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(54) **METHOD OF RECEIVING A RADIO PROGRAM AND RADIO RECEIVER**

(57) The invention relates to a method for receiving a radio program and an on-vehicle radio receiver. According to an exemplary embodiment of the invention, a method of receiving a radio program by a radio receiver placed in a vehicle comprises obtaining information on a future route of the vehicle, obtaining information on at least one radio program available on the future route and displaying the information on the at least one radio program on a display of the vehicle, receiving a user input selecting one of the at least one radio program, determining whether or not the selected radio program is available in a current location of the vehicle, and when the selected radio program is not available in the current location, receiving an IP radio service which is a real-time streaming service of the selected radio program.

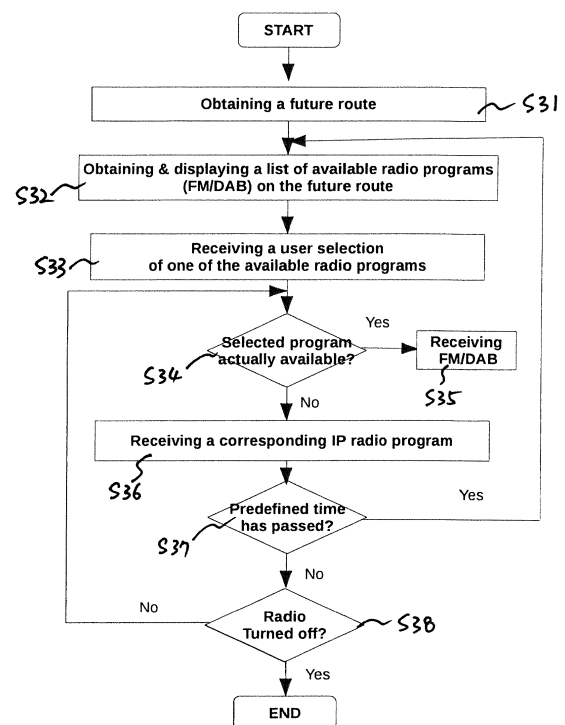


FIG. 3

Description

[0001] The present invention relates to receiving radio broadcasting, in particular to a method for receiving a radio program and an on-vehicle radio receiver.

[0002] Most vehicles are equipped with a radio receiver for receiving radio broadcasting which includes an AM radio service, a FM radio service, and a digital radio service like a digital audio broadcasting (DAB). An on-vehicle radio receiver may provide passengers of a vehicle with a radio program list containing information about available radio programs through a display placed in the vehicle. When a passenger selects one of the available radio programs on the list, the radio receiver starts receiving the selected radio program. In the conventional art, however, the list provided with the passengers contains information only about radio programs which are available in a location where the vehicle is currently located, which places some restrictions on the scope of user selection.

[0003] It would be therefore beneficial to provide a method of receiving a radio program and an on-vehicle radio receiver which allows for extending the scope of user selection. Further, it would also be beneficial to provide a vehicle equipped with such a radio receiver.

[0004] Exemplary embodiments of the invention include a method of receiving a radio program by a radio receiver placed in a vehicle, comprising obtaining information on a future route of the vehicle, obtaining information on at least one radio program available on the future route and displaying the information on the at least one radio program on a display of the vehicle, receiving a user input selecting one of the at least one radio program, determining whether or not the selected radio program is available in a current location of the vehicle, and when the selected radio program is not available in the current location, receiving an IP radio service which is a real-time streaming service of the selected radio program.

[0005] A number of optional features for the method are set out in the following. These features may be realized in particular embodiments, alone or in combination with any of the other features.

[0006] According to a further embodiment, the method may further comprise switching the IP radio service into the selected radio program when the selected radio program becomes available while the vehicle is driving on the future route.

[0007] According to a further embodiment, the information on the future route may be obtained from a navigation system or an artificial intelligence (AI) system of the vehicle. The AI system for predicting the future route of the vehicle may be implemented by a known technology.

[0008] According to a further embodiment, obtaining the information on the at least one radio program may comprise obtaining information on at least one first radio program which is available in the current location of the vehicle and obtaining information on at least one second

radio program which is not currently available, but will be available in the near future within a predefined area from the current location of the vehicle on the future route.

[0009] According to a further embodiment, obtaining the information on the at least one radio program may comprise obtaining information on at least one first radio program which is available in the current location of the vehicle, and obtaining information on at least one second radio program which is not currently available, but will be available in the near future within a predefined time period from the current location of the vehicle on the future route.

[0010] According to a further embodiment, an availability of the at least one second radio program in the near future may be determined based on a reception signal strength of the at least one second radio program at a specific location. Alternatively, an availability of the at least one second radio program in the near future may be determined based on a output signal strength of the at least one radio program and a location a radio station which broadcasts the at least one radio program.

