US007026984B1

(12) **United States Patent**
Thandu et al.

(10) **Patent No.: US 7,026,984 B1**
(45) **Date of Patent: Apr. 11, 2006**

(54) **INTELLIGENT UTILIZATION OF RESOURCES IN MOBILE DEVICES**

(75) Inventors: **Balasubramaniam K. Thandu**, Austin, TX (US); **Prabha Aithal**, Austin, TX (US)

(73) Assignee: **Cingular Wireless II, L.L.C.**, Atlanta, GA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/984,100**

(22) Filed: **Nov. 8, 2004**

(51) **Int. Cl.**
H04B 7/185 (2006.01)

(52) **U.S. Cl.** **342/357.09**; 342/357.06; 701/213

(58) **Field of Classification Search** 342/357.01, 342/357.06, 357.09, 357.12; 701/207, 213, 701/214, 215
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,786,789 A 7/1998 Janky
6,204,808 B1 3/2001 Bloebaum et al.
RE37,256 E 7/2001 Cohen et al.
2003/0201931 A1* 10/2003 Durst et al. 342/357.07
2004/0037313 A1* 2/2004 Gulati et al. 370/465
2004/0111535 A1* 6/2004 Boucher et al. 709/250
2004/0203879 A1* 10/2004 Gardner et al. 455/456.1
2005/0040953 A1* 2/2005 McDonald 340/573.1
2005/0113124 A1* 5/2005 Syrjarinne et al. 455/522

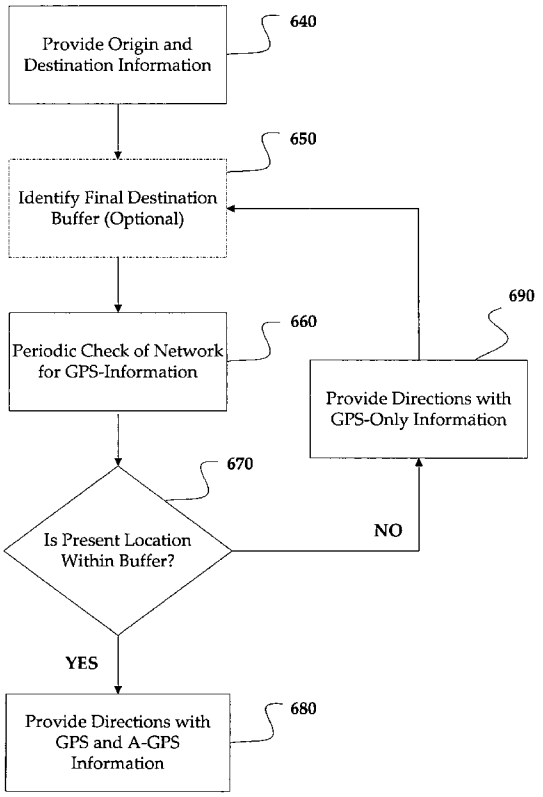
* cited by examiner

Primary Examiner—Dao Phan
(74) *Attorney, Agent, or Firm*—Carr & Ferrell LLP

(57) **ABSTRACT**

A programmable intelligent activation module to intelligently allow access to GPS resources is provided. In accordance with pre-programmed settings, an intelligent activation module will control the frequency by which a GPS module is allowed to access a GPS or GSM network in order to acquire location information of a mobile device equipped with GPS equipment. By controlling access to a GPS or GSM network, network resources such as bandwidth are conserved unless actually needed as is determined by the intelligent activation module. Similarly, battery resources for the mobile device are also conserved in that unnecessary activation of the GPS module is prevented until such activation is actually needed. The intelligent activation module can be programmed with a variety of settings including speed, map deltas, final destination information, or settings as pre-determined by a user of the mobile device.

