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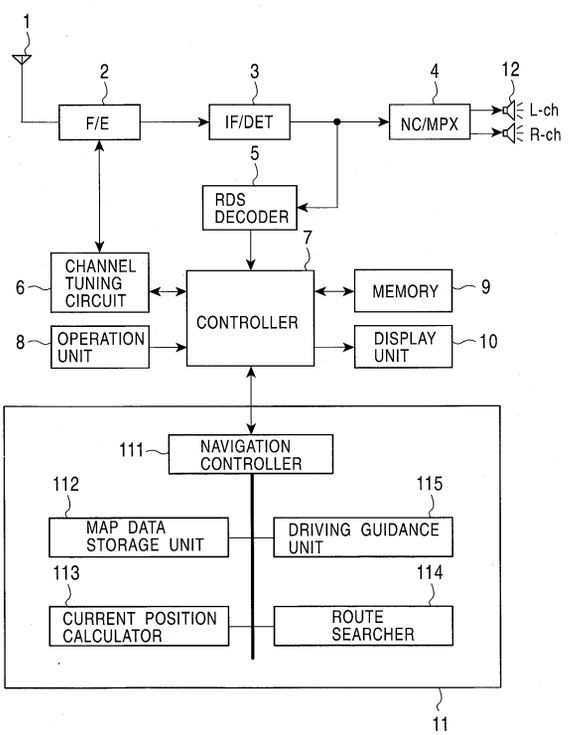
(54) Traffic information receiver and traffic information reception method

(57) When a vehicle is moving from country A to country B, a navigation system (11) predicts that the vehicle is entering country B based on a route and a current position. Until it is predicted that the vehicle is moving to country B, a controller (7) controls a channel tuning circuit (6) to receive traffic information concerning country A from a corresponding broadcasting station. If the navigation system (11) predicts that the vehicle is moving to country B when it has reached a point (301) in country A, the controller (7) controls the channel tuning circuit (6) to start receiving traffic information concerning country B from a corresponding broadcasting station.

FIG. 1



EP 1 515 466 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a traffic information receiver for receiving traffic information which is broadcast according to the region and providing it to users.

2. Description of the Related Art

[0002] A typical example of broadcast systems for broadcasting traffic information is a radio data system (RDS) for broadcasting various types of information, such as information concerning broadcast programs and traffic information, by multiplexing such information on audio broadcasts. For the sake of convenience, data multiplexed with audio broadcasts is referred to as "RDS data".

[0003] The configuration of the RDS data is shown in Figs. 5A and 5B. The RDS data is formed, as shown in Fig. 5A, in units of groups, each group having 104 bits and consisting of four blocks. Each block has 26 bits consisting of 16-bit information words (m0 through m15) and 10-bit check words and offset words (c'0 through c'9).

[0004] The RDS data groups are classified according to the type of information, and group type 8A is used as a channel for broadcasting traffic information programs (traffic message channel (TMC)).

[0005] Fig. 5B illustrates the data configurations of group type 8A and group type 3A.

[0006] In group 8A, block A contains, as shown in Fig. 5B, a program identification (PI) code for identifying a broadcasting station represented by a country code, an area code, and a broadcasting station code. Block B contains, not only a four-bit group type code, but also various codes for message management and extended systems, for example, a one-bit short message code (S) indicating that this message is a short message, a one-bit group message ID code (G) indicating whether this message is a single group message transmitted in one group data or a multi group message transmitted in multi group data, and a three-bit traffic congestion duration (duration-and-persistence-of-the disturbance) code (DP) indicating an approximate duration of traffic congestion. The DP code has eight levels of the traffic congestion duration (0 to 4 hours).

[0007] Block C contains a two-bit diversion ID code (D) indicating the presence or absence of a diversion, a three-bit extent code indicating the location offset address, and an 11-bit event code indicating an event, for example, weather conditions, construction work, traffic congestion, or public transportation.

[0008] Block D contains a 16-bit location code indicating the location at which the event indicated by the event code is occurring.

[0009] Group 3A specifies a location table in which the relationship between the location code used in group 8A and the position is defined by a location table number (LTN).

[0010] More specifically, in group 3A, block A contains the PI code. In block B, not only a four-bit group ID code representing the group 3A, but also the group type using the RDS data of the group 3A, i.e., the group 8A, are indicated. Block C contains the LTN. In block D, CD48 indicating the application concerning the RDS data of the group 3A is fixed.

[0011] The LTN of the group 3A and the location code of the group 8A can specify the location at which the event indicated by the event code of the group 8A is occurring.

[0012] More specifically, a broadcast receiver decodes the data of the group 8A while selecting a required location table from a plurality of prestored location tables according to the LTN designated by the group 3A. The broadcast receiver can then obtain traffic information (traffic congestion, accidents, weather, etc.) and provides it to the user.

[0013] For example, in the location tables used in Germany, the location code is represented by a combination of code representing the Federal State (codes 1 to 16 assigned to the 16 Federal States), code representing the district, administrative section, and local district, highway code representing, for example, Autobahn or national routes, code representing the Autobahn exit, interchange, and service area, and code representing a road diverged from a highway. Each area or point can be hierarchically specified by the location code.

[0014] For receiving traffic information from the above-described RDS broadcasting and providing it to the user via an on-vehicle receiver, the following technique disclosed in, for example, Japanese Unexamined Patent Application Publication No. 2002-64391, is known. A car navigation system determines the country in which a vehicle (driver) is currently located (which is sometimes referred to as a "current country") and provides traffic information transmitted only from a broadcasting station in that country to the user without providing traffic information from broadcasting stations in other countries.

[0015] According to this technique, a driver driving (or user) in a certain country does not have to receive unnecessary information from the other countries. Thus, the user is not confused, and an unnecessary load is not imposed on the receiver.