[0011] Exemplary embodiments of the invention include a radio receiver placed in a vehicle, comprising a display, an input unit for receiving a user input, a radio tuner for receiving a radio program from a radio broadcasting station, a mobile communication unit for receiving an IP radio service through the Internet, an IP radio player for playing the received IP radio service, and a control unit configured to obtain information on a future route of the vehicle, obtain information on at least one radio program available on the future route and displaying the information on the at least one radio program on the display of the vehicle, receive a user input selecting one of the at least one radio program, determine whether or not the selected radio program is available in a current location of the vehicle, and when the selected radio program is not available in the current location, receive an IP radio service which is a real-time streaming service of the selected radio program.

[0012] A number of optional features for the radio receiver are set out in the following. These features may be realized in particular embodiments, alone or in combination with any of the other features.

[0013] According to an embodiment of the radio receiver of the present invention, the control unit may be configured to obtain the information on the future route from a navigation system or an artificial intelligence (AI) system of the vehicle.

[0014] According to a further embodiment of the radio receiver, the information on the at least one radio program available on the future route may comprise information on at least one first radio program which is available in the current location of the vehicle, and information on at least one second radio program which is not currently available, but will be available in the near future within a predefined area from the current location of the vehicle on the future route.

[0015] According to a further embodiment of the radio receiver, the information on the at least one radio pro-

gram available on the future route may comprise information on at least one first radio program which is available in the current location of the vehicle, and information on at least one second radio program which is not currently available, but will be available in the near future within a predefined time period from the current location of the vehicle on the future route.

[0016] According to a further embodiment of the radio receiver, an availability of the at least one second radio program in the near future may be determined based on a reception signal strength of the at least one second radio program at a specific location. Alternatively, an availability of the at least one second radio program in the near future may be determined based on a output signal strength of the at least one radio program and a location a radio station which broadcasts the at least one radio program.

[0017] According to a further embodiment of the present invention, the at least one radio program may include a FM radio program, a digital audio broadcasting (DAB) program, or an AM radio program.

[0018] Exemplary embodiments of the invention include a vehicle equipped with the radio receiver according to the embodiments of the invention.

[0019] According to the embodiments of the present invention described herein, a radio program list containing both radio programs which are currently available and radio programs which are not currently available, but will be available in the near future can be provided to passengers of a vehicle and thereby increasing the number of listed radio programs and thereby extending the scope of user selection.

[0020] In the following an exemplary embodiment of the invention is described with reference to the enclosed figures.

Fig. 1 is a schematic diagram depicting a configuration of a radio broadcasting system according to an exemplary embodiment of the invention.

Fig. 2 is a schematic diagram depicting a configuration of a radio receiver according to an exemplary embodiment of the invention.

Fig. 3 is a flowchart showing a process according to an exemplary embodiment of the invention.

Fig. 4 is a diagram illustrating an example of a radio program management table according to an exemplary embodiment of the invention.

Fig. 5 is a diagram illustrating another example of a radio program management table according to an exemplary embodiment of the invention.

Fig. 6 is a schematic diagram illustrating an effect of an exemplary embodiment of the invention.

[0021] Fig. 1 is a schematic diagram depicting a configuration of a radio broadcasting system according to an exemplary embodiment of the invention.

[0022] With reference to Fig. 1, the radio broadcasting system comprises an on-vehicle radio receiver 1, a plurality of radio broadcasting stations 2, a radio DNS server 5, and a plurality of IP radio provider servers 4. The radio receiver 1 is configured to receive radio programs, i.e. radio broadcasting services, from the radio broadcasting stations 2. The radio programs may include AM programs, FM programs and digital radio programs like digital audio broadcasting (DAB). The radio receiver 1 is also configured to receive IP radio programs from the IP radio provider servers 4 through the Internet 3. The radio DNS server 5 provides URL information of the IP radio provider servers 4.

[0023] An IP radio program provided via the Internet 3 may be a real-time streaming service of a radio program broadcast by a radio broadcasting station 2. This relationship between a radio program and an IP radio program which is a real-time streaming service of the radio program may be called as "a simultaneous broadcasting relationship". In other words, the same contents of a radio program may be broadcast by a radio broadcasting station 2 and be streamlined via the Internet 3 simultaneously or with a slight time difference.

[0024] Fig. 2 is a schematic diagram depicting a configuration of a radio receiver 1 according to an exemplary embodiment of the invention. As shown in Fig. 1, the radio receiver 1 of Fig. 2 may be an on-vehicle radio receiver.

