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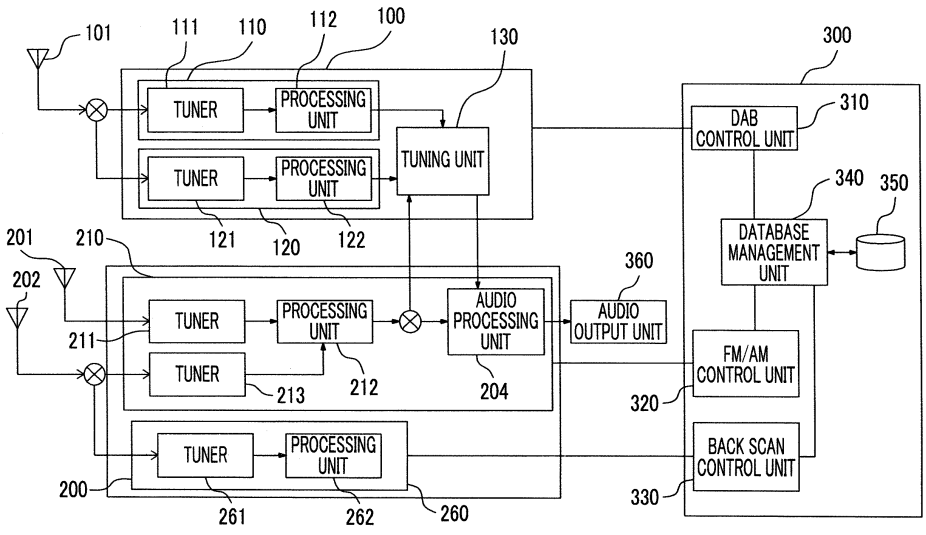
(54) RECEPTION APPARATUS

(57) Reception apparatus in which reception quality is improved by appropriately performing broadcast tuning. A first tuning reception unit (110) and a second tuning reception unit (210) receive a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast. A first back scan reception unit (120) and a second back scan reception unit (260) sequentially receive the plurality of broadcast waves. The reception evaluation unit (300) generates, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of a broadcast wave having the same service ID as that of a tuned broadcast wave among the broadcast waves received in the first back scan reception unit (120) and the second back scan reception unit (260). The tuning unit (130) determines a broadcast wave having the same service ID that is to be tuned based on the reception evaluation value.

FIG. 1



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Description

[0001] The present invention relates to a radio broadcast reception apparatus capable of receiving both of a digital audio broadcast and a radio data system broadcast.

[0002] In recent years, digital audio broadcasting has been widely used, and particularly, digital broadcasting called digital audio broadcasting (DAB) has been adopted in Europe. Meanwhile, FM/AM broadcasting has been conventionally used, and a reception apparatus that receives broadcasts by switching between digital broadcasting and FM/AM broadcasting has been used.

[0003] Particularly, in FM radio broadcasting, a radio data system (RDS) service is used. RDS is a service in which auxiliary data is inserted into a band of FM radio broadcasting and provided, and is used for, for example, traffic information. Information for identifying the contents of a program that is broadcast by RDS is transmitted, and a reception apparatus can identify a program using the data.

[0004] Both of DAB broadcasts and FM radio broadcasts are used, and the same programs are broadcast in a DAB broadcast and an FM radio broadcast. Switching can also be performed such that a DAB broadcast is received when the reception quality of the DAB broadcast is high, and an FM radio broadcast is received when the reception quality of the DAB broadcast is low. Since a DAB broadcast is a digital broadcast, information for identifying a program is included in a DAB broadcast, and since for an FM broadcast, a program can also be identified by RDS, both are managed by a database, and the same programs are identified by referring to the database, such that switching between the programs is technically possible. For example, PCT Japanese Translation Patent Publication No. 2014-523153 discloses that a DAB broadcast and the RDS of the same broadcast are switched between based on only the BER of the DAB broadcast.

[0005] However, in PCT Japanese Translation Patent Publication No. 2014-523153, only a bit error rate (BER) of a DAB broadcast is used as a reference for determining switching of the broadcasts, and there is no consideration for an FM broadcast side. Further, only the BER is considered in a digital broadcast, and indicators for other communications have not been particularly used. As a result, a broadcast with high communication quality and high reliability has not been appropriately selected at first when a DAB broadcast has been compared with an FM broadcast. Further, since a broadcast is immediately switched according to a specific reference, there is a problem in that frequent switching occurs in a case in which the reception qualities of a DAB broadcast and an FM broadcast are close to each other.

[0006] For a listener, first, the listening quality is degraded such as there being sound skips due to frequent switching of broadcasts. Further, since references for determining switching may not be accurate and broadcasts with a high quality may not be able to be received, there is room for further improvement in the reception quality in a reception apparatus as a whole.

[0007] The present invention provides a reception apparatus in which the reception quality is improved by appropriately performing appropriate broadcast tuning.

[0008] A reception apparatus according to an aspect of the present invention includes a tuning reception unit configured to receive a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast; a back scan reception unit configured to sequentially receive the plurality of broadcast waves; a reception evaluation unit configured to generate, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of a broadcast wave having the same service ID as the tuned broadcast wave among the broadcast waves received by the back scan reception unit; and a tuning unit configured to determine a broadcast wave that is to be tuned from the plurality of broadcast waves having the same service ID based on the reception evaluation value.

[0009] According to this configuration, since the reception evaluation value is obtained for each of a plurality of broadcast waves of the analog broadcast and the digital broadcast and tuning is performed based on the reception evaluation value, the reception quality is evaluated for the analog broadcast as well as the digital broadcast. Since the tuning is performed based on the evaluation of both of the analog broadcast and the digital broadcast, it is possible to determine the broadcast waves that can be received with high quality and realize stable tuning switching.

[0010] Preferably, the tuning reception unit includes a first tuning reception unit configured to receive a tuned broadcast among a plurality of digital broadcasts; and a second tuning reception unit configured to receive a tuned broadcast among a plurality of analog broadcasts, and the back scan reception unit includes a first back scan reception unit configured to sequentially receive the plurality of digital broadcast waves; and a second back scan reception unit configured to sequentially receive the plurality of analog broadcast waves.

[0011] According to this configuration, it is possible to perform both of the reception of a tuned broadcast and the reception as the back scan for predetermined digital broadcasting using the first tuning reception unit and the first back scan reception unit, and it is possible to perform both of the reception of a tuned broadcast and the reception as the back scan for predetermined analog broadcasting using the second tuning reception unit and the second back scan reception unit. Accordingly, it is possible to perform the reception of the tuned broadcast while performing the evaluation of the reception quality using the back scan for each of the digital broadcasting and the analog broadcasting.

[0012] Preferably, the reception evaluation unit generates a new reception evaluation value based on a previous reception evaluation value at predetermined time in-

tervals.

[0013] According to this configuration, since a previous reception evaluation value is reflected in generation of a new reception evaluation value, the reception evaluation value is stabilized and it is possible to prevent switching of tuning from becoming unstable.

[0014] Preferably, the reception evaluation unit evaluates the reception quality according to a plurality of evaluation items, obtains an increase and decrease value of the reception evaluation value for each of the evaluation items, and adds or subtracts the obtained increase and decrease value to or from the reception evaluation value to update the reception evaluation value.

[0015] According to this configuration, since the reception evaluation value is obtained using the evaluation items in a composite manner instead of using a single evaluation item, the accuracy of calculation of the reception evaluation value is improved and broadcast waves that can be received with high quality can be determined.

[0016] Preferably, when the reception evaluation value for a predetermined broadcast wave is smaller than a certain value, the reception evaluation unit further decreases the reception evaluation value.

[0017] According to this configuration, since the reception evaluation value becomes a value yet smaller than a certain value in a case in which the reception evaluation value is smaller than the certain value, some time is taken until the reception evaluation value returns to the certain value even when the reception evaluation value then has increased. As a result, since some time is taken until the reception evaluation value is greater than a reception evaluation value as a comparison target, it is possible to prevent the tuning switching from frequently occurring.