9 Claims, 13 Drawing Sheets



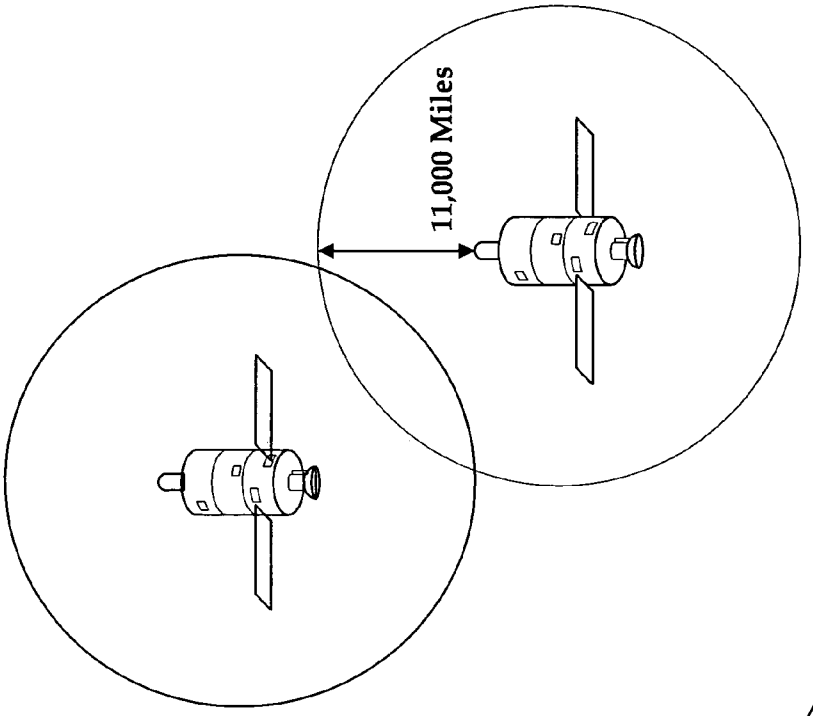


FIGURE 1B
PRIOR
ART

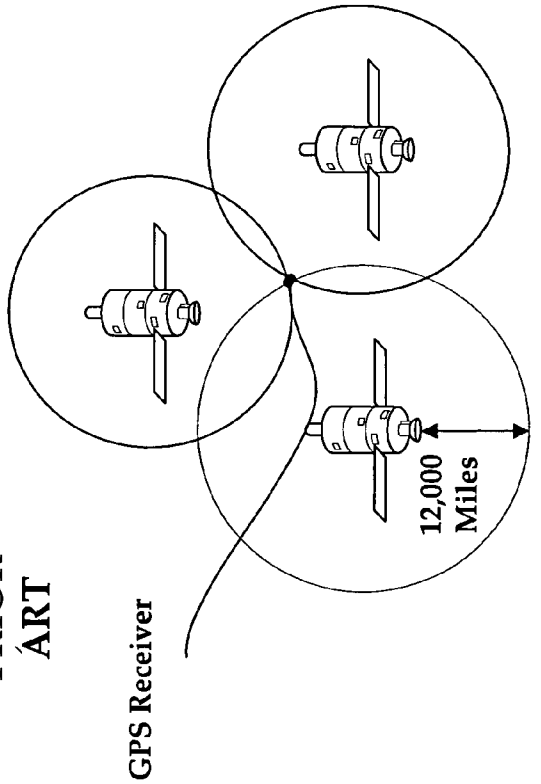


FIGURE 1C
PRIOR
ART

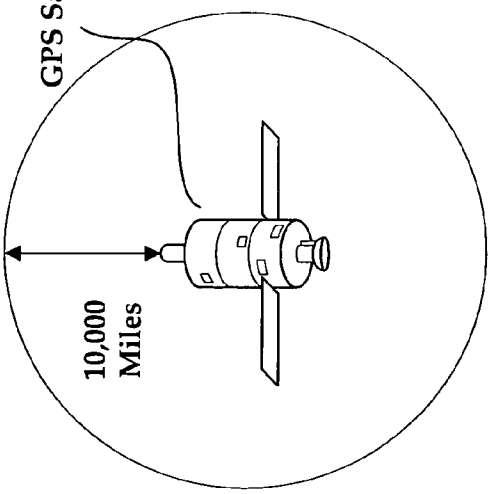


FIGURE 1A
PRIOR
ÁRT

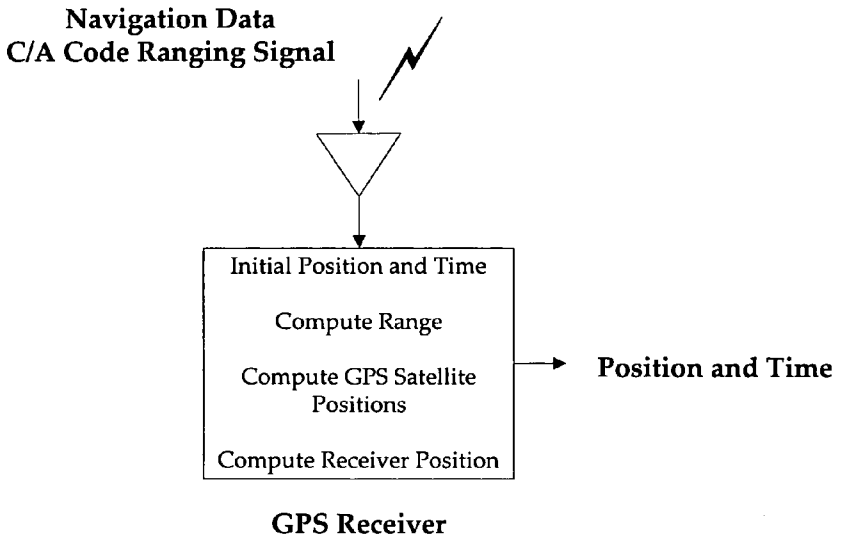


FIGURE 2A
PRIOR ART

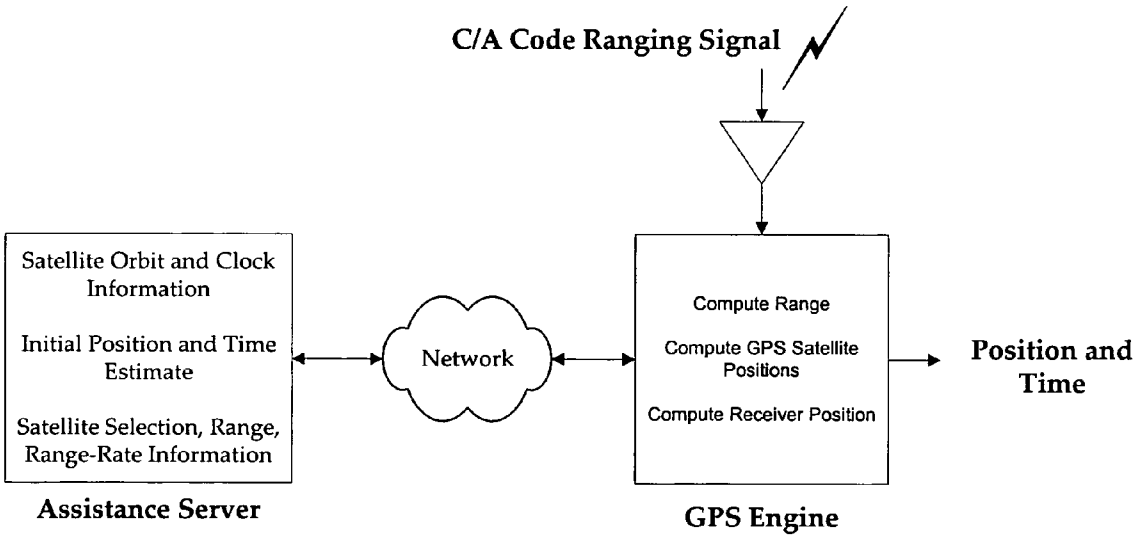


FIGURE 2B
