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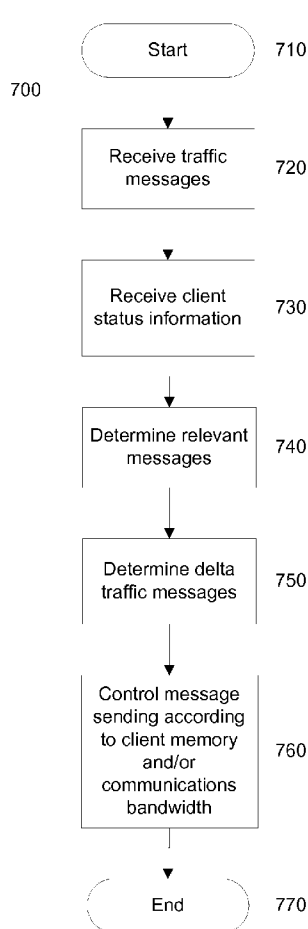


FIG. 7

(57) Abstract: This invention relates a method of communicating traffic or road information to a navigation device (200) comprising receiving traffic or road information at a server (302), determining status information associated with the navigation device (200) and, based upon the status information, determining whether the traffic or road information is relevant to the navigation device (200) such that only traffic or road information relevant to the navigation device (200) is communicated to the navigation device (200) by the server (302).



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Apparatus and Method for Providing Information to Navigation Devices

Field of the Invention

This invention relates to navigation devices and to apparatus and methods for providing information to navigation devices. Illustrative embodiments of the invention relate to portable navigation devices (so-called PNDs), in particular PNDs that include Global Positioning System (GPS) signal reception and processing functionality. Other embodiments relate, more generally, to any type of processing device that is configured to execute navigation software so as to provide route planning, and preferably also navigation, functionality.

Background to the Invention

Portable navigation devices (PNDs) that include GPS (Global Positioning System) signal reception and processing functionality are well known and are widely employed as in-car or other vehicle navigation systems.

In general terms, a modern PND comprises a processor, memory (at least one of volatile and non-volatile, and commonly both), and map data stored within said memory. The processor and memory cooperate to provide an execution environment in which a software operating system may be established, and additionally it is commonplace for one or more additional software programs to be provided to enable the functionality of the PND to be controlled, and to provide various other functions.

Typically these devices further comprise one or more input interfaces that allow a user to interact with and control the device, and one or more output interfaces by means of which information may be relayed to the user. Illustrative examples of output interfaces include a visual display and a speaker for audible output. Illustrative examples of input interfaces include one or more physical buttons to control on/off operation or other features of the device (which buttons need not necessarily be on the device itself but could be on a steering wheel if the device is built into a vehicle), and a microphone for detecting user speech. In a particularly preferred arrangement the output interface display may be configured as a touch sensitive display (by means of a touch sensitive overlay or otherwise) to additionally provide an input interface by means of which a user can operate the device by touch.

Devices of this type will also often include one or more physical connector interfaces by means of which power and optionally data signals can be transmitted to and received from the device, and optionally one or more wireless transmitters/receivers to allow communication over cellular telecommunications and other signal and data

networks, for example Wi-Fi, Wi-Max GSM and the like.

PND devices of this type also include a GPS antenna by means of which satellite-broadcast signals, including location data, can be received and subsequently processed to determine a current location of the device.

5 The PND device may also include electronic gyroscopes and accelerometers which produce signals that can be processed to determine the current angular and linear acceleration, and in turn, and in conjunction with location information derived from the GPS signal, velocity and relative displacement of the device and thus the vehicle in which it is mounted. Typically such features are most commonly provided in in-vehicle
10 navigation systems, but may also be provided in PND devices if it is expedient to do so.

 The utility of such PNDs is manifested primarily in their ability to determine a route between a first location (typically a start or current location) and a second location (typically a destination). These locations can be input by a user of the device, by any of a wide variety of different methods, for example by postcode, street name and house
15 number, previously stored "well known" destinations (such as famous locations, municipal locations (such as sports grounds or swimming baths) or other points of interest), and favourite or recently visited destinations.

 Typically, the PND is enabled by software for computing a "best" or "optimum" route between the start and destination address locations from the map data. A "best" or
20 "optimum" route is determined on the basis of predetermined criteria and need not necessarily be the fastest or shortest route. The selection of the route along which to guide the driver can be very sophisticated, and the selected route may take into account existing, predicted and dynamically and/or wirelessly received traffic and road information, historical information about road speeds, and the driver's own preferences
25 for the factors determining road choice (for example the driver may specify that the route should not include motorways or toll roads).

 In addition, the device may continually monitor road and traffic conditions, and offer to or choose to change the route over which the remainder of the journey is to be made due to changed conditions. Real time traffic monitoring systems, based on various
30 technologies (e.g. mobile phone data exchanges, fixed cameras, GPS fleet tracking) are being used to identify traffic delays and to feed the information into notification systems.

 PNDs of this type may typically be mounted on the dashboard or windscreen of a vehicle, but may also be formed as part of an on-board computer of the vehicle radio or indeed as part of the control system of the vehicle itself. The navigation device may also
35 be part of a hand-held system, such as a PDA (Portable Digital Assistant) a media player, a mobile phone or the like, and in these cases, the normal functionality of the

hand-held system is extended by means of the installation of software on the device to perform both route calculation and navigation along a calculated route.

Route planning and navigation functionality may also be provided by a desktop or mobile computing resource running appropriate software. For example, the Royal Automobile Club (RAC) provides an on-line route planning and navigation facility at <http://www.rac.co.uk>, which facility allows a user to enter a start point and a destination whereupon the server to which the user's PC is connected calculates a route (aspects of which may be user specified), generates a map, and generates a set of exhaustive navigation instructions for guiding the user from the selected start point to the selected destination. The facility also provides for pseudo three-dimensional rendering of a calculated route, and route preview functionality which simulates a user travelling along the route and thereby provides the user with a preview of the calculated route.

In the context of a PND, once a route has been calculated, the user interacts with the navigation device to select the desired calculated route, optionally from a list of proposed routes. Optionally, the user may intervene in, or guide the route selection process, for example by specifying that certain routes, roads, locations or criteria are to be avoided or are mandatory for a particular journey. The route calculation aspect of the PND forms one primary function, and navigation along such a route is another primary function.

During navigation along a calculated route, it is usual for such PNDs to provide visual and/or audible instructions to guide the user along a chosen route to the end of that route, i.e. the desired destination. It is also usual for PNDs to display map information on-screen during the navigation, such information regularly being updated on-screen so that the map information displayed is representative of the current location of the device, and thus of the user or user's vehicle if the device is being used for in-vehicle navigation.

An icon displayed on-screen typically denotes the current device location, and is centred with the map information of current and surrounding roads in the vicinity of the current device location and other map features also being displayed. Additionally, navigation information may be displayed, optionally in a status bar above, below or to one side of the displayed map information, examples of navigation information include a distance to the next deviation from the current road required to be taken by the user, the nature of that deviation possibly being represented by a further icon suggestive of the particular type of deviation, for example a left or right turn. The navigation function also determines the content, duration and timing of audible instructions by means of which the user can be guided along the route. As can be appreciated a simple instruction such

as “turn left in 100 m” requires significant processing and analysis. As previously mentioned, user interaction with the device may be by a touch screen, or additionally or alternately by steering column mounted remote control, by voice activation or by any other suitable method.

5 A further important function provided by the device is automatic route re-calculation in the event that: a user deviates from the previously calculated route during navigation (either by accident or intentionally); real-time traffic conditions dictate that an alternative route would be more expedient and the device is suitably enabled to recognize such conditions automatically, or if a user actively causes the device to
10 perform route re-calculation for any reason.

 It is also known to allow a route to be calculated with user defined criteria; for example, the user may prefer a scenic route to be calculated by the device, or may wish to avoid any roads on which traffic congestion is likely, expected or currently prevailing. The device software would then calculate various routes and weigh more favourably
15 those that include along their route the highest number of points of interest (known as POIs) tagged as being for example of scenic beauty, or, using stored information indicative of prevailing traffic conditions on particular roads, order the calculated routes in terms of a level of likely congestion or delay on account thereof. Other POI-based and traffic information-based route calculation and navigation criteria are also possible.

20 Although the route calculation and navigation functions are fundamental to the overall utility of PNDs, it is possible to use the device purely for information display, or “free-driving”, in which only map information relevant to the current device location is displayed, and in which no route has been calculated and no navigation is currently being performed by the device. Such a mode of operation is often applicable when the
25 user already knows the route along which it is desired to travel and does not require navigation assistance.

 Devices of the type described above, for example the 720T model manufactured and supplied by TomTom International B.V., provide a reliable means for enabling users to navigate from one position to another.

30 As noted above, navigation devices may wirelessly receive traffic and road information. Such information may be supplied from a server which obtains road and traffic information from one or more sources. However, it is problematic to transmit all available traffic and road information to navigation devices. For example, an available bandwidth for transmitting traffic and road information to navigation devices is limited.
35 Furthermore, a navigation device has limited processing and data storage capability which restricts the amount of traffic and road information which may be processed

and/or stored.

It is an aim of the present invention to address this problem, in particular to attempt to improve the provision of traffic and/or road information to navigation devices.

5 **Summary of the Invention**

In pursuit of this aim, a presently preferred embodiment of the present invention provides a method of communicating traffic or road information to a navigation device, the method comprising the steps of receiving traffic or road information at a server; determining status information associated with the navigation device; determining, based
10 upon the status information, whether the traffic or road information is relevant to the navigation device; and communicating the traffic or road information from the server to the navigation device if it is determined that if the traffic or road information is relevant to the navigation device.

Another embodiment of the present invention relates to a system, comprising a
15 server arranged to receive traffic or road information from one or more sources; and one or more navigation devices communicatively coupled to transmit status information to the server; wherein the server is arranged to determine traffic or road information relevant to each navigation device and to transmit first traffic or road information to a first navigation device and second traffic or road information to a second navigation device,
20 wherein the first and second traffic or road information have been determined by the server to be relevant to each respective navigation device.

Yet another embodiment of the present invention relates to computer software comprising one or more software modules operable, when executed in an execution environment, to cause a processor to receive traffic or road information at a server;
25 determining status information associated with the navigation device; determining, based upon the status information, whether the traffic or road information is relevant to the navigation device; and communicating the traffic or road information from the server to the navigation device if it is determined that if the traffic or road information is relevant to the navigation device.

30 According to an aspect of the present invention, there is provided a method of communicating traffic or road information to a navigation device comprising receiving traffic or road information at a server, determining status information associated with the navigation device and, based upon the status information, determining whether the traffic or road information is relevant to the navigation device such that only traffic or
35 road information relevant to the navigation device is communicated to the navigation device by the server.

Another embodiment of the present invention provides a navigation device communicatively coupleable to a server to receive traffic or road information, comprising: a store for storing messages indicative of a traffic or road events; the traffic or road information is communicated to the navigation device in a message container including one or more messages, wherein the container includes information indicative of whether the one or messages are to update corresponding messages held in the store or represent new messages for storage in the store; and the navigation device comprises a module arranged to update the corresponding messages or store the new messages in the store according to the information.

A still further embodiment of the present invention provides a method of communicating traffic or road information to a navigation device, the method comprising the steps of: receiving a message container comprising one or more messages including information associated with a traffic or road event; determining whether each message in the container corresponds to a deletion or update of a corresponding message stored in a memory of a navigation device, or is to be stored in the memory.

A yet further embodiment of the invention provides a system, comprising: a server communicatively coupled to at least one navigation device to communicate messages containing traffic or road information to the navigation device; wherein the server is arranged to determine messages in a message group previously communicated to the navigation device and to transmit a message container to the navigation device, the message container including messages representing a difference between the messages in the message group previously communicated to the navigation device and a current version of the message group stored on the server.

Advantages of these embodiments are set out hereafter, and further details and features of each of these embodiments are defined in the accompanying dependent claims and elsewhere in the following detailed description.

Brief Description of the Drawings

Various aspects of the teachings of the present invention, and arrangements embodying those teachings, will hereafter be described by way of illustrative example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a Global Positioning System (GPS);

Fig. 2 is a schematic illustration of electronic components arranged to provide a navigation device;

Fig. 3 is a schematic illustration of the manner in which a navigation device may receive information over a wireless communication channel;

Figs. 4A and 4B are illustrative perspective views of a navigation device;

Fig. 5 is a schematic representation of the software employed by the navigation device;

Fig. 6 is a schematic illustration of an apparatus according to an embodiment of the invention;

Fig. 7 is an illustration of a method according to an embodiment of the invention;

Fig. 8 is an illustration of a screen of a navigation device;

Fig. 9 is an illustration of a geographical region and bounding regions according to an embodiment of the invention;

Fig. 10 is an illustration of route information according to an embodiment of the invention;

Fig. 11 is an illustration of a bounding region and event horizons according to embodiments of the invention;

Fig. 12 is an illustration a further method according to an embodiment of the invention;

Fig. 13 is an illustration a still further method according to an embodiment of the invention;

Fig. 14 is an illustration of a structure of a traffic message according to an embodiment of the invention;

Fig. 15 is an illustration another method according to an embodiment of the invention; and

Fig. 16 is an illustration of yet another method according to an embodiment of the invention.

Detailed Description of Preferred Embodiments

Preferred embodiments of the present invention will now be described with particular reference to a PND. It should be remembered, however, that the teachings of the present invention are not limited to PNDs but are instead universally applicable to any type of processing device that is configured to execute navigation software so as to provide route planning and navigation functionality. It follows therefore that in the context of the present application, a navigation device is intended to include (without limitation) any type of route planning and navigation device, irrespective of whether that device is embodied as a PND, a navigation device built into a vehicle, or indeed a computing resource (such as a desktop or portable personal computer (PC), mobile telephone or portable digital assistant (PDA)) executing route planning and navigation software.