[0018] Preferably, the reception evaluation value is obtained within a range with common upper and lower limit values for each broadcast wave, and the reception evaluation unit sets the reception evaluation value to be the same as the upper limit value when the reception evaluation value is greater than the upper limit value due to the increase and decrease value being added, and sets the reception evaluation value to be the same as the lower limit value when the reception evaluation value is smaller than the lower limit value due to the increase and decrease value being subtracted.

[0019] According to this configuration, since a change range is set in the reception evaluation value, the reception evaluation value is not increased when the reception evaluation value is equal to or greater than an upper limit value, and the reception evaluation value is not decreased when the reception evaluation value is equal to or smaller than a lower limit value, a reception evaluation value that can be compared in each of a plurality of broadcast waves can be generated and compared, and the broadcast waves that can be received with high quality can be selected.

[0020] Preferably, the reception evaluation unit obtains the reception evaluation value for the analog broadcast and the reception evaluation value for the digital broadcast using different references, and sets any of the reception evaluation values to be within ranges of common upper and lower limit values.

[0021] According to this configuration, since the reference for determining the quality originally differs between the analog broadcast and the digital broadcast, the analog broadcast and the digital broadcast can be compared with each other by matching the upper and lower limit values of the reception evaluation value with each other to obtain a common range, and the broadcast waves that can be received with high quality can be selected.

[0022] Preferably, the tuning unit compares the reception evaluation value for the analog broadcast with the reception evaluation value for the digital broadcast, tunes the broadcast waves of the analog broadcast in a case in which the reception evaluation value for the analog broadcast is great, and tunes the broadcast waves of the digital broadcast in a case in which the reception evaluation value for the digital broadcast is great.

[0023] According to this configuration, it is possible to select broadcast waves that can be received with high quality by comparing reception evaluation values having a common range between the analog broadcast and the digital broadcast.

[0024] A suitable reception method includes a first step of receiving a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast; a second step of sequentially receiving the plurality of broadcast waves; a third step of generating, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of the broadcast wave having the same service ID as the tuned broadcast wave among the broadcast waves received in the second step; and a fourth step of determining a broadcast wave that is to be tuned from the plurality of broadcast waves having the same service ID based on the reception evaluation value.

[0025] A preferred computer program product comprises software code sections that cause a computer of a reception apparatus to execute: a first step of receiving a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast; a second step of sequentially receiving the plurality of broadcast waves; a third step of generating, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of the broadcast wave having the same service ID as the tuned broadcast wave among the broadcast waves received in the second step; and a fourth step of determining a broadcast wave that is to be tuned from the plurality of broadcast waves having the same service ID based on the reception evaluation value.

Effect of the Invention

[0026] According to the present invention, it is possible to provide a reception apparatus in which the reception quality is improved by appropriately performing appro-

priate broadcast tuning.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a block diagram illustrating a reception apparatus according to an embodiment of the present invention;

Fig. 2 is a diagram illustrating a reception evaluation value according to an embodiment of the present invention;

Fig. 3 is a flowchart illustrating a flow of an entire process of calculating a reception evaluation value according to an embodiment of the present invention;

Fig. 4 is a flowchart illustrating a process of updating a reception evaluation value of a digital radio according to an embodiment of the present invention;

Fig. 5 is a flowchart illustrating a process of updating a reception evaluation value of an analog radio according to an embodiment of the present invention; and

Fig. 6 is a flowchart illustrating a tuning process according to an embodiment of the present invention.

[0028] Fig. 1 is a block diagram illustrating a reception apparatus according to an embodiment of the present invention. The reception apparatus according to this embodiment includes a first reception unit 100 that receives a digital broadcast, a second reception unit 200 that receives an analog broadcast and a RDS, a reception evaluation unit 300, and an audio output unit 360.

[0029] The first reception unit 100 includes a first tuning reception unit 110 that receives a tuned broadcast among a plurality of digital broadcasts, a first back scan reception unit 120 that sequentially receives a plurality of digital broadcast waves, and a tuning unit 130.

[0030] The first reception unit 100 receives a DAB broadcast received from an antenna 101. The received DAB broadcast is sent to each of a tuner 111 and a tuner 121. Each of the tuner 111 and the tuner 121 includes a local oscillator, a mixer, a filter, and an A/D converter, and receives a received broadcast and then processes an analog signal into a digital signal. The filter is used for anti-aliasing and image removal.

[0031] The first tuning reception unit 110 receives a tuned broadcast among a plurality of digital broadcasts, and the first back scan reception unit 120 does not tune a specific broadcast, but sequentially receives a plurality of digital broadcast waves. Since the first back scan reception unit 120 is not capable of simultaneously processing a plurality of broadcasts, the first back scan reception unit 120 receives the broadcasts while switching, for example, frequencies of the broadcasts that are reception targets at certain time intervals, and sends a result of the reception based on an RDS signal in the broadcast to a reception evaluation unit 300 to be described below.

[0032] Each of the processing unit 112 and the processing unit 122 includes a demodulator and a DAB decoder, and processes the signal sent from the tuner 111 and the tuner 121, through the demodulator and the DAB decoder, and sends a resultant signal to the tuning unit 130.

[0033] The tuning unit 130 performs a tuning process. The tuning is also performed at a point in time of the first tuning reception unit 110, but since a broadcast signal is sent from the second reception unit 200, the tuning unit 130 determines which signal is selected and audio-output on the basis of a signal sent from the reception evaluation unit 300. The tuning unit 130, particularly, determines a broadcast wave that is to be tuned from a plurality of broadcast waves having the same service ID on the basis of the reception evaluation value sent from the reception evaluation unit 300.

[0034] Here, the same service ID is assigned to broadcasts having the same content. That is, the broadcasts having the same content are performed at a plurality of broadcast waves (stations).

[0035] On the other hand, for the audio output, if simple switching is performed for convenience of switching between an audio output by the first reception unit 100 and an audio output by the second reception unit 200, timings are likely to be different. Further, although the timings match, switching with unnatural break may not be often appropriate. The tuning unit 130 executes audio switching at an appropriate point in time between the audio output from the first reception unit 100 and the audio output from the second reception unit 200 by measuring respective timings.

[0036] The second reception unit 200 includes the second tuning reception unit 210 that receives a tuned broadcast among a plurality of analog broadcasts, and a second back scan reception unit 260 that sequentially receives a plurality of analog broadcast waves.

[0037] The second reception unit 200 receives an FM/AM broadcast received from an antenna 201 and an FM broadcast received from an antenna 202. The FM/AM broadcast received from the antenna 201 is sent to the second tuning reception unit 210, and the FM broadcast received from the antenna 202 is sent to the second tuning reception unit 210 and the second back scan reception unit 260.

[0038] The FM broadcast received from the antenna 202 is sent to a tuner 213 and a tuner 261. Each of the tuner 211, the tuner 213, and the tuner 261 includes a local oscillator, a mixer, a filter, and an A/D converter, and receives the received broadcast and processes an analog signal into a digital signal. The filter is used for anti-aliasing and image removal.

[0039] The second tuning reception unit 210 receives a tuned broadcast among a plurality of FM broadcasts, and the second back scan reception unit 260 does not tune a specific broadcast and sequentially receives a plurality of digital broadcast waves. Since the second back

scan reception unit 260 is not capable of simultaneously processing a plurality of broadcasts, the second back scan reception unit 260 receives the broadcasts while switching, for example, frequencies of the broadcasts that are reception targets at certain time intervals, and sends a result of the reception based on an RDS signal in the broadcast to a reception evaluation unit 300 to be described below.

[0040] A processing unit 212 includes a diversity circuit, an analog demodulator, an RDS demodulator/decoder, and a radio standard emulator. In the diversity circuit, radio waves of which a reception state is good among the FM broadcasts sent from the tuner 211 and the tuner 213 are selectively received, and a signal is processed through the analog demodulator, the RDS demodulator/decoder, and the radio standard emulator and sent to the tuning unit 130, an audio processing unit 204, and the reception evaluation unit 300.