[0025] Referring to Fig. 2, the radio receiver 1 comprises a control unit 11, and an input unit 12, a display unit 13, a memory 14, a mobile communication unit 15, a DAB tuner 16, a FM tuner 17, an IP radio player 18, a selector 19, an amplifier 20, and a speaker 21. In Fig. 2, at least one of an artificial intelligence (AI) system 30 or a navigation (NAVI) system 40 is provided in the vehicle 6 to provide the control unit 11 with information about a future route of the vehicle 6. The AI system 30 is configured to predict the future route which the vehicle 6 will be traveling in the near future. The AI system 30 for predicting the future route of the vehicle may be implemented by a known technology. For example, an artificial intelligence technology like "deep learning" has been developed to predict the future route. The AI system 30 may be implemented by utilizing the deep learning algorithm. US 2005/0102098 A1 discloses an adaptive navigation system with artificial intelligence.

[0026] It may also be possible for the AI system 30 or the NAVI system 40 to be implemented as a component of the radio receiver 1.

[0027] The control unit 11 is configured to control each unit of the radio receiver 1 to perform its overall operations of an embodiment of the present invention, as will be discussed below in detail. The input unit 12 is configured to receive an user input such as a turn-on/off instruction, a channel selection, and a volume-up/down etc. The display unit 13 is configured to display informa-

tion about radio programs, e.g. a list of available radio programs and contents relating to a radio program that the radio receiver 1 is or will be receiving. The memory 14 is configured to store data, information, and programs/applications which are necessary for performing the operations of the radio receiver 1. The mobile communication unit 15 is configured to perform wireless communications to receive IP radio programs, i.e. IP radio streaming services through the Internet 3.

[0028] The DAB tuner 16 is configured to receive radio frequency (RF) signals of a digital radio service/program following the Digital Audio Broadcasting (DAB) technical standard and to convert the received RF signals into intermediate signals which can be further processed by the radio receiver 1 to produce audio sound. The FM tuner 17 is configured to receive RF signals of a FM radio program and to convert them into intermediate signals for further processing in the radio receiver 1. The radio receiver 1 may comprise two or more DAB tuners 16 and FM tuners 17. The radio receiver 1 may further comprise a plurality of AM tuners for receiving an AM radio service. The IP radio player 18 is configured to convert IP radio program signals received by the mobile communication unit 15 to produce audio sound.

[0029] The selector 19 is configured to select one of sound output from the DAB tuner 16, sound output from the FM tuner 17, and sound output from the IP radio player 18, and to output the selected sound. The amplifier 20 is configured to amplify sound output from the selector 19 and output the amplified sound via the speaker 21.

[0030] Fig. 3 is a flowchart showing an overall process performed by the control unit 11 of the radio receiver 1 according to an exemplary embodiment of the invention. Reference will also be made to Fig. 1 and Fig. 2 to describe the embodiment of Fig. 3.

[0031] Referring to Fig. 3, upon turning on the radio receiver 1 by a passenger of the vehicle 6, the process starts and, at S31, the control unit 11 obtains information about a future route of the vehicle 6 from the AI system 30 or the NAVI system 40. At S32, the control unit 11 obtains a list of radio programs available on the future route and displays the list through the display unit 13. The list may include at least one DAB radio service and/or at least one FM radio service available within the predefined area on the future route. The list may further include AM radio services available on the future route. The list may contain information about a program identification (PI), a program name (PS), and/or a frequency of the available radio programs.

[0032] The list may comprise two parts. The first part contains currently available radio programs and the second part contains radio programs which are not currently available, but will be available in the near future, i.e. within the predefined area, e.g. within 10km or within 30 minutes running distance from a current spot where the vehicle 6 is currently located.

[0033] The information about the currently available radio programs may be obtained using multiple tuners. In

particular, as described above, the radio receiver 1 may comprise a plurality of DAB tuners 16 and a plurality of FM tuners 17. One of the plurality of DAB tuners 16 may be used to receive a DAB radio program and another DAB tuner 16 may scan all channels to detect currently available DAB radio programs. The plurality of FM tuners 17 may work the same way. In this way, the control unit 11 may obtain the currently available radio programs on the spot where the vehicle 6 is currently located.

[0034] Fig. 4 shows a radio program management table containing information about DAB/FM radio programs. The table of Fig. 4 may be stored in the memory 14 of the radio receiver 1. The second part of the list which contains the radio programs, which are not currently available, but will be available in the near future, may be obtained using the table shown in Fig. 4.