PRIOR ART

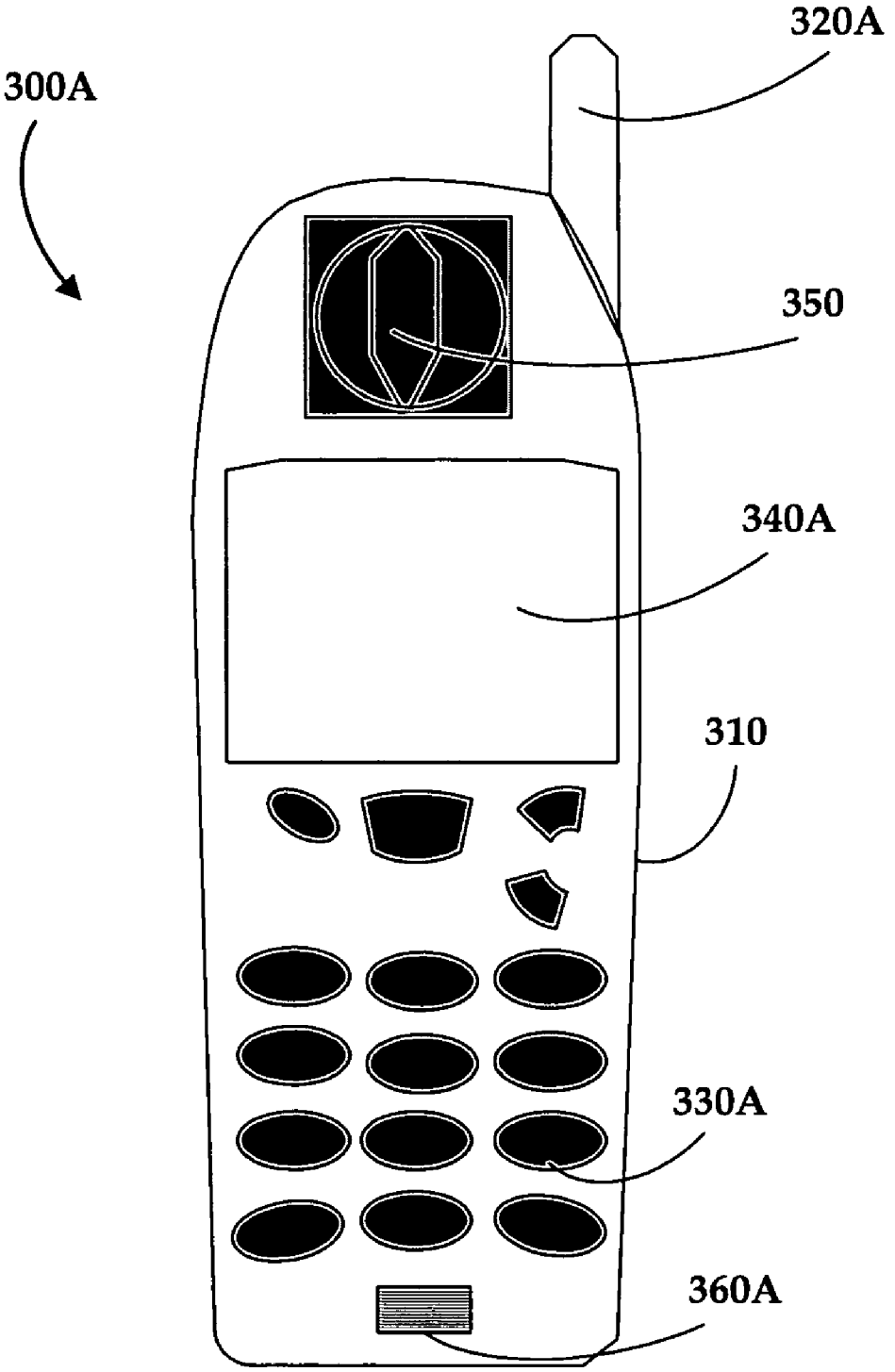


FIGURE 3A

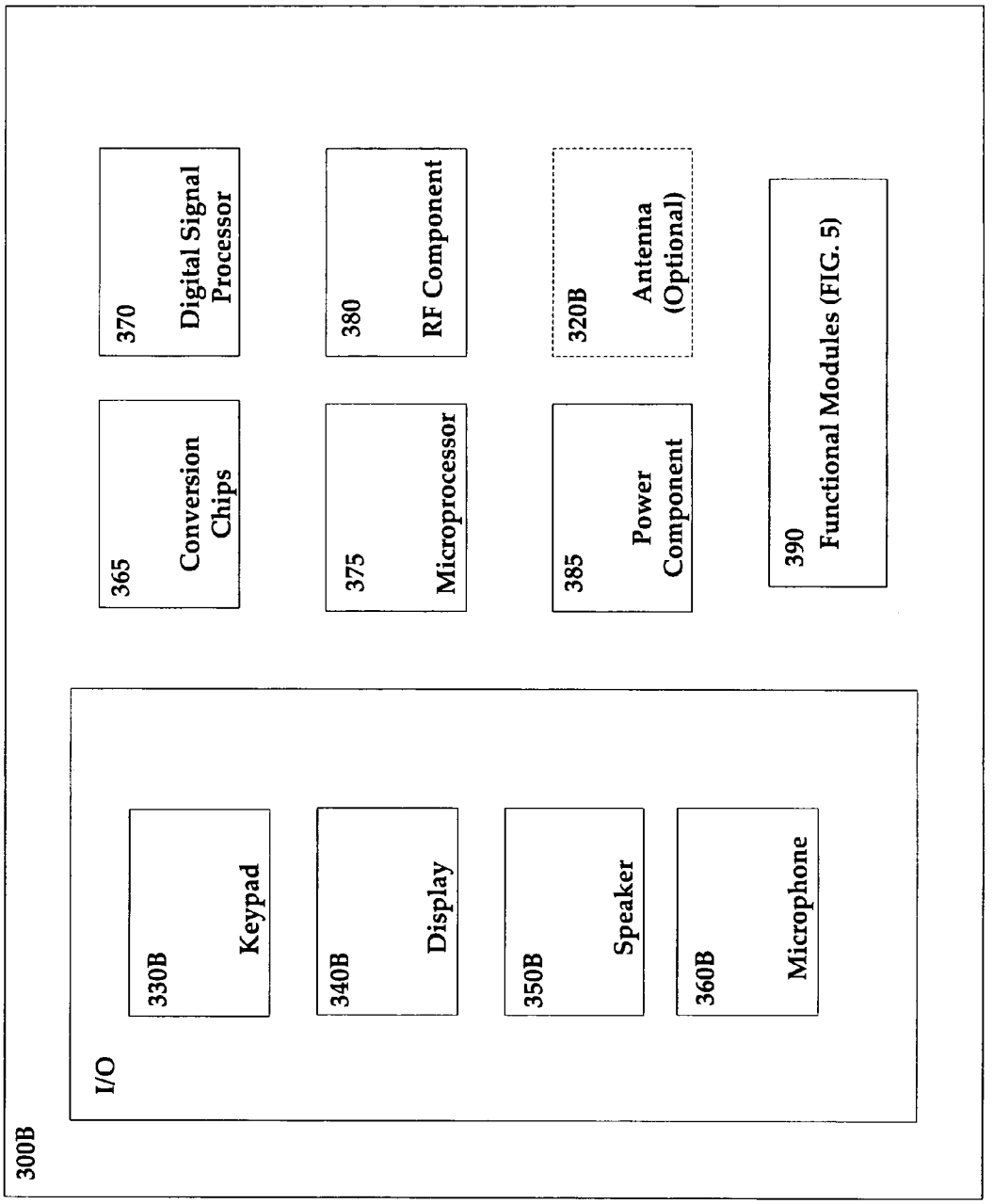

300B
I/O
330B
Keypad
340B
Display
350B
Speaker
360B
Microphone
365
Conversion Chips
370
Digital Signal Processor
375
Microprocessor
380
RF Component
385
Power Component
320B
Antenna (Optional)
390
Functional Modules (FIG. 5)

