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(54) **A programme switching method and a radio apparatus for in-vehicle use**

(57) A programme switching method of switching a radio tuner between frequencies on which related radio stations broadcast, the method comprising: tuning the radio tuner to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station; detecting, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts; periodically monitoring at least one quality indicator of a second programme signal of the second frequency; detecting, in the first programme signal, a transmission code indicating transmission of a particular type of programme in the second programme signal on the second frequency; determining, from the monitored at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and switching the radio tuner to the second frequency to receive the said second programme signal if it is determined that the second programme signal is receivable, and keeping the radio tuner tuned to the first frequency to continue receiving the first programme signal if it is determined that the second programme signal is not receivable.

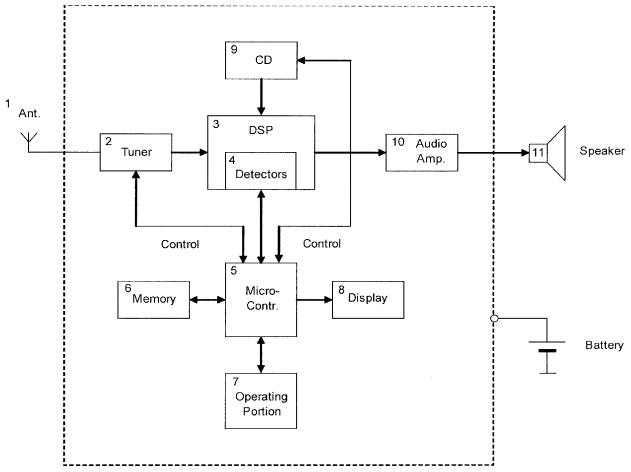

FIG. 1

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Description

[0001] The invention relates to a programme switching method and to a radio receiving apparatus for in-vehicle use.

[0002] In Europe, a radio system known as the Radio Data System (RDS) has been developed. This system provides a means for enabling a radio receiving apparatus to perform 'network following' by using codes embedded in a received radio signal.

[0003] In the RDS system, detailed information about other frequencies on which the same programme is transmitted is included in an RDS data channel of the received programme signal. This information enables the receiving apparatus to check for alternative frequencies on which the same programme (radio station broadcast) is transmitted, and to change the frequency to which it is tuned if its received signal level becomes too low. In other words, the receiver is able to use the information transmitted in the RDS system to 'follow' a particular radio station (radio programme/channel broadcast) across different frequencies.

[0004] In the RDS system, a data link layer consists of blocks of data. Each block typically has 26 bits, consisting of 16 bits of data and 10 check bits. An RDS Group consists of 4 blocks, as shown in Table 1.

16 10

Table 1

[0005] In the Group, block A includes a program identification (PI) code, which is the unique identifier of a radio station. The PI code is repeated 11.4 times per second and uniquely identifies a programme (radio station) and the country in which the programme is broadcast. In addition, use of the code enables selection of a programme independently of frequency, and further enables a receiver to perform automatic changes (i.e. without user input) of the received frequency so as to change to an alternative frequency on which the same programme is broadcast. Also transmitted in the RDS data is alternative frequency information. The alternative frequency information includes the other frequencies on which the programme currently tuned to is also being broadcast. The PI code and the alternative frequency information enable the radio receiver to perform the above-described network following.

[0006] In addition to providing the programme identification (PI) code, the RDS system also provides codes (flags) indicating whether a particular radio station transmits a particular type of programme and when the radio station is transmitting the particular type of programme. The particular type of programme is a traffic announcement (i.e. traffic news bulletin).

[0007] If a radio station transmits traffic news bulletins, this is indicated by a code (flag) TP in the RDS data link layer of the signal transmitted by that radio station.

[0008] If the radio station is actually transmitting a traffic news bulletin, this is indicated by a code (flag) TA in the RDS data link layer.

[0009] As well as providing the possibility for a station to include the TP and TA codes for that station, the RDS system also enables a radio station to indicate if another, related radio station is broadcasting a traffic news bulletin. This uses the Enhanced Other Network (EON) feature of the RDS system.

[0010] Using this feature, a radio station can transmit information in its programme signal relating to traffic announcements being made on other related radio stations. For example, a radio station Bayern 1 could transmit information in its programme signal indicating a traffic announcement on a related radio station Bayern 2 or Bayern 3. If the radio receiver is tuned to Bayern 1, on detecting this information in the programme signal of Bayern 1, the radio receiver can switch to a frequency of Bayern 2 or Bayern 3 on which the traffic announcement is made. In this way, a user can listen to his preferred station whilst still being kept informed of the traffic news.

