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(54) METHOD FOR IMPROVEMENT OF TRANSIT OF EMERGENCY VEHICLES BY USE OF BEACONS

(57) Method for improving the traffic of emergency vehicles through the use of beacons, in which each emergency vehicle (1) has a TE (Terminal Equipment) (3) which can access a wireless access network (4) which manages the traffic improvement service. It also uses positioning beacons (6) placed at different spots of the road network (8), which communicate via radio to the vehicles travelling near them. Knowing the position of the emergency vehicle (1) when it goes by near a beacon (6), the network (4) informs of the its presence to the rest of the vehicles (7) with a TE (11) and some means (10) to determine the position, and which are located at a certain distance from said beacon, either on the same road (8) as the emergency vehicle (1) or on an adjacent road (9), so that said vehicles (7) clear the way for the emergency vehicle (1)

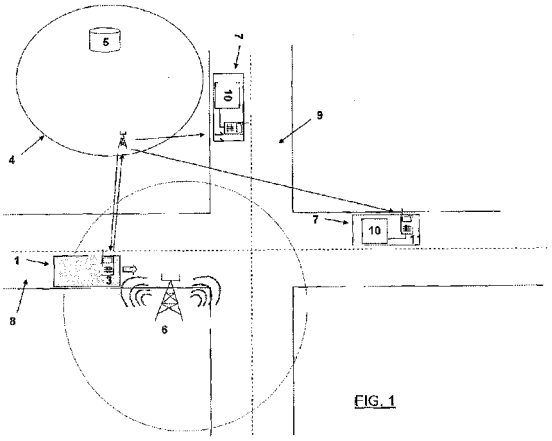

FIG. 1

EP 2 116 982 A2

Description

Field of the invention

[0001] The present invention refers to a method for improving the traffic of emergency vehicles, in which the emergency vehicles using this method on the road network have a terminal with access to a wireless network (for example, the mobile phone network). Knowing the position of the emergency vehicle by means of the beacons placed on different spots of the road network, the network informs the rest of the vehicles in the road network, provided they are within short distance from the emergency vehicle of the security parameters (such as maximum speed allowed, safe distance from the preceding vehicle) and other requirements which must be fulfilled in order to facilitate the movement of said emergency vehicle, minimising accident risks.

Background of the invention

[0002] Nowadays, traffic alerts on streets and roads about emergency vehicles such as ambulances, fire engines or patrol cars in emergency situation are based on the use of acoustic and light signals intended to make the other cars clear the road and allow the emergency vehicles to reach their destination in the least time possible.

[0003] Security in these vehicles is many times jeopardized, especially at crossroads or railroad intersections, which also jeopardizes the security of the rest of the vehicles.

[0004] Besides, on many occasions, and due to the Doppler Effect of sound, the vehicles preceding the emergency vehicles cannot distinguish the exact location of the vehicle, or which lane it is coming from; therefore, on many occasions, no manoeuvres can be executed to clear the way for emergency vehicles.

[0005] The method object of the invention solves the hereby stated problem by informing the drivers for them to clear the roads for the emergency vehicles and therefore reducing the time it takes for them to reach their destination, plus increasing safety, especially at crossroads.

Description of the invention

[0006] The present invention refers to a method for improving the traffic of emergency vehicles through the use of beacons, according to claim 1 and claim 6, in its two alternative solutions. Preferred embodiments of said method are defined in the dependent claims.

[0007] In both methods, each emergency vehicle subscribed to the service called Traffic Accident Prevention for Emergency Services using Beacons, (PATSEMB, Prevención de Accidentes de Tráfico para Servicios de Emergencias mediante Balizas), service which provides said method, is provided with a TE - terminal equipment - (for example a mobile phone with an application installed, or a personal digital assistant PDA) which can access a wireless access network (for example a wireless phone network). The method in both alternative solutions works by means of beacons placed at different spots of the road network, beacons which, via radio, send out their identifier ID_B and the identifier $ID_{PATSEMB}$ belonging to the PATSEMB service they provide.