FIGURE 3B

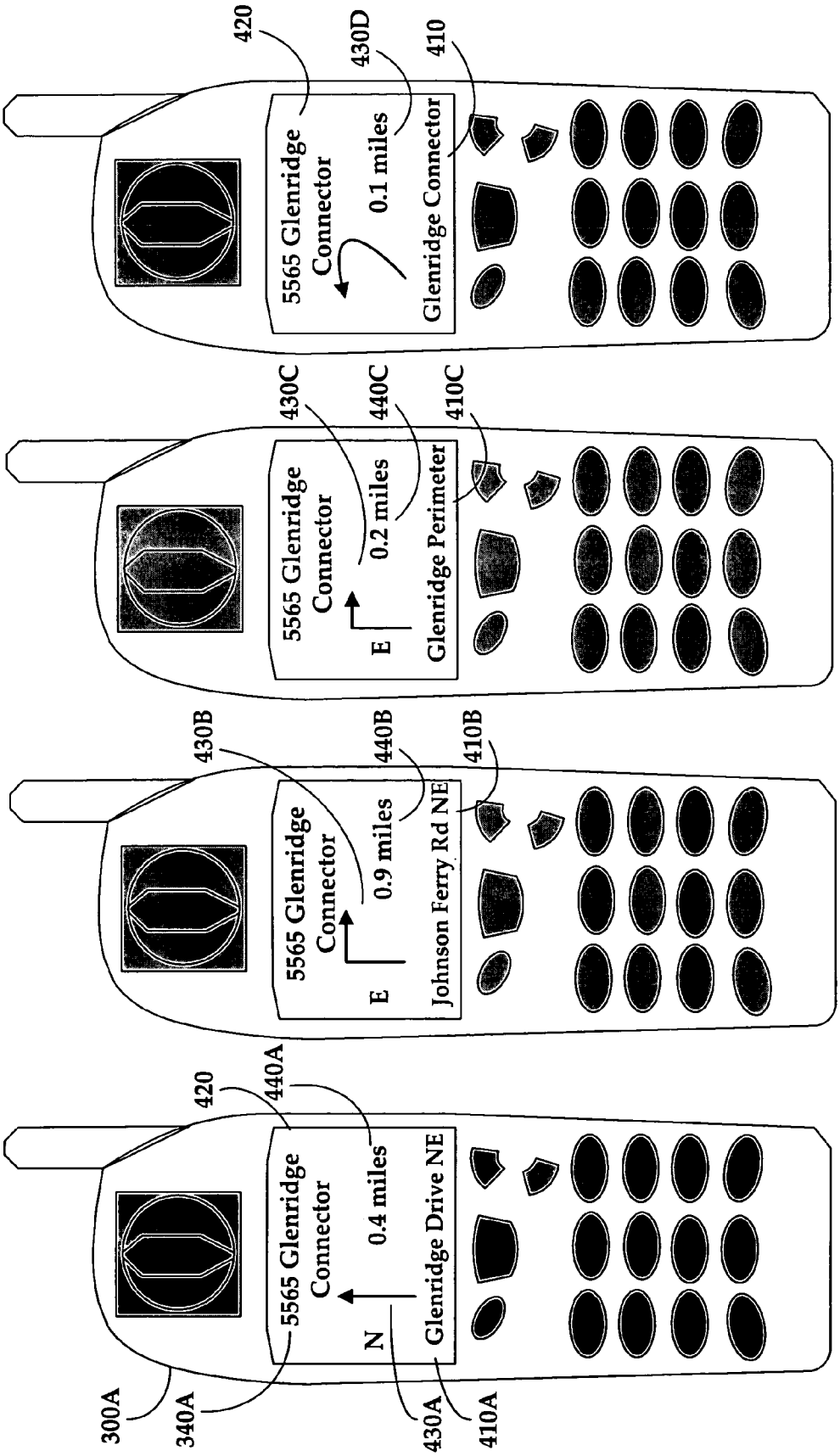


FIGURE 4D

FIGURE 4C

FIGURE 4B

FIGURE 4A

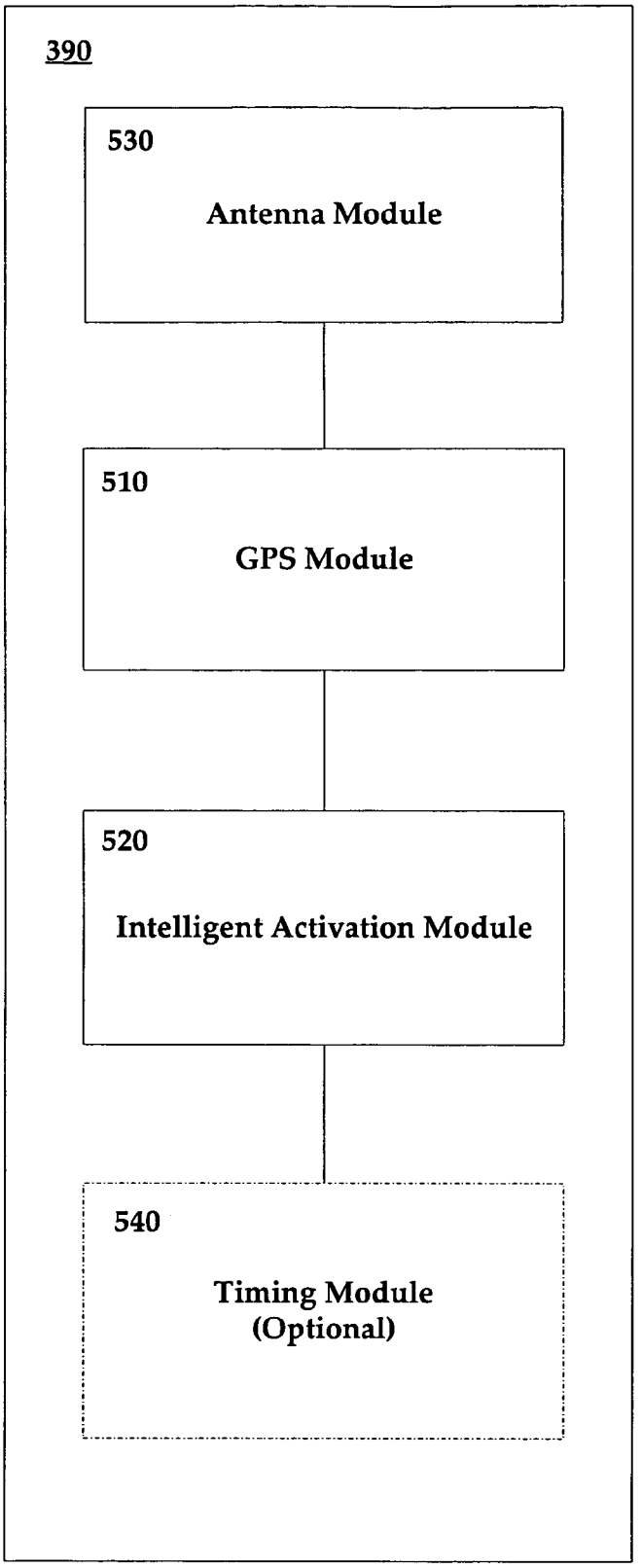

390
530
Antenna Module
510
GPS Module
520
Intelligent Activation Module
540
Timing Module
(Optional)