[0016] In this technique, however, when moving from one country to another country, the user cannot obtain traffic information of the country to which the user is moving until he/she actually enters that country. Accordingly, even if traffic congestion is occurring one kilometer ahead of the user, the user cannot obtain information concerning the traffic congestion if it is occurring in another country. If traffic congestion is occurring across

two countries, the navigation system may disadvantageously provide a congestion distance shorter than the actual distance for the user since information only concerning the current country can be obtained.

SUMMARY OF THE INVENTION

[0017] Accordingly, it is an object of the present invention to provide an on-vehicle traffic information receiver for receiving traffic information which is broadcast according to the region and suitably providing traffic information to a user.

[0018] In order to achieve the above-described object, the present invention provides an on-vehicle traffic information receiver for receiving traffic information which is broadcast from a broadcasting station according to each region. The traffic information receiver includes: a current position calculator for calculating the current position of a vehicle; a traffic information receiving unit for receiving traffic information concerning the region containing the current position from a corresponding broadcasting station; a prediction unit for predicting that the vehicle is moving from the region containing the current position to another region; and a traffic-information prior-reception controller for switching the broadcasting station from which the traffic information receiver receives the traffic information to the broadcasting station broadcasting traffic information concerning the region to which the vehicle is moving when the prediction unit predicts the movement of the vehicle.

[0019] With this configuration, when a vehicle is moving from region A to region B, it is predicted that the vehicle is moving to region B while traveling in region A, and the reception of traffic information concerning region B is started. Accordingly, traffic information concerning the region to which the vehicle is moving can be obtained and provided to the user although the vehicle has not reached the region.

[0020] In the aforementioned on-vehicle traffic information receiver may further include a storage unit for storing the traffic information received by the traffic information receiving unit. Upon predicting the movement of the vehicle by the prediction unit, when the traffic information concerning the region to which the vehicle is moving, which is received from the corresponding broadcasting station within a predetermined past time, is stored in the storage unit and when a predetermined time after starting to receive the traffic information concerning the region containing the current position has not been reached, the traffic-information prior-reception controller may switch the broadcasting station from which the traffic information reception unit receives the traffic information to the broadcasting station broadcasting the traffic information concerning the region to which the vehicle is moving and which is predicted by the prediction unit after the predetermined time has been reached.

[0021] With this arrangement, even when the vehicle is moving frequently in and out of more than one region, traffic information on one region can be obtained sufficiently before switching to another region by utilizing the latest traffic information stored in the storage unit. Thus, the traffic information concerning each region can be provided to the user according to the actual traffic condition without causing a serious delay.

[0022] In the aforementioned on-vehicle traffic information receiver, when the vehicle has not reached the region predicted by the prediction unit even after a predetermined lapse of time after the prediction unit predicts the movement of the vehicle, the traffic-information prior-reception controller may switch the broadcasting station from which the traffic information receiving unit receives the traffic information between a plurality of broadcasting stations alternately including at least the broadcasting station broadcasting the traffic information concerning the region predicted by the prediction unit and the broadcasting station broadcasting the traffic information concerning the region containing the current position.

[0023] With this arrangement, even if the vehicle has not reached the destination region because of, for example, traffic congestion, after it is predicted that the vehicle is moving to the region, the latest traffic information concerning the current region can still be obtained while continuing receiving the traffic information concerning the region to which the vehicle is moving.

[0024] The present invention also provides an on-vehicle traffic information receiver for receiving traffic information which is broadcast from a broadcasting station according to each region. The traffic information receiver includes: a current position calculator for calculating the current position of a vehicle; a traffic information receiving unit for receiving traffic information from a corresponding broadcasting station; a storage unit for storing the traffic information received by the traffic information receiving unit; and a traffic information reception controller for switching the broadcasting station from which the traffic information receiving unit receives traffic information to the broadcasting station broadcasting the traffic information concerning the region determined at least by the current position of the vehicle. Upon changing the region determined at least by the current position, when the traffic information concerning the region determined at least by the current position, which is received from the broadcasting station within the predetermined past time, is stored in the storage unit, and when a predetermined time after starting to receive the traffic information concerning the region from the current broadcasting station has not been reached, the traffic information reception controller switches the broadcasting station from which the traffic information receiving unit receives the traffic information to the broadcasting station broadcasting the traffic information concerning the region determined at least by the current position.

[0025] With this configuration, in a traffic information receiver adapted to receive traffic information concern-

ing a region in which the vehicle is currently located, even when the vehicle is moving frequently in and out of more than one region, traffic information on one region can be obtained sufficiently before switching to another region by utilizing the latest traffic information stored in the storage unit. Thus, the traffic information concerning each region can be provided to the user according to the actual traffic condition without causing a serious delay.

[0026] The above-described region may be a country.

[0027] The present invention also provides a traffic information reception method for controlling the reception of traffic information in an on-vehicle traffic information receiver for receiving traffic information which is broadcast from a broadcasting station according to each region. The traffic information reception method includes: a first step of calculating the current position of a vehicle; a second step of switching the broadcasting station from which traffic information is received to a broadcasting station broadcasting traffic information concerning a region containing the current position; a third step of predicting that the vehicle is moving from the region containing the current position to another region; and a fourth step of switching the broadcasting station from which the traffic information is received to a broadcasting station broadcasting traffic information concerning the region to which the vehicle is moving when it is predicted that the vehicle is moving.

[0028] According to the present invention, traffic information can be suitably provided to the user regardless of whether the vehicle remains in the same region or is moving to another region.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a block diagram illustrating the configuration of a traffic information receiver according to an embodiment of the present invention;

Fig. 2 is a flowchart illustrating traffic information reception processing according to an embodiment of the present invention;

Figs. 3A, 3B, and 3C illustrate examples of the traffic information reception processing according to an embodiment of the present invention;

Figs. 4A and 4B illustrate examples of the traffic information reception processing according to an embodiment of the present invention; and

Figs. 5A and 5B illustrate formats of RDS data.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0030] The present invention is described in detail below with reference to the accompanying drawings through illustration of an embodiment.

[0031] The configuration of an on-vehicle traffic information receiver for receiving RDS broadcasting according to an embodiment of the present invention is shown in Fig. 1.