[0041] A processing unit 262 includes an analog demodulator, an RDS demodulator/decoder, and a radio standard emulator, and processes a signal through these and sends a resultant signal to the reception evaluation unit 300. The audio processing unit 204 converts the broadcasting signal sent from the tuning unit 130 into an audio output, and sends the audio output to the audio output unit 360. The audio output unit 360 reproduces the sound output using a speaker or the like.

[0042] Further, the first tuning reception unit 110, the first back scan reception unit 120, the second tuning reception unit 210, and the second back scan reception unit 260 can be regarded as another combination. That is, the first tuning reception unit 110 and the second tuning reception unit 210 may be tuning reception units that receive a tuned broadcast among a plurality of broadcast waves of the analog broadcast and the digital broadcast. Further, the first back scan reception unit 120 and the second back scan reception unit 260 may be back scan reception units that sequentially receive the plurality of broadcast waves.

[0043] The reception evaluation unit 300 generates, for each broadcast wave, a reception evaluation value that is an evaluation value of reception quality of the broadcast waves having the same service ID as that of the tuned broadcast waves among the broadcast waves received by the back scan reception unit (the first back scan reception unit 120 and the second back scan reception unit 260). A detailed configuration will be described with reference to Fig. 2

[0044] Fig. 2 is a diagram illustrating the reception evaluation value. The reception evaluation unit 300 generates reception quality information 400 included in the digital broadcast received by the first back scan reception unit 120 and reception quality information 410 received by the second back scan reception unit 260, and generates reception evaluation information 420 based on the reception quality information 400 and the reception quality information 410. The reception evaluation unit 300 sends a reception evaluation value (a degree of reliability)based on the reception evaluation information 420 to the first reception unit 100 and the second reception unit 200, and the tuning unit 130 performs a tuning process.

[0045] The reception evaluation unit 300 includes a DAB control unit 310, an FM/AM control unit 320, a back scan control unit 330, a database management unit 340, and a database 350. The DAB control unit 310 receives information on the quality of the DAB broadcast sent from the first reception unit 100, generates the reception quality information 400, and sends the reception quality information 400 to the database management unit 340. The back scan control unit 330 receives information on the quality of the FM broadcast included in the RDS, which is sent from the second back scan reception unit 260, generates the reception quality information 410, and sends the reception quality information 410 to the database management unit 340.

[0046] The DAB control unit 310 performs SPI communication with the first reception unit 100. The DAB control unit 310 issues a command to the first tuning reception unit 110 through the SPI communication to acquire information. Accordingly, the DAB control unit 310 acquires information on audio signal quality, such as S/N or BER.

[0047] Further, the DAB control unit 310 acquires information through command processing for each tuning with respect to the first back scan reception unit 120 through SPI communication. That is, tuning is performed for each channel by a back scan, service information such as EID or SID is acquired, and information on signal quality such as a frequency, S/N, or BER is acquired. The reception quality information 400 obtained as above includes a reception frequency, S/N (SNR), BER (FICBER), a time difference of a seamless link, an a detection time of seamless time difference for each service ID. In the reception quality information 400, information on the reception quality is arranged for each service ID.

[0048] S/N is a ratio of a signal to noise, but is assumed to be a ratio of a signal intensity (field intensity: RSSI) at a center frequency to a signal intensity at a frequency slightly apart from an end of a frequency band. A frequency slightly apart from the end of the frequency band is a frequency at which there should be no broadcast waves and is a frequency close to a channel to be received. The BER is an abbreviation of a bit error rate (ratio), and is a code error rate. A data stream is greatly divided into two types of a header portion and an actual data portion, and FICBER is an error rate of the header portion in the data stream of the digital broadcast.

[0049] The FM/AM control unit 320 and the back scan control unit 330 perform IIC communication with the second reception unit 200. The FM/AM control unit 320 issues a command to the second tuning reception unit 210 to acquire information through the IIC communication. Accordingly, the FM/AM control unit 320 acquires information on audio signal quality such as S/N or BER.

[0050] Further, the back scan control unit 330 acquires information through command processing for each tun-

ing with respect to the second back scan reception unit 260 through IIC communication. That is, tuning is performed for each channel by back scan, service information such as RDS, including PI, is acquired, and information on the signal quality such as a frequency or RSSI is acquired. The reception quality information 410 obtained as above includes information on acquisition of a frequency, RSSI, and RDSPI for each service ID. In the reception quality information 410, information on the reception quality is arranged for each service ID.

[0051] Since the reception quality information 400 is information sent from the first reception unit 100, the reception quality information 400 is broadcast quality for the DAB broadcast, and since the reception quality information 410 is information sent from the second reception unit 200, the reception quality information 410 is broadcast quality for the FM broadcast. Accordingly, the reception quality information is information based on different reference, as illustrated in Fig. 2. The information with the different reference is sent to the database management unit 340, and the database management unit 340 re-builds the information as a reference of common data to generate the reception evaluation information 420. The reception evaluation information 420 is stored in the database 350.

[0052] The reception evaluation information 420 is arranged in an order of the reception evaluation values for each service ID. That is, a service having a greatest reception evaluation value is first arranged, a service having a next reception evaluation value is arranged in next, and a service having a smallest reception evaluation value is last arranged. By arranging the reception evaluation information 420 in an order of the reception evaluation values as above, it is possible to perform reproduction switching without requiring a processing load at the time of a comparison by always confirming the top of the database 350.

[0053] The reception evaluation information 420 includes both of an item included in the reception quality information 400 and an item included in the reception quality information 410. Accordingly, items that are not included in the DAB broadcast are blanks, and items that are not included in the FM broadcast are blanks. A determination process is performed on each of the items, weighting is applied, and then, the reception evaluation value is calculated. Accordingly, the reception evaluation value is an evaluation value of the reception quality of each broadcast wave having the same service ID as that of a tuned broadcast wave. In other words, the reception evaluation value is a degree of reliability for reception of a predetermined broadcast wave.

[0054] The database management unit 340 generates and updates the reception evaluation information 420 and generates and updates the reception evaluation value included in the reception evaluation information 420. The DAB control unit 310 sends the reception evaluation value to the first reception unit 100, and the FM/AM control unit 320 sends the reception evaluation value to the second reception unit 200.

[0055] The first back scan reception unit 120 and the second back scan reception unit 260 receive the broadcast waves while switching between the broadcast waves of different services, and each service of the received broadcast wave is managed by the service ID. This service ID is received as information included in the digital broadcast in the first back scan reception unit 120 and as information included in the RDS in the second back scan reception unit 260. Since broadcasts have the same content when the service IDs are the same, the broadcasts are the same broadcasts for a listener, but since broadcasting is performed by a plurality of channels, broadcast waves of different channels with the same service ID is switched by the tuning unit 130. The reception evaluation value is used for this switching determination, and the reception evaluation unit 300 obtains the reception evaluation value for each broadcast wave.

[0056] The reception evaluation value is given in a range of 0 to 15, and this range may be the same between the digital broadcast received by the first reception unit 100 and the FM broadcast received by the second reception unit 200. A great value thereof means that a degree of reception reliability is high. If the reception evaluation value is 15, the degree of reliability is the highest, and if the reception evaluation value is 0, the degree of reliability is the lowest. That is, for the reception evaluation values, the reception evaluation value for the analog broadcast and the reception evaluation value for the digital broadcast are obtained using different references, and any of the reception evaluation values is obtained within a range with a common upper limit value 15 and a common lower limit value 0 for each broadcast wave. The reception evaluation unit 300 sets the reception evaluation value to be the same as the upper limit value 15 when the reception evaluation value is greater than the upper limit value 15 due to the increase and decrease value being added, and sets the reception evaluation value to be the same as the lower limit value 0 when the reception evaluation value is smaller than the lower limit value 0 due to the increase and decrease value being subtracted.

[0057] The reception evaluation unit 300 generates a new reception evaluation value based on the previous reception evaluation value at predetermined time intervals. The reception evaluation unit 300 evaluates the reception quality according to a plurality of evaluation items shown in the reception quality information 400 and the reception quality information 410, obtains an increase and decrease value of the reception evaluation value for each of the evaluation items, and adds or subtracts the obtained increase and decrease value to or from the reception evaluation value to update the reception evaluation value and the reception evaluation information 420.

