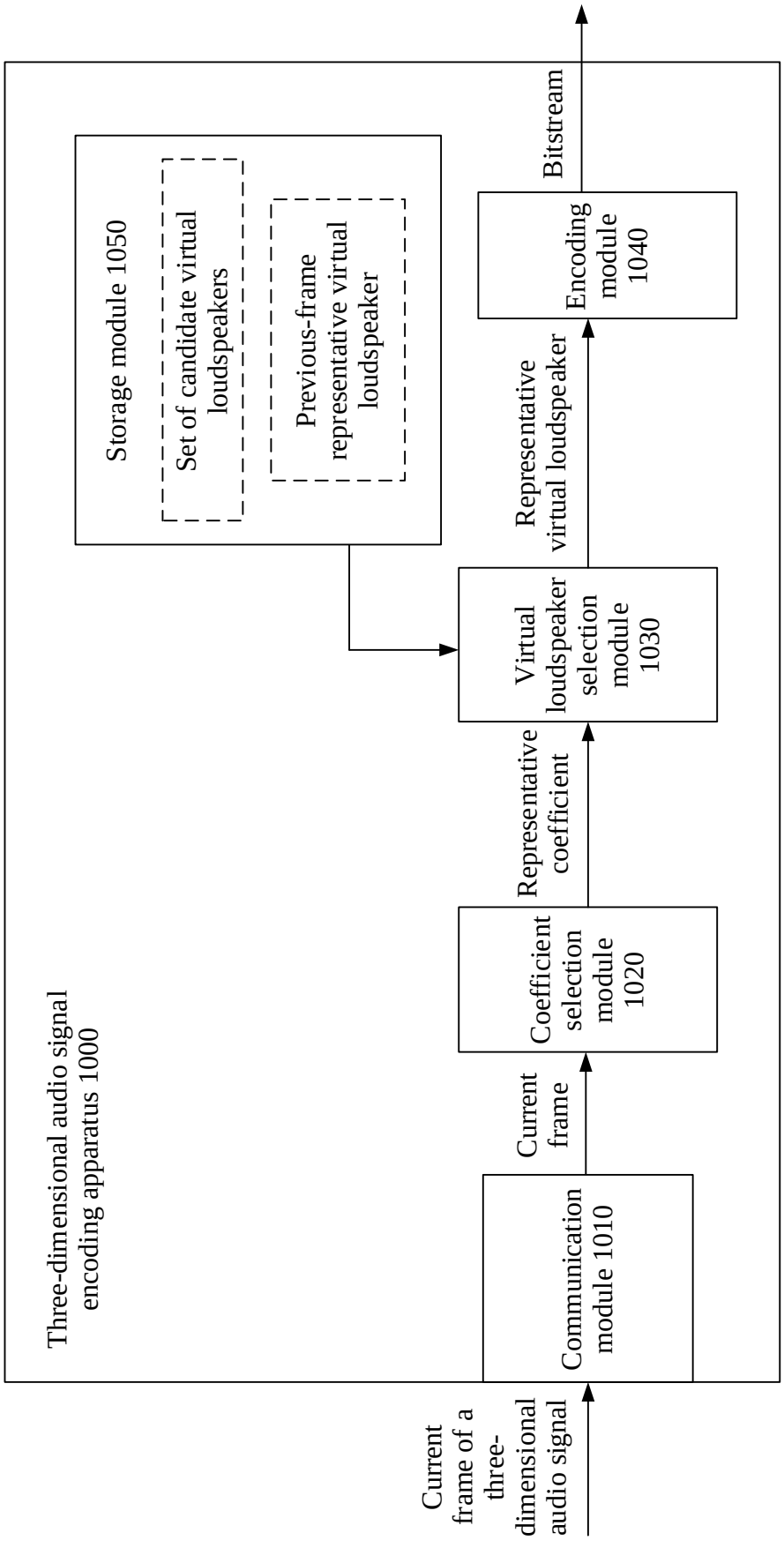

Three-dimensional audio signal encoding apparatus 1000
Current frame of a three-dimensional audio signal
Communication module 1010
Current frame
Coefficient selection module 1020
Representative coefficient
Virtual loudspeaker selection module 1030
Representative virtual loudspeaker
Encoding module 1040
Bitstream
Storage module 1050
Set of candidate virtual loudspeakers
Previous-frame representative virtual loudspeaker

FIG. 10

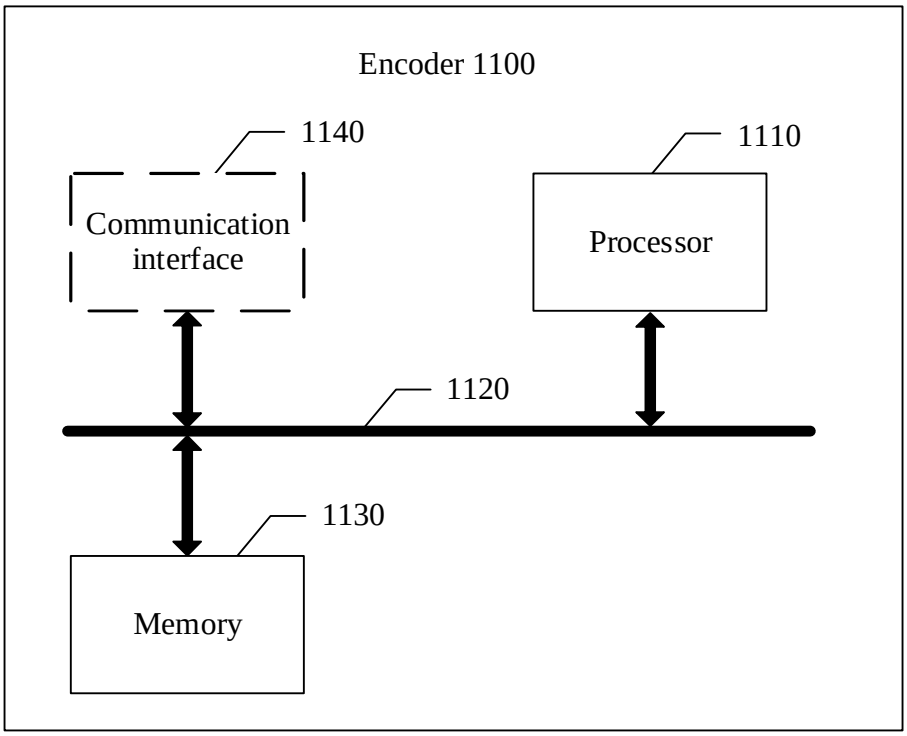

Encoder 1100
1140
Communication interface
1110
Processor
1120
1130
Memory

FIG. 11