[0011] Table 2 shows a list of values for TA and TP corresponding to the traffic programme and enhanced other network features of a radio station.

Table 2

TP	TA	Feature of the radio station
0	0	No traffic announcement, and no support of EON
0	1	No traffic announcement, but support of EON

(continued)

TP	TA	Feature of the radio station
1	0	Traffic program, announcement not active
1	1	Traffic program, announcement active

[0012] Thus, using the above system, a user can set the radio receiver to switch radio station when a traffic news bulletin is transmitted on a radio station different from the station currently being received. The radio receiver will then switch radio station when it detects, in the programme signal broadcast by the currently-received radio station, information that a traffic news bulletin is to be broadcast on a related radio station.

[0013] A problem occurs in this system, however, when the related station to be switched to (i.e. the station broadcasting the traffic news bulletin) is not receivable by the radio receiver.

[0014] This problem may occur, for example, if the station currently received is a nationwide available station (e.g. BBC Radio 1) and the station to be switched to is a regional station (e.g. BBC London or BBC Oxford).

[0015] In this case, if the user is listening to the nationwide available station (e.g. BBC Radio 1) and a traffic announcement is made on the regional station (e.g. BBC London), the radio receiver will automatically switch to the regional station to receive the traffic announcement.

[0016] Unfortunately, however, it can occur that the regional station is not receivable at the current location of the radio receiver. In this case, the radio receiver will detect the information in the programme signal of the nationwide station that a traffic announcement is to be made on the regional station and will try to switch to a frequency on which the regional station is broadcast.

[0017] The radio receiver will then find that the regional station is not receivable on the frequency switched to. Accordingly, it will try an alternative frequency on which the regional station is broadcast, and will find that the regional station is not receivable on this frequency also. The radio receiver will continue this process until it has searched through all of the alternative frequencies on which the regional station is broadcast. During this period the audio output of the radio apparatus is muted.

[0018] After all of the alternative frequencies of the regional station have been checked, the radio receiver returns to the national station.

[0019] It is therefore desirable to provide a programme switching method for a radio receiver, and a radio receiver for in-vehicle use, that can switch between programmes broadcast by related radio stations effectively whilst mitigating the above problems.

[0020] According to a first aspect of the invention, there is provided a programme switching method of switching a radio tuner between frequencies on which related radio stations broadcast, the method comprising: tuning the radio tuner to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station; detecting, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts; periodically monitoring at least one quality indicator of a second programme signal of the second frequency; detecting, in the first programme signal, a transmission code indicating transmission of a particular type of programme in the second programme signal on the second frequency; determining, from the (most recent value of the) monitored at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and switching the radio tuner to the second frequency to receive the said second programme signal if it is determined that the second programme signal is receivable, and keeping the radio tuner tuned to the first frequency to continue receiving the first programme signal if it is determined that the second programme signal is not receivable.

[0021] In this method, after an information code is detected in the programme signal of the radio station currently being received, wherein the information code indicates that a related radio station sometimes broadcasts a particular type of programme (e.g. traffic news bulletins), the signal quality of the programme signal of the related radio station is periodically monitored.

[0022] Therefore, when the transmission code (indicating actual transmission of the particular type of programme) is detected in the programme signal of the first radio station, a determination can be made based on the monitored quality of the programme signal of the second, related radio station, as to whether or not to switch between the broadcasts of the two radio stations. In this way, the problems associated with the prior art programme switching method are mitigated.

[0023] According to an embodiment of the invention, the method may further comprise: detecting, in the first programme signal, additional information codes indicating additional frequencies on which related radio stations broadcast; and periodically monitoring at least one quality indicator of the programme signal of each additional frequency. At least some of the additional frequencies may be alternative frequencies on which the second radio station broadcasts the second programme signal.

[0024] Thus, according to the method, the quality of a plurality of frequencies on which the particular type of programme

is broadcast may be monitored. These frequencies may each belong to a different radio station (i.e. to second, third, fourth etc. related radio stations such as BBC London, BBC Oxford and so forth) or some of the frequencies may represent alternative frequencies of a particular radio station (i.e. alternative frequencies on which a radio station broadcasts the same programme, such as alternative frequencies on which Radio London is broadcast).

[0025] According to a further embodiment, the method includes: storing, in a table, the second frequency and each additional frequency, together with, for each said frequency, the programme identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and updating the table each time the at least one quality indicator of the programme signal of a said frequency is monitored. The last decoded programme identification code and the age of the last decoded programme identification code, and/or the age of the last time of monitoring may be stored in the table for each said frequency also.