[0035] Referring to Fig. 4, the table comprises a program ID field, a program name field, and an IP radio ID field, a reception quality field, and a location field. The program ID field contains identification information of a DAB/FM/MA radio program. The program name field contains a program name of a corresponding radio program. The IP radio ID field contains location information, e.g. a uniform resource locator (URL) of an IP radio provider server providing an IP radio service which has the simultaneous broadcasting relationship with the corresponding radio program. The reception quality field contains quality information, e.g. a strength of reception signals of the corresponding radio program at a specific location. The strength of reception signals may be represented in the unit of dBuV/m for example. The location field contains location information, e.g. a GPS coordinate, of the specific location where the strength of reception signals are measured. The strength of reception signals may be measured by the radio receiver 1 at a certain location while the radio receiver 1 is receiving a corresponding radio program, and the measured quality and the location information may be added into the table of Fig. 4 whenever the radio receiver 1 receives a radio program. Alternatively, reception quality information and location information may be provided beforehand by a relevant organization, e.g. <https://fmscan.org>.

[0036] Based on the reception quality information and the location information for a certain radio program included in the table of Fig. 4, the control unit 11 of the radio receiver 1 may predict if the radio program is available in the near future within the predefined area on the future route. In this way, the control unit 11 can obtain the second part of the list which contains radio programs, which are not currently available, but will be available in the near future within the predefined area on the future route.

[0037] Further referring to Fig. 3, after displaying the list containing the first and second parts of available radio programs on the display unit 13, the control unit 11 receives a user input through the input unit 12 selecting one of the available radio programs at S33. Upon receiving the user input, at S34, the control unit 11 determines

if the selected radio program is currently available, i.e. determining if the selected radio program belongs to the first part or the second part of the list. If the answer is positive, the control unit 11 controls the DAB tuner 16 or the FM tuner 17 to receive the selected DAB or FM radio program at S35. If the answer is negative, i.e. if the selected radio program is not currently available, at S36, the control unit 11 starts receiving an IP radio program which is a real-time streaming service of the selected radio program, i.e. which has the simultaneous broadcasting relationship with the selected radio program. The control unit 11 can receive the IP radio program using the IP radio ID included in the table of Fig. 4.

[0038] At S37, the control unit 11 checks if a predefined time has passed to periodically update the available radio programs. If the answer is positive, the process returns to S32 to obtain and display an updated list of available radio programs. If the answer is negative and the radio receiver is not turned off at S38, however, the process returns to S34 to check if the selected radio program is currently available. When the selected radio program is currently available, the control unit 11 switches the IP radio program with the selected radio program. In other words, the control unit 11 stops receiving the IP radio program and then starts receiving the selected FM or DAB program.

[0039] Fig. 5 shows another example of the radio program management table containing information about DAB/FM radio programs. Compared to the example of Fig. 4, the reception quality field is replaced with an output quality field which contains a signal strength of a radio program broadcast by a radio station 2 and the location field contains location information of the radio station 2. Based on the output quality information and the location information for a certain radio program included in the table of Fig. 5, the control unit 11 of the radio receiver 1 may predict if the radio program is available in the near future within the predefined area on the future route. In this way, the control unit 11 can obtain the second part of the list which contains radio programs, which are not currently available, but will be available in the near future within the predefined area on the future route.

[0040] A further another example of the radio program management table may contain the reception quality field and the location field of Fig. 4, and the output quality field and the location field of Fig. 5, based upon which the control unit 11 can obtain the second part of the list which contains radio programs, which are not currently available, but will be available in the near future within the predefined area on the future route.

[0041] Fig. 6 is a schematic diagram illustrating an effect of an exemplary embodiment of the invention. Fig. 6(a) shows that a DAB program named "DAB_A" is available in a circled area only and that a radio receiver 1 placed in a vehicle 6 can detect the availability of DAB_A when the vehicle 6 arrives at a point "A". On the other hand, in Fig. 6(b), the radio receiver 1 can predetermine the availability of DAB_A at a point "B" even before the

vehicle 6 approaches the point "A" and display the relevant information of DAB_A. If DAB_A is selected by a passenger of the vehicle 6 before the vehicle 6 arrives at the point "A," the radio receiver 1 starts receiving an IP radio service which has a simultaneous broadcasting relationship with DAB_A. In this way, as shown in Fig. 6(c), the available area of DAB_A can be virtually enlarged and thereby extending the scope of user selection.

[0042] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adopt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention is not limited to the particular embodiments disclosed, but that the invention includes all embodiments falling within the scope of the claims.

Claims

1. A method of receiving a radio program by a radio receiver (1) placed in a vehicle (6), the method comprising:

obtaining information (S31) on a future route of the vehicle (6);
obtaining (S32) information on at least one radio program available on the future route and displaying the information on the at least one radio program on a display of the vehicle (6);
receiving (S33) a user input selecting one of the at least one radio program;
determining (S34) whether or not the selected radio program is available in a current location of the vehicle (6); and
when the selected radio program is not available in the current location, receiving (S36) an IP radio service which is a real-time streaming service of the selected radio program.