It will also be apparent from the following that the teachings of the present invention even have utility in circumstances where a user is not seeking instructions on how to navigate from one point to another, but merely wishes to be provided with a view of a given location. In such circumstances the "destination" location selected by the user need not have a corresponding start location from which the user wishes to start navigating, and as a consequence references herein to the "destination" location or indeed to a "destination" view should not be interpreted to mean that the generation of a route is essential, that travelling to the "destination" must occur, or indeed that the presence of a destination requires the designation of a corresponding start location.

With the above provisos in mind, Fig. 1 illustrates an example view of Global Positioning System (GPS), usable by navigation devices. Such systems are known and are used for a variety of purposes. In general, GPS is a satellite-radio based navigation system capable of determining continuous position, velocity, time, and in some instances direction information for an unlimited number of users. Formerly known as NAVSTAR, the GPS incorporates a plurality of satellites which orbit the earth in extremely precise orbits. Based on these precise orbits, GPS satellites can relay their location to any number of receiving units.

The GPS system is implemented when a device, specially equipped to receive GPS data, begins scanning radio frequencies for GPS satellite signals. Upon receiving a radio signal from a GPS satellite, the device determines the precise location of that satellite via one of a plurality of different conventional methods. The device will continue scanning, in most instances, for signals until it has acquired at least three different satellite signals (noting that position is not normally, but can be determined, with only two signals using other triangulation techniques). Implementing geometric triangulation, the receiver utilizes the three known positions to determine its own two-dimensional position relative to the satellites. This can be done in a known manner. Additionally, acquiring a fourth satellite signal will allow the receiving device to calculate its three dimensional position by the same geometrical calculation in a known manner. The position and velocity data can be updated in real time on a continuous basis by an unlimited number of users.

As shown in Figure 1, the GPS system is denoted generally by reference numeral 100. A plurality of satellites 120 are in orbit about the earth 124. The orbit of each satellite 120 is not necessarily synchronous with the orbits of other satellites 120 and, in fact, is likely asynchronous. A GPS receiver 140 is shown receiving spread spectrum GPS satellite signals 160 from the various satellites 120.

The spread spectrum signals 160, continuously transmitted from each satellite

120, utilize a highly accurate frequency standard accomplished with an extremely accurate atomic clock. Each satellite 120, as part of its data signal transmission 160, transmits a data stream indicative of that particular satellite 120. It is appreciated by those skilled in the relevant art that the GPS receiver device 140 generally acquires spread spectrum GPS satellite signals 160 from at least three satellites 120 for the GPS receiver device 140 to calculate its two-dimensional position by triangulation. Acquisition of an additional signal, resulting in signals 160 from a total of four satellites 120, permits the GPS receiver device 140 to calculate its three-dimensional position in a known manner.

Figure 2 is an illustrative representation of electronic components of a navigation device 200 according to a preferred embodiment of the present invention, in block component format. It should be noted that the block diagram of the navigation device 200 is not inclusive of all components of the navigation device, but is only representative of many example components.

The navigation device 200 is located within a housing (not shown). The housing includes a processor 210 connected to an input device 220 and a display screen 240. The input device 220 can include a keyboard device, voice input device, touch panel and/or any other known input device utilised to input information; and the display screen 240 can include any type of display screen such as an LCD display, for example. In a particularly preferred arrangement the input device 220 and display screen 240 are integrated into an integrated input and display device, including a touchpad or touchscreen input so that a user need only touch a portion of the display screen 240 to select one of a plurality of display choices or to activate one of a plurality of virtual buttons.

The navigation device may include an output device 260, for example an audible output device (e.g. a loudspeaker). As output device 260 can produce audible information for a user of the navigation device 200, it should equally be understood that input device 240 can include a microphone and software for receiving input voice commands as well.

In the navigation device 200, processor 210 is operatively connected to and set to receive input information from input device 220 via a connection 225, and operatively connected to at least one of display screen 240 and output device 260, via output connections 245, to output information thereto. Further, the processor 210 is operably coupled to a memory resource 230 via connection 235 and is further adapted to receive/send information from/to input/output (I/O) ports 270 via connection 275, wherein the I/O port 270 is connectible to an I/O device 280 external to the navigation device

200. The memory resource 230 comprises, for example, a volatile memory, such as a Random Access Memory (RAM) and a non-volatile memory, for example a digital memory, such as a flash memory. The external I/O device 280 may include, but is not limited to an external listening device such as an earpiece for example. The connection
5 to I/O device 280 can further be a wired or wireless connection to any other external device such as a car stereo unit for hands-free operation and/or for voice activated operation for example, for connection to an ear piece or head phones, and/or for connection to a mobile phone for example, wherein the mobile phone connection may be used to establish a data connection between the navigation device 200 and the internet
10 or any other network for example, and/or to establish a connection to a server via the internet or some other network for example.

Fig. 2 further illustrates an operative connection between the processor 210 and an antenna/receiver 250 via connection 255, wherein the antenna/receiver 250 can be a GPS antenna/receiver for example. It will be understood that the antenna and receiver
15 designated by reference numeral 250 are combined schematically for illustration, but that the antenna and receiver may be separately located components, and that the antenna may be a GPS patch antenna or helical antenna for example.

Further, it will be understood by one of ordinary skill in the art that the electronic components shown in Fig. 2 are powered by power sources (not shown) in a
20 conventional manner. As will be understood by one of ordinary skill in the art, different configurations of the components shown in Fig. 2 are considered to be within the scope of the present application. For example, the components shown in Fig. 2 may be in communication with one another via wired and/or wireless connections and the like. Thus, the scope of the navigation device 200 of the present application includes a
25 portable or handheld navigation device 200.

In addition, the portable or handheld navigation device 200 of Fig. 2 can be connected or "docked" in a known manner to a vehicle such as a bicycle, a motorbike, a car or a boat for example. Such a navigation device 200 is then removable from the docked location for portable or handheld navigation use.

30 Referring now to Fig. 3, the navigation device 200 may establish a "mobile" or telecommunications network connection with a server 302 via a mobile device (not shown) (such as a mobile phone, PDA, and/or any device with mobile phone technology) establishing a digital connection (such as a digital connection via known Bluetooth technology for example). Thereafter, through its network service provider, the mobile
35 device can establish a network connection (through the internet for example) with a server 302. As such, a "mobile" network connection is established between the

navigation device 200 (which can be, and often times is mobile as it travels alone and/or in a vehicle) and the server 302 to provide a “real-time” or at least very “up to date” gateway for information.

5 The establishing of the network connection between the mobile device (via a service provider) and another device such as the server 302, using an internet (such as the World Wide Web) for example, can be done in a known manner. This can include use of TCP/IP layered protocol for example. The mobile device can utilize any number of communication standards such as CDMA, GSM, WAN, etc.

10 As such, an internet connection may be utilised which is achieved via data connection, via a mobile phone or mobile phone technology within the navigation device 200 for example. For this connection, an internet connection between the server 302 and the navigation device 200 is established. This can be done, for example, through a mobile phone or other mobile device and a GPRS (General Packet Radio Service)-connection (GPRS connection is a high-speed data connection for mobile devices
15 provided by telecom operators; GPRS is a method to connect to the internet).

The navigation device 200 can further complete a data connection with the mobile device, and eventually with the internet and server 302, via existing Bluetooth technology for example, in a known manner, wherein the data protocol can utilize any number of standards, such as the GSRM, the Data Protocol Standard for the GSM
20 standard, for example.

The navigation device 200 may include its own mobile phone technology within the navigation device 200 itself (including an antenna for example, or optionally using the internal antenna of the navigation device 200). The mobile phone technology within the navigation device 200 can include internal components as specified above, and/or
25 can include an insertable card (e.g. Subscriber Identity Module or SIM card), complete with necessary mobile phone technology and/or an antenna for example. As such, mobile phone technology within the navigation device 200 can similarly establish a network connection between the navigation device 200 and the server 302, via the internet for example, in a manner similar to that of any mobile device.

30 For GRPS phone settings, a Bluetooth enabled navigation device may be used to correctly work with the ever changing spectrum of mobile phone models, manufacturers, etc., model/manufacture specific settings may be stored on the navigation device 200 for example. The data stored for this information can be updated.

35 In Fig. 3 the navigation device 200 is depicted as being in communication with the server 302 via a generic communications channel 318 that can be implemented by any of a number of different arrangements. The server 302 and a navigation device 200

can communicate when a connection via communications channel 318 is established between the server 302 and the navigation device 200 (noting that such a connection can be a data connection via mobile device, a direct connection via personal computer via the internet, etc.).

5 The server 302 includes, in addition to other components which may not be illustrated, a processor 304 operatively connected to a memory 306 and further operatively connected, via a wired or wireless connection 314, to a mass data storage device 312. The processor 304 is further operatively connected to transmitter 308 and receiver 310, to transmit and send information to and from navigation device 200 via
10 communications channel 318. The signals sent and received may include data, communication, and/or other propagated signals. The transmitter 308 and receiver 310 may be selected or designed according to the communications requirement and communication technology used in the communication design for the navigation system 200. Further, it should be noted that the functions of transmitter 308 and receiver 310
15 may be combined into a signal transceiver.

 Server 302 is further connected to (or includes) a mass storage device 312, noting that the mass storage device 312 may be coupled to the server 302 via communication link 314. The mass storage device 312 contains a store of navigation data and map information, and can again be a separate device from the server 302 or
20 can be incorporated into the server 302.

 The navigation device 200 is adapted to communicate with the server 302 through communications channel 318, and includes processor, memory, etc. as previously described with regard to Fig. 2, as well as transmitter 320 and receiver 322 to send and receive signals and/or data through the communications channel 318, noting
25 that these devices can further be used to communicate with devices other than server 302. Further, the transmitter 320 and receiver 322 are selected or designed according to communication requirements and communication technology used in the communication design for the navigation device 200 and the functions of the transmitter 320 and receiver 322 may be combined into a single transceiver.

30 Software stored in server memory 306 provides instructions for the processor 304 and allows the server 302 to provide services to the navigation device 200. One service provided by the server 302 involves processing requests from the navigation device 200 and transmitting navigation data from the mass data storage 312 to the navigation device 200. Another service provided by the server 302 includes processing
35 the navigation data using various algorithms for a desired application and sending the results of these calculations to the navigation device 200.

The communication channel 318 generically represents the propagating medium or path that connects the navigation device 200 and the server 302. Both the server 302 and navigation device 200 include a transmitter for transmitting data through the communication channel and a receiver for receiving data that has been transmitted
5 through the communication channel.

The communication channel 318 is not limited to a particular communication technology. Additionally, the communication channel 318 is not limited to a single communication technology; that is, the channel 318 may include several communication links that use a variety of technology. For example, the communication channel 318 can
10 be adapted to provide a path for electrical, optical, and/or electromagnetic communications, etc. As such, the communication channel 318 includes, but is not limited to, one or a combination of the following: electric circuits, electrical conductors such as wires and coaxial cables, fibre optic cables, converters, radio-frequency (RF) waves, the atmosphere, empty space, etc. Furthermore, the communication channel
15 318 can include intermediate devices such as routers, repeaters, buffers, transmitters, and receivers, for example.

In one illustrative arrangement, the communication channel 318 includes telephone and computer networks. Furthermore, the communication channel 318 may be capable of accommodating wireless communication such as radio frequency,
20 microwave frequency, infrared communication, etc. Additionally, the communication channel 318 can accommodate satellite communication.

The communication signals transmitted through the communication channel 318 include, but are not limited to, signals as may be required or desired for given communication technology. For example, the signals may be adapted to be used in
25 cellular communication technology such as Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), Global System for Mobile Communications (GSM), etc. Both digital and analogue signals can be transmitted through the communication channel 318. These signals may be modulated, encrypted and/or compressed signals as may be desirable for the
30 communication technology.

The server 302 includes a remote server accessible by the navigation device 200 via a wireless channel. The server 302 may include a network server located on a local area network (LAN), wide area network (WAN), virtual private network (VPN), etc.

The server 302 may include a personal computer such as a desktop or laptop
35 computer, and the communication channel 318 may be a cable connected between the personal computer and the navigation device 200. Alternatively, a personal computer

may be connected between the navigation device 200 and the server 302 to establish an internet connection between the server 302 and the navigation device 200. Alternatively, a mobile telephone or other handheld device may establish a wireless connection to the internet, for connecting the navigation device 200 to the server 302 via the internet.

The navigation device 200 may be provided with information from the server 302 via information downloads which may be periodically updated automatically or upon a user connecting navigation device 200 to the server 302 and/or may be more dynamic upon a more constant or frequent connection being made between the server 302 and navigation device 200 via a wireless mobile connection device and TCP/IP connection for example. For many dynamic calculations, the processor 304 in the server 302 may be used to handle the bulk of the processing needs, however, processor 210 of navigation device 200 can also handle much processing and calculation, oftentimes independent of a connection to a server 302.

As indicated above in Fig. 2, a navigation device 200 includes a processor 210, an input device 220, and a display screen 240. The input device 220 and display screen 240 are integrated into an integrated input and display device to enable both input of information (via direct input, menu selection, etc.) and display of information through a touch panel screen, for example. Such a screen may be a touch input LCD screen, for example, as is well known to those of ordinary skill in the art. Further, the navigation device 200 can also include any additional input device 220 and/or any additional output device 241, such as audio input/output devices for example.

Figs 4A and 4B are perspective views of a navigation device 200. As shown in Fig. 4A, the navigation device 200 may be a unit that includes an integrated input and display device 290 (a touch panel screen for example) and the other components of fig. 2 (including but not limited to internal GPS receiver 250, microprocessor 210, a power supply, memory systems 230, etc.).

The navigation device 200 may sit on an arm 292, which itself may be secured to a vehicle dashboard/window/etc. using a suction cup 294. This arm 292 is one example of a docking station to which the navigation device 200 can be docked.