[0026] According to this embodiment of the invention, the relevant information for each frequency is stored in a table, and the table is dynamically updated each time a quality indicator of a frequency is monitored (sampled). The table may also be updated each time a said frequency of a related radio station is switched to for receiving a broadcast programme. In this way, the information on which of the second and additional frequencies is receivable at the receiver is kept constantly up-to-date in a format which can be easily read. Therefore, a decision can be made quickly and accurately, using the table, as to whether or not to switch the radio tuner between radio station broadcasts.

[0027] According to a further embodiment, the updating of the table includes re-ordering the order in which the frequencies are listed in the table, such that the frequencies are maintained in an order according to their at least one quality indicators.

[0028] According to another embodiment, the at least one quality indicator includes a field strength value V(FS) of the second programme signal.

[0029] By using the field strength value, it can be readily determined whether or not the second programme signal is receivable (available) at the location of the radio receiver.

[0030] According to a second aspect of the invention, there is provided a radio apparatus for in-vehicle use, the apparatus comprising: a tuner for tuning the radio apparatus to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station; first detecting means operable to detect, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts, and to detect, in the first programme signal, a transmission code indicating transmission of a particular type of programme in a second programme signal of the second frequency; controlling means operable to cause the tuner to periodically sample the second programme signal of the second frequency; second detecting means operable to detect at least one signal quality indicator of the second programme signal of the second frequency each time the second programme signal is sampled; determining means for determining, from the (most recent value of the) at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and switching means configured to switch the tuner to the second frequency to receive the said second programme signal when the first detecting means detects the transmission code and the determining means determines that the second programme signal is receivable, and configured to keep the tuner tuned to the first frequency to continue receiving the first programme signal when the first detecting means detects the transmission code and the determining means determines that the second programme signal is not receivable.

[0031] According to an embodiment, the apparatus further comprises: a table, stored in memory, the table including the or each second frequency, together with, for each said frequency, the programme identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and table updating means for updating the table each time the at least one quality indicator of the programme signal of a said frequency is sampled. The table may further include, for each said frequency, the last detected identification code; and possibly further, the age of the last detected identification code of that frequency and/or the age of the last time of sampling of that frequency. The table can be updated not only when a said frequency is sampled, but also when a said frequency is switched to in order to receive the programme broadcast on that frequency. The age of the last time of sampling can, of course, be the age of the receiving of the switched-to programme broadcast.

[0032] According to a further embodiment, the second detecting means is arranged to detect a field strength of the second programme signal as a said signal quality indicator; and the determining means is operable to perform a non-linear conversion on the detected field strength to generate a field strength quality value, and to determine whether the second programme signal is receivable based on the field strength quality value.

[0033] Reference is now made, by way of example only, to the accompanying drawing, in which:

Fig. 1 shows a radio receiver apparatus according to an embodiment of the invention;

[0034] Fig. 1 shows a radio receiver apparatus according to an embodiment of the invention. The apparatus includes an antenna 1, a tuner 2, a digital signal processor (DSP) 3 including detectors 4, a microcontroller (CPU) 5, memory 6, an operating portion 7, a display portion 8, a CD input 9, audio amplifier circuitry 10 and speakers 11. The apparatus

also has a connector for connection to the power supply of the vehicle (i.e. to the vehicle battery).

[0035] Through the antenna 1 incoming radio waves can be picked up and input into the apparatus. The tuner 2 can be tuned to different frequencies, so that different radio programmes from different radio stations can be received. The DSP 3 performs signal processing in the digital domain on the signal output by the tuner 2. The detectors 4 enable codes/flags in the received programme signal to be detected and enable indicators of the received signal quality to be detected. The CPU 5 is in overall control of the apparatus, for example it controls the frequency to which the tuner is tuned. Memory 6 associated with the CPU 5 stores program code for operating the apparatus, and also stores operating information such as frequency information on related radio stations, which can be dynamically updated during use.

[0036] The operating portion 7 is provided to enable a user to input operation instructions, such as an instruction as to the radio station to be tuned to or the sound volume to be output. The operating portion could be, for example, a combination of buttons and knobs on the front panel of the apparatus. The display 8 enables information to be displayed to the user, such as whether the input signal is from the radio or a CD, and which radio station is being listened to. The display 8 could be an LCD display. The CD input 9 enables a CD to be input into the apparatus and played. The speakers 11 output the desired audio sound, after processing by the audio amplifier circuitry 10, to the listeners (users).

[0037] The detectors 4 include an RDS data decoder for decoding the RDS data included in the currently received programme signal received from the currently tuned to radio station. If the currently tuned to radio station is part of an enhanced other network (EON) this is detected from the RDS data. In addition, information giving the broadcast frequencies of the related (EON) radio stations which broadcast traffic news bulletins is detected.