2. The method according to claim 1, further comprising switching the IP radio service into the selected radio program when the selected radio program becomes available while the vehicle (6) is driving on the future route.

3. The method according to claim 1 or 2, wherein the information on the future route is obtained from a navigation system (40) or an artificial intelligence (AI) system (30) of the vehicle (6).

4. The method according to any of the preceding claims, wherein obtaining the information on the at least one radio program comprises:

- obtaining information on at least one first radio program which is available in the current location of the vehicle (6); and
 obtaining information on at least one second radio program which is not currently available, but will be available in the near future within a predefined area from the current location of the vehicle (6) on the future route. 5
5. The method according to any of claims 1-4, wherein obtaining the information on the at least one radio program comprises: 10
- obtaining information on at least one first radio program which is available in the current location of the vehicle (6); and
 obtaining information on at least one second radio program which is not currently available, but will be available in the near future within a predefined time period from the current location of the vehicle (6) on the future route. 15 20
6. The method according to claim 4 or 5, wherein an availability of the at least one second radio program in the near future is determined based on a reception signal strength of the at least one second radio program at a specific location. 25
7. The method according to claim 4 or 5, wherein an availability of the at least one second radio program in the near future is determined based on a output signal strength of the at least one radio program and a location the radio station. 30
8. A radio receiver (1) placed in a vehicle for receiving a radio program, the radio receiver comprising: 35
- a display (13);
 an input unit (12) for receiving a user input;
 a radio tuner (16, 17) for receiving a radio program from a radio broadcasting station (2): 40
- a mobile communication unit (15) for receiving an IP radio service through the Internet (3); 45
- an IP radio player (18) for playing the received IP radio service;
 a control unit (11) configured to:
- obtain information on a future route of the vehicle (6); 50
- obtain information on at least one radio program available on the future route and displaying the information on the at least one radio program on the display (13) of the vehicle (6); 55
- receive a user input selecting one of the at least one radio program through the
- input unit (12);
 determine whether or not the selected radio program is available in a current location of the vehicle (6); and
 when the selected radio program is not available in the current location, receive an IP radio service which is a real-time streaming service of the selected radio program.
9. The radio receiver according to claim 8, wherein the control unit (11) is further configured to switch the IP radio service into the selected radio program when the selected radio program becomes available while the vehicle (6) is driving on the future route.
10. The radio receiver according to claim 8 or 9, wherein the control unit (11) is configured to obtain the information on the future route from a navigation system (40) or an artificial intelligence (AI) system (30) of the vehicle (6).
11. The radio receiver according to any of claims 8-11, wherein the information on the at least one radio program available on the future route comprises:
- information on at least one first radio program which is available in the current location of the vehicle (6); and
 information on at least one second radio program which is not currently available, but will be available in the near future within a predefined area from the current location of the vehicle (6) on the future route.
12. The radio receiver according to any of claims 8-11, wherein the information on the at least one radio program available on the future route comprises:
- information on at least one first radio program which is available in the current location of the vehicle (6); and
 information on at least one second radio program which not currently available, but will be available in the near future within a predefined time period from the current location of the vehicle (6) on the future route.
13. The radio receiver according to claim 11 or 12, wherein an availability of the at least one second radio program in the near future is determined based on a reception signal strength of the at least one second radio program at a specific location.
14. The radio receiver according to claim 11 or 12, wherein an availability of the at least one second radio program in the near future is determined based on a output signal strength of the at least one radio

program and a location the radio station.