[0008] The method described in claim 1 comprises the following stages for each vehicle subscribed to the PATSEMB service:

- The TE belonging to the emergency vehicle sends out a request to the wireless access network to subscribe to the PATSEMB service, along with that request, it sends the identifier of the PATSEMB being requested, a single ID_{VE} identifier for the emergency vehicle and optionally, a $IDVE_{PASS}$ password to access the service for that ID_{VE}.
- The wireless access network verifies the validity of the TE subscription.
- If the subscription is valid, the wireless access network sends to the TE of the emergency vehicle a temporary $IDVE_{TEMP}$ identifier for said TE. The network can regularly send a new $IDVE_{TEMP}$ identifier to the emergency vehicle.
- The TE is set to listening mode to receive information about the positioning beacons in the communication channel used by said beacons to contact the emergency vehicles using the PATSEMB service.
- Once a message sent by a positioning beacon is received, the TE verifies that the service provided by said beacon corresponds to the PATSEMB service, in which case, every time it receives a message from a beacon, and provided it is considered necessary, the TE sends to the wireless access network the ID_B identifier of said beacon and its $IDVE_{TEMP}$ identifier;
- The wireless access network, when it considers it relevant, informs about the presence of an emergency vehicle near said beacon to a plurality of vehicles on the road network.

[0009] The notification to the other vehicles, which is carried out by the network, about the presence of an emergency vehicle near the beacon takes place at least in one of the following ways:

- Using signalling means placed near the beacon;
- For the vehicles which have a TE with access to the wireless access network, through those TEs using the positioning beacons, which send via radio at least one of the following:
  - security parameters to be fulfilled by the vehicles;
  - a message requiring some specific action;

- For those vehicles which have means to determine the position and a TE with access to the wireless access network and to the information provided by such means, through said TEs, the network sends at least one of the following: security parameters the vehicles must fulfil (for example maximum speed allowed), and a message requiring some specific action from them, such as clearing one of the lanes. The wireless access network will know the position of said vehicles at all times because their own terminals will inform the network about the position of the vehicle, and therefore, the wireless access network will determine which specific vehicles must be informed about the presence of the emergency vehicle.

[0010] The emergency vehicle subscribed to the PATSEMB service can end its subscription to said service when said emergency vehicle does not contact the network in a predetermined time, T_{EXP}, or when said emergency vehicle sends the network a request to end the subscription to the PATSEMB service. In case the emergency service has willingly ended its subscription, and in order to request a new subscription, the TE of the emergency vehicle can send the network the PATSEMB service identifier and the $IDVE_{TEMP}$ temporary identifier belonging to said terminal; the network will later verify that the validity of said $IDVE_{TEMP}$ has not expired.

[0011] Emergency vehicles subscribe to the PATSEMB service if they wish the other vehicles to be informed about their presence. The vehicles which participate in the PATSEMB service are those connected to the wireless access network, through a terminal in each vehicle, and can receive information from the PATSEMB service warning them about the presence of an emergency vehicle. Those vehicles which do not have a terminal to access the wireless access network do not participate in the PATSEMB service; therefore, they cannot receive messages from the wireless access network.

[0012] Those vehicles which do not take part in the PATSEMB service may be informed by means of information signs controlled by the PATSEMB service itself and located at troubled spots of the road network (for example in those areas in which the beacons are placed). In case the PATSEMB service obtains the corresponding permission, traffic lights and other traffic signs could be controlled, in order to warn all surrounding vehicles of the presence of an emergency vehicle.

[0013] There exists another alternative method according to claim 6. In this case, the TE belonging to the emergency vehicle sends out a request to the wireless access network to subscribe to the PATSEMB service, and along with that request, it sends the PATSEMB service identifier being requested, a single ID_{VE} identifier for the emergency vehicle and optionally, a password $IDVE_{PASS}$ to have access to the service for that ID_{VE}-The wireless access network verifies the validity of the TE subscription and sends to the TE of the emergency vehicle a temporary $IDVE_{TEMP}$ identifier. The TE is set to listening mode to receive information of the positioning beacons in the communication channel used by said beacon to communicate with the emergency vehicles using the PATSEMB service. The TE verifies, after receiving a message sent by a positioning beacon, that the service provided by said beacon corresponds to the PATSEMB service, in which case each time it receives a message from a beacon, and if considered necessary, the TE sends to the positioning beacon its $IDVE_{TEMP}$ identifier and optionally, the ID_B identifier thereof. Every time the beacon receives such information from the emergency vehicle, said beacon sends to the wireless access network the $IDVE_{TEMP}$ identifier, and its ID_B identifier. When considered necessary, the wireless access network informs a plurality of vehicles from the rest of the vehicles moving along the road network about the presence of an emergency vehicle near that beacon. The procedure the wireless access network follows to inform the rest of the vehicles about the presence of the emergency vehicle is identical to the one previously described. The procedure to end the subscription to the service and to ask for a new subscription is also identical to the one described in the first method.