[0038] The RDS data decoder detects that the currently tuned to radio station is part of an Enhanced Other Network by detecting that the TP code of the received programme signal is 0 and that the TA code is 1, as shown in the earlier described Table 1. The TP code and the TA code are included, in the RDS data link layer, in the RDS Groups 0A and 0B.

[0039] The RDS data decoder detects the broadcast frequencies of the related radio stations which periodically broadcast traffic announcements from EON information included in Group 14A. In this regard, the RDS decoder detects from the information (information code) given in Group 14A the programme identification (PI) code of a related radio station which broadcasts traffic announcements together with each alternative frequency over which that radio station broadcasts its programme signal. The RDS decoder detects this information for each of the related radio stations.

[0040] After this information has been detected by the RDS data decoder, the CPU 5 stores the information in a related radio stations (EON) table in the memory 6. An example configuration of the table headers is shown in Table 3.

Table 3

Frequency MHz	PI Code	Field Strength	Noise	Multi- Sample Path	Age	Last Decoded PI code	Age Last Decoded PI code

[0041] Thus, the CPU 5 is able to populate the first two fields (Frequency and PI code) of the table with this information. There will then be an entry in the table for each frequency on which a related radio station broadcasts.

[0042] For example, if the radio receiver is tuned to BBC Radio 1, and the related radio stations include BBC London, BBC Oxford, BBC Cambridge and BBC Kent, there will be an entry (row) in the table for each frequency on which each of these related radio stations broadcast. Thus, for example, if BBC London is broadcast over five alternative frequencies then there will be five rows in the table for BBC London, i.e. one row for each frequency over which it is broadcast. The same will apply to the frequencies over which each of the other related radio stations broadcasts.

[0043] After the radio apparatus has detected the above information for a related station from the RDS data included in the programme signal of the currently tuned-to radio station, the CPU instigates a monitoring process to be performed on the detected frequencies over which the related radio station broadcasts. The monitoring process is performed for each frequency of each related radio station identified from the RDS data.

[0044] In order to perform the monitoring process, the CPU 5 controls the tuner 2 to periodically sample each of the detected frequencies over which the related radio stations broadcast. Thus, the CPU 5 controls the tuner 2 to periodically tune the tuner to each of the detected frequencies.

[0045] In this regard, a detected frequency is tuned to for a length of time short enough so as not to be noticeable to a listener, but long enough to sample one or more quality indicators of the signal of the frequency. This length of time should be less than 10 milliseconds. The one or more quality indicators may be field strength, or field strength, noise and multipath, for example. Due to the short length of time of the sampling, it is not possible to decode the programme identification (PI) code of the frequency signal during the sampling.

[0046] The CPU 5 controls the tuner 2 to tune to each of the detected frequencies cyclically. In other words, each occasion the tuner is diverted from the currently-received programme signal it is tuned to a different one of the detected

frequencies. The detected frequencies can thus be worked through in a cyclical sequence. Sound quality information on each detected (EON) frequency is in this way gathered in the background whilst the tuner is essentially, as far as the listener is concerned, tuned to one specific frequency (i.e. the currently received frequency).

[0047] Each time a sampling occurs, i.e. each time the tuner is tuned to a frequency of a related radio station on which the particular type of programme (e.g. traffic announcement) is broadcast, and the one or more quality indicators of that radio station are detected, the relevant detected values are stored in the table (Table 3) in the memory 6.

[0048] In the presently described embodiment, the values stored in the table include measures of the field strength, noise and multipath of the signal of the sampled frequency.

[0049] The field (signal) strength may be detected using a fieldstrength detector included in the detectors 4. The signal strength is directly related to signal quality because the signal-to-noise ratio mainly depends on it. This detector is calibrated to compensate for tolerances of the analogue components of the receiver hardware.

[0050] The multipath may be detected using a multipath detector included in the detectors 4. This detector evaluates amplitude fluctuations of the received signal. If strong multipath conditions exist, then the amplitude fluctuations will be large. The multipath detector does not require any alignment.

[0051] The noise may be detected using an Ultra Sonic Noise (USN) detector, which is also included in the detectors 4. This detector detects the amplitude of the high frequency content of the multiplex (MPX) signal. This is measured in the frequency range of around 80-150kHz. The USN detector gives information on noise due to an adjacent channel.

[0052] In addition, a time stamp at which the frequency is sampled is included also, so as to subsequently indicate the age of the sample.