15. A vehicle (6) equipped with the radio receiver according to any of claims 8-14.

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FIG. 1

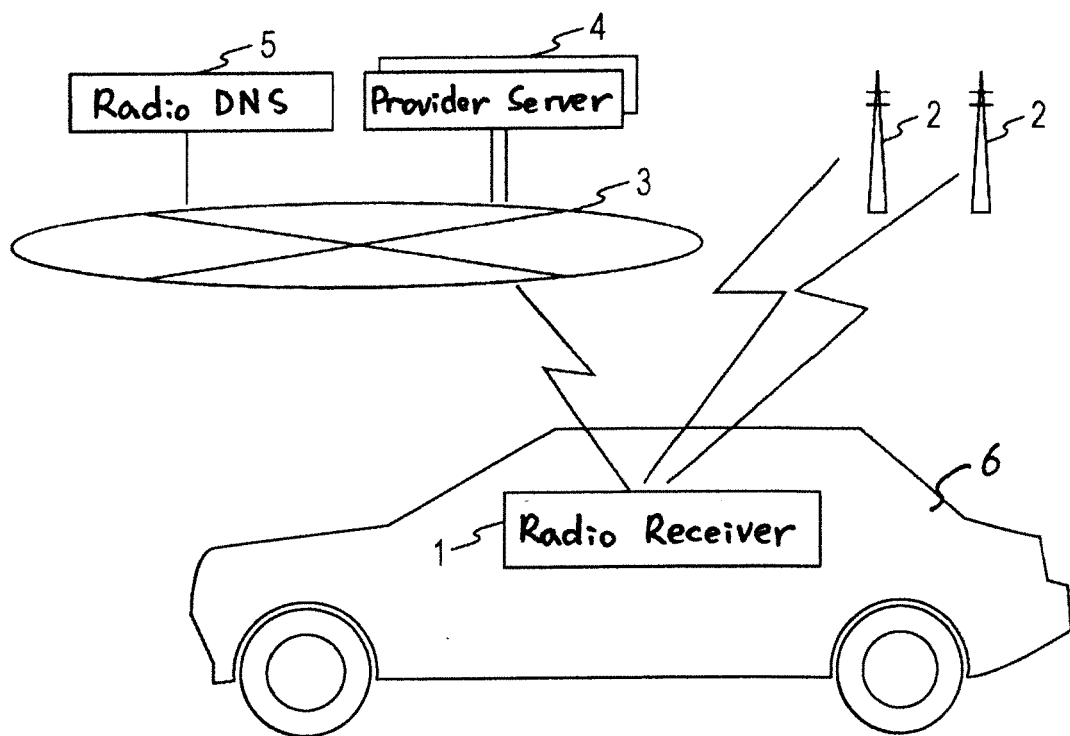
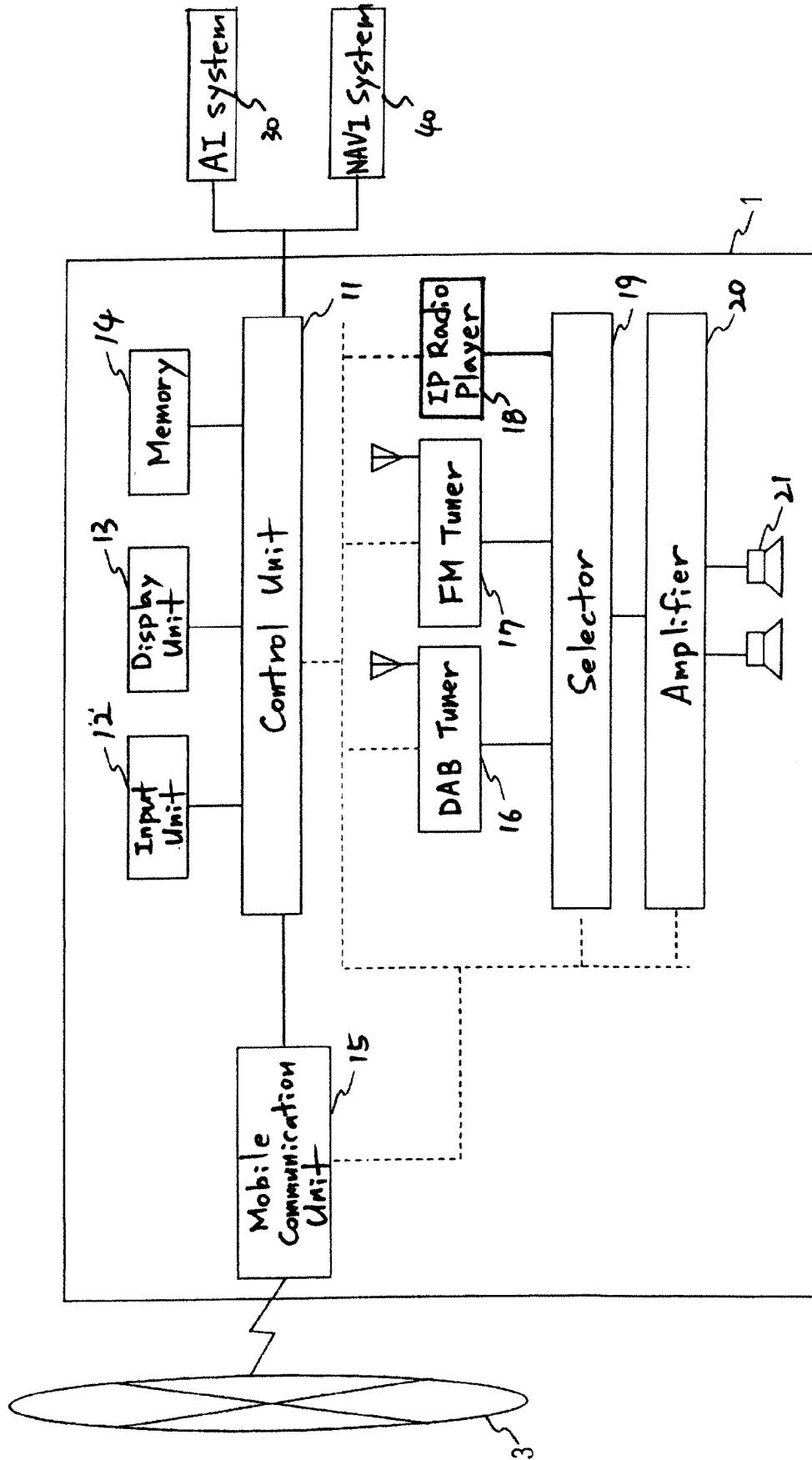