[0058] Based on the above reception evaluation value, the tuning unit 130 performs a tuning process. The tuning unit 130 compares the reception evaluation value for broadcast waves of the analog broadcast with the recep-

tion evaluation value for broadcast waves of the digital broadcast. The tuning unit 130 tunes the broadcast waves of the analog broadcast in a case in which the reception evaluation value for the broadcast waves of the analog broadcast is greater, and tunes the broadcast waves of the digital broadcast in a case in which the reception evaluation value for the broadcast waves of the digital broadcast is greater. The process of calculating the reception evaluation value will be described with reference to Figs. 3 to 6.

[0059] Fig. 3 is a flowchart illustrating a flow of an entire process of calculating the reception evaluation value. The database management unit 340 first performs an initial setting of the reception evaluation value (step S10). That is, the database management unit 340 sets the reception evaluation value to 7 which is an initial value. Then, the database management unit 340 updates the reception evaluation value (step S11). Accordingly, the database management unit 340 performs a service detection process, and determines whether digital radio signal detection is ON or OFF. In a case in which the digital radio detection is ON, the database management unit 340 updates the reception evaluation value of a digital radio (that is, the DAB broadcast) (step S12), and in a case in which the digital radio detection is OFF, the database management unit 340 updates the reception evaluation value of the analog radio (that is, the FM broadcast) (step S13).

[0060] Fig. 4 is a flowchart illustrating a process of updating the reception evaluation value of the digital radio. When the reception evaluation value of the digital radio in Fig. 3 is updated (step S12), the database management unit 340 determines whether the service ID is the same service ID as that of a reproduction service or whether the service ID of the reproduced radio is the same as a predetermined service ID of the database 350. In a case in which the service IDs are not the same, the process proceeds to a process for other items.

[0061] In a case in which it is determined that the service IDs are the same, it is determined whether S/N is a value equal to or greater than the threshold value (step S21). In a case in which S/N is determined not to be equal to or greater than the threshold value, the reception evaluation value decreases by 2 (step S22). It is determined that the reception evaluation value is greater than 7, the reception evaluation value decreases by 1 in a case in which the reception evaluation value is greater than 7, and the reception evaluation value is set to 0 in a case in which the reception evaluation value is equal to or smaller than 7.

[0062] Thus, in a case in which the reception evaluation value for a predetermined broadcast wave is smaller than a certain value (= 7), the reception evaluation unit 300 further decreases the reception evaluation value. Accordingly, since the reception evaluation value becomes a value smaller than the certain value in a case in which the reception evaluation value is smaller than the certain value, a time is taken until the reception evaluation value is returned to the certain value even when the reception evaluation value then increases. As a result, since a time is taken until the reception evaluation value is greater than a reception evaluation value as a comparison target, it is possible to prevent the tuning switching from frequently occurring.

[0063] In a case in which S/N is determined to be a value equal to or greater than a threshold value, it is determined whether FICBER is a value equal to or smaller than a threshold value (step S23). In a case in which it is determined whether FICBER is a value equal to or smaller than the threshold value, 2 is added to the reception evaluation value (step S24). It is determined whether the reception evaluation value is greater than 15, and the reception evaluation value is set to 15 in a case in which the reception evaluation value is greater than 15.

[0064] In a case in which FICBER is determined not to be a value equal to or smaller than the threshold value, 1 is added to the reception evaluation values (step S25). It is determined whether the reception evaluation value is greater than 15, and in a case in which the reception evaluation value is greater than 15, the reception evaluation value is set to 15. Thus, the process of updating the reception evaluation value of the digital radio is performed based on the values of S/N and FICBER.

[0065] Fig. 5 is a flowchart illustrating a process of updating the reception evaluation value of the analog radio. When the reception evaluation value of the analog radio in Fig. 3 is updated (step S13), the database management unit 340 determines whether the service ID is the same service ID as that of a reproduction service or whether the service ID of the reproduced radio is the same as a predetermined service ID of the database 350. In a case in which the service IDs are not the same, the process proceeds to a process for other items.

[0066] In a case in which it is determined that the service IDs are the same, it is determined whether RSSI is a value equal to or greater than a threshold value (step S31). In a case in which RSSI is determined not to be equal to or greater than the threshold value, the reception evaluation value decreases by 2 (step S32). It is determined that the reception evaluation value is greater than 7, the reception evaluation value decreases by 1 in a case in which the reception evaluation value is greater than 7, and the reception evaluation value is set to 0 in a case in which the reception evaluation value is equal to or smaller than 7.

[0067] Thus, for the analog broadcast, in a case in which the reception evaluation value for a predetermined broadcast waves is smaller than a certain value (= 7), the reception evaluation unit 300 further decreases the reception evaluation value. Accordingly, since the reception evaluation value becomes a value smaller than the certain value in a case in which the reception evaluation value is smaller than the certain value, a time is taken until the reception evaluation value is returned to the certain value even when the reception evaluation value then increases. As a result, since a time is taken until the re-

ception evaluation value is greater than a reception evaluation value as a comparison target, it is possible to prevent the tuning switching from frequently occurring.

[0068] In a case in which the RSSI is determined to be a value equal to or greater than the threshold value, it is determined whether the PI (service ID) is able to be acquired (step S33). In a case in which the PI is determined to be able to be acquired, 2 is added to the reception evaluation value (step S34). It is determined whether the reception evaluation value is greater than 15, and in a case in which the reception evaluation value is greater than 15, the reception evaluation value is set to 15.

[0069] In a case in which the PI is determined not to be able to be acquired, 1 is added to the reception evaluation values (step S35). It is determined whether the reception evaluation value is greater than 15, and in a case in which the reception evaluation value is greater than 15, the reception evaluation value is set to 15. Thus, the process of updating the reception evaluation value of the analog radio is performed based on an acquisition situation of the RSSI value and the PI.

[0070] Although the process of updating the reception evaluation value in the reception evaluation unit 300 has been described above, the tuning unit 130 performs the tuning process based on the updated reception evaluation value. A flowchart of this tuning process will be described with reference to Fig. 6.

[0071] Fig. 6 is a flowchart illustrating the tuning process. The tuning unit 130 receives the updated reception evaluation value through the communication process with the reception evaluation unit 300. The tuning unit 130 monitors a first service within the database 350 (step S40). Since the reception evaluation information 420 is arranged in an order of the reception evaluation value for each service ID and stored in the database 350, the service having the greatest reception evaluation value is first arranged.

[0072] The tuning unit 130 determines whether the reception evaluation value is equal to or greater than 7 for a service of which the reception evaluation value is the greatest (step S41). In a case in which the reception evaluation value is smaller than 7, the current service is continued, and the tuning process ends.

[0073] In a case in which the reception evaluation value is equal to or greater than 7, it is determined whether seamless link switching can be performed (step S42). That is, it is confirmed whether there is no difference in a timing between services, and then, the switching is performed. In a case in which the switching can be performed, seamless link switching is performed, and in a case in which the switching cannot be performed, service switching is performed by a manual operation.

[0074] Through the configuration as above, information on the quality of the DAB broadcast received from the antenna 101 and the FM broadcast received from the antenna 201 and the antenna 202 is sent to the reception evaluation unit 300. The reception evaluation unit 300 generates and updates the reception evaluation information 420 and generates and updates the reception evaluation value. The reception evaluation value is sent back to the first reception unit 100 and the second reception unit 200, and a high-quality broadcast with a high degree of reliability in digital and analog signals is selected from among the broadcasts with the same service ID based on the reception evaluation value.

[0075] According to this configuration, since the reception evaluation value is obtained for each of a plurality of broadcast waves of the analog broadcast and the digital broadcast and tuning is performed based on the reception evaluation value, the reception quality is evaluated for the analog broadcast as well as the digital broadcast. Since the tuning is performed based on the evaluation of both of the analog broadcast and the digital broadcast, it is possible to determine the broadcast waves that can be received with high quality and realize stable tuning switching.