As shown in Fig. 4B, the navigation device 200 can be docked or otherwise connected to an arm 292 of the docking station by snap connecting the navigation device 292 to the arm 292 for example. The navigation device 200 may then be rotatable on the arm 292, as shown by the arrow of Fig. 4B. To release the connection between the navigation device 200 and the docking station, a button on the navigation device 200 may be pressed, for example. Other equally suitable arrangements for

coupling and decoupling the navigation device to a docking station are well known to persons of ordinary skill in the art.

Referring now to Fig. 5 of the accompanying drawings, the memory resource 230 stores a boot loader program (not shown) that is executed by the processor 210 in order to load an operating system 470 from the memory resource 230 for execution by functional hardware components 460, which provides an environment in which application software 480 can run. The operating system 470 serves to control the functional hardware components 460 and resides between the application software 480 and the functional hardware components 460. The application software 480 provides an operational environment including the GUI that supports core functions of the navigation device 200, for example map viewing, route planning, navigation functions and any other functions associated therewith. In accordance with the preferred embodiment of the present invention, part of this functionality comprises a traffic and road information module 490 which receives traffic and road information in the form of messages from the server 302 via the communications channel 318. Furthermore, in embodiments of the invention, the traffic and road information module 490 transmits information to the server 302 to enable the server 302 to reduce a data volume of road and traffic messages communicated to the navigation device 200, as will be explained.

Figure 6 illustrates an apparatus 600 according to an embodiment of the invention. The apparatus 600 is arranged to determine traffic and road information to be sent to a client navigation device 200. The apparatus 600 may be implemented in hardware, software, for example as software modules within one or more computing devices such as a server 302, or as a combination of hardware and software modules. Although the operation of embodiments of the present invention will be explained with reference to traffic messages, embodiments of the invention may be applied to traffic and road information i.e. information indicating road conditions. Furthermore, the operation of embodiments of the invention will be explained with reference to a client navigation device, although it will be realised that in practice embodiments of the invention will operate in relation to a plurality of client navigation devices i.e. the apparatus 600 will communicate traffic information to the plurality of navigation devices.

The apparatus 600 is arranged to receive traffic information in the form of a stream of traffic messages 601. The traffic messages 601 may be received from a traffic information server (not shown), for example a further server which collects and collates information from one or more traffic monitoring systems, such as those based on mobile telephone data exchanges, fixed cameras, GPS, fleet tracking and the like to identify traffic delays. It is also envisaged that the traffic information server may also be

provided by the server 302.

The apparatus comprises a relevance filter 610 which filters the received traffic messages 601 according to one or more predetermined criteria in order to determine only those traffic messages 601 relevant to each client navigation device 200. The traffic messages relevant to each client are determined according to client status information 602 which, in some embodiments of the invention, is received from each client navigation device 200 by a client status receiving unit 630 as will be explained. However, in other embodiments of the invention, status information for each client navigation device 200 may be stored in a data storage device such as a database. The apparatus 600 further comprises a delta message determining unit 620 which receives traffic messages determined to be relevant to a client navigation device 200 and outputs delta traffic messages containing only information which differs from traffic information currently held by the client navigation device 200. In some embodiments, the server 302 stores state information indicating a state of each client navigation device 200 i.e. the server 302 is stateful. In these embodiments, the delta traffic messages 603 are determined by the delta message determining unit 620 with respect to a client history database 660 which stores information indicating the traffic information previously sent to each client navigation device 200, as will be explained. However, in other embodiments, the apparatus 600 does not store state information for each client navigation device 200 i.e. the server 302 is stateless. In these embodiments, the apparatus 600 receives status information 602 from each navigation device 200 which indicates the traffic information previously sent to that navigation device 200 and the delta message determining unit 620 determines the delta traffic messages based upon the received information, as will be explained. Stateless embodiments of the server 302 do not therefore need to include the message history database 660. In the case that traffic information concerning a traffic event has not previously been sent to a navigation device, then a complete traffic message is sent to that navigation device i.e. no delta message is produced. A message limiting unit 640 is arranged to limit the traffic messages sent to each navigation device at once, in order to prevent the navigation device 200 receiving too much data or data at too high a rate to be processed. In one embodiment, messages are limited by ordering the traffic messages output from the delta message determining unit 620 such that the most relevant messages may be extracted or output while less relevant messages may be discarded. Criteria to determine the relevance are e.g. impact of the traffic event, distance to the traffic event, age of the traffic event in the navigation device 200. Messages output from the message limiting unit 640 are received by a bandwidth control unit 650 unit. The

bandwidth control unit 650 is arranged to control, or limit, the rate of data transmitted to each navigation device 200. The data rate may be controlled according to information received from each navigation device 200 which indicates a maximum data rate for that navigation device. The data rate may be controlled to allow sharing of an available bandwidth between the server 302 and the navigation device 200 between different services. Furthermore, payment to a service provider i.e. provider of the server 302 may be based on the amount of data transferred, thus a user may wish to limit the bandwidth usage. The bandwidth control unit 650 sorts the traffic messages based on relevance and data size. For example a new message requires more bytes than an update or a cancellation of a message, as will be explained.

A method 700 of operation of the apparatus 600 shown in Figure 6 will now be explained with reference to Figure 7. As shown in Figure 7, the method begins in step 710 and in step 720 one or more traffic messages 601 are received from one or more traffic message sources, such as the traffic message server. Whilst in the exemplary method of Figure 7 one or more traffic messages are shown as being received in a discrete step, it will be realised that one or more traffic messages may be continuously received whilst other steps of the method are being performed. In step 730 client status information 602 is received from one or more client navigation devices 200. As will be explained, the client status information 602 may include information identifying a geographical location of the navigation device 200, e.g. in the form of geographic coordinates, or may relate to an operational state of the navigation device 200, e.g. information representing a geographical region displayed on the display screen 240 or route information indicating a programmed destination or determined route. The client status information 602 may be received in the form of one or more status messages accompanied by a request for traffic information, or may be periodically sent from the navigation device 200. Furthermore, whilst in the exemplary method of Figure 7 client status information 602 is shown as being received in a discrete step 730, it will be realised that client status information may be continuously received whilst other steps of the method are being performed. In step 740 relevant traffic messages are determined for each client navigation device 200. The relevant messages are determined according to one or more criteria from the received traffic messages 601 in combination with the received client status information 602. Relevant traffic messages are determined by the relevance filter 610 in the apparatus of Figure 6. In step 750 one or more delta traffic messages 603 are generated representing a difference between traffic information held by each client navigation device 200 and the relevant traffic messages determined in step 740. The delta traffic messages 603 are determined by the delta message

determining unit 620 of Figure 6 and are outputted to the message limiting unit 640. In step 760 messages are transmitted to each client navigation device at a predetermined rate to prevent the navigation device being overloaded with traffic messages. The method ends in step 770.

5 Embodiments of step 740 will now be explained with reference to Figures 8 to 12. As noted above, in step 740 messages relevant to each client navigation device 200 are determined such that the client navigation device 200 only receives relevant traffic information.

 A first embodiment of step 740 will be described with reference to Figure 8.
10 Figure 8 shows the display screen 240 of the navigation device. When providing route guidance or displaying a summary of a determined route between first and second geographic locations, for example start and destination addresses, the display screen 240 of the navigation device 200 displays a map 800 showing a geographic area. When providing route guidance, the map 800 may show a region relatively close to the current
15 geographic location of the navigation device 200. When displaying the summary of the route, the map 800 may show the entire route or may show a part of the route, for example a first route portion e.g. first half of the route, although other sub-sections of the route may be considered. The geographic region of the map 800 shown on the display screen 240 is used to determine the relevant traffic messages to be sent to the
20 navigation device 200 by the server 302. In step 730, information about the map 800 area is sent to the server 302 by the traffic and road information module 490. In the first embodiment, the traffic and road information module 490 communicates map information to the server 302 which indicates a centre 810 of the map 800 and information indicating an extent of the map 800. The information indicating the extent of
25 the map 800 may indicate a height (vertical region) 820 and width (horizontal region) 830 of the map 800. From this information, the server 302 is able to determine a relevant region for traffic messages i.e. traffic messages relevant to the geographic area shown on the display screen 240. Only traffic messages relevant, to i.e. denoting traffic events within the geographic area shown on the display screen 240, are communicated to the
30 navigation device.

 A second embodiment of step 740 will now be described with reference to Figure 9. In this embodiment, for every traffic message received by the relevance filter 610, a bounding region 921, 922, 923, 924 is determined. The traffic message bounding region 921, 922, 923, 924 is a geographical area affected by the event denoted by the traffic
35 message. A navigation device bounding region 930 is also determined around a current geographic location 910 of the navigation device 200. If the traffic message bounding

region 921, 922, 923, 924 at least partly intersects or overlaps the navigation device bounding region 930, the respective traffic message is determined to be relevant to the navigation device 200 and is consequently output by the relevance filter 610, rather than being discarded for that navigation device 200.

5 Referring to Figure 9 a representation of a geographic region 900 is shown in which is located roads 901-909. A current location of a navigation device 200 is indicated with reference numeral 910. Four traffic delays in the region, shown as highlighted road portions, are also indicated with reference numerals 911-914. A bounding region 921, 922, 923, 924 around each traffic delay 911-914 has been
10 determined by the relevance filter 610. In this shown embodiment, each bounding region 921, 922, 923, 924 is rectangular and is determined as a best fit of the respect traffic delay 911, 912, 913, 914 i.e. a minimum sized rectangle to enclose the respective traffic delay 911, 912, 913, 914. However, it will be realised that other shape bounding regions may be determined, such as square, circular, oval, polygonal etc. A navigation
15 device bounding region 930 is also determined around the location 910 of the navigation device 200. In the described embodiment, the navigation device bounding region 930 is rectangular and centred on the location of the navigation device 910. The navigation device bounding region 930 may be landscape in orientation and have a predefined size (height, width), although other orientations and dynamically determined size are
20 possible.

A traffic delay 911-914 is determined to be relevant to the navigation device 200 if the bounding region of the traffic delay 921-924 at least partly intersects the navigation device bounding region 930. Considering each traffic delay in turn, the bounding region 921 of delay 911 is entirely within the navigation device bounding region 930 so is
25 determined to be relevant to the navigation device 200, as is delay 914. The bounding region 922 of delay 912 partly intersects the navigation device bounding region 930 and is also deemed to be relevant to the navigation device 200. However, no intersecting region exists between the bounding region 923 of delay 913 and the navigation device bounding region 930. Therefore a traffic message indicating delay 913 is not
30 communicated to the navigation device 200. In this way, only traffic messages relevant to each navigation device are communicated, thereby reducing a data volume to each navigation device 200.

A further embodiment of steps 730 and 740 shown in Figure 7 will now be described with reference to Figures 10 to 12. In this embodiment of the invention the
35 client navigation device 200 is arranged to communicate journey information to the server 302 indicative of a planned journey. In response, the server 302 is arranged to

communicate traffic messages to the client navigation device 200 which are relevant to the planned journey. In particular, the server 302 is arranged to determine a region which encapsulates the planned journey, wherein traffic messages relevant to the region encapsulating the journey are communicated to the navigation device 200. In some
 5 embodiments, one or more horizons are determined and traffic messages are communicated to the navigation device according to an expected duration and a location of the event to which they relate and the one or more horizons.

Referring to Figure 10, a representation of journey information 1000 is shown which includes the current location 1010 of the navigation device and the destination
 10 location 1020 set by the user of the navigation device 200. In one embodiment, the region encapsulating the journey information is determined based upon the current 1010 and destination locations 1020 alone, whereas other embodiments utilise route information indicating a determined route 1030 between the current 1010 and destination 1020 locations. It will be noted that the route information which indicates the
 15 route 1030 between the current 1010 and destination locations 1020 normally deviates from a direct airline path 1040, or the as-the-crow-flies path, between the locations 1010, 1020 as would be expected due to directional deviations of roads etc.

Figure 11 illustrates a region 1110 determined to encapsulate the current location 1010 and the destination location 1020. In the described embodiment, the region 1110
 20 is elliptically shaped and is arranged such that the airline path 1040 lies along a semi-major axis of the ellipse 1110 with the current 1010 and destination 1020 locations equidistant from the centre of the ellipse 1110.

Figure 12 illustrates a method 1200 of determining the elliptical region 1110 according to an embodiment of the invention which begins in step 1210. In step 1220 it
 25 is determined whether it is possible to determine a length of the route 1030 between the current 1010 and destination 1020 locations, for example by route length information having been received from the navigation device 200 in step 730 of the method shown in Figure 7. If it is not possible to determine the route length, then the method moves to step 1230 where a default ellipse size factor (ESF) is utilised to determine the ellipse
 30 1110. A default ellipse size factor of 1.4 is utilised in some embodiments. Most routes 1030 are expected to have a length within 30% of a length of the airline path 1040, thus an ESF of 1.4 allows a further 10% margin. It will of course be realised that other ESFs may be selected. The eccentricity e of the ellipse 1110 may be determined by:

35
$$e = \frac{1}{ESF}$$

Furthermore, a length l of the ellipse (along the semi-major axis) may be calculated as:

$$l = \frac{d}{e}$$

5

wherein d is a distance between the start and destination locations 1010, 1020. An extension distance r of the ellipse beyond the start and destination locations 1010, 1020 along the semi-major axis may be determined as:

10

$$r = \frac{l - d}{2}$$

Further, as the current and destination locations 1020, 1030 represent foci of the ellipse, the distance $(a+b)$ is a fixed distance to any point on the ellipse 1110, as will be appreciated.

15

The server 302 is arranged to only communicate traffic messages to the client navigation device 200 if they relate to an event within the region 1110 i.e. that the location of the event is with the elliptical region 1110. As in the previously described embodiment, a bounding region, such as a rectangle, may be determined around each traffic event to determine whether to communicate a message concerning that traffic event to the client navigation device i.e. a traffic message is only sent to the navigation device 200 if the bounding region at least partly intersects with the ellipse 1110.