[0032] The traffic information receiver includes, as shown in Fig. 1, an antenna 1 for receiving radio waves broadcast from broadcasting stations, a front end (F/E) 2 for receiving a specific reception frequency channel, an intermediate-frequency (IM)-amplification/frequency modulation (FM)-detection circuit (IF/DET) 3 for conducting IM amplification and FM detection on an output signal of the F/E 2, a noise-cancellation/stereo-demodulation circuit (NC/MPX) 4 for conducting noise cancellation and stereo demodulation on an output signal of the IF/DET 3 and outputting the resulting signal to a speaker 12, an RDS decoder 5, a channel tuning circuit 6, a controller 7, an operation unit 8, a memory 9, a display unit 10, and a navigation system 11.

[0033] The RDS decoder 5 extracts traffic information from the RDS data contained in the IF signal output from the IF/DET 3, decodes the extracted RDS data, and sends it to the controller 7. The channel tuning circuit 6 inputs the frequency signal according to the broadcasting station designated by the controller 7 into the F/E 2 so as to switch the reception frequency channel in the F/E 2.

[0034] The navigation system 11 further includes the following items. A map data storage unit 112 stores road map data. A current position calculator 113 includes a speed sensor, a gyroscope, a global positioning system (GPS), etc. so as to calculate the current position of the vehicle by using the road map data. A route searcher 114 searches for a suitable route from the current position to a destination specified by the user. A driving guidance unit 115 generates a driving guidance image, for example, a mark indicating the current position, a route diagram illustrating a searched suitable route, or a mark indicating the destination on a map of the area around the current position. A navigation controller 111 controls the entirety of the navigation system 11.

[0035] The controller 7 controls the storage of traffic information transmitted from the RDS decoder 5 in the memory 9, the display of traffic information received within a predetermined past time and stored in the memory 9 on the display unit 10, and the display of driving guidance images generated by the driving guidance unit 115 and received via the navigation controller 111 on the display unit 10.

[0036] The display of traffic information on the display unit 10 may be performed as follows. The controller 7 sends traffic information received within a predetermined past time and stored in the memory 9 to the navigation system 11. The driving guidance unit 115 of the navigation system 11 generates a driving guidance image from the traffic information received via the navigation controller 111 as information on the map. The controller 7 then controls the display of the driving guidance image generated by the driving guidance unit 115 on the display unit 10.

[0037] With this configuration, the controller 7 performs the following traffic information reception processing indicated by the flowchart of Fig. 2 to control the reception of traffic information to be displayed on the display unit 10.

[0038] The controller 7 performs the processing shown in Fig. 2 while regularly querying the navigation controller 111 to receive information concerning a country in which the vehicle is currently located. The navigation controller 111 determines a country containing the current position of the vehicle as the current country based on the map data and the current position calculated by the current position calculator 113, and responds to the controller 7.

[0039] Upon starting the traffic information receiving processing, in step 202, the controller 7 controls the channel tuning circuit 6 to change the reception frequency to search for the broadcasting station broadcasting the RDS data containing the PI code indicating the current country. Then, the controller 7 starts receiving the RDS data from the searched broadcasting station. The controller 7 also starts storing the traffic information decoded from the RDS data in the memory 9.

[0040] Then, in step 204, the controller 7 queries the navigation controller 111 as to whether the vehicle is moving to another country within predetermined L minutes (for example, 10 minutes). The navigation controller 111 then predicts whether the vehicle is moving to another country within the predetermined L minutes based on the current position, the current route, the map data, and the current driving speed. If it is predicted that the vehicle is moving to another country, the navigation controller 111 sends an affirmative response to the controller 7.

[0041] The controller 7 then determines in step 206 from this response whether it is predicted that the vehicle is moving to another country. If the outcome of step 206 is NO, the controller 7 continues receiving the RDS data containing the PI code indicating the current country from the corresponding broadcasting station.

[0042] If the outcome of step 206 is YES, the controller 7 checks in step 208 for traffic information decoded and stored in the memory 9 within a predetermined past time (for example, 20 minutes) from the RDS data containing the PI code of the predicted country. If such information is not stored, in step 210, the controller 7 searches for the broadcasting station broadcasting the RDS data containing the PI code indicating the predicted country, and starts receiving the RDS data of the searched broadcasting station. The controller 7 also starts storing the traffic information decoded from the received RDS data in the memory 9.

[0043] Then, the controller 212 determines in step 212 whether predetermined m minutes (for example, 25 minutes) have elapsed after starting receiving the RDS data containing the PI code indicating the predicted country from the broadcasting station. If the result of step 212 is NO, the controller determines in step 214 whether the vehicle has moved to the predicted country. If the vehicle has moved to the predicted country before the predetermined m minutes have elapsed, the controller 7 returns to step 204.

[0044] It is now assumed that the vehicle is moving from country A to country B, as shown in Fig. 3A. In this case, when the vehicle has reached a point 301 in country A, it can be predicted that the vehicle is entering country B, and starts receiving traffic information concerning country B. Accordingly, traffic information concerning a country to which the vehicle is moving can be obtained in advance and provided to the user before the vehicle enters the country. In this case, since the latest traffic information concerning country A is still stored in the memory 9, it can be provided to the user.

[0045] Referring back to Fig. 2, if the controller 7 determines in step 208 from the RDS data containing the PI code of the predicted country that traffic information decoded within a predetermined past time (for example, 20 minutes) is stored in the memory 9, the process proceeds to step 216. The controller 7 then determines in step 216 whether n minutes (for example, 15 minutes) have elapsed after the PI code contained in the RDS data was last switched, i.e., after the country from which traffic information is received was last switched. If the outcome of step 216 is YES, the process proceeds to step 210. If the result of step 216 is NO, the controller 7 waits until n minutes have elapsed, and proceeds to step 210. If it is determined in step 218 that the vehicle has moved to the predicted country before n minutes have elapsed, the controller 7 queries the navigation controller 111 in step 220 as to whether the vehicle is moving to another country within L minutes. If the controller 7 determines in step 222 that the vehicle is moving to another country within L minutes, the process returns to step 208. It is assumed that n minutes is a sufficient time for obtaining traffic information on a certain country from RDS data containing the PI code of that country.