[0053] The table also includes a field (column) for the last decoded PI code obtained for each frequency, together with a field indicating the age of the last decoded PI code. As already mentioned above, during a sampling the PI code of the sampled frequency can not be decoded because the decoding requires longer than the ≤10 ms allowed for the sampling (so as not to create an audible mute whilst sampling is performed). However, the PI code of a frequency of a related radio station can, of course, be decoded when that frequency is tuned to for a longer period of time, i.e. when that frequency is tuned to so as to receive a programme broadcast by the related radio station on that frequency.

[0054] Hence, whenever one of the frequencies in the table is actually tuned to so as to receive a broadcast programme, i.e. is tuned to not just for sampling but for a period of time long enough to enable the PI code to be decoded, the decoded PI code is entered into the table. In addition, an indicator of the age of the decoded PI code, such as a time stamp of when it was obtained, is stored in the table also. The last decoded PI code and its time stamp are also updated in the table if the PI code is detected during another operation, such as manual tuning or an automatic scan of the FM band.

[0055] Each time the CPU 5 instructs the tuner 2 to sample a frequency of a related radio station, the results of the sampling are put into the table (Table 3). In addition, if a frequency of a related radio station is tuned to so as to receive a broadcast programme (e.g. a traffic announcement) the table is also updated, including an update of the field for the last decoded PI code and the age of that code. In this way, the table is constantly updated. Thus, the table represents a dynamically updated list of the frequencies on which the related radio stations broadcast the particular type of programme (e.g. traffic announcement), including an indication of the quality (i.e. from the quality indicators) of the signal of each such frequency.

[0056] From the quality indicators stored for each frequency, it can easily be determined whether the frequency is receivable (available) at the radio receiving apparatus.

[0057] For example, a decision can be made as to whether the signal is receivable using the field strength alone. If the field strength is above a threshold, then it is determined that the signal is receivable. If the field strength is below the threshold, then it is determined that the signal is not receivable.

[0058] Alternatively, the other quality indicators of multipath and noise may be used also, for example by comparing each of the multipath value and the noise value against a respective threshold.

[0059] Further, the frequencies are preferably stored in the table in the order of their quality. For example, the frequencies may be stored in the order of their field strength (particularly if field strength is the only quality indicator which is detected). Alternatively, the frequencies which have noise and multipath values above their respective thresholds may be stored in the order of their field strength, with the frequencies which have noise or multipath values below their respective thresholds provided lower in the table (in the order of their field strengths).

[0060] As a further alternative, a single quality value can be calculated from the quality indicators, for example by subtracting the noise and multipath values from the field strength; the frequencies can then be arranged in the table in the order of their single quality value.

[0061] As yet another alternative, if the age of a sample or the age of the last decoded PI code reaches a threshold, then the respective frequency may be dropped to the bottom of the table (because the obtained information is no longer reliable). Similarly, if the last decoded PI code for the frequency does not match the known PI code for the frequency, the frequency may be dropped to the bottom of the table.

[0062] With the frequencies stored in the table in the order of their quality (i.e. in order of how good signal reception is at the receiver), and the table dynamically updated each time a frequency signal is sampled or tuned-to to receive a

broadcast programme (or otherwise monitored, e.g. due to manual tuning), the table represents a dynamically changing list of the different frequencies arranged in order of their 'receivability' at the radio apparatus.

[0063] The RDS data of the programme signal currently received, i.e. of the radio station currently tuned to, also includes transmission information (transmission code) indicating if one of the related radio stations is actually transmitting the particular type of programme (e.g. a traffic announcement). This information is transmitted in addition to the information code (notification information) explained above. The transmission information is transmitted in Group 14B of the RDS data link layer and is a trigger indicating that a traffic announcement is actually being broadcast (or is about to begin).

[0064] When the RDS data decoder of the radio receiving apparatus detects the transmission information in the RDS data it notifies the CPU 5. The CPU 5 then compares the PI code of the related radio station which is actually broadcasting the traffic announcement against the programme identification (PI)codes or the last decoded PI codes stored in the table, starting in order from the topmost row in the table.

[0065] The alternative frequency of the related radio station having the best quality is therefore easily determined. If the quality of this frequency is satisfactory then the CPU 5 controls the tuner 2 to tune to this frequency of the related radio station. In this way, the desired particular programme type - for example, traffic announcement - is received at the radio apparatus and heard by the listener. The quality may be deemed satisfactory in the manner described above, for example if the field strength is above the threshold; or if each of the field strength, multipath and noise is above its threshold; or if the single quality value is above its threshold.