FIGURE 5

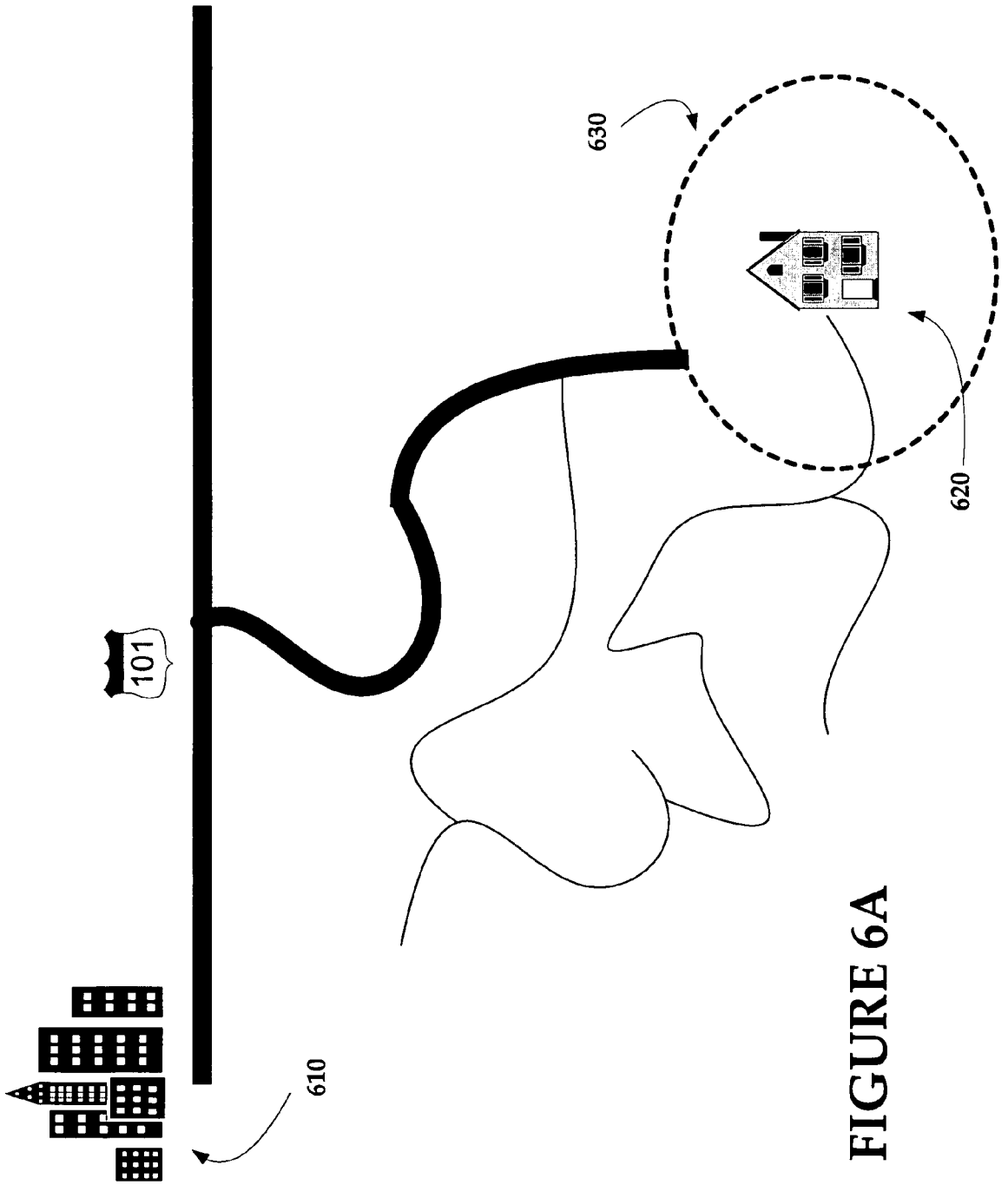


FIGURE 6A

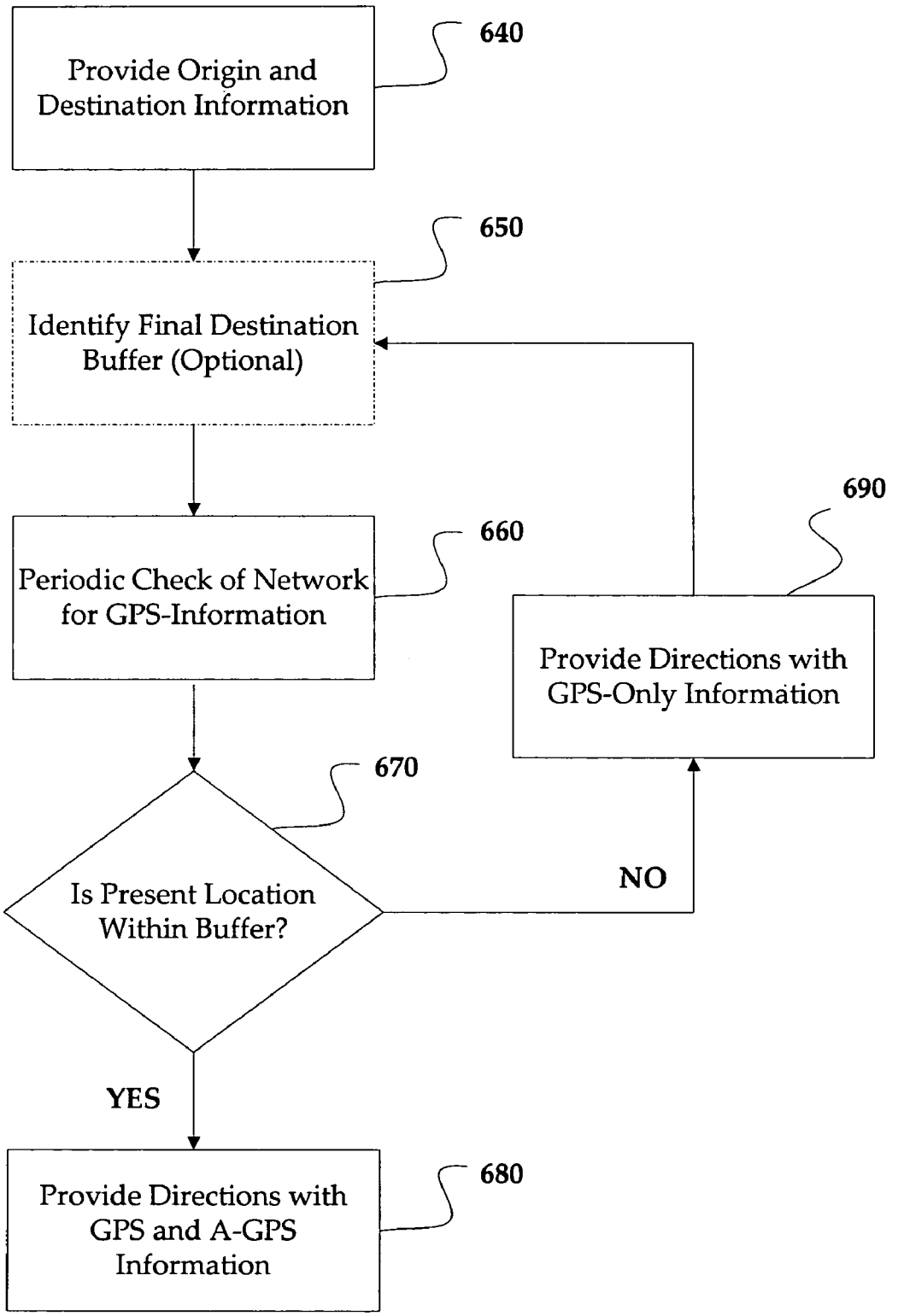

Provide Origin and Destination Information
640
Identify Final Destination Buffer (Optional)
650
Periodic Check of Network for GPS-Information
660
Provide Directions with GPS-Only Information
690
Is Present Location Within Buffer?
670
NO
YES
Provide Directions with GPS and A-GPS Information
680

FIGURE 6B

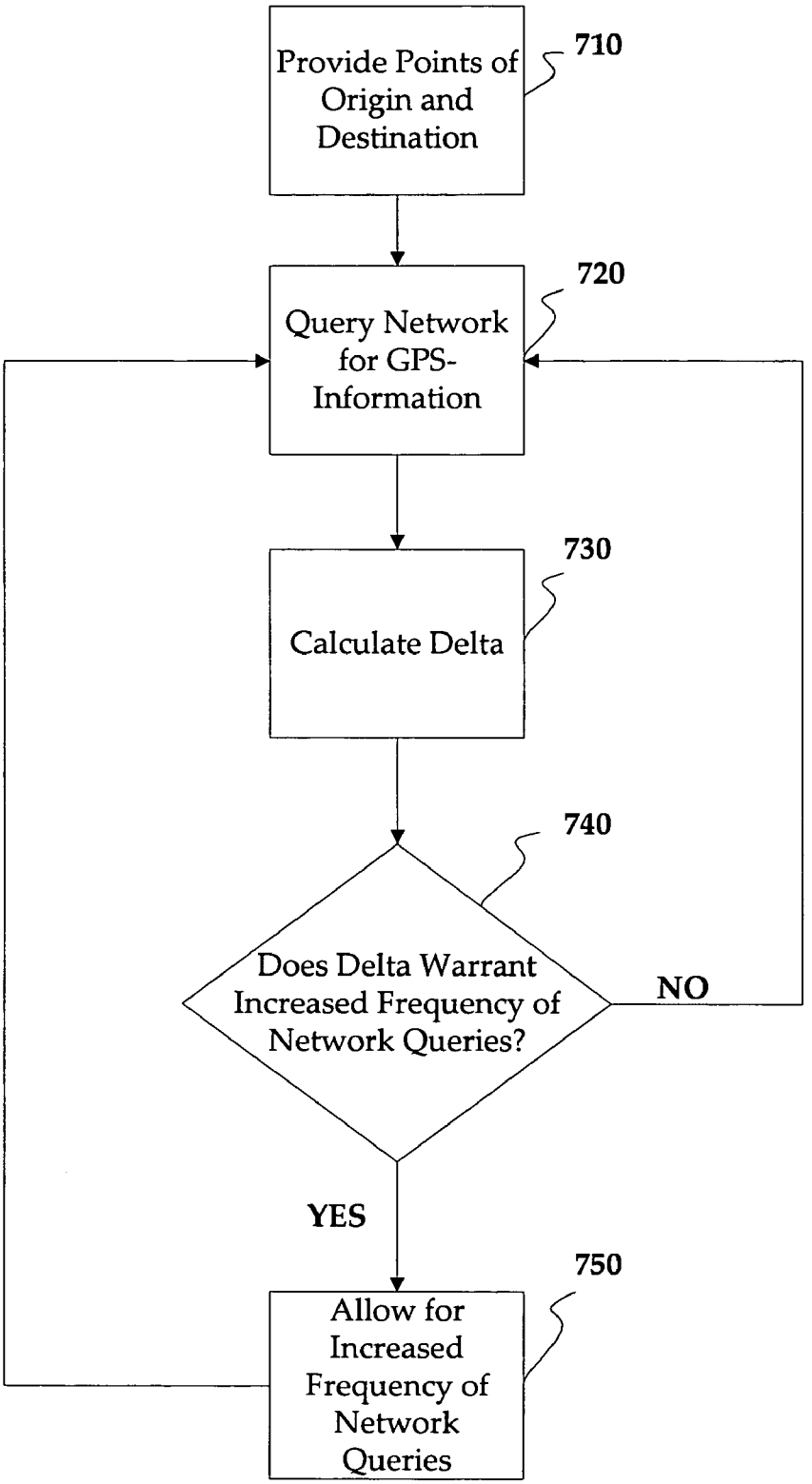

Provide Points of Origin and Destination
710
Query Network for GPS-Information
720
Calculate Delta
730
Does Delta Warrant Increased Frequency of Network Queries?
740
NO
YES
Allow for Increased Frequency of Network Queries
750