[0046] When the vehicle is moving in the order of country A, country B, country A, and country B, as shown in Fig. 3B, traffic information is received in the order of country A, country B, country A, and country B if steps 208 and 216 through 222 are not provided in the above-described processing. However, when the vehicle is moving frequently in and out of more than one country, traffic information on one country sometimes cannot be obtained sufficiently before switching to another country. For example, when the vehicle is moving in the order of country A, country B, and country A, traffic information concerning country B sometimes cannot be obtained sufficiently. In the route from country A, country B, and country A shown in Fig. 3B, it is not always necessary to obtain traffic information concerning country A while the vehicle is traveling in a zone 311 and the zone in country B before the zone 311 since the latest traffic information concerning country A has already been obtained when the vehicle was first traveling in country A and stored in the memory 9.

[0047] Accordingly, in steps 208 and 216, the second reception of the traffic information concerning country A is set to be shorter to extend the time to obtain the traffic information on country B.

[0048] Steps 218, 220, 222, and 208 are provided for a case where the vehicle is moving in the order of country A, country B, country A, and country C, as shown in Fig. 3C. In this case, priority is given to the reception of traffic information concerning country C, which is not yet stored in the memory 9, over the extension of the time for obtaining the traffic information concerning country B in the zone 311 after the vehicle has moved in the order of country A, country B, and country A.

[0049] In this manner, when information concerning a country from which traffic information is to be subsequently received is already stored in the memory 9, the time for currently receiving traffic information can be extended. This technique is also applicable to when a vehicle remains in the same country without moving to another country.

[0050] Referring back to Fig. 2, if it is determined in step 212 that the predetermined m minutes (for example, 25 minutes) have elapsed after starting to receive the RDS data containing the PID code indicating the predicted country from the corresponding broadcasting station, the traffic-information alternate reception is started in step 224. The predetermined m minutes is a sufficient time, in relation to the L minutes used for predicting that the vehicle is moving to another country, for determining that the vehicle is caught in traffic congestion since the vehicle has not moved to the predicted country even after the lapse of m minutes.

[0051] The traffic-information alternate reception is to alternately receive, every predetermined minutes (for example, 15 minutes) for each country, RDS data containing the PI code of the current country from the corresponding broadcasting station and RDS data containing the PI code of the country to which the vehicle is moving within predetermined minutes (for example, 20 minutes).

[0052] Upon starting the traffic-information alternate reception, the controller 7 determines in step 226 whether the vehicle has moved to the predicted country. If the outcome of step 226 is YES, the controller 7 switches in step 228 the reception broadcasting station to the broadcasting station from which the RDS data containing the PI code indicating the position of the current country is received. Thereafter, the process returns to step 204.

[0053] It is now assumed, as shown in Fig. 4A, that it is predicted at a point 401 in country A that the vehicle is moving to country B and starts receiving the traffic information concerning country B, however, the vehicle has not reached country B because of traffic congestion. In this case, the above-described alternate traffic-information reception processing is started to alternately receive traffic information concerning country A and traffic information concerning country B in a zone from a point 402 at which traffic congestion has been detected to country B. Accordingly, the traffic information on country B can be received before the vehicle moves to country B, and also, the reception of the latest traffic information concerning country A can be continued.

[0054] If, as shown in Fig. 4B, it is predicted in country A that the vehicle is moving to country C immediately after moving to country B, not only traffic information concerning country A and country B, but also traffic information concerning country C can be obtained in a zone from a point 402 at which traffic congestion has been detected to country B. Accordingly, traffic information concerning a country to which the vehicle is moving can be obtained from the route and provided to the user.

[0055] In the foregoing embodiment, the reception of traffic information is switched according to the country based on the PI code contained in the RDS data. If, however, the countries are not associated with the areas covered by the location table, the reception of traffic information may be switched according to the area covered by the location table based on the location table number contained in the RDS data.

[0056] In the above-described embodiment, the navigation system 11 predicts whether the vehicle is moving to another country within the predetermined L minutes based on the route. However, the navigation system 11 may predict the movement of a vehicle even when a route is not set. More specifically, the navigation system 11 may predict the movement of a vehicle based on the road in which the vehicle is traveling by referring to the current position, the driving direction, and the map data.

[0057] In this embodiment, the factor for predicting the movement of a vehicle to another country is the predetermined L minutes. Instead, another factor may be used, for example, the navigation system 11 may predict the movement of a vehicle to another country within a predetermined driving distance.

[0058] If the traffic information receiver is adapted to simultaneously receive broadcasting from a plurality of broadcasting stations, it is preferable that traffic information concerning a current country and traffic information concerning a country to which the vehicle is moving be simultaneously received. In this case, regardless of whether the vehicle is moving to another country, traffic information concerning the current country and traffic information concerning an adjacent country may be simultaneously received.

Claims

1. An on-vehicle traffic information receiver for receiving traffic information which is broadcast from a broadcasting station according to each region, comprising:

   current position calculation means (113) for calculating a current position of a vehicle;

traffic information reception means (6) for receiving traffic information concerning a region containing the current position from a corresponding broadcasting station;
prediction means (11) for predicting that the vehicle is moving from the region containing the current position to another region; and
traffic-information prior-reception control means (7) for switching the broadcasting station from which the traffic information reception means (6) receives the traffic information to a broadcasting station broadcasting traffic information concerning the region to which the vehicle is moving when the prediction means (11) predicts the movement of the vehicle.