[0076] Particularly, it is possible to perform both of the reception of a tuned broadcast and the reception as the back scan for predetermined digital broadcasting using the first tuning reception unit 110 and the first back scan reception unit 120, and it is possible to perform both of the reception of a tuned broadcast and the reception as the back scan for predetermined analog broadcasting using the second tuning reception unit 210 and the second back scan reception unit 260. Accordingly, it is possible to perform the reception of the tuned broadcast while performing the evaluation of reception quality using the back scan for each of the digital broadcasting and the analog broadcasting.

[0077] Further, since a previous reception evaluation value is reflected in generation of a new reception evaluation value, the reception evaluation value is stabilized and it is possible to prevent switching of tuning from becoming unstable. Since the reception evaluation value is obtained using the evaluation items in a composite manner instead of using a single evaluation item, accuracy of calculation of the reception evaluation value is improved and broadcast waves that can be received with high quality can be determined.

[0078] The present invention is not limited to the above-described embodiment. That is, it should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur according to design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

[0079] In the above embodiment, a radio reception terminal that receives the DAB radio broadcast and the FM radio broadcast has been described as a target, but the present invention is not particularly limited thereto and can be applied to a reception apparatus that receives a digital broadcast not limited to the DAB radio broadcast and an analog broadcast not limited to the FM radio broadcast.

Claims

1. A reception apparatus, comprising:

   a tuning reception unit configured to receive a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast;
   a back scan reception unit configured to sequentially receive the plurality of broadcast waves;
   a reception evaluation unit (300) configured to generate, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of the broadcast wave having the same service ID as the tuned broadcast wave among the broadcast waves received by the back scan reception unit; and
   a tuning unit (130) configured to determine a broadcast wave that is to be tuned from the plurality of broadcast waves having the same service ID based on the reception evaluation value.

2. The reception apparatus according to claim 1, wherein the tuning reception unit includes:

   a first tuning reception unit (110) configured to receive a tuned broadcast among a plurality of digital broadcasts; and
   a second tuning reception unit (210) configured to receive a tuned broadcast among a plurality of analog broadcasts, and
   the back scan reception unit includes:

      a first back scan reception unit (120) configured to sequentially receive the plurality of digital broadcast waves; and
      a second back scan reception unit (260) configured to sequentially receive the plurality of analog broadcast waves.

3. The reception apparatus according to claim 1 or 2, wherein the reception evaluation unit (300) generates a new reception evaluation value based on a previous reception evaluation value at predetermined time intervals.

4. The reception apparatus according to any one of claims 1 to 3,
   wherein the reception evaluation unit (300) evaluates the reception quality according to a plurality of evaluation items, obtains an increase and decrease value of the reception evaluation value for each of the evaluation items, and adds or subtracts the obtained increase and decrease value to or from the reception evaluation value to update the reception evaluation value.

5. The reception apparatus according to claim 4, wherein when the reception evaluation value for a predetermined broadcast wave is smaller than a certain value, the reception evaluation unit (300) further decreases the reception evaluation value.

6. The reception apparatus according to claim 4, wherein the reception evaluation value is obtained within a range with common upper and lower limit values for each broadcast wave, and
   the reception evaluation unit (300) sets the reception evaluation value to be the same as the upper limit value when the reception evaluation value is greater than the upper limit value due to the increase and decrease value being added, and sets the reception evaluation value to be the same as the lower limit value when the reception evaluation value is smaller than the lower limit value due to the increase and decrease value being subtracted.

7. The reception apparatus according to any one of claims 1 to 6,
   wherein the reception evaluation unit (300) obtains the reception evaluation value for the analog broadcast and the reception evaluation value for the digital broadcast using different references, and sets any of the reception evaluation values to be within ranges with common upper and lower limit values.

8. The reception apparatus according to claim 7, wherein the tuning unit (130) compares the reception evaluation value for the analog broadcast with the reception evaluation value for the digital broadcast, tunes the broadcast waves of the analog broadcast in a case in which the reception evaluation value for the analog broadcast is great, and tunes the broadcast waves of the digital broadcast in a case in which the reception evaluation value for the digital broadcast is great.

9. A reception method, comprising:

   a first step of receiving a tuned broadcast among a plurality of broadcast waves of an analog broadcast and a digital broadcast;
   a second step of sequentially receiving the plurality of broadcast waves;
   a third step of generating, for each broadcast wave, a reception evaluation value that is an evaluation value of a reception quality of the broadcast wave having the same service ID as the tuned broadcast wave among the broadcast waves received in the second step; and
   a fourth step of determining a broadcast wave that is to be tuned from the plurality of broadcast waves having the same service ID based on the reception evaluation value.

10. A computer program product comprising software

code sections that cause a computer of a reception apparatus to execute a method according to claim 9.

FIG. 1

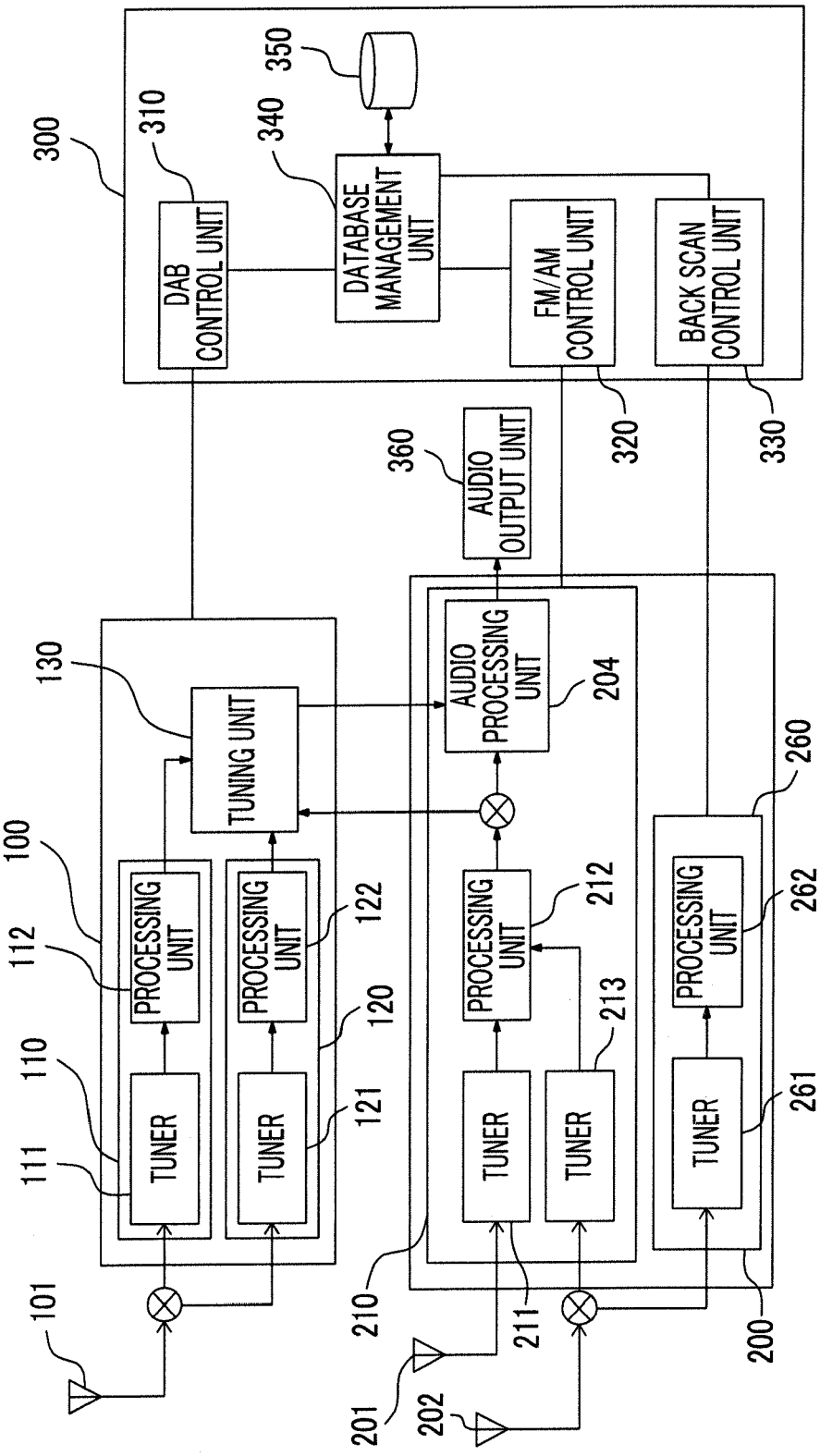

300
310
DAB CONTROL UNIT
340
DATABASE MANAGEMENT UNIT
350
FM/AM CONTROL UNIT
320
BACK SCAN CONTROL UNIT
330
360
AUDIO OUTPUT UNIT
130
TUNING UNIT
AUDIO PROCESSING UNIT
204
100
112
PROCESSING UNIT
122
212
262
260
110
120
213
111
121
261
TUNER
101
210
211
200
201
202