20

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If, in step 1220, the route length is available to the server 302 e.g. has been communicated from the navigation device 200, then the method moves to step 1240 wherein an adaptive route ratio (ARR) is determined. Firstly, in order to determine the ARR, an adaptive route length (ARL) is determined which allows for relatively small increases in route length and is found by:

$$ARL = ARLF \times RouteLength$$

30

wherein ARLF is an adaptive route length factor and RouteLength is the length of the calculated route 1030. The ARLF may equal 1.02 which allows for a 2% increase in route length, although it will be realised that other factors may be used. The ARR is then calculated by:

$$ARR = \frac{ARL}{d}$$

wherein d is the airline distance 1040.

In step 1250 it is determined whether the ARR is less than or equal to a minimum ellipse size factor (Min_ESF). The Min_ESF may be 1.2, although other values may be used. If ARR is less than or equal to Min_ESF then ESF is set equal to the Min_ESF i.e. $ESF=1.2$ in step 1260. Following step 1260 the method ends in step 1295. However, if in step 1250 the ARR is greater than Min_ESF , then the method moves to step 1270 where it is determined whether ARR is greater than or equal to a maximum ellipse size factor Max_ESF which may be 1.6, although other values may be selected. If ARR is greater than or equal to Max_ESF then the method moves to step 1280 where the ellipse size factor ESF is set to equal Max_ESF . The method then ends in step 1295. However, if in step 1270 ARR is less than Max_ESF , the method moves to step 1290 where ESF is set to equal ARR . The elliptical region 1110 may then be determined according to the value of ESF .

As noted above, in order to determine a route or to monitor traffic conditions along a previously determined route, the navigation device 200 takes into account received traffic information. In embodiments of the invention, the relevance filter 610 determines whether an event to which a traffic message relates is located, at least partly, within the elliptical bounding region 1110. If the event is at least partly located within the bounding region then the corresponding traffic message passes the relevance filter for communication to the navigation device 200. Otherwise the traffic message is disregarded with respect to that navigation device 200.

In some embodiments of the invention, in addition to considering whether an event to which a traffic message relates is located within the bounding region 1110, the relevance filter 610 is arranged to further consider an expected duration of the event in relation to one or more event horizons. Figure 11 shows a short term event horizon circle 1050 having a short term event horizon ($STEHR$) radius 1160. Figure 11 further illustrates a circle indicating a long term event horizon 1170 having a long term event horizon ($LTEHR$) radius 1180. The $STEHR$ radius 1160 may be 200 km and the $LTEHR$ radius 1180 may be 1500 km although other values may be selected. The short and long term event horizons 1150, 1170 are circular in shape and centred on the current location of the navigation device 1010.

Figure 13 illustrates a method 1300 according to an embodiment of the invention utilising the short and long term event horizons 1150, 1170. However it will be realised

that only one of the event horizons 1150, 1170 may be utilised. The method may be performed by the relevance filter 610. The method 1300 starts in step 1310 and in step 1320 it is determined whether an event to which a traffic message relates is within the bounding ellipse 1110 shown in Figure 11. If the event is not within the ellipse 1110, even partly, then the message is discarded or filtered out in step 1360 as far as that particular navigation device 200 is concerned. Of course, the event may reside within a bounding region of another navigation device 200 and may be communicated to that other navigation device 200 in a further iteration of the method 1300. If the event to which the traffic message relates is within the ellipse 1110, then the method moves to step 1330 where it is determined whether the event is expected to be a relatively short term event. In other words, step 1330 considers whether the event has an expected duration which is shorter or longer than a predetermined duration. If the event is expected to last less than the predetermined duration, i.e. is shorter than, it is considered to be a short term event and the method moves to step 1340 where it is determined whether the message is within the short term event horizon 1150. For example, it is determined in step 1340 whether the event is within 200km of the current location of the navigation device 1010. If the event is not within the short term event horizon 1150 then it is discarded or filtered out for that navigation device, i.e. it is not communicated to that navigation device 200, in step 1360. However, if in step 1330 it had been determined that the event was not expected to be a short term event, i.e. that its expected duration is longer than the predetermined duration, then in step 1350 it is determined whether the event is within the long term event horizon 1170. If the event is within the long term event horizon 1170 then the method moves to step 1370 where the message is communicated to the navigation device 200, or is passed for further processing in the apparatus of Figure 6. If the event is not within the long term event horizon 1170 then it is discarded in step 1360. The method ends in step 1380. As will be appreciated, the method 1300 determines whether a traffic message is geographically and temporally relevant to a navigation device 200.

Referring to Figure 14 the content of a traffic message 1400 according to an embodiment of the invention will now be described. The traffic message 1400 is divided into a number of sections, although it will be realised that the ordering of these sections in Figure 14 is merely illustrative. Furthermore, it will be realised that not all sections may be present in every traffic message 1400. The traffic message 1400 contains a message management section 1410 for storing information relevant to the management and identification of the traffic message 1400; a location information section 1420 for storing information identifying a location of an event to which the message 1400 relates;

an event information section 1430 which stores information about the event, for example identifying the event type and providing information about the effect of the event; and a filter information section 1440 which stores information for traffic message filtering. Furthermore, in some embodiments of the traffic message 1400, an additional
5 information section 1450 may be provided which is used by the server 302 or navigation device 200 for storing additional information.

The message management section 1410 contains identification information which uniquely identifies each traffic message 1400. The identification information may be a MessageID field for storing a unique value associated with the traffic message
10 1400. The value stored in the MessageID field may be recycled after an appropriate period of time, or the system may support the explicit cancelling of messages such that the value of the MessageID field may be re-used once a particular message 1400 has been cancelled. In some embodiments the MessageID is, for example, a 32-bit field (although other values may be used) which is made up two parts. A first part is a
15 TrafficMessageID which uniquely identifies the traffic message 1400. A second part may be a MessageGroupID which identifies a message group to which the traffic message 1400 belongs or is associated. The TrafficMessageID and MessageGroupID may each be, for example, 16-bits in length, although other values may be considered and, furthermore, the TrafficMessageID and MessageGroupID need not be the same
20 length. The message group is a logical entity to which each traffic message 1400 is uniquely assigned, as will be explained. All traffic messages 1400 assigned to the same message group are similar in one or more respects, such as indicating events in the same geographical region. The message management section 1410 may further contain information identifying an expiry time of the message 1400. The expiry time may
25 be a value indicating a duration of time for which the message 1400 is to be retained by the navigation device 200, or may contain a value indicating a time at which the message 1400 will expire or cease to be relevant.

The location information section 1420 contains information identifying the location of the event (an event being e.g. traffic congestion, accident, road closure etc.).
30 The location information may identify the location in on or more ways, such as identifying an area, a stretch or linear location e.g. stretch of a road, or point, e.g. identified by geographic coordinates, for which the message 1400 is relevant. Furthermore, the location information may contain information identifying one or more road features to which the message is relevant i.e. a road identifier, information indicating to which part of
35 the road the message applies e.g. a main part of the road, an entry part of the road or an exit part of the road. In addition, in some embodiments of the message 1400, the

location information section 1420 contains information identifying a direction of the event i.e. the direction of the road having traffic congestion and a length of the event i.e. a length of the traffic congestion along the road.

The event information section 1430 stores information identifying the event to which the message 1400 relates. The event information 1430 may contain a value indicating one of a plurality of predetermined event types and, in some embodiments, associated information indicating further features of the event i.e. expected event duration, duration type, event nature, a start time of the event, effect information, urgency information etc. The duration type may provide a coarse indication of the expected duration of the event e.g. 0=short & 1=long (wherein long is predetermined threshold duration). The event duration may provide a further refinement of the duration type e.g. may store one of a plurality of predetermined values each indicating a particular expected duration, or may store a value indicating the expected duration of the event. The urgency information may indicate whether the event is designated as extremely urgent and therefore should be communicated to a navigation device 200 as soon as possible. The event nature may indicate the type of event i.e. weather-related, accident, traffic congestion etc. The effect information may indicate the effect of the event e.g. a reduction in speed or a time delay caused by the event.

The filter information section 1440 stores information related to message filtering. In one embodiment, the filter information section 1440 stores information indicating a bounding region around the event. The bounding region may be defined as a rectangle surrounding the location of the event, as previously discussed. The bounding rectangle may be defined in the filter information section 1440 by information identifying opposing corners of the bounding rectangle. In one embodiment, the bounding rectangle is defined by information identifying opposing corners of the bounding rectangle, e.g. lower left and upper right corners, in a predetermined coordinate system such as longitude and latitude. Furthermore, in some embodiments, the filter information section 1440 may contain information identifying a class of road or the road to which the message 1400 applies.

The additional information section 1450 is used to store any additional information which is not appropriate to the other message sections 1410-1440. In one embodiment, the additional information section 1450 stores one or more of: information identifying a message version and/or a reception time i.e. a time at which the message was received from a message source.

As noted above, each traffic message 1400 is uniquely assigned to a message group by the server 302. The server 302 may assign a traffic message 1400 to a

message group according to one or more criteria, such as the geographical relationship between the traffic message 1400 and the message group. For example, all traffic messages 1400 in a message group may relate to events within a geographical area. Alternatively, all messages 1400 in a message group may relate to the same road e.g. a particular highway etc.

The set of traffic messages 1400 assigned to a message group at a particular point in time is a message set. Each message set has a version identified by a MessageSetVersionID. Each time the server 302 receives new traffic information from a source and one or more new traffic messages 1400 are assigned to a message group, the MessageSetVersionID associated with the message set is updated e.g. incremented. In the case that a traffic message 1400 is not similar to any existing traffic messages 1400 and is therefore determined to not belong to an existing message group, a new message group is created having a new MessageGroupID. The traffic message 1400 is then assigned to the newly created message group as a first message set version having a first MessageSetVersionID. When a second similar message 1400 is received, it is assigned to the message group to create a new message set having the same MessageGroupID and a second MessageSetVersionID i.e. an incremented version of the first MessageSetVersionID. Thus, each message set has a MessageGroupID and MessageSetVersionID. A message group may be sent to one client navigation device 200 at a time, or may be sent to a plurality of client navigation devices, a navigation device group, at a time. That is, traffic messages may be updated for a group of navigation devices at a time.

The traffic information held by a client navigation device 200 at a particular point in time is a collection of one or more message sets. A group status is a collection of one or more GroupIDs and corresponding MessageSetVersionIDs which identifies the traffic information held by the client navigation device 200. Use of message sets and group status allows the extent of the information held by a navigation device 200 to be communicated to the server 302 in a convenient manner within minimal data. The client navigation device 200 may send to the server 302 a current traffic status message containing, for each desired message group, the GroupID and corresponding MessageSetVersionID thereby allowing the server 302 to ascertain the traffic information held by the navigation device 200. The current traffic status message removes the need for the server 302 to hold state information for each client in the message history database 660. The current traffic status message may also include completeness information identifying a completeness of the message set i.e. whether the message set has been filtered or not. The completeness information may be a bit indicating that the

message set is either complete (full set of messages) or is a partial set (a filtered set of messages).

To allow updating of client navigation devices 200 in a manner which requires a minimum bandwidth a traffic container is used. A traffic container is an array which describes the contents of a message set. There are two types of traffic containers: a full traffic container which contains all traffic messages in a message set; and a delta traffic container which contains only the differences between a message set and a previous version of the message set for the respective message group. A full traffic container is used in the case a message group is sent to the navigation device 200, or group of navigation devices, for the first time, or if the server 302 wishes to send a complete refresh of traffic messages to the one or more navigation devices 200 e.g. in the case that a navigation device 200 has been reset, or the server 302 has merged two message groups in which case both would be deleted and the new merged group sent to the navigation devices 200. A delta traffic container can be used if the one or more client navigation devices 200 have a previous version of the message group. Each traffic container contains information identifying the message group to which it relates and the message set version it is carrying

A method 1500 of updating traffic information on a navigation device 200 by the server 302 will be explained with reference to Figure 15. The method starts in step 1510. In step 1520 the delta message determining unit 620 on the server 302 determines which traffic messages are held by a client navigation device 200 either by reference to the message history database 660 or by receiving a traffic status message 602 from the navigation device 200. The traffic status message may contain information indicating the group status, as discussed above, for the navigation device 200. Upon determining the traffic information i.e. traffic information messages held by the navigation device 200, the delta determining unit 620 selects, in a first iteration of step 1530, a first message group. The message group may be selected from the one or more message groups currently held by the navigation device 200. Alternatively, the message group may be a message group which has not yet been communicated to the navigation device 200, for example a newly created message group. In step 1540 the delta message determining unit 620 determines whether an update to the message group is required. An update may be required when one or more traffic messages have been received at the server 302 which relate to that message group but have not yet been communicated to the navigation device 200, or when the message group has not yet been communicated to the navigation device 200. Furthermore, an update may be required when it is determined by the server 302 that the message group is no longer

relevant to that navigation device 200, such as when the navigation device 200 has moved from or out of an area covered by the message group. If no update is required, the method moves to step 1580. If an update is required, then in step 1550 it is determined whether the group is still in scope for the navigation device 200 i.e. whether the scope of traffic messages in the group is still relevant to the navigation device 200. If the message group is not relevant for that navigation device 200 any more, then the method moves to step 1560 wherein a traffic container is sent to the navigation device which identifies the selected message group as being obsolete. However, if the group is still in scope for the navigation device 200, then the method moves to step 1570 where a traffic container is sent to the navigation device 200. If the navigation device currently has a previous version of the message group, then the traffic container is a delta traffic container. The delta traffic container contains an indication of the selected message group being updated, the message set version and one or more traffic messages indicating the difference between the message set version currently held by the navigation device 200 and those held by the server 302. A traffic message 1400 in the delta traffic container may indicate that the corresponding traffic message is to be deleted i.e. discarded from the navigation device 200 storage, contain updated information for that traffic message 1400 e.g. indicating changed information for the respective traffic event, or may be a new traffic message for the message group relating to a new event.