2. The on-vehicle traffic information receiver according to claim 1, further comprising storage means (9) for storing the traffic information received by the traffic information reception means (6),

wherein, upon predicting the movement of the vehicle by the prediction means (11), when the traffic information concerning the region to which the vehicle is moving, which is received from the corresponding broadcasting station within a predetermined past time, is stored in the storage means (9) and when a predetermined time after starting to receive the traffic information concerning the region containing the current position has not been reached, the traffic-information prior-reception control means (7) switches the broadcasting station from which the traffic information reception means (6) receives the traffic information to the broadcasting station broadcasting the traffic information concerning the region to which the vehicle is moving and which is predicted by the prediction means (11) after the predetermined time has been reached.

3. The on-vehicle traffic information receiver according to claim 1, wherein, when the vehicle has not reached the region predicted by the prediction means (11) even after a predetermined lapse of time after the prediction means (11) predicts the movement of the vehicle, the traffic-information prior-reception control means (7) switches the broadcasting station from which the traffic information reception means (6) receives the traffic information between a plurality of broadcasting stations alternately including at least the broadcasting station broadcasting the traffic information concerning the region predicted by the prediction means (11) and the broadcasting station broadcasting the traffic information concerning the region containing the current position.

4. The on-vehicle traffic information receiver according to any one of claims 1 to 3, wherein the prediction means (11) is a navigation system (11).

5. The on-vehicle traffic information receiver according to claim 4, wherein the navigation system (11) predicts the movement of the vehicle based on a route.

6. The on-vehicle traffic information receiver according to any one of claims 1 to 5, wherein the region is a country.

7. The on-vehicle traffic information receiver according to any one of claims 1 to 6, wherein the broadcasting is radio data system broadcasting.

8. A traffic information reception method for controlling the reception of traffic information in an on-vehicle traffic information receiver for receiving traffic information which is broadcast from a broadcasting station according to each region, comprising:

a first step of calculating a current position of a vehicle;
a second step of switching a broadcasting station from which traffic information is received to a broadcasting station broadcasting traffic information concerning a region containing the current position;
a third step of predicting that the vehicle is moving from the region containing the current position to another region; and
a fourth step of switching the broadcasting station from which the traffic information is received to a broadcasting station broadcasting traffic information concerning the region to which the vehicle is moving when it is predicted that the vehicle is moving.

9. The traffic information reception method according to claim 8, further comprising the step of storing the received traffic information,

wherein, in the fourth step, upon predicting that the vehicle is moving, when the traffic information concerning the region to which the vehicle is moving, which is received from the corresponding broadcasting station within a predetermined past time, is stored and when a predetermined time after starting to receive the traffic information concerning the region containing the current position has not been reached, the broadcasting station from which the traffic information is received is switched to the broadcasting station broadcasting the traffic information concerning the region to which the vehicle is moving after the predetermined time has been reached.

10. The traffic information reception method according to claim 8, further comprising the step of switching the broadcasting station from which the traffic information is received between a plurality of broadcast-

ing stations alternately including at least the broadcasting station broadcasting the traffic information concerning the predicted region and the broadcasting station broadcasting the traffic information concerning the region containing the current position when the vehicle has not reached the predicted region even after a predetermined lapse of time after it is predicted that the vehicle is moving.