Brief description of the drawings

[0014] The following is a brief description of a series of drawings which will help understand the invention better relating to an embodiment of said invention which is presented as an illustrative and non-limiting example thereof. To this end, we refer to the attached drawings, in which:

Figure 1 shows the interaction between the TE of the emergency vehicle and the positioning beacon and the wireless access network provided by the PATSEMB service.

Figure 2 shows an alternative solution in which the beacon communicates to the wireless access network.

Description of a preferred embodiment of the invention

[0015] As shown in **Figure 1,** the method object of this invention is based on the availability in emergency vehicle 1 of a TE 3 which is used by the driver of said vehicle 1; TE 3 has a client application installed. The method uses positioning beacons 6 fixed to the rails and/or mobile beacons 6 (being the latter usually equipped with means to determine their position) which use any kind of wireless technology, usually short-range such as RFID. Beacons 6 broadcast within their reach, in diffusion mode, or they can be activated by means of a vehicle sensor so that their ID_B identifier and the $ID_{PATSEMB}$ service identifier provided are not continuously broadcasting. The proce-

dures used to implement it are the following:

P1. The TE 3 subscribes to the service for the first time. To that end, it sends out a registration request to a wireless access network 4, in charge of managing the PATSEMB Traffic Accidents Prevention for Emergency Services using Beacons. The parameters included in the request are:

- the PATSEMB service identifier, $ID_{PATSEMB}$;
- a single ID_{VE} identifier for the emergency vehicle 1;
  and optionally:
- an $IDVE_{PASS}$ password to have access to the service for that ID_{VE}. The wireless access network 4 contains, for example, a database 5 including the pairs (ID_{VE}, $IDVE_{PASS}$) allowed for the PATSEM service; and
- the current position of the TE (3), manually inserted or informed about using some other means.

P2. As an answer to this request, the network will save the previous data in the data base 5 and will try to authenticate the user by means of an authentication mechanism, for example a credential sending mechanism. In this mechanism, using as input parameters the user identity and password, the network 4 and the user generate and answer which must be the same at both ends to consider the user authenticated and grant access. As the calculation of the answer is based on something that only the network 4 and the user know, if the answer is the same, the user is a registered user. The network will verify that the ID_{VE}, $IDVE_{PASS}$ pair is correct. If it is incorrect, it will reject the request.

P3. If it is correct, it will confirm its subscription to the PATSEMB service and send the TE 3 a temporary identifier to the emergency vehicle $IDVE_{TEMP}$.

P4. If in the P1 stage the emergency vehicle 1 was incapable of introducing its position, the network 4 will optionally try to calculate its position and inform the rest of the vehicles as described in the P7 stage.

P5. The TE 3 will be set to listening mode so that it will hear the information broadcasted by the beacons 6. In case the beacon transmits via RFID, the terminal TE 2 will listen to the frequency associated for this service.

P6. When the TE 3 listens to the message broadcasted by a beacon 6, it will verify the service identifier provided by said beacon 6. If it coincides with that of the PATSEMB service, $ID_{PATSEMB}$, the TE 3 will send the network 4 the beacon identifier, ID_B, and its identifier $IDVE_{TEMP}$. Another possibility is that the TE 3 sends these data to the beacon 6 and said beacon 6 forwards them to the network 4, as shown in figure 2 and as described in claim 6. Then, the network 4 saves the values received in the service data base DB 5, confirms the terminal TE 3 of the reception of the data sent, and informs the rest of the vehicles 7 of their presence, As described in stage P7.

P7. The rest of the vehicles 7 are informed of the presence of the emergency vehicle 1 near the beacon 6. At this point there are three possibilities:

a- The network informs the rest of the vehicles within a predetermined distance to the beacon 6 of the presence of the emergency vehicle 1.
b- The network informs the adequate beacons to transmit specific information, such as maximum speed allowed, specific instructions as to how to clear a lane, etc.
c- Or else, a combination of both alternatives (a and b).