In step 1580 it is determined whether there are one or more message groups still to be considered. If no further message groups exist, then the method ends in step 1590. However, if further message groups exist, the method moves returns to step 1530 where a next message group is selected for a further iteration of steps 1540-1580.

Figure 16 illustrates a method 1600 performed in the navigation device 200 upon receiving a traffic container from the server 302. The method starts in step 1610. In step 1620 it is determined whether the traffic container is a full traffic container or a delta traffic container. This may be indicated in the traffic container e.g. by the setting a corresponding bit in a header of the traffic container by the server 302. If it is a full container then the method moves to step 1630 where it is determined whether the message group, as denoted by the message group ID, currently exists in the navigation device 200. This may be achieved by inspecting a message group list identifying the message groups currently stored in the navigation device 200. If the message group currently exists in the navigation device 200 then the method moves to step 1640 wherein all traffic messages currently assigned to that message group are deleted from or discarded by the navigation device 200. This is because the full traffic container is

providing an updates message set for that message group. The message group ID may also be removed from the message group list in step 1640. In step 1650 the message group is added to the message group list (if it was removed in step 1640 or else this step may be omitted). Then, in step 1660, the traffic messages in the traffic container are added to the message group as a new message set. The message set version ID may also be added to the message set list in step 1660 or updated in the message set list. The method ends in step 1695, whereupon it may be repeated for one or more additional traffic containers. However, if in step 1620 it had been determined that the traffic container was not a full traffic container then the method moves to step 1670 where it is verified that the message group to which the delta traffic container relates is currently held by the navigation device 200. This may be achieved by inspecting the message group list. If the message group does not exist in the navigation device 200, then the delta container is discarded by the navigation device 200 and the method ends in step 1695, assuming that the delta traffic container had been sent to the navigation device 200 in error. A message may be communicated to the server 302 from the navigation device 200 indicating the erroneous sending of the delta traffic container to the navigation device 200. If the message group exists in step 1670 then the method moves to step 1680 where information in the traffic container indicating a previous message set version ID for which the delta traffic container is to update is checked. The message set version ID may be compared against a current message set version ID held by the navigation device 200 to ensure that the delta traffic container is applicable to that navigation device 200. If the previous message set version ID is not correct then the method moves to step 1695 or, if the previous ID is correct, the method moves to step 1690. In step 1690 the traffic messages in the message group are updated. Updating the traffic messages may include one or more of: updating message set information, such as the message set version ID etc.; deleting any traffic messages which are indicated in the delta traffic container to be deleted from the message set, updating any traffic messages which are present in the existing message set on the navigation device 200 and in the delta container, and adding any new traffic messages present in the delta traffic container but not in the existing message set on the navigation device 200. The method then ends in step 1695. The method may be repeated for one or more further traffic containers received by the navigation device 200.

Advantageously, management of traffic messages utilising traffic containers and, in particular, delta traffic containers provides efficient communication and updating of traffic information on navigation devices. Traffic messages may be deleted, updated or added to existing traffic messages on a navigation device without having to send an

entire message set to the navigation device, or to all navigation devices.

It will be apparent from the foregoing that the teachings of the present invention provide efficient communication of information to navigation devices. Some embodiments of the invention determine relevant traffic information for navigation
5 devices, thus at least reducing communication of irrelevant traffic information to navigation devices. Some embodiments provide efficient updating of traffic information through use of delta traffic messages which avoid a repetition of traffic information communication to navigation devices.

It will also be appreciated that whilst various aspects and embodiments of the
10 present invention have heretofore been described, the scope of the present invention is not limited to the particular arrangements set out herein and instead extends to encompass all arrangements, and modifications and alterations thereto, which fall within the scope of the appended claims.

For example, whilst embodiments described in the foregoing detailed description
15 refer to GPS, it should be noted that the navigation device may utilise any kind of position sensing technology as an alternative to (or indeed in addition to) GPS. For example the navigation device may utilise using other global navigation satellite systems such as the European Galileo system. Equally, it is not limited to satellite based but could readily function using ground based beacons or any other kind of system that
20 enables the device to determine its geographic location.

It will also be well understood by persons of ordinary skill in the art that whilst the preferred embodiment implements certain functionality by means of software, that functionality could equally be implemented solely in hardware (for example by means of one or more ASICs (application specific integrated circuit)) or indeed by a mix of
25 hardware and software. As such, the scope of the present invention should not be interpreted as being limited only to being implemented in software.

Lastly, it should also be noted that whilst the accompanying claims set out particular combinations of features described herein, the scope of the present invention is not limited to the particular combinations hereafter claimed, but instead extends to
30 encompass any combination of features or embodiments herein disclosed irrespective of whether or not that particular combination has been specifically enumerated in the accompanying claims at this time.

CLAIMS

1. A method of communicating traffic or road information to a navigation device (200), the method comprising the steps of:

5

receiving traffic or road information at a server (302);

characterised by:

10

determining status information associated with the navigation device;

determining, based upon the status information, whether the traffic or road information is relevant to the navigation device (200); and

15

communicating the traffic or road information from the server (302) to the navigation device (200) if it is determined that if the traffic or road information is relevant to the navigation device (200).

20

2. The method of claim 1, comprising receiving the status information at the server from the navigation device (200).

25

3. The method of claim 1 or 2, wherein the status information indicates a geographic region (800) displayed on a display device (240) of the navigation device (200).

30

4. The method of claim 3, wherein the server is arranged to determine that traffic or road information is relevant to the navigation device (200) when a geographic location relevant to the traffic or road information is at least partly included in the geographic region displayed on the display device (240).

35

5. The method of claim 1 or 2, wherein the status information indicates a current location (1010) of the navigation device (200), and the method comprises determining a navigation device bounding region (930, 1110) based upon the current location (1010), wherein the traffic or road information is determined to be relevant to the navigation device (200) according to a location of an event indicated by the road or traffic information and the navigation device (200) bounding region.

6. The method of claim 5, wherein the status information indicates a destination location (1020) and the navigation device bounding region (1110) is determined to encapsulate the current (1010) and destination (1020) locations.

5

7. The method of claim 5 or 6, wherein the status information indicates a route (1030) between the current and destination locations and the navigation device bounding region (1110) is determined based in part on a length of the route (1030).

10 8. The method of any of claims 5 to 7, wherein the navigation device bounding region (1110) is elliptically-shaped, and a size of the ellipse is determined according to an ellipse size factor (ESF) based upon an airline distance (1040) between the current and destination locations (1010, 1020) and a length of the route (1030).

15 10. The method of any of claims 5 to 8, comprising: determining an event bounding region (921, 922, 923, 924) encapsulating the event indicated by the traffic or road information, wherein the traffic or road information is determined to be relevant to the navigation device when the navigation device bounding region (930) and event bounding region (921, 922, 923, 924) at least partly intersect.

20

11. The method of any preceding claim, comprising controlling a rate at which the traffic or road information is communicated to the navigation device (200) based upon information received from the navigation device (200).

25 12. The method of any preceding claim, wherein the server (302) is arranged to sort the traffic or road information according to a relevance of the information to the navigation device (200), and to communicate the traffic or road information to the navigation device substantially in the sorted order.

30 13. Computer software comprising one or more software modules operable, when executed in an execution environment, to cause a processor (210) to perform the method of any preceding claim.

14. A system, comprising:

35

a server (302) arranged to receive traffic or road information from one or more

sources; and

one or more navigation devices (200) communicatively coupled to transmit status information to the server (302);

5

characterised in that the server (302) is arranged to determine traffic or road information relevant to each navigation device and to transmit first traffic or road information to a first navigation device (200) and second traffic or road information to a second navigation device (200), wherein the first and second traffic or road information have been determined by the server to be relevant to each respective navigation device (200).

10

15. The system or claim 14, wherein:

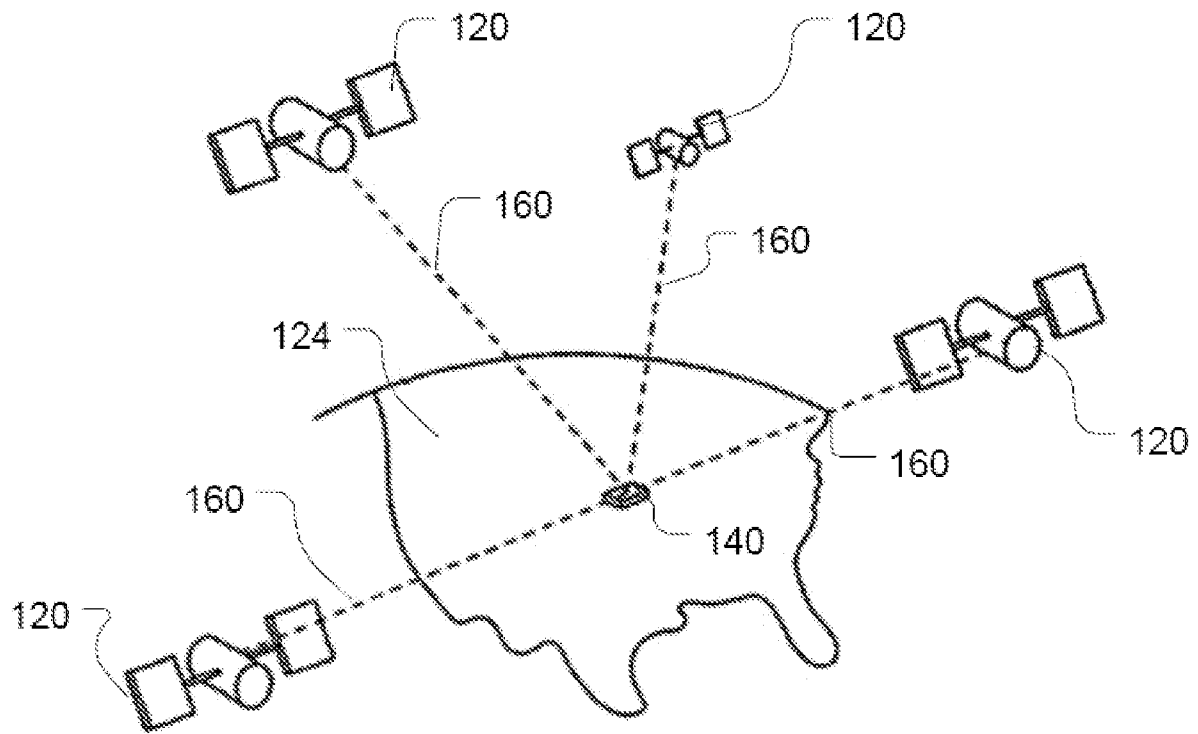
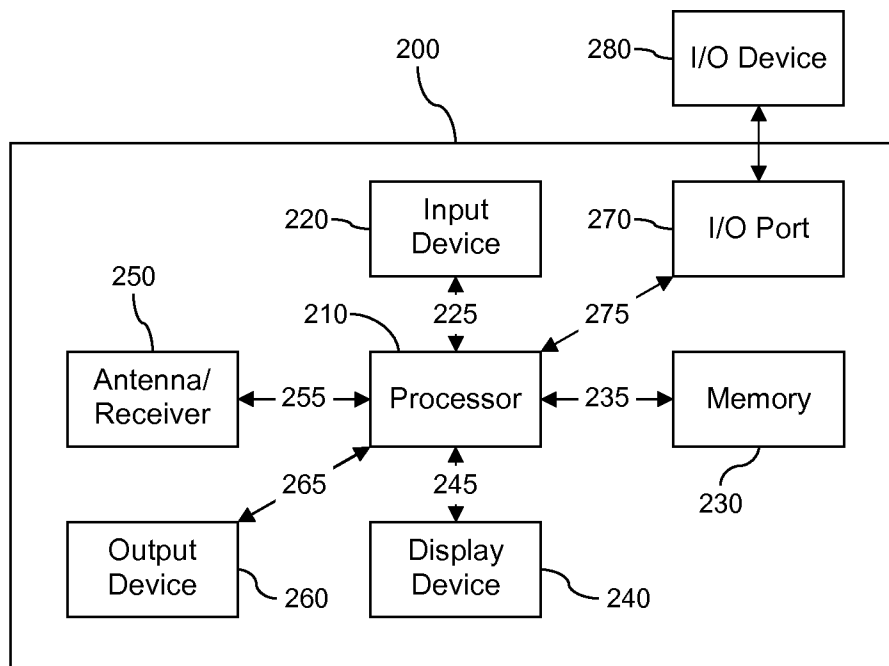
15

at least one or the first or second navigation devices (200) is arranged to transmit status information to the server (302) indicating a current location (1010) of the navigation device (200), a destination location (1020) and a route (1030) determined between the current and destination locations; and

20

the server (302) is arranged to determine a bounding region (1110) encapsulating the current and destination locations (1010, 1020), wherein a size of the bounding region (1110) is determined according, at least in part, to a length of the route (1030) between the current and destination locations (1010, 1020), and traffic or road information is determined to be relevant to the navigation device (200) according to a location of an event to which it relates and the bounding region (1110).