FIG. 1

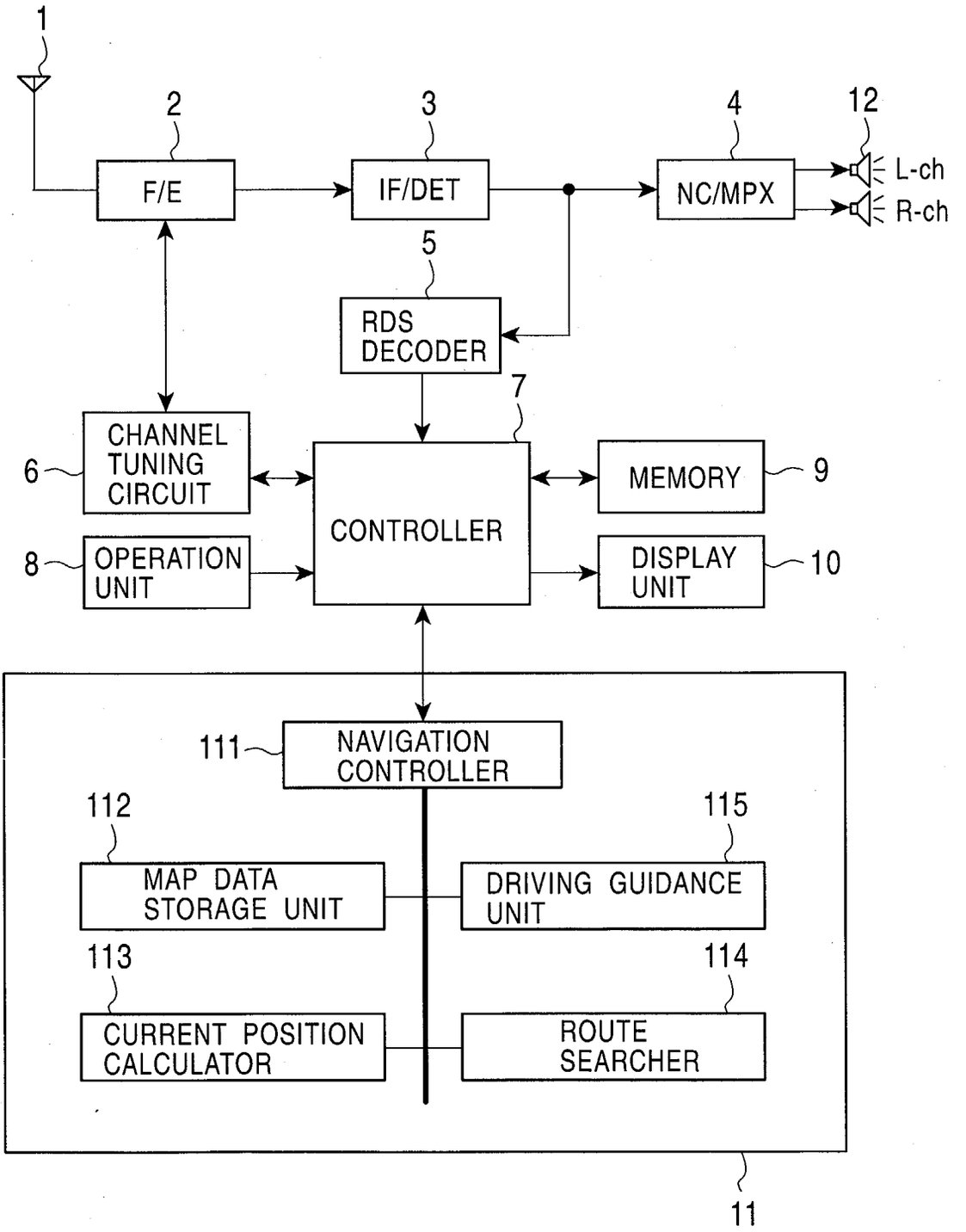

1
2
3
4
12
F/E
IF/DET
NC/MPX
L-ch
R-ch
5
RDS DECODER
7
CHANNEL TUNING CIRCUIT
6
CONTROLLER
MEMORY
9
OPERATION UNIT
8
DISPLAY UNIT
10
111
NAVIGATION CONTROLLER
112
115
MAP DATA STORAGE UNIT
DRIVING GUIDANCE UNIT
113
114
CURRENT POSITION CALCULATOR
ROUTE SEARCHER
11