[0066] On the other hand, if the quality of the frequency is not satisfactory then the CPU 5 controls the tuner 2 to remain tuned to the frequency currently being received. In this way, a switch to a frequency which cannot be received at the radio apparatus is avoided. An undesirable mute is therefore avoided.

[0067] After the traffic announcement has ended, this is indicated in the RDS data of the switched-to frequency. The RDS decoder detects this and the CPU 5 causes the tuner 2 to switch once again to the originally-tuned programme. In other words, after playing the traffic news bulletin, the radio apparatus reverts to playing the listener's preferred radio station.

[0068] The embodiments of the invention can provide a particularly marked effect in cases where there are a large number of related radio stations, i.e. a large number of stations within the Enhanced Other Network. In such a situation there will be a burst of transmission information messages at certain times of day, for example on the hour every hour. In the prior art receiver, this causes a string of mutes to occur as the receiver tries all of the alternative frequencies of each of the related radio stations which is not receivable at the radio apparatus. According to embodiments of the invention, however, the receiver only switches to a frequency of a related station which it knows it can receive.

[0069] Whilst embodiments of the invention have been described with reference to the European RDS system, the present application is not limited thereto. It can be applied in any suitable system, including the US RBDS system.

Claims

1. A programme switching method of switching a radio tuner between frequencies on which related radio stations broadcast, the method comprising:

tuning the radio tuner to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station;
detecting, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts;
periodically monitoring at least one quality indicator of a second programme signal of the second frequency;
detecting, in the first programme signal, a transmission code indicating transmission of a particular type of programme in the second programme signal on the second frequency;
determining, from the monitored at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and
switching the radio tuner to the second frequency to receive the said second programme signal if it is determined that the second programme signal is receivable, and keeping the radio tuner tuned to the first frequency to continue receiving the first programme signal if it is determined that the second programme signal is not receivable.

2. A method according to claim 1, the method further comprising:

detecting, in the first programme signal, additional information codes indicating additional frequencies on which related radio stations broadcast; and
periodically monitoring at least one quality indicator of the programme signal of each additional frequency.

3. A method according to claim 2, wherein at least some of the additional frequencies are alternative frequencies on which the second radio station broadcasts the second programme signal.

4. A method according to claim 2 or 3, further comprising:

storing, in a table, the second frequency and each additional frequency, together with, for each said frequency, the identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and
updating the table each time the at least one quality indicator of the programme signal of a said frequency is monitored.

5. A method according to claim 4, wherein the table is also updated each time a said frequency is switched to in order to receive the particular type of programme.

6. A method according to claim 4 or 5, wherein the age of the last decoded identification code and/or the age of the last time of monitoring is stored in the table for each said frequency also.

7. A method according to claim 4, 5 or 6, wherein the updating of the table includes re-ordering the order in which the frequencies are listed in the table, such that the frequencies are maintained in an order according to their at least one quality indicators.

8. A method according to claim 7 when appended to claim 6, wherein, when the age of the last decoded identification code of a said frequency reaches a threshold, the frequency is moved to a lower-quality position in the order.

9. A method according to any of claims 1 to 8, wherein the at least one quality indicator includes a field strength value V(FS) of the second programme signal.

10. A method according to claim 9, wherein the at least one quality indicator includes a multipath value and a noise value of the second programme signal.

11. A method according to any of claims 1 to 10, wherein the transmission code indicates transmission of a traffic bulletin as the particular type of programme.

12. A radio apparatus for in-vehicle use, the apparatus comprising:

a tuner for tuning the radio apparatus to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station;
first detecting means operable to detect, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts, and to detect, in the first programme signal, a transmission code indicating transmission of a particular type of programme in a second programme signal of the second frequency;
controlling means operable to cause the tuner to periodically sample the second programme signal of the second frequency;
second detecting means operable to detect at least one signal quality indicator of the second programme signal of the second frequency each time the second programme signal is sampled;
determining means for determining, from the at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and
switching means configured to switch the tuner to the second frequency to receive the said second programme signal when the first detecting means detects the transmission code and the determining means determines that the second programme signal is receivable, and configured to keep the tuner tuned to the first frequency to continue receiving the first programme signal when the first detecting means detects the transmission code and the determining means determines that the second programme signal is not receivable.

13. A radio apparatus according to claim 12, the apparatus further comprising:

a table, stored in memory, the table including the or each second frequency, together with, for each said frequency, the identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and

table updating means for updating the table each time the at least one quality indicator of the programme signal of a said frequency is sampled.

14. A radio apparatus according to claim 13, wherein the table further includes, for each said frequency, the age of the last detected identification code of that frequency and/or the age of the last time of sampling of that frequency.