FIG. 2

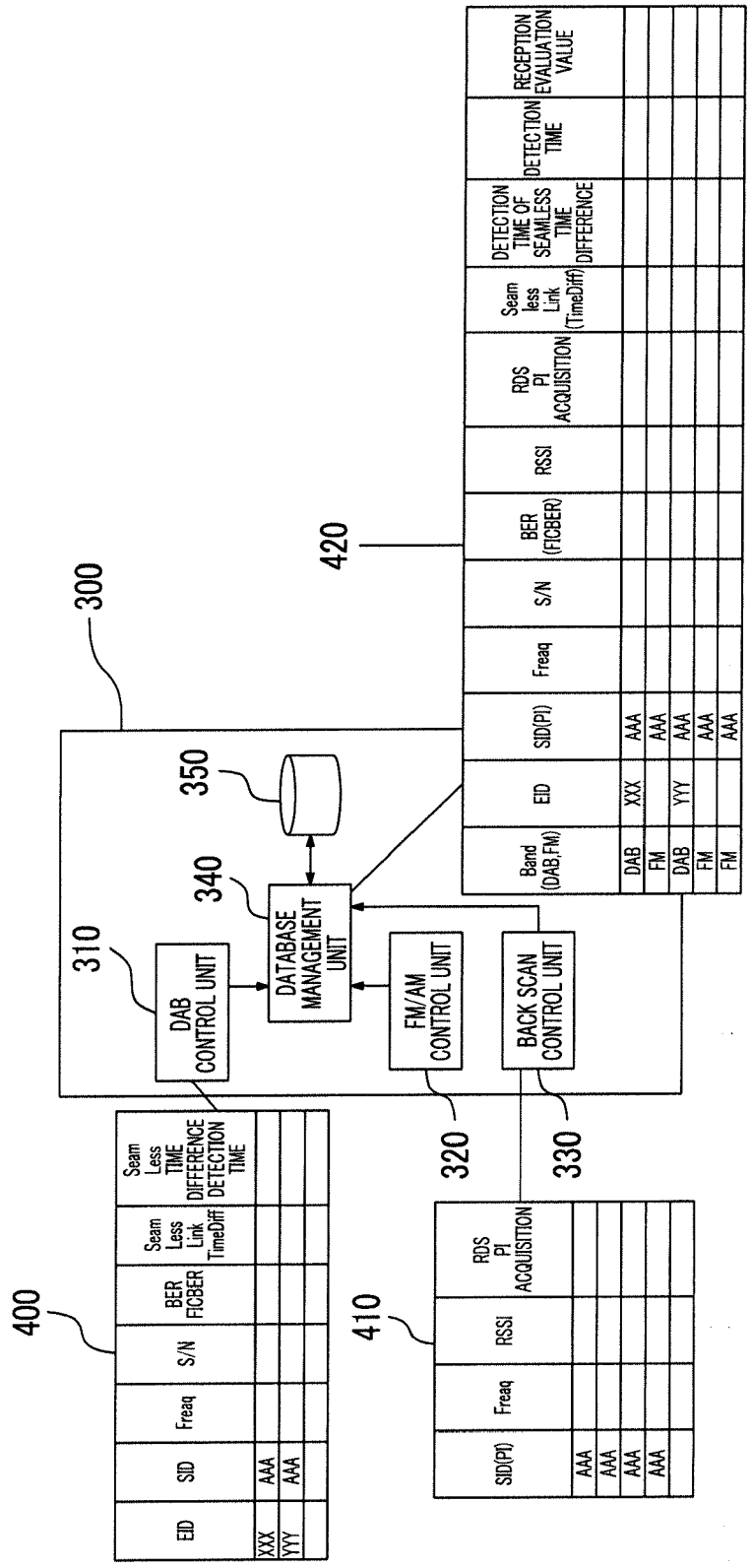

300
310
DAB CONTROL UNIT
340
DATABASE MANAGEMENT UNIT
350
FM/AM CONTROL UNIT
320
BACK SCAN CONTROL UNIT
330
420
Band (DAB,FM)
EID
SID(PI)
Freaq
S/N
BER (FICBER)
RSSI
RDS PI ACQUISITION
Seam less Link (TimeDiff)
DETECTION TIME OF SEAMLESS TIME DIFFERENCE
DETECTION TIME
RECEPTION EVALUATION VALUE
DAB XXX AAA
FM AAA
DAB YYY AAA
FM AAA
FM AAA
400
EID
SID
Freaq
S/N
BER FICBER
Seam Less Link TimeDiff
Seam Less TIME DIFFERENCE DETECTION TIME
XXX AAA
YYY AAA
410
SID(PI)
Freaq
RSSI
RDS PI ACQUISITION
AAA
AAA
AAA
AAA

FIG. 3

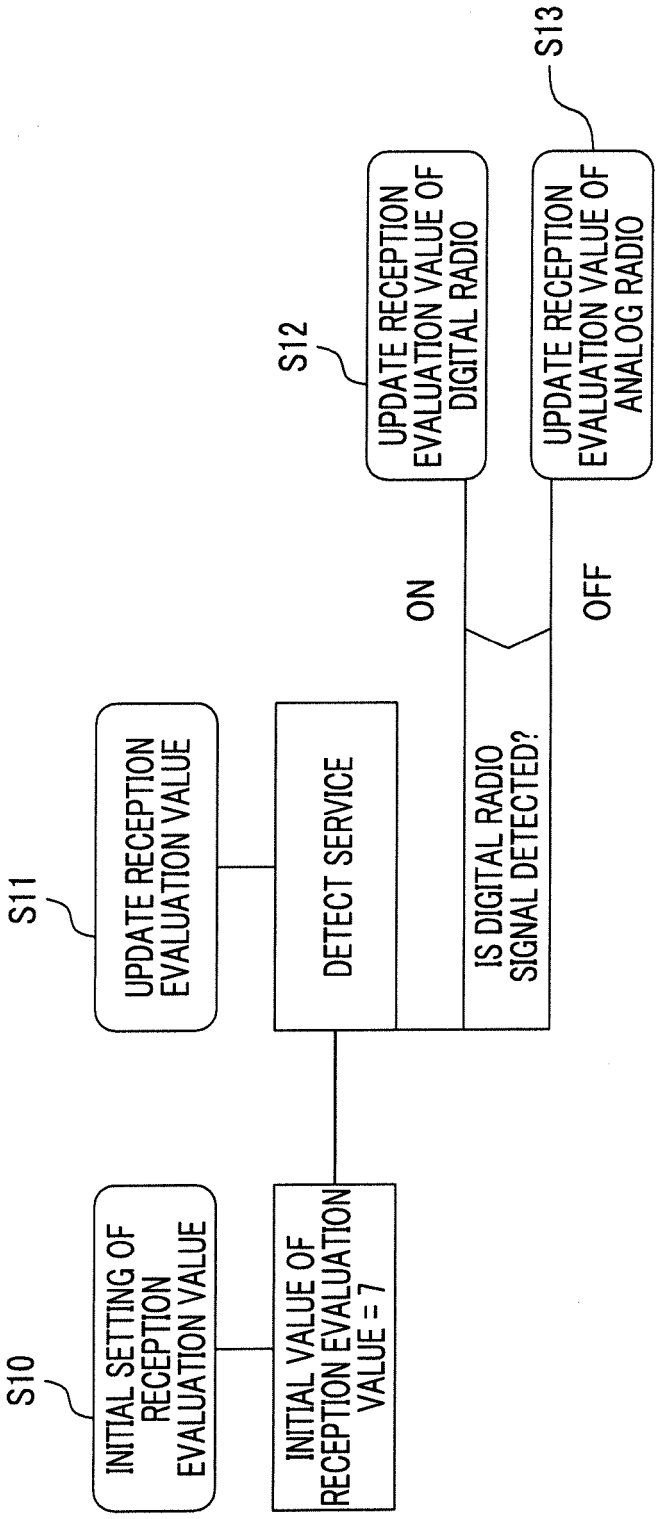

S10
INITIAL SETTING OF RECEPTION EVALUATION VALUE
INITIAL VALUE OF RECEPTION EVALUATION VALUE = 7
S11
UPDATE RECEPTION EVALUATION VALUE
DETECT SERVICE
IS DIGITAL RADIO SIGNAL DETECTED?
ON
S12
UPDATE RECEPTION EVALUATION VALUE OF DIGITAL RADIO
OFF
S13
UPDATE RECEPTION EVALUATION VALUE OF ANALOG RADIO