FIG. 2

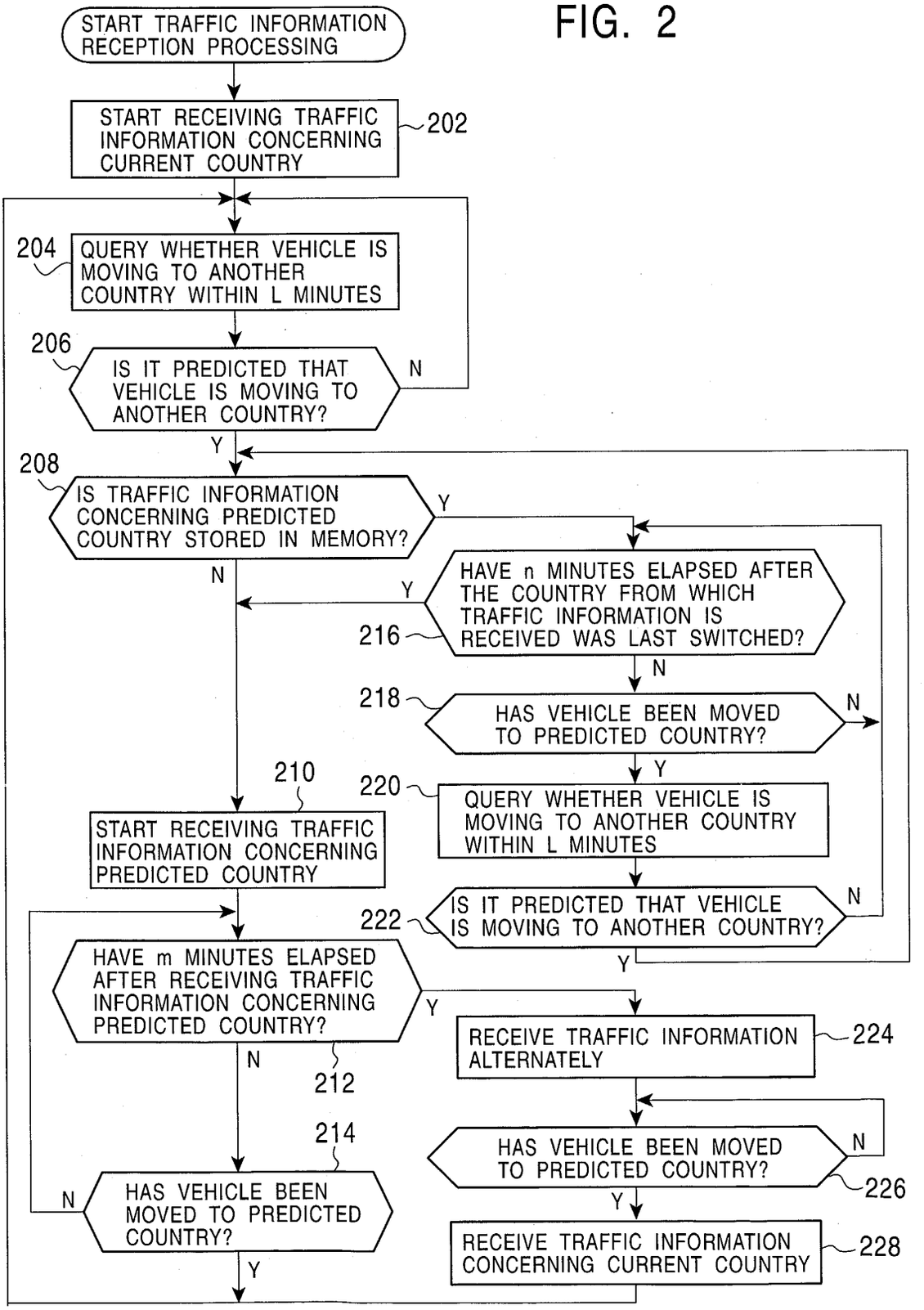

START TRAFFIC INFORMATION RECEPTION PROCESSING
START RECEIVING TRAFFIC INFORMATION CONCERNING CURRENT COUNTRY
202
204
QUERY WHETHER VEHICLE IS MOVING TO ANOTHER COUNTRY WITHIN L MINUTES
206
IS IT PREDICTED THAT VEHICLE IS MOVING TO ANOTHER COUNTRY?
N
Y
208
IS TRAFFIC INFORMATION CONCERNING PREDICTED COUNTRY STORED IN MEMORY?
Y
N
HAVE n MINUTES ELAPSED AFTER THE COUNTRY FROM WHICH TRAFFIC INFORMATION IS RECEIVED WAS LAST SWITCHED?
Y
216
N
218
HAS VEHICLE BEEN MOVED TO PREDICTED COUNTRY?
N
Y
210
220
START RECEIVING TRAFFIC INFORMATION CONCERNING PREDICTED COUNTRY
QUERY WHETHER VEHICLE IS MOVING TO ANOTHER COUNTRY WITHIN L MINUTES
IS IT PREDICTED THAT VEHICLE IS MOVING TO ANOTHER COUNTRY?
222
N
Y
HAVE m MINUTES ELAPSED AFTER RECEIVING TRAFFIC INFORMATION CONCERNING PREDICTED COUNTRY?
Y
N
212
RECEIVE TRAFFIC INFORMATION ALTERNATELY
224
214
HAS VEHICLE BEEN MOVED TO PREDICTED COUNTRY?
N
226
Y
N
HAS VEHICLE BEEN MOVED TO PREDICTED COUNTRY?
Y
RECEIVE TRAFFIC INFORMATION CONCERNING CURRENT COUNTRY
228