FIG. 2



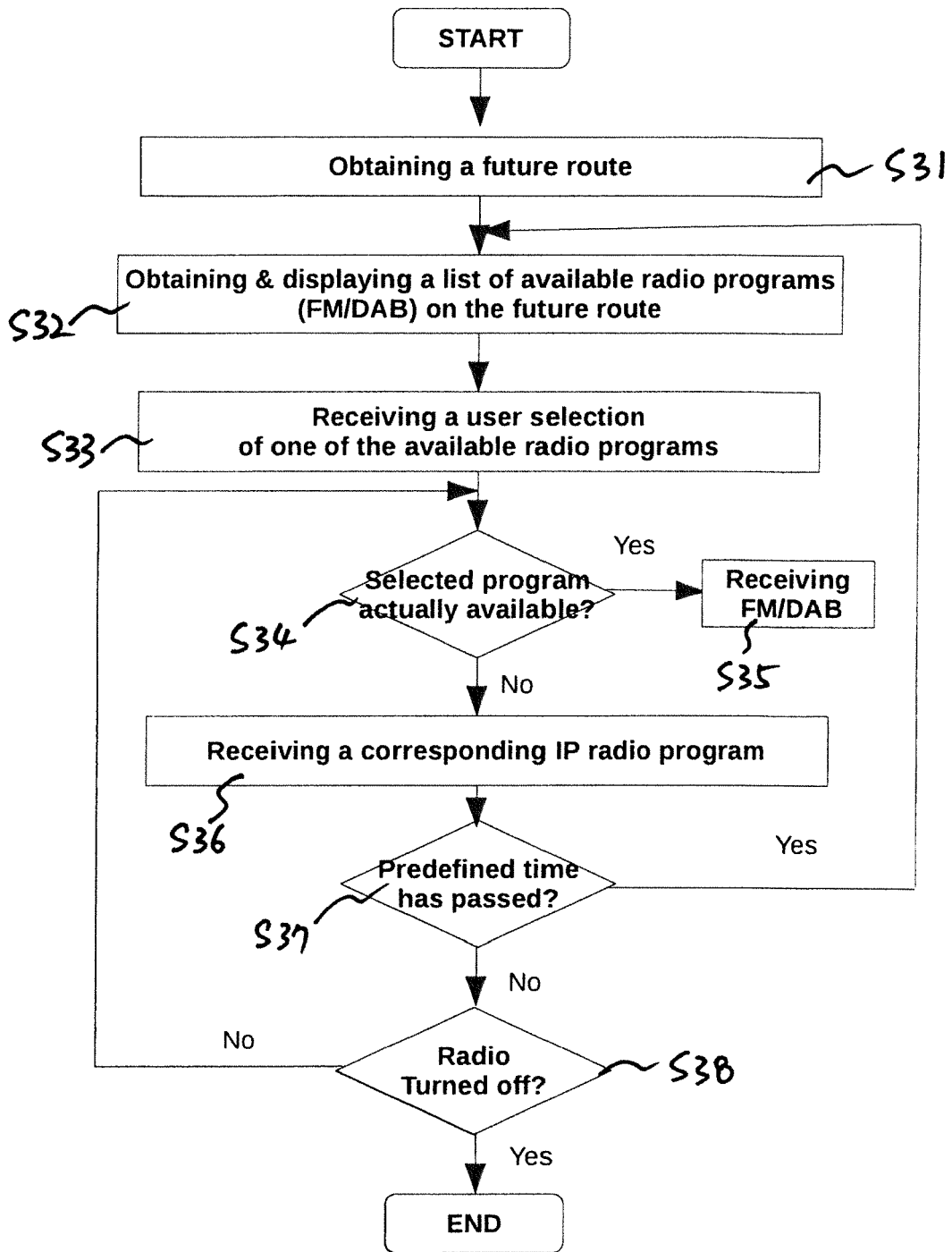


FIG. 3

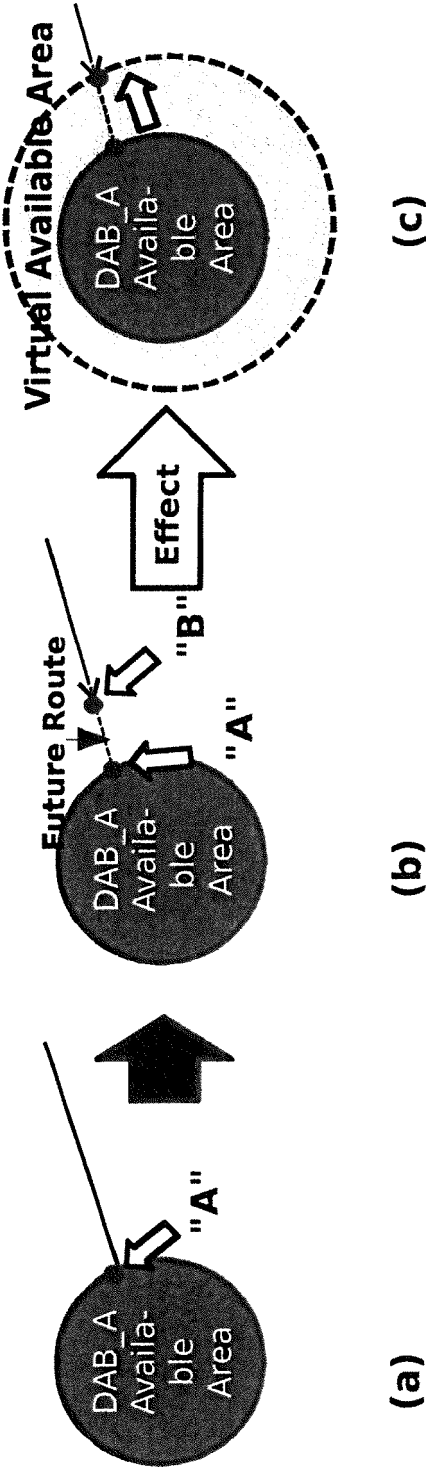
FIG. 4

Program ID (FM/DAB)	Program Name	IP Radio ID (URL)	Reception Quality (dBuV/m)	Location (GPS Coordinates)
ce1.c1a5.c47f.0	BBC Radio	http://bbcradio.com/VIS/414/	10 20 . . .	51°30'30.71" N 0°07'32.66" E 52°32'33.66" N 0°08'35.55" E . . .
09580.c586.ce1	Classic FM	http://classicfm.com/VIS/ce8/	. . .	. . .
ce1.b2a3.c18c.0	Heart London	http://bbcradio.com/VIS/527/	. . .	. . .
. . .	. . .	. . .	. . .	. . .

FIG. 5

Program ID (FM/DAB)	Program Name	IP Radio ID (URL)	Output Quality (kW)	Location (GPS Coordinates)
ce1.c1a5.c47f.0	BBC Radio	http://bbcradio.com/VIS/414/	1 3 . . .	51°30'30.71" N 0°07'32.66" E 52°32'33.66" N 0°08'35.55" E . . .
09580.c586.ce1	Classic FM	http://classicfm.com/VIS/ce8/	. . .	. . .
ce1.b2a3.c18c.0	Heart London	http://bbcradio.com/VIS/527/	. . .	. . .
. . .	. . .	. . .	. . .	. . .

FIG. 6





EUROPEAN SEARCH REPORT

Application Number
EP 19 19 4527

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2013/203340 A1 (NAMBA YURI [JP]) 8 August 2013 (2013-08-08) * paragraph [0003] - paragraph [0010] * * paragraph [0028] - paragraph [0078]; figures 1-5 *	1-15	INV. H04W88/06 H04H20/20 H04H20/24 H04H20/26 H04H60/11 H04H60/44 H04H60/51
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Y	US 2016/119066 A1 (OLDEWURTEL FRANK [DE] ET AL) 28 April 2016 (2016-04-28) * paragraph [0001] - paragraph [0025] * * paragraph [0031] - paragraph [0031] *	1-15	
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Y	EP 3 324 561 A1 (ALPINE ELECTRONICS INC [JP]) 23 May 2018 (2018-05-23) * paragraph [0001] - paragraph [0020] * * paragraph [0074] - paragraph [0080]; figure 7 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) H04H H04W
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 January 2020	Examiner Wuillème, Cédric
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 19 4527

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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