15. A radio apparatus according to claim 13 or 14, wherein the table updating means is operable to re-order the order in which the frequencies are listed in the table, such that the frequencies are maintained in an order according to their at least one quality indicators.

16. A radio apparatus according to any of claims 12 to 15, wherein
the second detecting means is arranged to detect a field strength of the second programme signal as a said signal quality indicator.

Amended claims in accordance with Rule 137(2) EPC.

1. A programme switching method of switching a radio tuner (2) of a radio apparatus between frequencies on which radio stations related through an enhanced other network broadcast, the method comprising:

tuning the radio tuner (2) to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station for outputting by the radio apparatus to a listener;
detecting, in the first programme signal, an information code indicating a second frequency on which a second, related radio station broadcasts;
periodically monitoring at least one quality indicator of a second programme signal of the second frequency, by sampling the second programme signal for a length of time short enough so as not to be noticeable to the listener;
detecting, in the first programme signal, a transmission code indicating transmission of a particular type of programme in the second programme signal on the second frequency;
determining, from the monitored at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and
switching the radio tuner (2) to the second frequency to receive the said second programme signal for outputting by the radio apparatus to the listener if it is determined that the second programme signal is receivable, and keeping the radio tuner (2) tuned to the first frequency to continue receiving the first programme signal for outputting by the radio apparatus to the listener if it is determined that the second programme signal is not receivable.

2. A method according to claim 1, the method further comprising:

detecting, in the first programme signal, additional information codes indicating additional frequencies on which related radio stations broadcast; and
periodically monitoring at least one quality indicator of the programme signal of each additional frequency.

3. A method according to claim 2, wherein at least some of the additional frequencies are alternative frequencies on which the second radio station broadcasts the second programme signal.

4. A method according to claim 2 or 3, further comprising:

storing, in a table, the second frequency and each additional frequency, together with, for each said frequency, the identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and
updating the table each time the at least one quality indicator of the programme signal of a said frequency is monitored.

5. A method according to claim 4, wherein the table is also updated each time a said frequency is switched to in order to receive the particular type of programme.

6. A method according to claim 4 or 5, wherein the age of the last decoded identification code and/or the age of the last time of monitoring is stored in the table for each said frequency also.

7. A method according to claim 4, 5 or 6, wherein the updating of the table includes re-ordering the order in which the frequencies are listed in the table, such that the frequencies are maintained in an order according to their at least one quality indicators.

8. A method according to claim 7 when appended to claim 6, wherein, when the age of the last decoded identification code of a said frequency reaches a threshold, the frequency is moved to a lower-quality position in the order.

9. A method according to any of claims 1 to 8, wherein the at least one quality indicator includes a field strength value V(FS) of the second programme signal.

10. A method according to claim 9, wherein the at least one quality indicator includes a multipath value and a noise value of the second programme signal.

11. A method according to any of claims 1 to 10, wherein the transmission code indicates transmission of a traffic bulletin as the particular type of programme.

12. A method according to any of claims 1 to 11, wherein the length of time of sampling the second programme signal is less than 10 milliseconds.

13. A radio apparatus for in-vehicle use, the apparatus comprising:

a tuner (2) for tuning the radio apparatus to a first frequency on which a first radio station broadcasts so as to receive a first programme signal of the first radio station for outputting to a listener;
first detecting means (5) operable to detect, in the first programme signal, an information code indicating a second frequency on which a second radio station broadcasts, the first and second radio stations being related through an enhanced other network, and to detect, in the first programme signal, a transmission code indicating transmission of a particular type of programme in a second programme signal of the second frequency;
controlling means (5) operable to cause the tuner (2) to periodically sample the second programme signal of the second frequency, wherein the length of time of the sampling is short enough so as not to be noticeable to the listener;
second detecting means (4) operable to detect at least one signal quality indicator of the second programme signal of the second frequency each time the second programme signal is sampled;
determining means (5) for determining, from the at least one quality indicator of the second programme signal, whether the second programme signal is receivable; and
switching means (5) configured to switch the tuner (2) to the second frequency to receive the said second programme signal for outputting to the listener when the first detecting means (5) detects the transmission code and the determining means (5) determines that the second programme signal is receivable, and configured to keep the tuner (2) tuned to the first frequency to continue receiving the first programme signal for outputting to the listener when the first detecting means (5) detects the transmission code and the determining means (5) determines that the second programme signal is not receivable.

14. A radio apparatus according to claim 13, the apparatus further comprising:

a table, stored in memory (6), the table including the or each second frequency, together with, for each said frequency, the identification code that indicates the frequency and the at least one quality indicator of the programme signal of the frequency; and
table updating means (5) for updating the table each time the at least one quality indicator of the programme signal of a said frequency is sampled.