[0016] The information sent to said vehicles will depend on where they are located:

- For those vehicles located on lane 8 where the emergency vehicle 1 is located (determined by checking a map and the information on traffic direction):
  - The parameters sent by the network 4 associated to security, security parameters such as maximum speed, can be complemented, in the following beacons which are placed in the traffic direction of the emergency vehicle 1 (known by the network since it has a beacon record for the area where the emergency vehicle is travelling), with stricter security parameters, indicating, for example, that it is required that the left lane be cleared for the emergency vehicle to travel along it.
  - The network 4 will send the vehicles which have recently gone by the beacon 6 where the emergency vehicle 1 is now travelling an update of security parameters and a change of lane could be requested from them.
- The vehicles in adjacent roads 9, which are perpendicular to road 8 along which the emergency vehicle 1 is travelling (determined using a map) are informed that, for example, they have to clear the intersection with road 8 along which the emergency vehicle 1 is travelling, reduce their speed, and, if appropriate, stop for the emergency vehicle 1 to go by.

[0017] On the other hand, the network 4 will regularly send the emergency vehicle 1 a new $IDVE_{TEMP}$. If there is no activity of the terminal TE 3 of the emergency vehicle

1 during a time to be defined (that is, if it does not communicate with the wireless access network 4 during a specific time), said terminal TE 3 will have to subscribe again. The emergency vehicle 1 itself can also end its subscription to the service voluntarily when it does not require travelling in emergencies. When the emergency vehicle 1 wishes to subscribe again, it will do so sending the same parameters as those indicated in P1 if a validity period has passed, established by the network 4 according to configuration, associated to said emergency vehicle 1. If said period has not expired, the parameters the network will send in the step subscription P1 will be the PATSEMB service identifier and the temporary identifier $IDVE_{TEMP}$ of the emergency vehicle 1. In step P2, the network will verify that said $IDVE_{TEMP}$ has not expired and therefore, access to the service is guaranteed.

[0018] The solution described in the method object of the invention is valid to any other vehicle that is not an emergency vehicle 1 with the only requirement that it has the application charged in the terminal TE. In this case, the ID_{VE} could be, for example, its number plate and the $IDVE_{PASS}$ the reason why the service is needed. For security reasons, the activation (and, therefore, the input on the data base of the network where the allowed pairs (ID_{VE}. $IDVE_{PASS}$) are recorded) can be performed from an emergency call centre.

Claims

1. Method for improving the traffic of emergency vehicles through the use of beacons, in which each emergency vehicle (1) which subscribes to the service of Traffic Accident Prevention for Emergency Services using Beacons, PATSEMB, which provides said method, has a Terminal Equipment TE (3) which can access a wireless access network (4) which manages the PATSEMB service, **characterized in that** said PATSEMB service has positioning beacons (6) placed at different spots of the road network (8), which transmit via radio their identifier ID_B and the identifier $ID_{PATSEMB}$ belonging to the PATSEMB service they provide, and **in that** said method comprises the following stages:

a- the TE (3) of the emergency vehicle (1) sends out a request to the wireless access network (4) to subscribe to the PATSEMB service, sending along with that request the following data:

- the identifier of the PATSEMB service being requested;
- a single ID_{VE} identifier for the emergency vehicle (1);

and optionally:

- an $IDVE_{PASS}$ password to access the service for that ID_{VE};

b- the wireless access network (4) verifies the validity of the TE (3) subscription;

c- if the subscription is valid, the wireless access network (4) sends to the TE (3) of the emergency vehicle (1) a temporary $IDVE_{TEMP}$ identifier for said TE (3);

d- the TE (3) is set to listening mode to receive information from the positioning beacons (6) in the communication channel used by said beacons (6) to contact the emergency vehicles (1) using the PATSEMB service.

e- once a message sent by a positioning beacon (6) is received, the TE (3) verifies that the service provided by said beacon corresponds to the PATSEMB service, in which case, every time it receives a message from a beacon (6), and provided it is considered necessary, the TE (3) sends to the wireless access network (4):

- the ID_B identifier of said beacon (6),
- its $IDVE_{TEMP}$ identifier;

f- the wireless access network (4), when it considers it relevant, informs, about the presence of an emergency vehicle (1) near said beacon (6), to a plurality of vehicles of the rest of vehicles (7) on the road network.