FIGURE 7

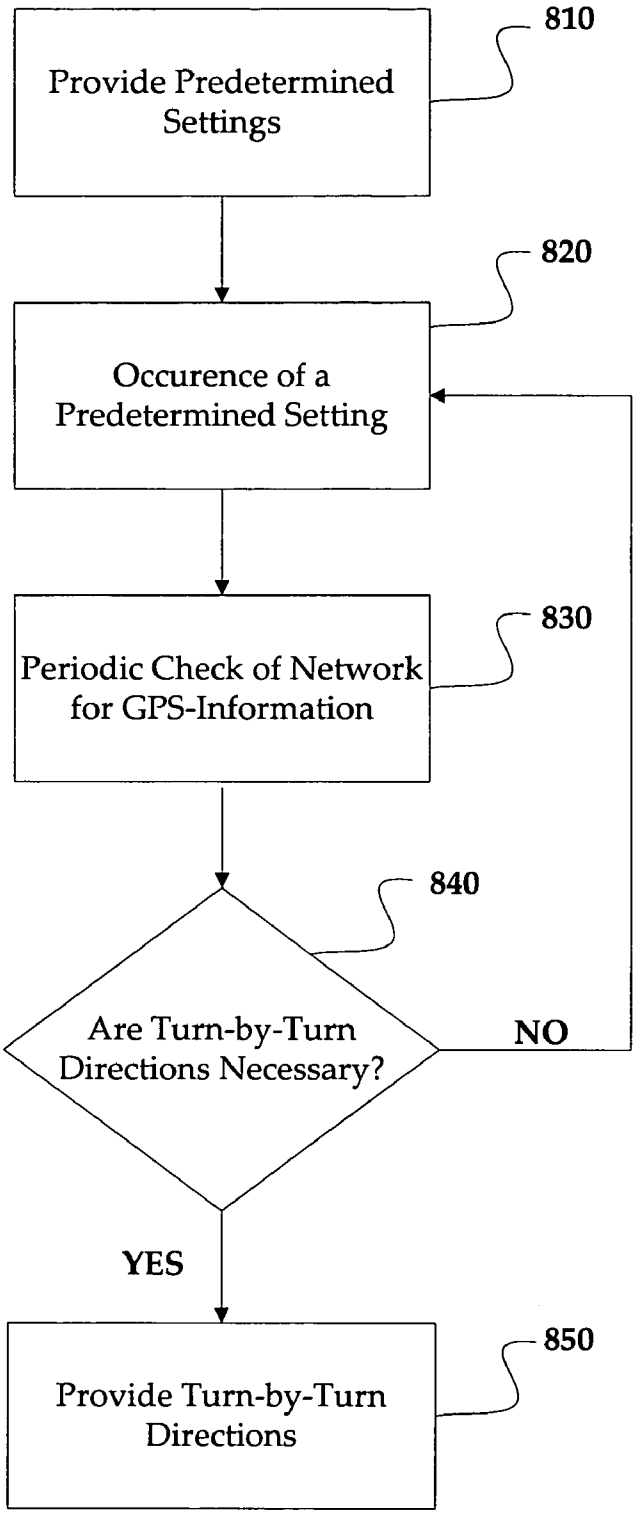

Provide Predetermined Settings
810
Occurence of a Predetermined Setting
820
Periodic Check of Network for GPS-Information
830
Are Turn-by-Turn Directions Necessary?
840
NO
YES
Provide Turn-by-Turn Directions
850

FIGURE 8

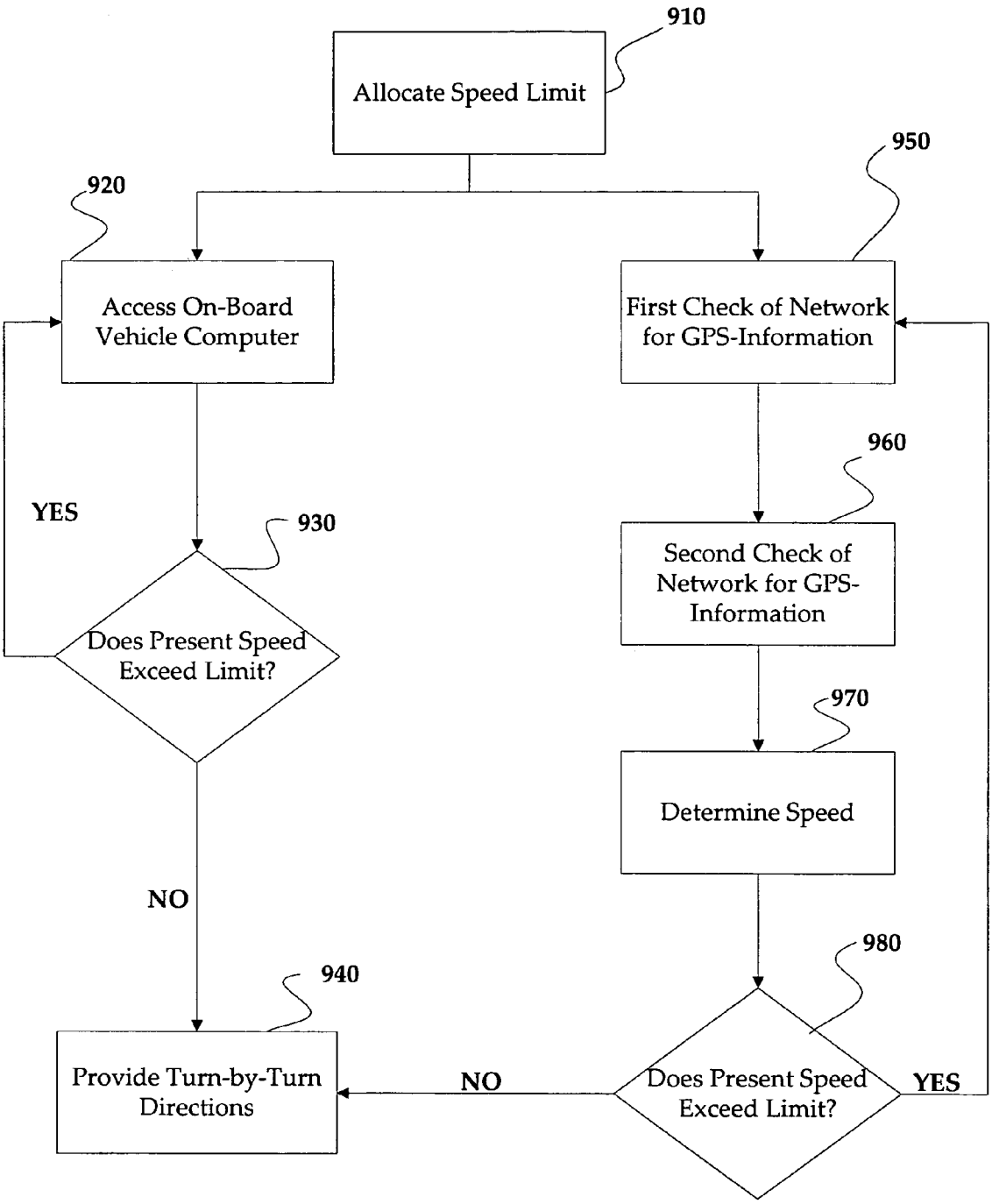

910
Allocate Speed Limit
920
Access On-Board Vehicle Computer
950
First Check of Network for GPS-Information
960
Second Check of Network for GPS-Information
930
Does Present Speed Exceed Limit?
YES
970
Determine Speed
NO
980
940
Provide Turn-by-Turn Directions
NO
Does Present Speed Exceed Limit?
YES