FIG. 4

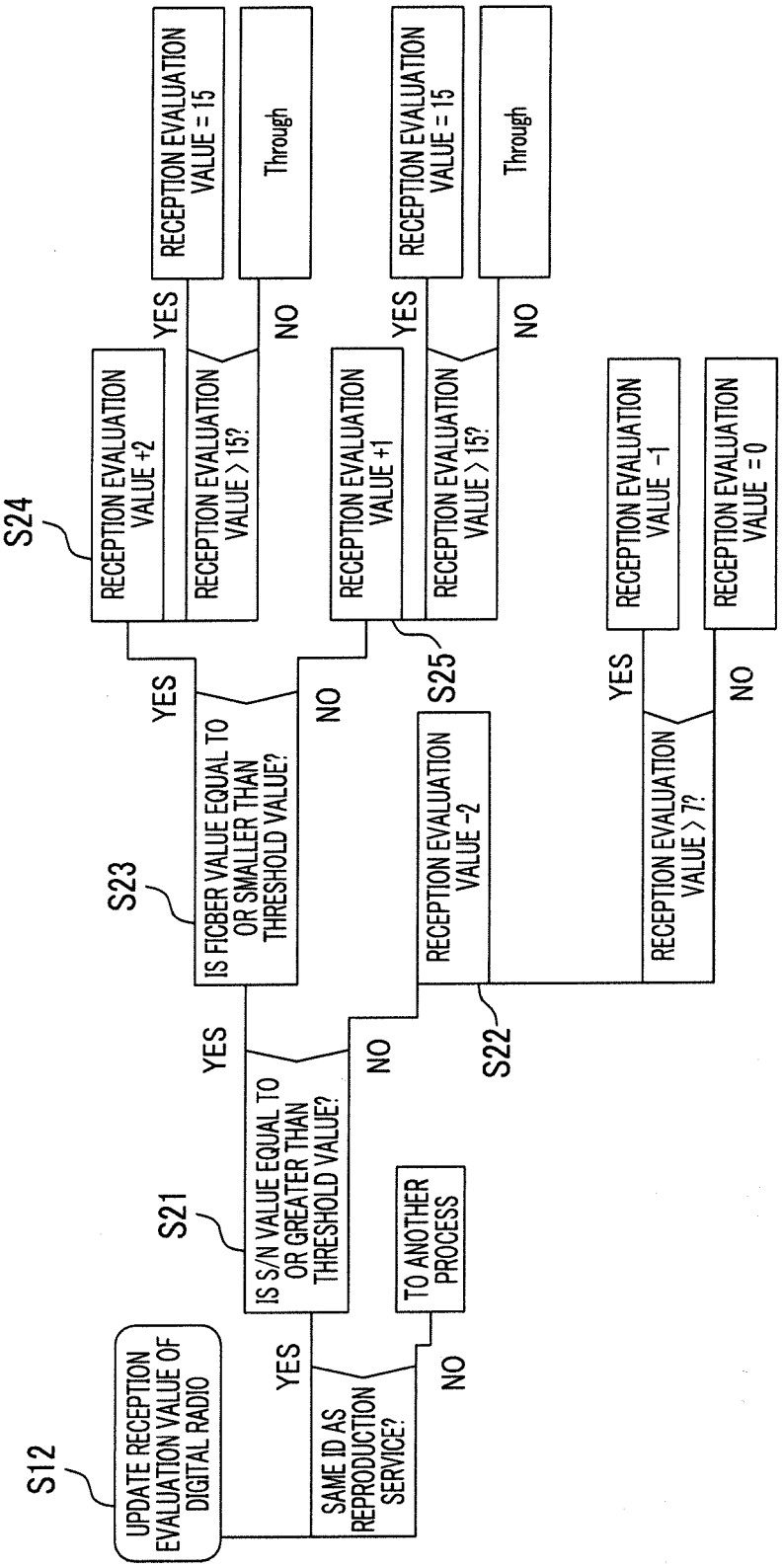

S12
UPDATE RECEPTION EVALUATION VALUE OF DIGITAL RADIO
SAME ID AS REPRODUCTION SERVICE?
YES
NO
TO ANOTHER PROCESS
S21
IS S/N VALUE EQUAL TO OR GREATER THAN THRESHOLD VALUE?
YES
NO
S22
RECEPTION EVALUATION VALUE -2
RECEPTION EVALUATION VALUE -1
RECEPTION EVALUATION VALUE = 0
RECEPTION EVALUATION VALUE > 7?
YES
NO
S23
IS FICBER VALUE EQUAL TO OR SMALLER THAN THRESHOLD VALUE?
YES
NO
S24
RECEPTION EVALUATION VALUE +2
RECEPTION EVALUATION VALUE = 15
Through
RECEPTION EVALUATION VALUE > 15?
YES
NO
S25
RECEPTION EVALUATION VALUE +1
RECEPTION EVALUATION VALUE = 15
Through
RECEPTION EVALUATION VALUE > 15?
YES
NO