25

**FIG. 1****FIG. 2**

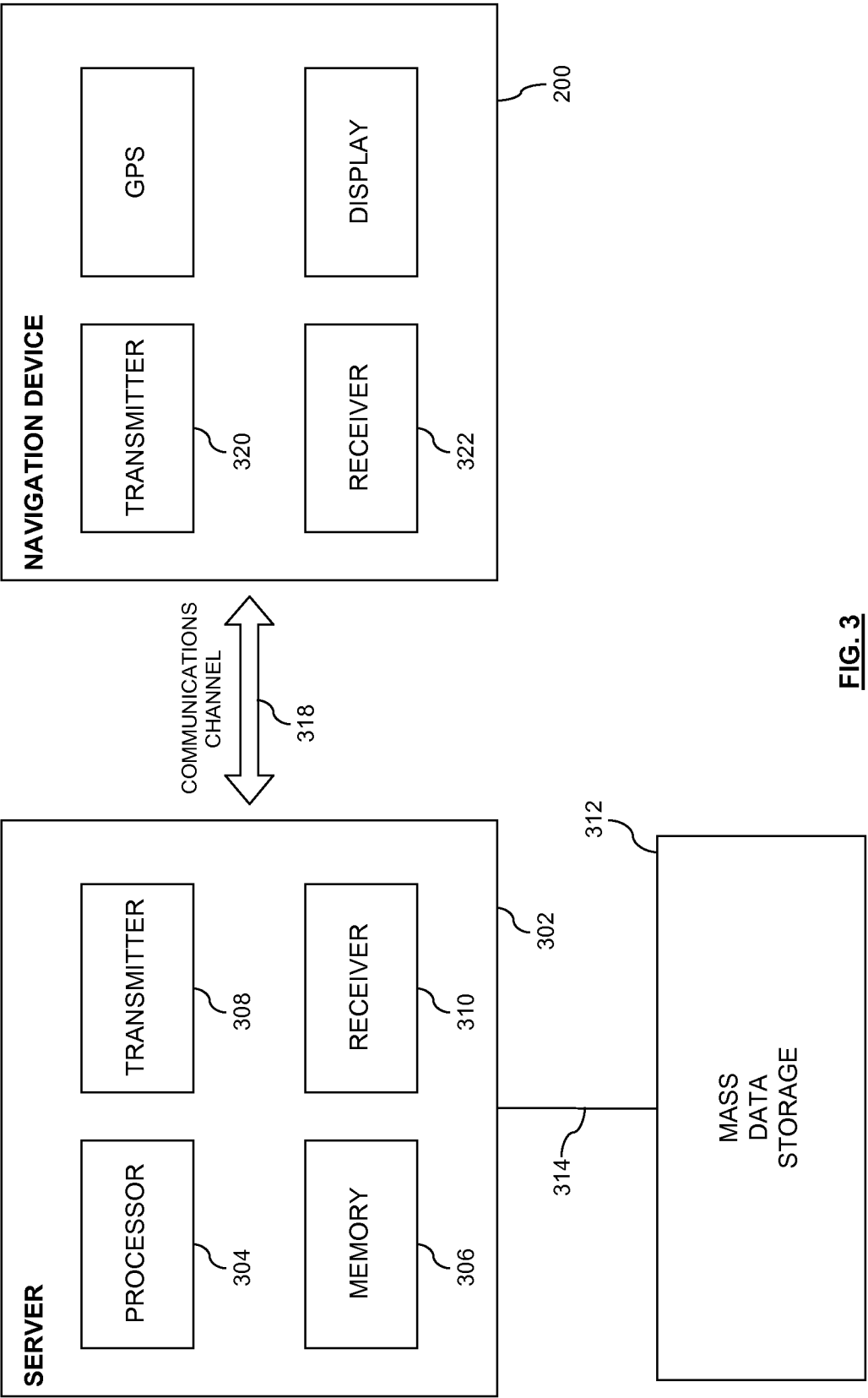
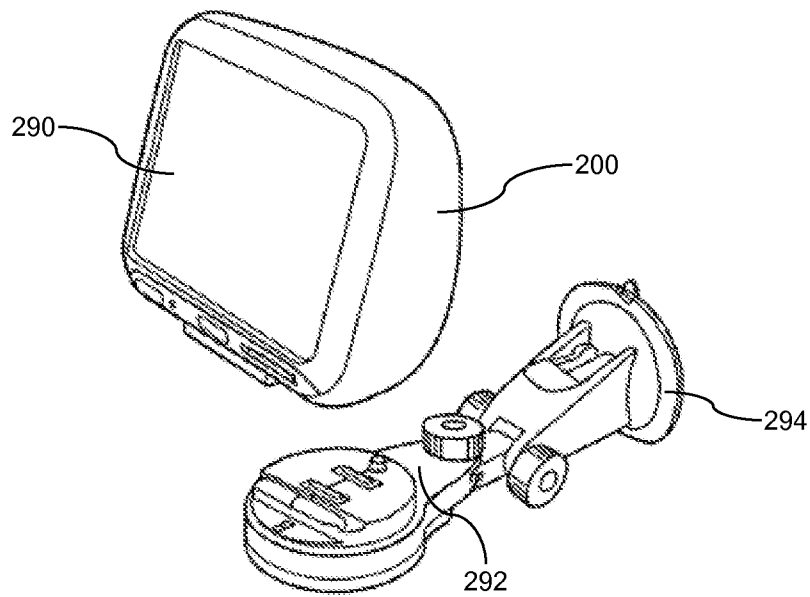
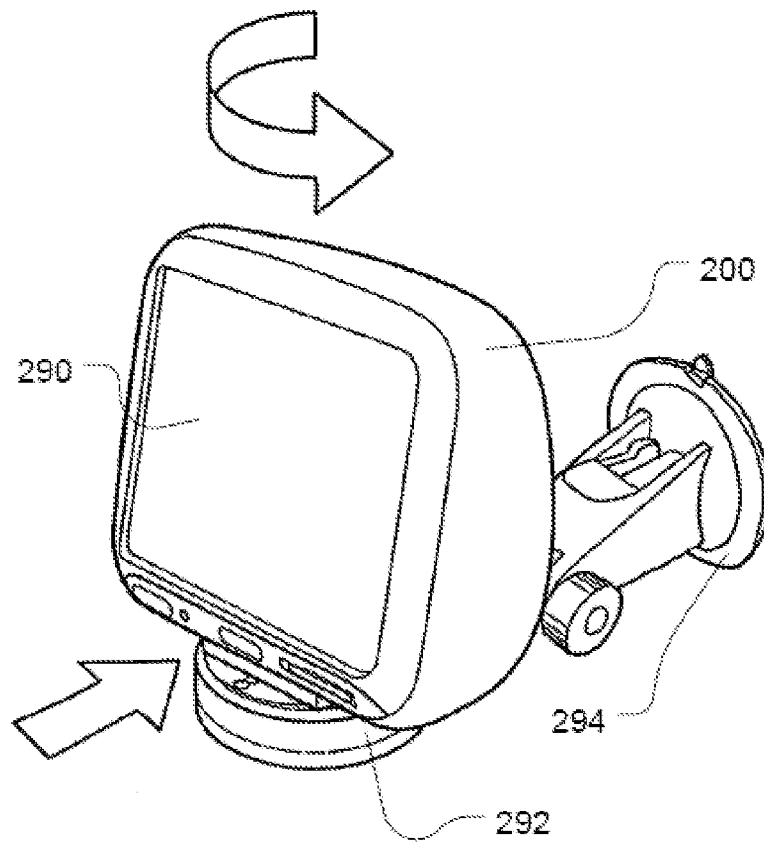
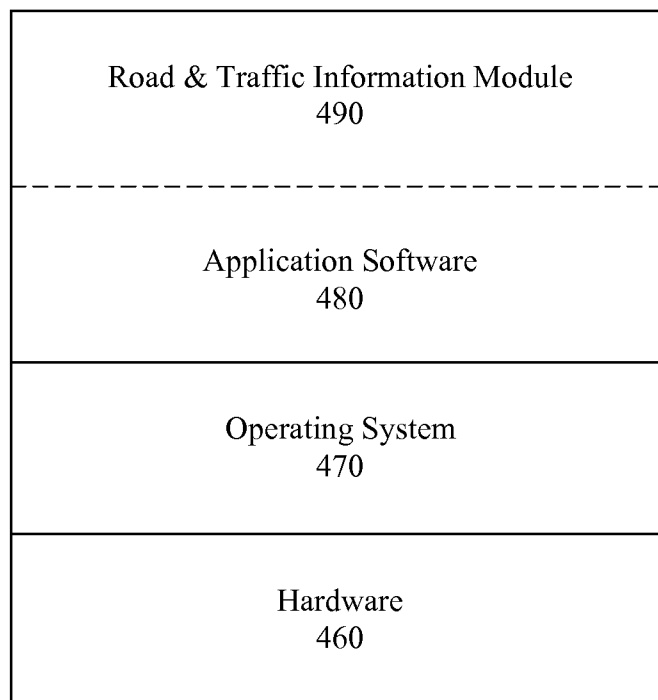
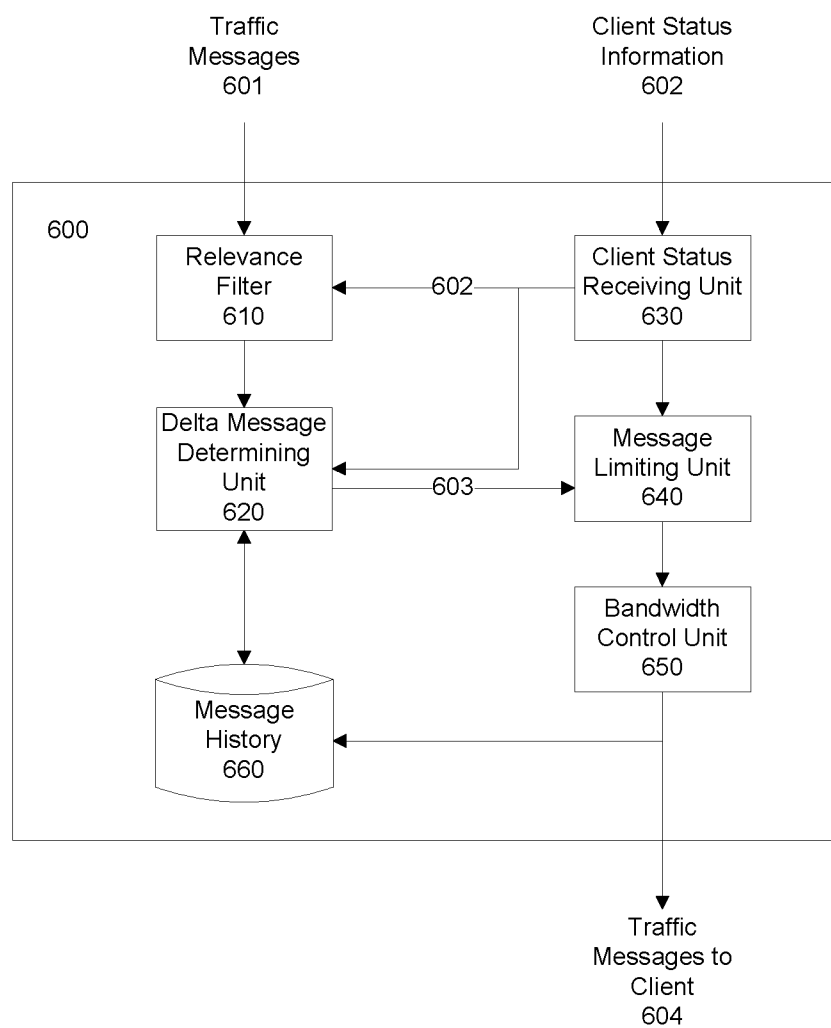
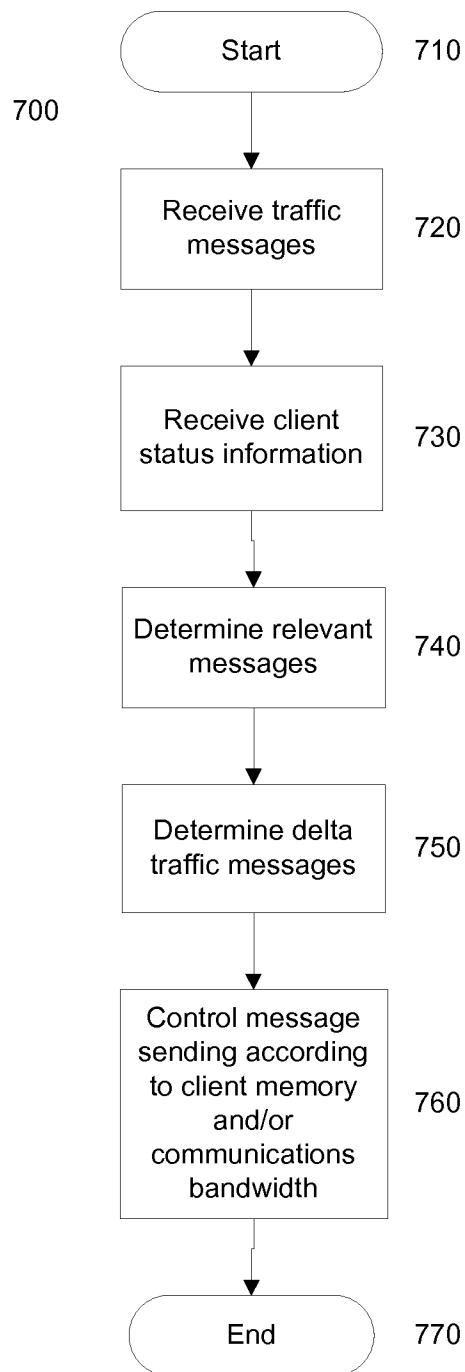