FIGURE 9A

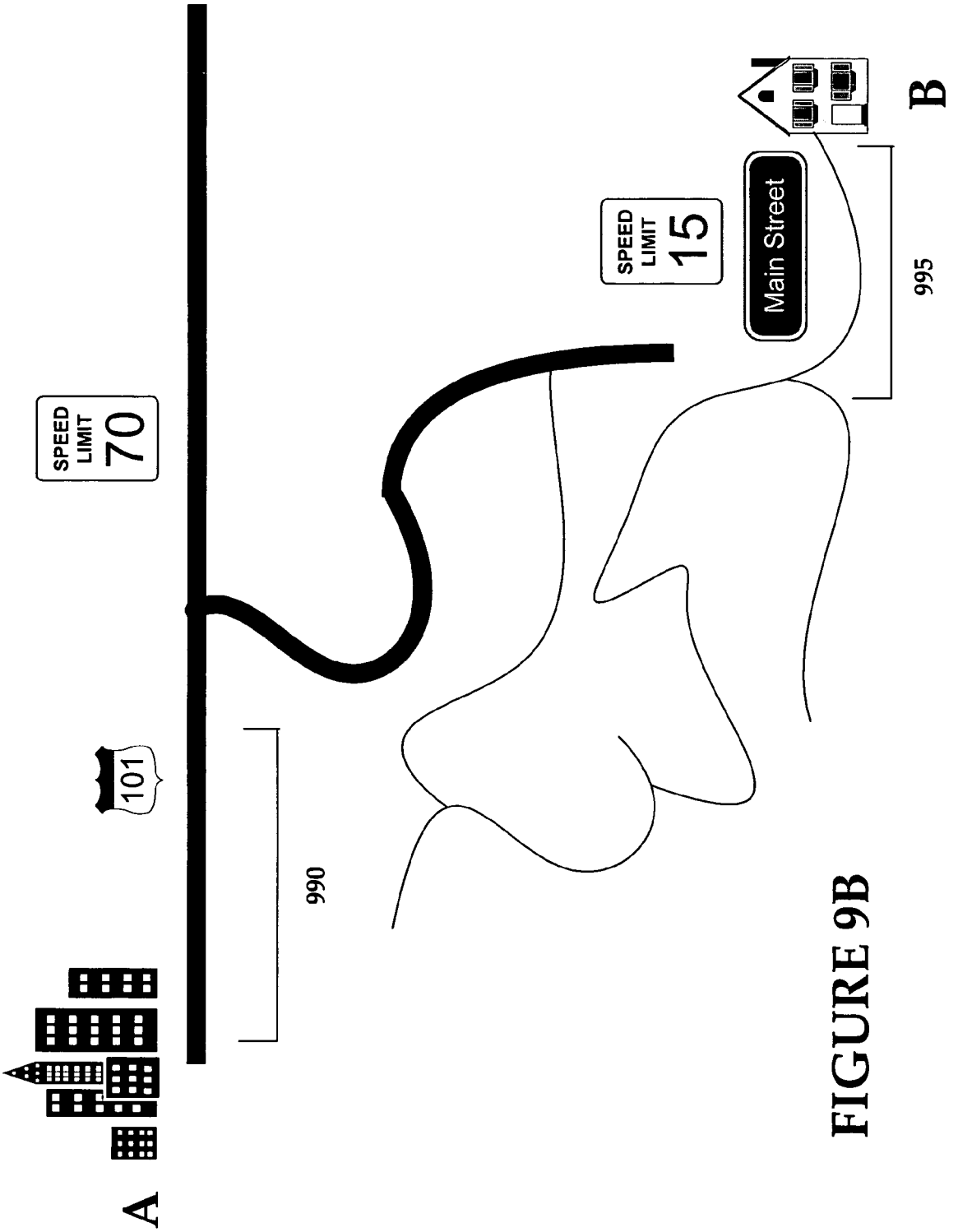


FIGURE 9B

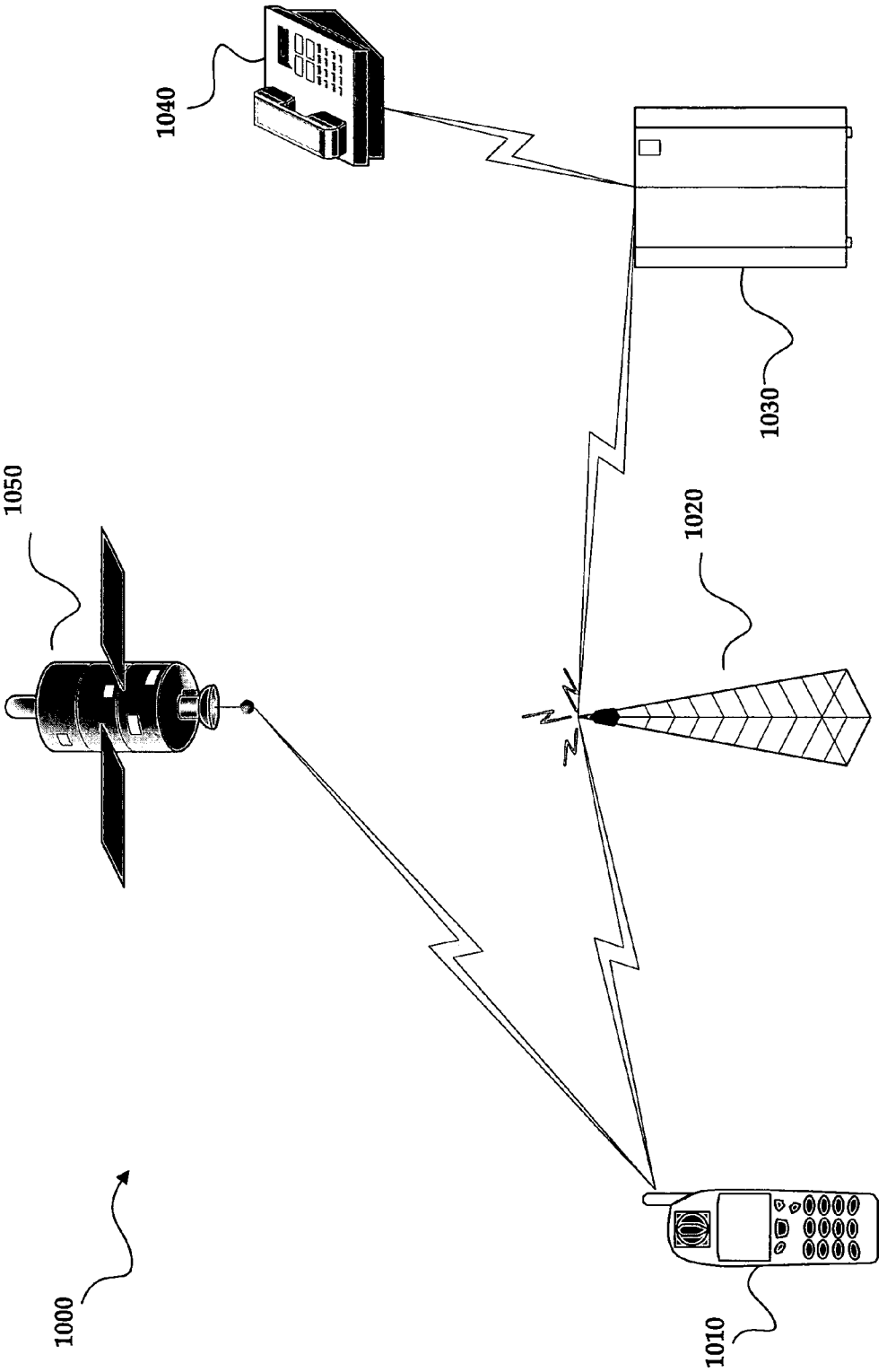


FIGURE 10

INTELLIGENT UTILIZATION OF RESOURCES IN MOBILE DEVICES

BACKGROUND

1. Field of the Invention

The present invention relates to use of the Global Positioning System (GPS) and other location based resources in mobile devices such as cellular phones and handheld devices. More specifically, the present invention relates to intelligent utilization of GPS and location based resources in a mobile device in order to preserve battery life of the mobile device and minimize network bandwidth resources accessed by the mobile device.

2. Description of the Related Art

Operation of the GPS

The GPS is a series of twenty-four space-based satellites transmitting signals to a GPS receiver on the ground. Each GPS satellite transmits data that indicates that particular satellite's location and the current time. All GPS satellites synchronize operations so that these repeated signals are transmitted at the same instant as provided by atomic clocks at the U.S. Naval Observatory and an atomic clock on board each GPS satellite.