2. Method according to claim 1, **characterized in that** the notification to the other vehicles, which is carried out by the network (4), about the presence of an emergency vehicle (1) near the beacon (6) takes place at least in one of the following ways:

- Using signalling means placed near the beacon (6);
- For the vehicles which have a TE (11) with access to the wireless access network (4), through those TEs (11) using the positioning beacons (6), which send via radio at least one of the following:

  - security parameters to be fulfilled by the vehicles;
  - a message requiring some specific action from them;

- For those vehicles which have means (10) to determine the position and a TE (11) with access to the wireless access network (4) and to the information provided by such means, through said TEs (11), the network (4) sends at least one of the following:

  - security parameters the vehicles must fulfil;
  - a message requiring some specific action from them.

3. Method according to any of the preceding claims, **characterized in that** the network regularly sends to the emergency vehicle (1) a new identifier $IDVE_{TEMP}$.

4. Method according to any of the preceding claims, **characterized in that** the emergency vehicle (1) subscribed to the PATSEMB service ends its subscription to said service in any of the following cases:

- if said emergency vehicle (1) does not contact the network in a predetermined time, T_{EXP}; or
- if said emergency vehicle (1) sends the network a request to end the subscription to the PATSEMB service.

5. Method according to the preceding claim, where the emergency vehicle (1) has ended its subscription voluntarily, **characterized in that** in order to request a new subscription, the TE (3) of the emergency vehicle (1) sends the network the following data:

- the PATSEMB service identifier being requested;
- the $IDVE_{TEMP}$ temporary identifier of said terminal (3);

the network (4) verifying that the validity of said $IDVE_{TEMP}$ has not expired.

6. Method for improving the traffic of emergency vehicles through the use of beacons, in which each emergency vehicle (1) subscribed to the service of Traffic Accident Prevention for Emergency Services using Beacons, PATSEMB, provided by said method has a TE (3) which can access a wireless access network (4) which manages the PATSEMB service, **characterized in that** said PATSEMB service has positioning beacons (6) placed at different spots of the road network (8), which transmit via radio their identifier ID_B and the identifier $ID_{PATSEMB}$ belonging to the PATSEMB service they provide, and **in that** said method comprises the following stages:

a- the TE (3) of the emergency vehicle (1) sends out a request to the wireless access network (4) to subscribe to the PATSEMB service, sending along with that request the following data:

- the identifier of the PATSEMB being requested;
- a single ID_{VE} identifier for the emergency vehicle (1);

and optionally:

- an $IDVE_{PASS}$ password to access the service for that ID_{VE};

b- the wireless access network (4) verifies the validity of the TE (3) subscription;

c- the wireless access network (4) sends to the TE (3) of the emergency vehicle (1) a temporary $IDVE_{TEMP}$ identifier for said TE (3);

d- the TE (3) is set to listening mode to receive information from the positioning beacons (6) in the communication channel used by said beacons (6) to contact the emergency vehicles (1) using the PATSEMB service.

e- once a message sent by a positioning beacon (6) is received, the TE (3) verifies that the service provided by said beacon corresponds to the PATSEMB service, in which case, every time it receives a message from a beacon (6), and provided it is considered necessary, the TE (3) sends to the positioning beacon (6):

- its $IDVE_{TEMP}$ identifier;

and optionally:

- its ID_B identifier;

f- each time the beacon (6) receives said information from the emergency vehicle (1), said beacon (6) sends the wireless access network (4) the $IDVE_{TEMP}$ identifier and its ID_B identifier;

g- when it considers it necessary, the wireless access network (4) informs about the presence of an emergency vehicle (1) near said beacon (6) to a plurality of vehicles of the rest of vehicles (7) on the road network (8).

7. Method according to claim 6, **characterized in that** the notification to the vehicles, which is carried out by the network (4), about the presence of an emergency vehicle (1) near the beacon (6) takes place at least in one of the following ways:

- Using signalling means placed near the beacon (6);
- For the vehicles which have a TE (11) with access to the wireless access network (4), through those TEs (11) using the positioning beacons (6), which send via radio at least one of the following:

  - security parameters to be fulfilled by the vehicles;
  - a message requiring some specific action from them;

- For those vehicles which have means (10) to determine the position and a TE (11) with access to the wireless access network (4) and to the information provided by such means, through said TEs (11), the network (4) sends at least one of the following:

  - security parameters the vehicles must ful-

fil;
- a message requiring some specific action from them.