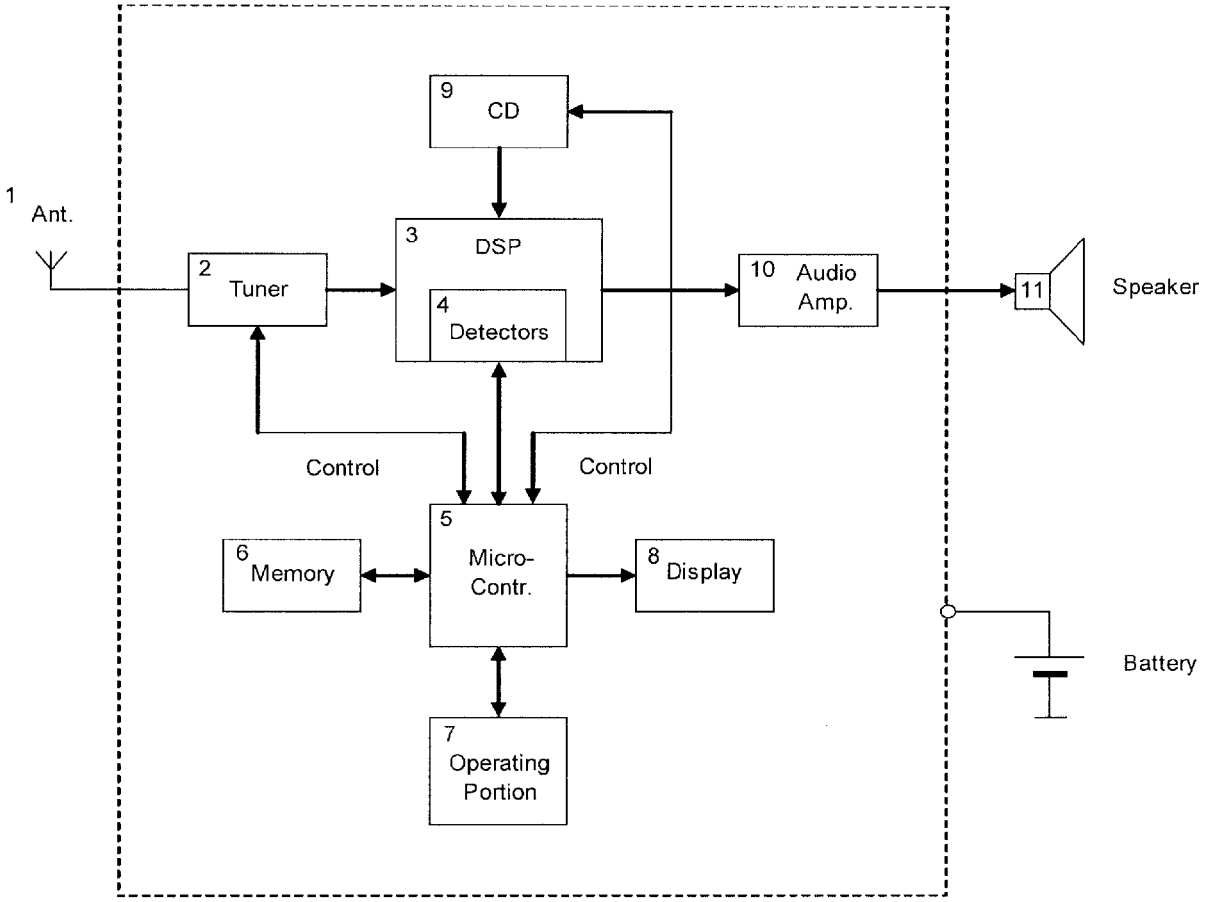
15. A radio apparatus according to claim 14, wherein the table further includes, for each said frequency, the age of the last detected identification code of that frequency and/or the age of the last time of sampling of that frequency.

16. A radio apparatus according to claim 14 or 15, wherein the table updating means is operable to re-order the order in which the frequencies are listed in the table, such that the frequencies are maintained in an order according to their at least one quality indicators.

17. A radio apparatus according to any of claims 13 to 16, wherein
the second detecting means (4) is arranged to detect a field strength of the second programme signal as a said

signal quality indicator.

18. A radio apparatus according to any of claims 13 to 17, wherein the length of time of the sampling of the second programme signal is less than 10 milliseconds.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Memory
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Display
7
Operating
Portion
Battery

FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 07 15 0399

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H04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 March 2008	D'Attilia, Marco

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