FIG. 3A

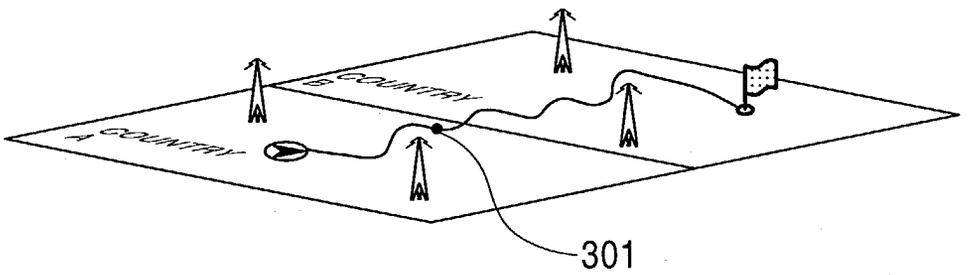


FIG. 3B

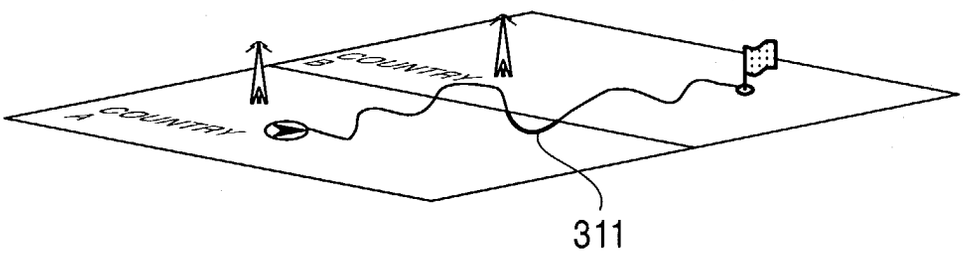


FIG. 3C

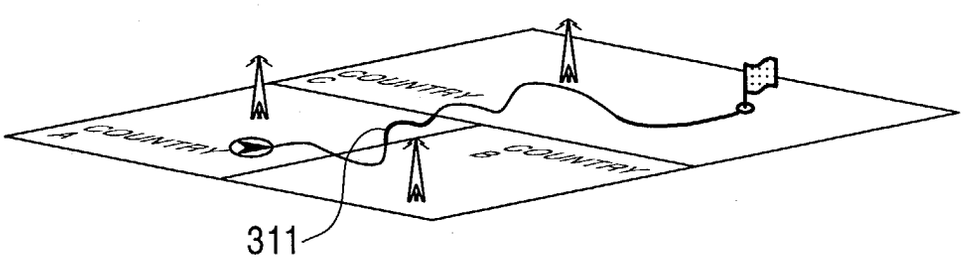


FIG. 4A

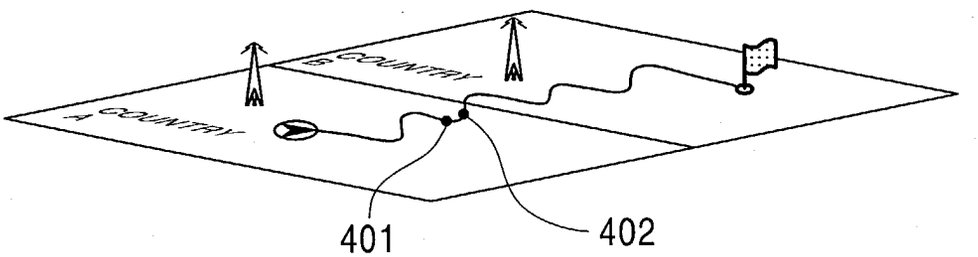

B COUNTRY
A COUNTRY
401
402

FIG. 4B

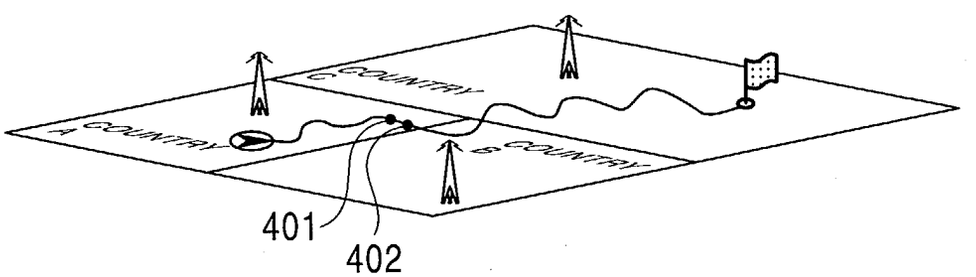

C COUNTRY
A COUNTRY
B COUNTRY
401
402

FIG. 5A

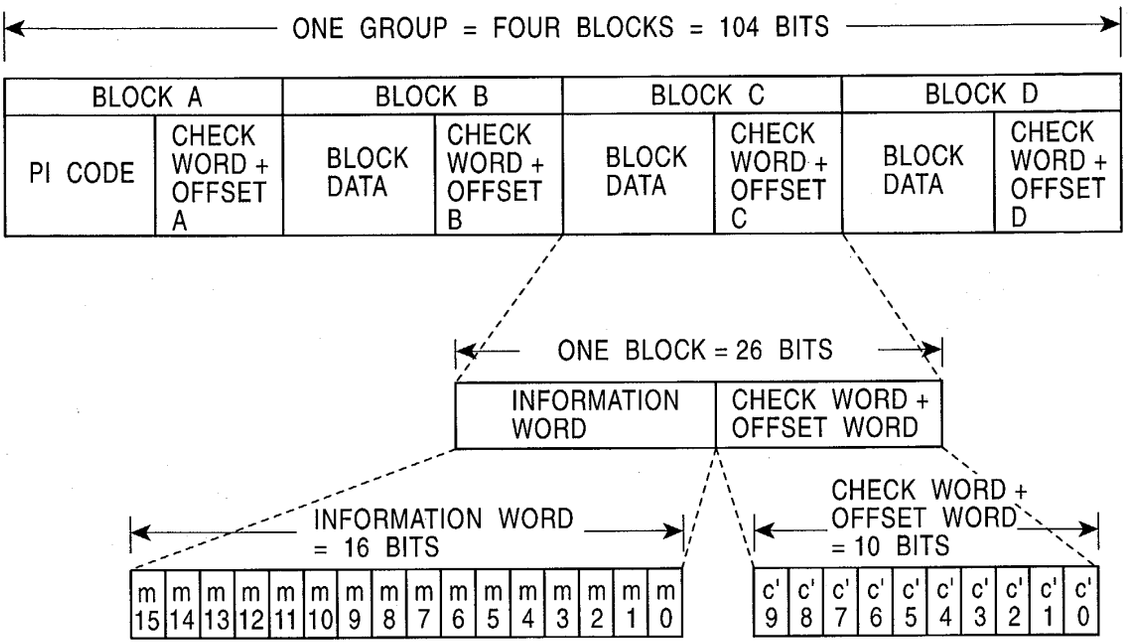
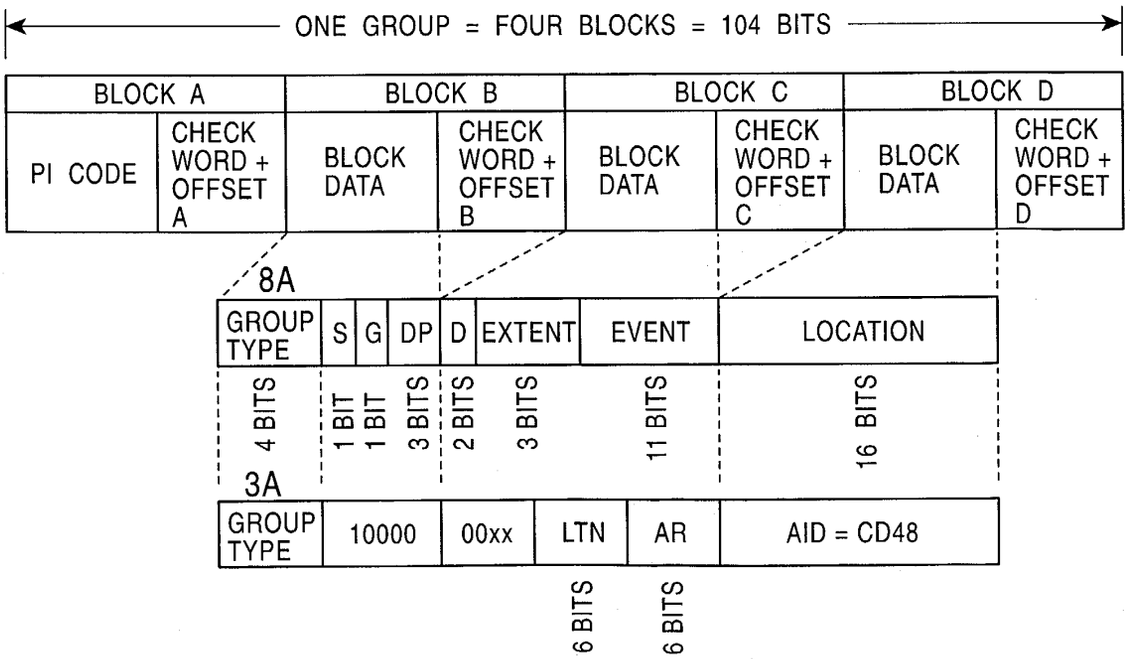

ONE GROUP = FOUR BLOCKS = 104 BITS
BLOCK A
BLOCK B
BLOCK C
BLOCK D
PI CODE
CHECK WORD + OFFSET A
BLOCK DATA
CHECK WORD + OFFSET B
BLOCK DATA
CHECK WORD + OFFSET C
BLOCK DATA
CHECK WORD + OFFSET D
ONE BLOCK = 26 BITS
INFORMATION WORD
CHECK WORD + OFFSET WORD
INFORMATION WORD = 16 BITS
CHECK WORD + OFFSET WORD = 10 BITS
m 15 m 14 m 13 m 12 m 11 m 10 m 9 m 8 m 7 m 6 m 5 m 4 m 3 m 2 m 1 m 0
c' 9 c' 8 c' 7 c' 6 c' 5 c' 4 c' 3 c' 2 c' 1 c' 0

FIG. 5B


ONE GROUP = FOUR BLOCKS = 104 BITS
BLOCK A
BLOCK B
BLOCK C
BLOCK D
PI CODE
CHECK WORD + OFFSET A
BLOCK DATA
CHECK WORD + OFFSET B
BLOCK DATA
CHECK WORD + OFFSET C
BLOCK DATA
CHECK WORD + OFFSET D
8A
GROUP TYPE
S
G
DP
D
EXTENT
EVENT
LOCATION
4 BITS
1 BIT
1 BIT
3 BITS
2 BITS
3 BITS
11 BITS
16 BITS
3A
GROUP TYPE
10000
00xx
LTN
AR
AID = CD48
6 BITS
6 BITS