8. Method according to any of the claims 6 to 7, **characterized in that** the network regularly sends to the emergency vehicle (1) a new $IDVE_{TEMP}$ identifier.

9. Method according to any of the claims 6 to 8, **characterized in that** the emergency vehicle (1) subscribed to the PATSEMB service ends its subscription to said service in any of the following cases:

- if said emergency vehicle (1) does not contact the network in a predetermined time, T_{EXP}; or
- if said emergency vehicle (1) sends the network a request to end the subscription to the PATSEMB service.

10. Method according to the preceding claim, where the emergency vehicle (1) has ended its subscription voluntarily, **characterized in that** in order to request a new subscription, the TE (3) of the emergency vehicle (1) sends the network the following data:

- the PATSEMB service identifier being requested;
- the $IDVE_{TEMP}$ temporary identifier of said TE (3);

the network (4) verifying that the validity of said $IDVE_{TEMP}$ has not expired.

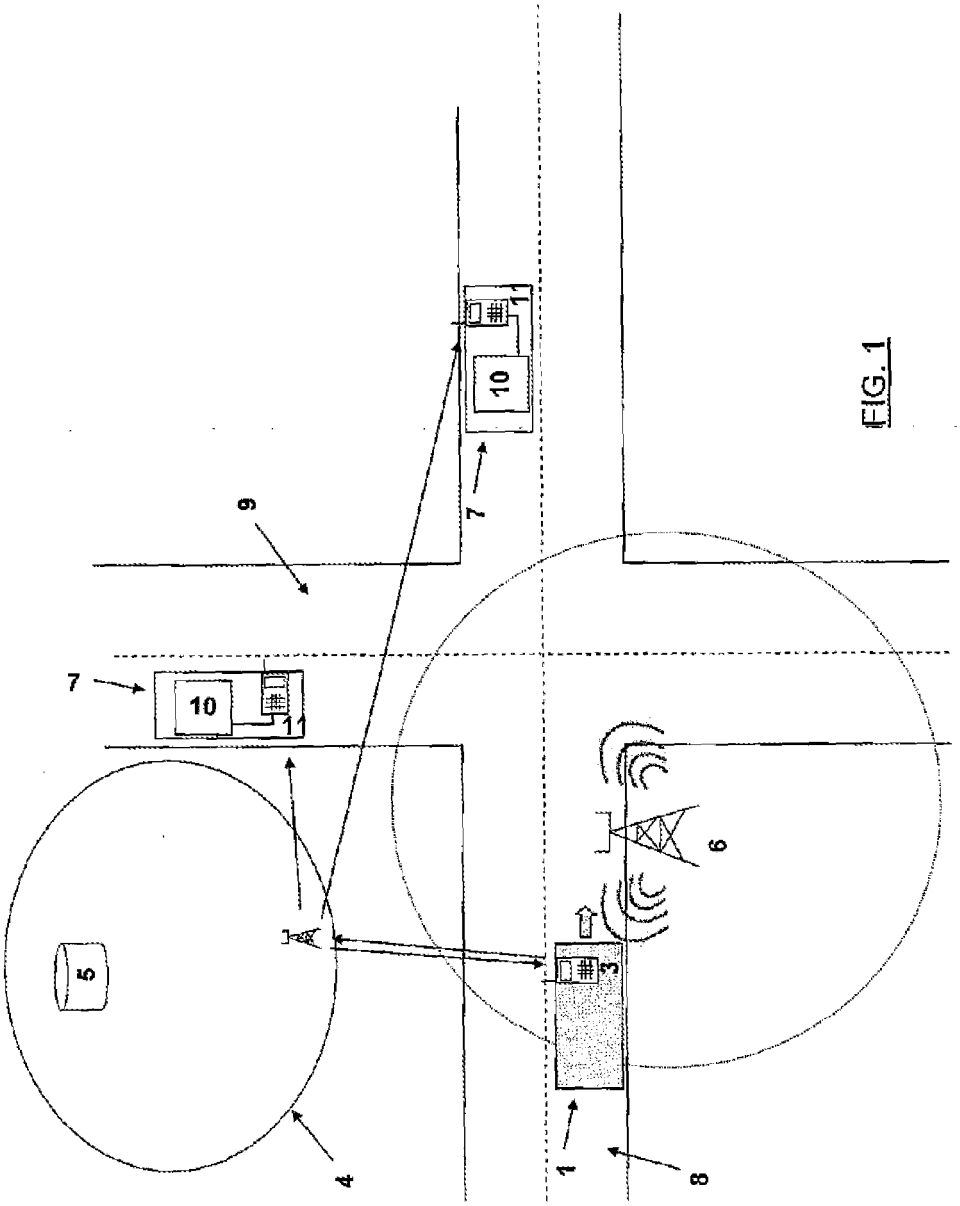

FIG. 1

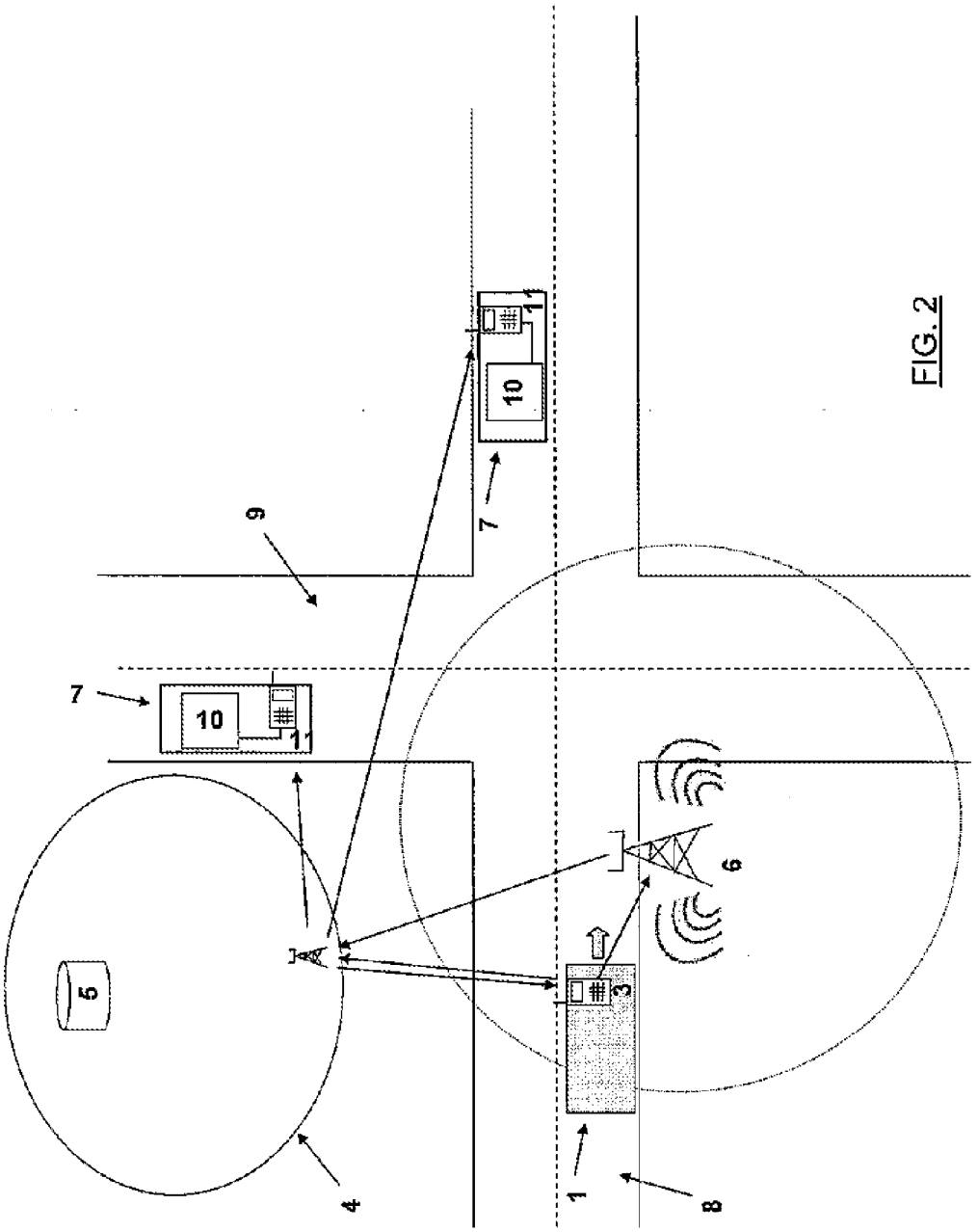

FIG. 2