FIG. 5

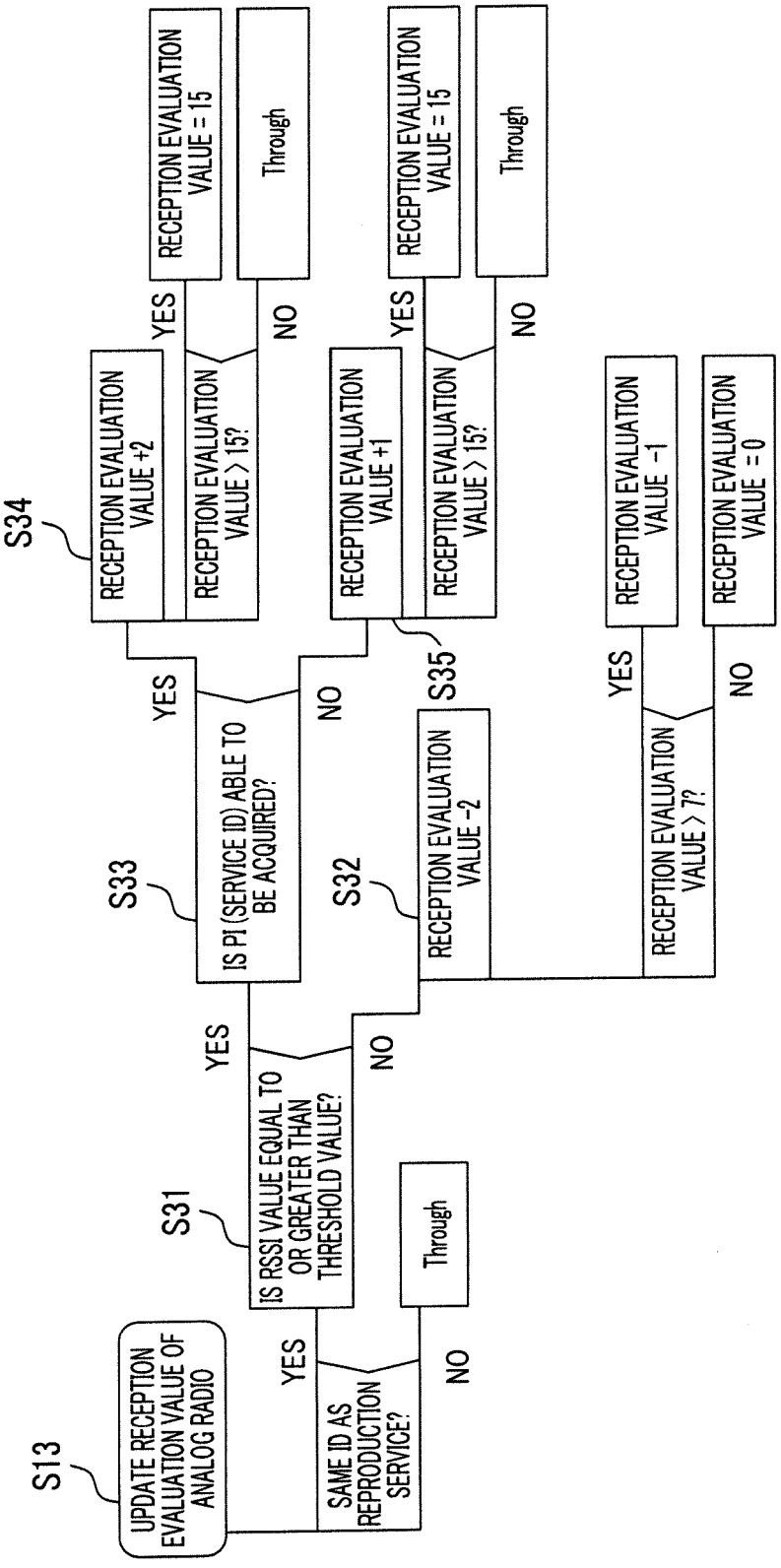
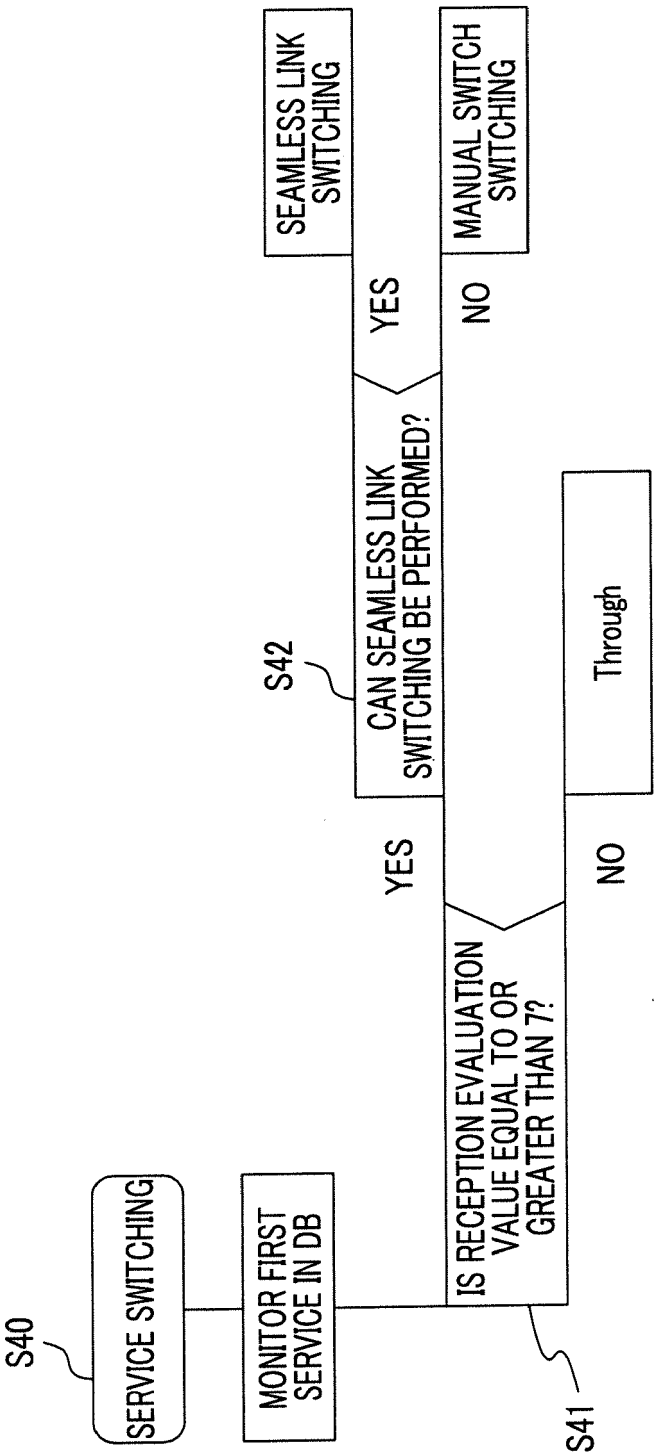

S13
UPDATE RECEPTION EVALUATION VALUE OF ANALOG RADIO
SAME ID AS REPRODUCTION SERVICE?
YES
NO
Through
S31
IS RSSI VALUE EQUAL TO OR GREATER THAN THRESHOLD VALUE?
YES
NO
S33
IS PI (SERVICE ID) ABLE TO BE ACQUIRED?
YES
NO
S34
RECEPTION EVALUATION VALUE +2
RECEPTION EVALUATION VALUE > 15?
YES
NO
RECEPTION EVALUATION VALUE = 15
Through
S32
RECEPTION EVALUATION VALUE -2
S35
RECEPTION EVALUATION VALUE +1
RECEPTION EVALUATION VALUE > 15?
YES
NO
RECEPTION EVALUATION VALUE = 15
Through
RECEPTION EVALUATION VALUE > 7?
YES
NO
RECEPTION EVALUATION VALUE -1
RECEPTION EVALUATION VALUE = 0

FIG. 6


S40
SERVICE SWITCHING
MONITOR FIRST SERVICE IN DB
S41
IS RECEPTION EVALUATION VALUE EQUAL TO OR GREATER THAN 7?
YES
NO
Through
S42
CAN SEAMLESS LINK SWITCHING BE PERFORMED?
YES
NO
SEAMLESS LINK SWITCHING
MANUAL SWITCH SWITCHING

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 9179

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 3 016 087 A1 (CONTINENTAL AUTOMOTIVE FRANCE [FR]; CONTINENTAL AUTOMOTIVE GMBH [DE]) 3 July 2015 (2015-07-03) * figure 1 * * page 2, lines 18-32 * * page 4, lines 6-14 * * page 5, lines 28-32 * * page 6, lines 4-10 * * page 9, lines 22-27 *	1-10	INV. H04H20/22
A	EP 1 357 687 A2 (BOSCH GMBH ROBERT [DE]) 29 October 2003 (2003-10-29) * paragraph [0001] * * paragraphs [0032] - [0035] * * paragraphs [0039] - [0041] * * paragraphs [0044] - [0060] * * paragraphs [0064] - [0065] *	1,3,6-10	
A	WO 2014/194970 A1 (AUDI AG [DE]) 11 December 2014 (2014-12-11) * page 3, lines 4-24 * * page 7, line 11 - page 8, line 11 *	1,3,4,9, 10	TECHNICAL FIELDS SEARCHED (IPC) H04H
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 November 2016	Torcal Serrano, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document

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18-11-2016

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		EP 1357687 A2	29-10-2003
WO 2014194970 A1	11-12-2014	CN 105284067 A	27-01-2016
		DE 102013009670 A1	11-12-2014
		EP 3005591 A1	13-04-2016
		US 2016119066 A1	28-04-2016
		WO 2014194970 A1	11-12-2014
DE 112011105466 T5	17-04-2014	CN 103563394 A	05-02-2014
		DE 112011105466 T5	17-04-2014
		JP 5748854 B2	15-07-2015
		JP WO2013014711 A1	23-02-2015
		WO 2013014711 A1	31-01-2013

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Patent documents cited in the description

- JP 2014523153 PCT **[0004] [0005]**