FIG. 3

**FIG. 4a****FIG. 4b**

**FIG. 5****FIG. 6**

**FIG. 7**

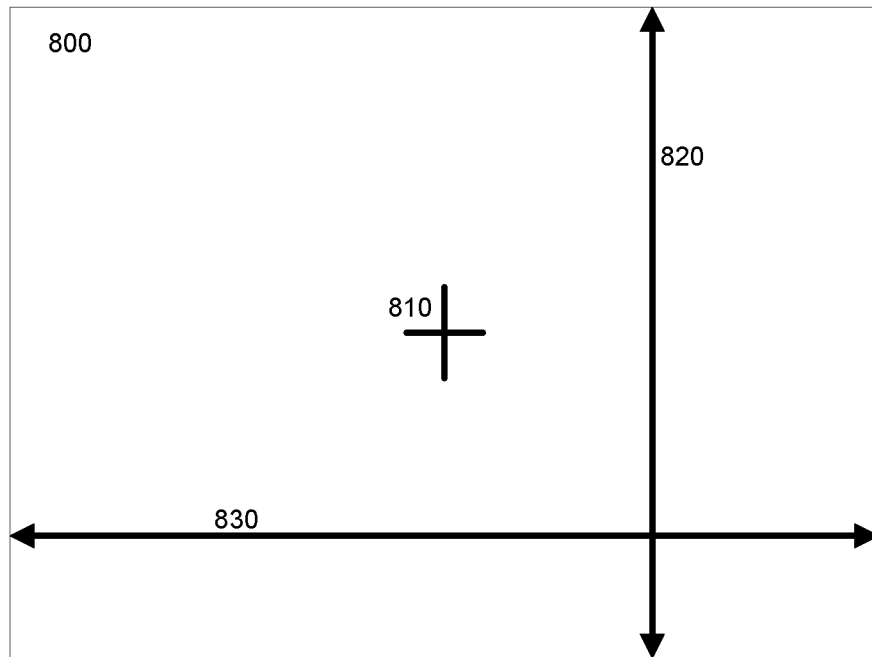


FIG. 8

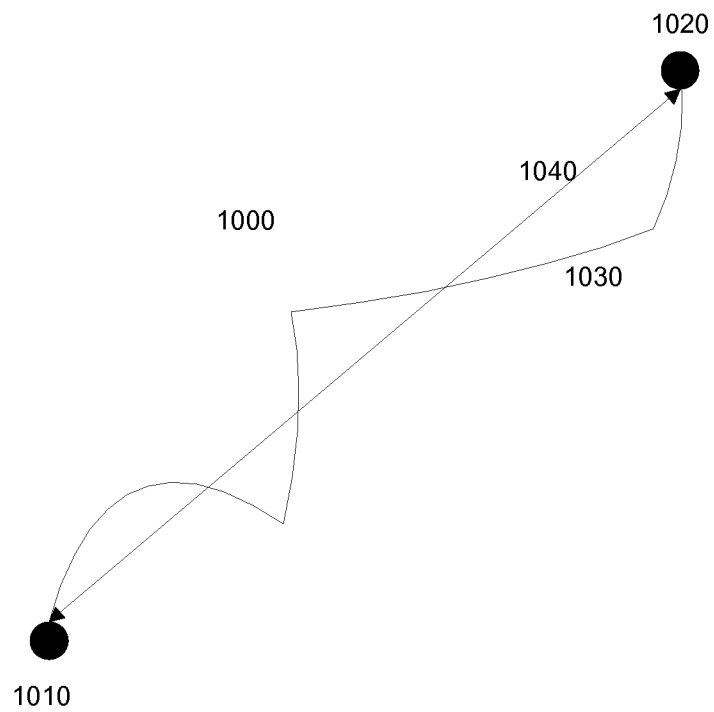


FIG. 10

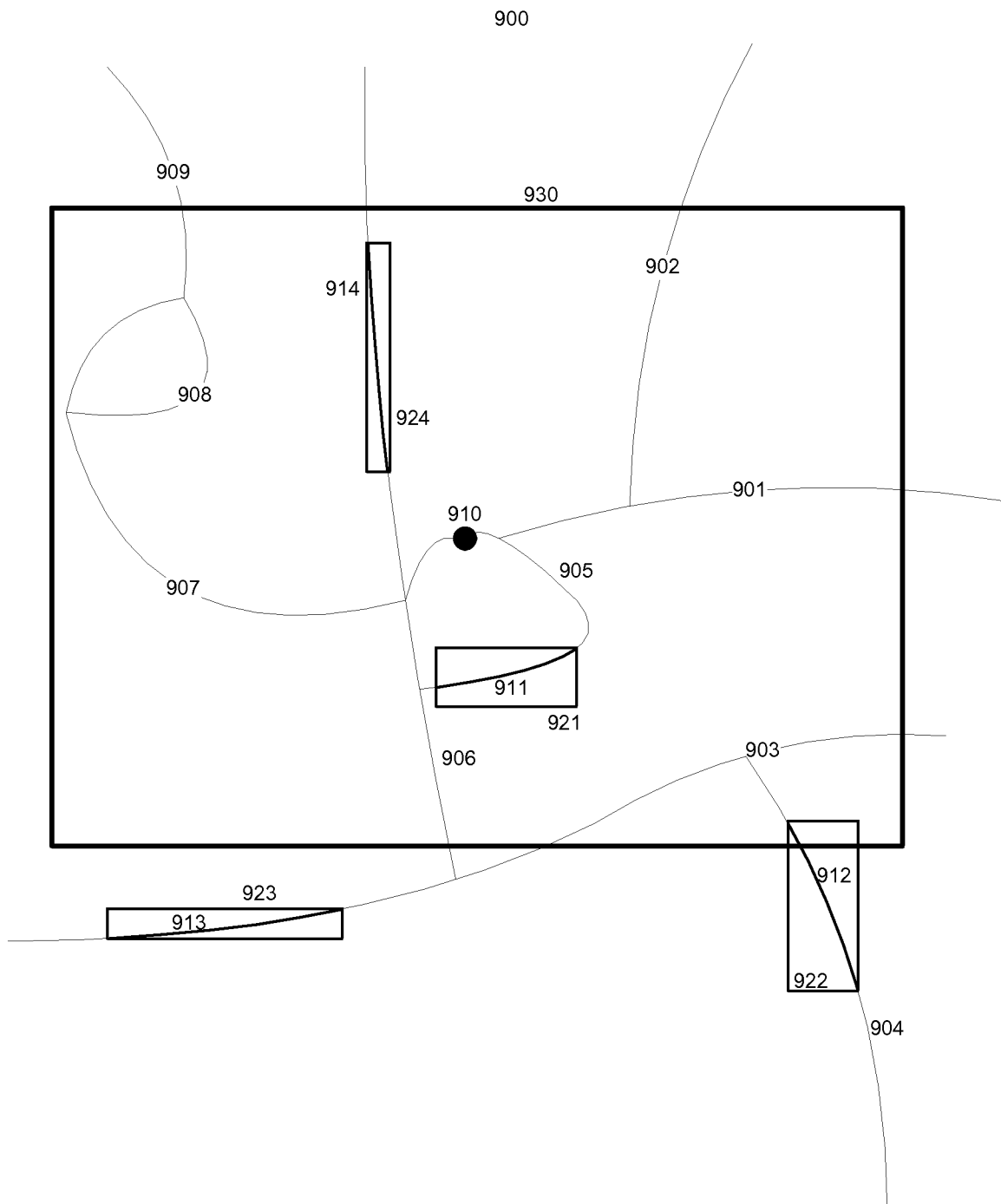
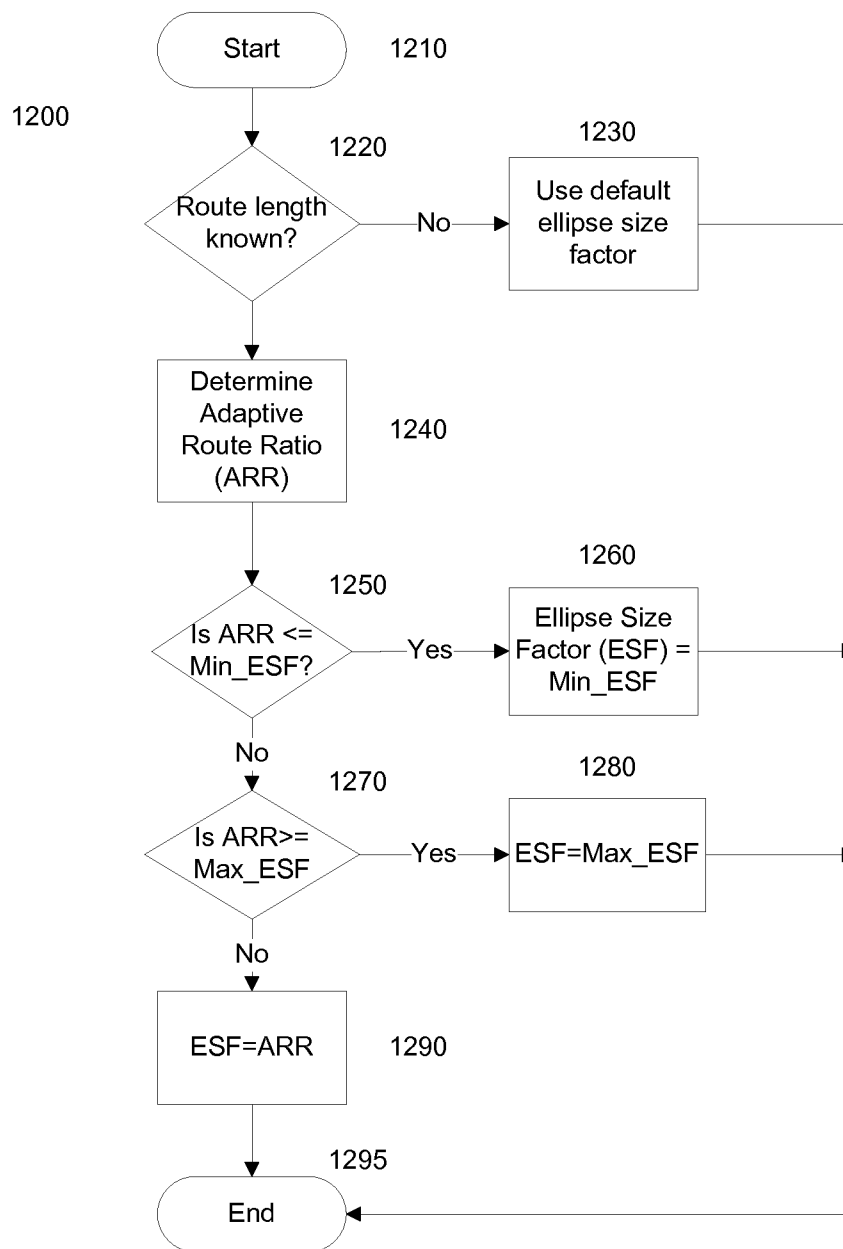
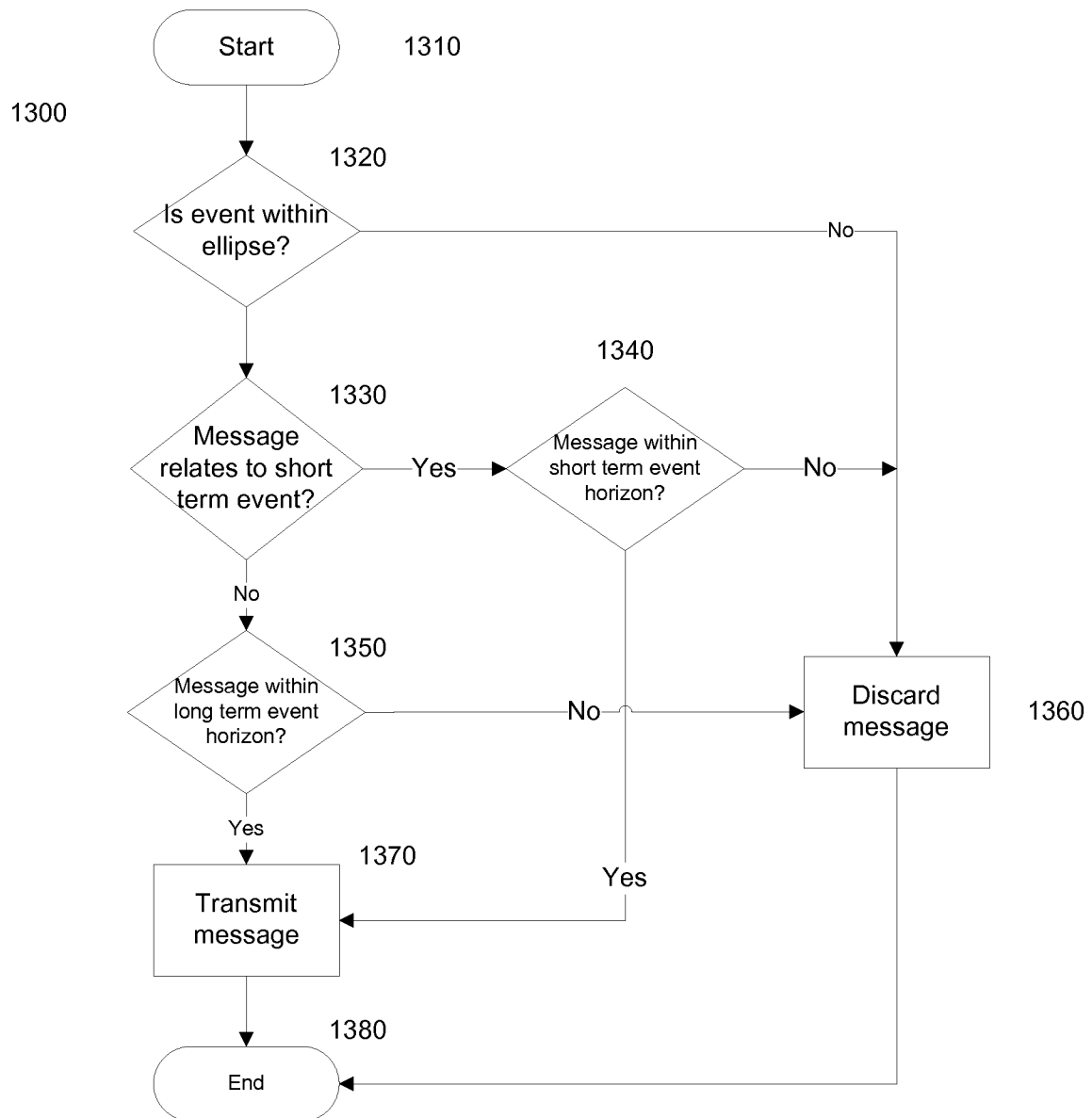


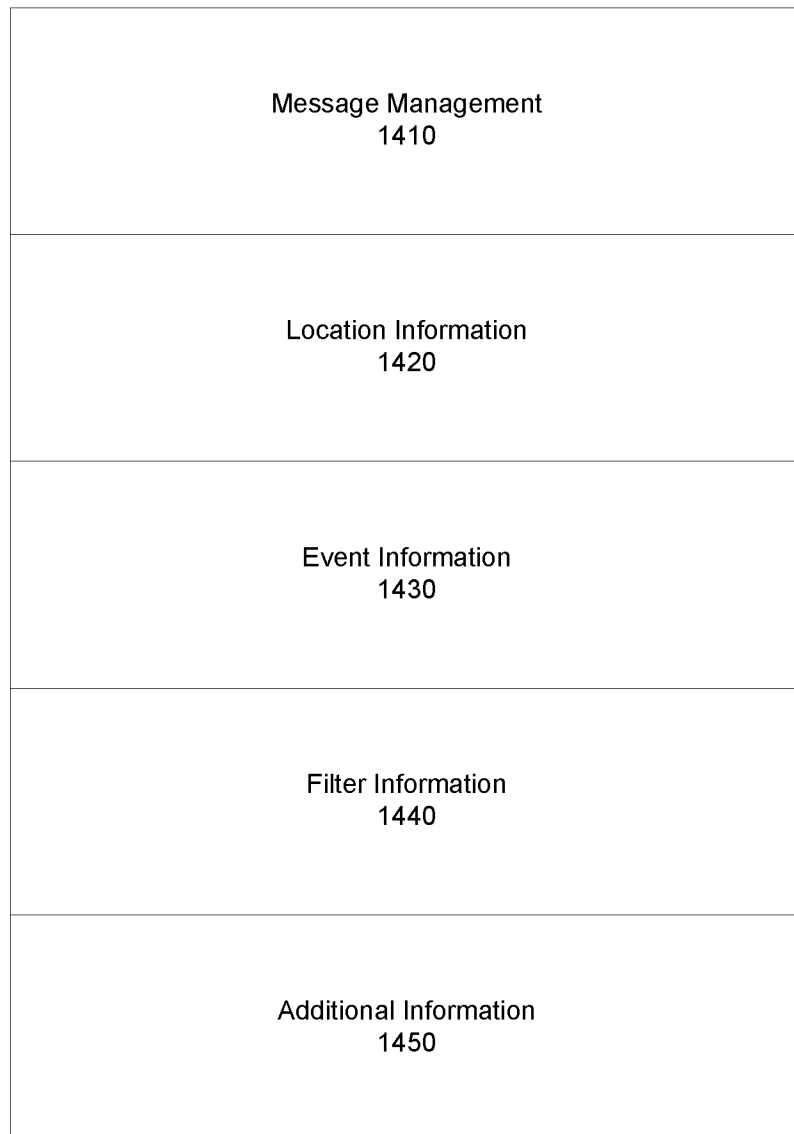
FIG. 9

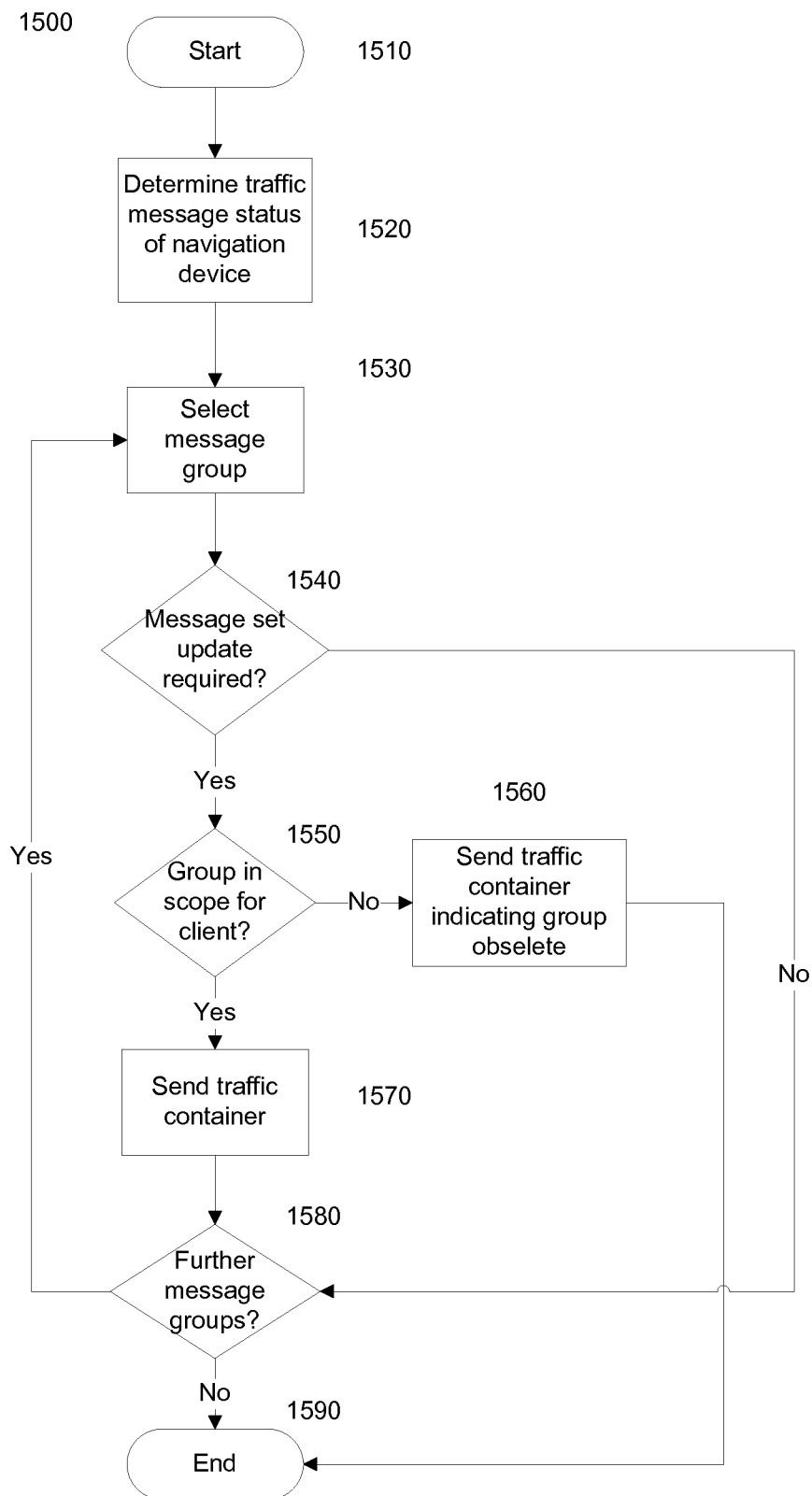
FIG. 11

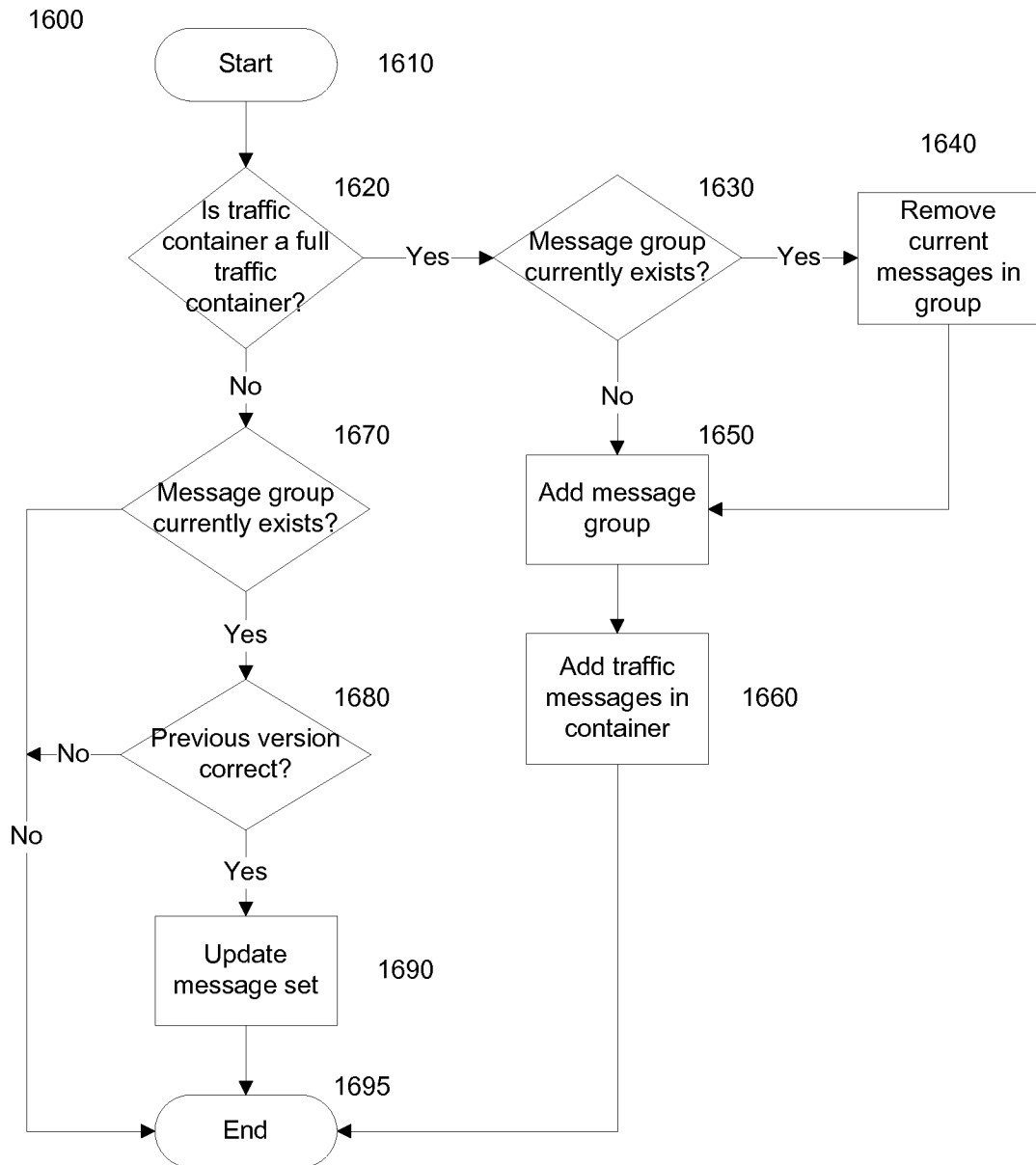
**FIG. 12**

**FIG. 13**

1400

**FIG. 14**

**FIG. 15**

**FIG. 16**

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/061914

A. CLASSIFICATION OF SUBJECT MATTER
INV. G08G1/0967

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2004 125504 A (ZANAVY INFORMATICS KK; HITACHI LTD; HCX KK) 22 April 2004 (2004-04-22) paragraph [0006] paragraph [0011] - paragraph [0014] paragraph [0016] - paragraph [0021] paragraph [0035] - paragraph [0040]; figures 19,22	1-2, 5-10, 13-15
X	US 2007/058625 A1 (FUSHIKI TAKUMI [JP] ET AL) 15 March 2007 (2007-03-15) paragraph [0037] - paragraph [0039] paragraph [0109] figure 1	1-4, 12-14
	----- -/--	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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- *&* document member of the same patent family

Date of the actual completion of the international search

28 January 2010

Date of mailing of the international search report

03/02/2010

Name and mailing address of the ISA/

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Fax: (+31-70) 340-3016

Authorized officer

Seisdedos, Marta

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/061914

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/052552 A1 (SUZUKI HIROTAKE [JP]) 8 March 2007 (2007-03-08) paragraph [0006] - paragraph [0007] paragraph [0025] - paragraph [0026] paragraph [0036] - paragraph [0042] paragraph [0062] figure 3 -----	1-2, 5-7, 12-15
X	US 2002/121989 A1 (BURNS RONNIE [US]) 5 September 2002 (2002-09-05) paragraph [0044] - paragraph [0047] paragraph [0056] - paragraph [0057] paragraph [0064]; figure 2 paragraph [0066] - paragraph [0067] -----	1-2, 5-6, 9, 13-14
X	US 2004/068364 A1 (ZHAO WEI [US] ET AL) 8 April 2004 (2004-04-08) paragraph [0054] - paragraph [0055] paragraph [0114] -----	1-2, 5-7, 13-15
X, P	US 2009/209233 A1 (MORRISON JAMES [US]) 20 August 2009 (2009-08-20) the whole document -----	1-2, 5-10, 13-15
X	DE 101 18 544 A1 (RENSCHKE MARTINA [DE]) 7 November 2002 (2002-11-07) paragraph [0004] - paragraph [0005] paragraph [0007] paragraph [0012] - paragraph [0014] paragraph [0016] paragraph [0018] paragraph [0033] figures 2, 3 -----	11
X, P	US 2008/275628 A1 (XU XIANG [CN] ET AL) 6 November 2008 (2008-11-06) paragraph [0028] paragraph [0039] -----	11
A	EP 1 821 270 A2 (SAMSUNG ELECTRONICS CO LTD [KR]) 22 August 2007 (2007-08-22) the whole document -----	11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2009/061914

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10, 12-15

A method of communicating to a navigation only the relevant road or traffic information, wherein the relevance is of the road or traffic information is determined in relation to the status information of the navigation device.

2. claim: 11

A method for controlling the rate at which the traffic or road information is communicated to a navigation device.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/061914

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