Signals emitted by GPS satellites arrive at a GPS receiver at different times because some GPS satellites are farther away than other GPS satellites in relation to the GPS receiver; information relating to the location of each GPS satellite is included in GPS satellite transmissions. The distance to a GPS satellite from a GPS receiver can be determined by the time it takes for a GPS satellite signal to reach a GPS receiver. The GPS receiver can calculate its location in relation to these GPS satellite transmissions through a process known as trilateration. Through trilateration, a GPS receiver measures the distance from the GPS satellite using travel time of the GPS satellite signals.

For example, the distance from a GPS receiver and a GPS satellite might be 10,000 miles. The location of the receiver relative to the particular GPS satellite is limited to a sphere with a radius of 10,000 miles, the GPS satellite serving as the center point as shown in FIG. **1**A. The distance between the same GPS receiver and a second GPS satellite might be 11,000 miles. As was the case with the first GPS satellite, the location of the receiver relative to the second satellite is limited to a sphere with a radius of 11,000, the second GPS satellite serving as the center point as shown in FIG. **1**B. Combining the information from these two GPS satellites relative to the GPS receiver, we can determine that the GPS receiver is located "somewhere" where the two spheres intersect. By obtaining a relative measurement from a third GPS satellite (e.g., 12,000 miles), the location of the GPS receiver is further narrowed to a point where the 10,000 miles and 11,000 mile spheres intersect with the 12,000 mile sphere as shown in FIG. **1**C.

Mobile Devices and the GPS

With the proliferation of mobile devices such as cellular phones-over 150,000,000 cellular phones are presently in service—the mobile device handset has become increasingly functional beyond that of a mere telephonic device. Many cellular phones are now integrated with other mobile features such as a Personal Digital Assistant (PDA), camera, instant messaging and electronic-mail. The Federal Communications Commission, too, recognized this proliferation and the possible safety advantages of equipping mobile devices with GPS tracking under its E911 mandate.

While a 911 emergency phone call placed from a land-line is associated with a phone number assigned to a physical address, a 911 emergency phone call placed from a cellular phone can originate from the user's home but also from, for example, the user's office, while on vacation, or even while stranded in a remote location. Sending an emergency response team to the user's home address when the call was placed in one of these latter locations fails to provide the necessary emergency services where needed but also distracts those services from other possible emergencies. GPS tracking solves this conundrum by associating a phone number with actual physical location. In this regard, GPS technology in cellular handsets and other mobile devices also offers additional commercial advantages such as the user determining their location or obtaining turn-by-turn directions to a particular destination.

Receipt of GPS satellite signals is not a simple feat, however, especially for a mobile device with less power than a conventional GPS receiver that is designed for—and only for—receipt of GPS signals. Mobile devices such as cellular phones are, obviously, phones first and foremost. Additional features such as electronic mail and GPS functionality require additional processing power in the mobile device that represents an additional strain on battery availability in addition to another strain on outside resources such as a GSM (Global System for Mobile Communications) network that allows a user to connect to a proprietary cellular network via local base stations.

Representing a further strain on battery and network resources is the fact that GPS signals shift in frequency due to the relative motion between, for example, a handset GPS receiver and the constant motion of GPS satellites. This Doppler frequency shift requires the GPS receiver to, first, find the frequency of the signal before the GPS receiver can lock onto the signal and make a determination of location. As such, prior knowledge of a GPS satellite's position and velocity data and the initial handset receiver position can reduce the number of frequencies to be searched because the GPS receiver directly computes the Doppler frequency shift instead of searching over a whole possible frequency range.

Many GPS equipped cellular phones are also equipped with technology known as the Assisted Global Positioning System ("A-GPS"). A-GPS uses a combination of GPS satellites and cellular phone base stations to pinpoint location of the mobile device and its GPS receiver and to offer a determination of location that is more accurate than GPS alone. Mobile device GPS receivers, in correlation with an estimate of the mobile handset's location as determined by a cell-sector, can predict with greater accuracy the GPS signal the handset will receive and send that information to the mobile device handset. With this assistance, the size of the frequency search space is reduced and the time-to-first-fix (TTFF) of the signal is reduced from minutes to seconds. A-GPS handset receivers can also detect and demodulate signals that are weaker in magnitude than those required by a traditional GPS receiver.

A-GPS requires precise timing information to perform satellite signal processing. A-GPS can utilize precise time from a synchronized network, which provides optimized TTFF and sensitivity, or derive it on either a synchronized or an asynchronous network from aiding data received from an assistance server. The assistance server communicates with the GPS receiver via a wireless network link. The assistance server, generally, provides three types of data to the GPS receiver: GPS satellite orbit and clock information; initial position and time estimate; and for A-GPS-only receivers, satellite selection, range, and range-rate informa-

tion. The assistance server is also able to compute position solutions, leaving the GPS receiver with the sole job of collecting range measurements. With assistance from the network, the receiver can operate more quickly and efficiently than it would unassisted, because a set of tasks that it would normally handle is shared with the server. The architecture of conventional GPS receiver implementation compared to that of an A-GPS implementation is reflected in FIGS. **2**A and **2**B, respectively.

A-GPS operates on any air interface network, synchronized or not, without requiring any costly equipment to derive time, and will operate with enhanced efficiency and performance on precisely synchronized networks. The A-GPS architecture, in and of itself, helps increase capabilities on the cellular phone with regard to battery conservation. Nevertheless, constantly querying the GSM Network and/or GPS satellite network represents an ongoing drain on battery power in addition to a strain on requisite networks. Therefore, there is a need in the art for a GPS handset solution that incorporates A-GPS architecture with an intelligent system for making queries of location on an as-needed basis.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A–**1**C illustrates an operation of three GPS satellites to determine a position of a GPS receiver;

FIGS. **2**A and **2**B illustrate an operation of a traditional GPS receiver and a GPS engine operating in conjunction with an A-GPS assistance server;

FIGS. **3**A and **3**B show an exemplary GPS-equipped cellular telephone;

FIGS. **4**A–**4**D shows use of the exemplary GPS-equipped cellular telephone to provide turn-by-turn directions;

FIG. **5** illustrates a GPS module and intelligent activation module of the present invention as it would interact with an antenna module, according to an exemplary embodiment;

FIG. **6** reflects an exemplary intelligent utilization of GPS resources as they pertain to final destination information;

FIG. **7** reflects an exemplary intelligent utilization of GPS resources utilizing deltas and map information;

FIG. **8** reflects an exemplary intelligent utilization of GPS resources utilizing predetermined settings;

FIG. **9** reflects an exemplary intelligent utilization of GPS resources utilizing speed information; and

FIG. **10** illustrates an interaction between a GPS-equipped cellular telephone, a base station, a switching station and a GPS satellite.

SUMMARY OF THE INVENTION

The present invention advantageously provides a mobile device comprising a GPS module and an intelligent activation module. The GPS module comprises a chip configured to receive location based information from at least one network. Location based information can comprise GPS-information that may be provided by a GPS-network. The use of the term 'location based information' throughout the specification is meant to be illustrative and is not to be interpreted as limiting the scope of the invention to only GPS-information. The intelligent activation module is configured to control the activation of the GPS module dependent upon at least one control setting. By intelligently activating the GPS module on an as-needed basis, resources such as network bandwidth and battery power are conserved.

The present invention also provides a method for intelligently utilizing resources in a mobile device by determining when access to a GPS-information network is required as defined by final destination information. According to this method, the intelligent activation module will allow the GPS module to access a GPS-information network when the mobile device is within a defined 'buffer' zone from the final destination.

The present invention also provides a method for intelligently utilizing resources in a mobile device by determining when access to an A-GPS-information network is required as defined by changes in deltas as they related to proximity to a final destination. Access to GPS-information prior to accessing the A-GPS network is limited to GPS-only network information.

The present invention also provides a method for intelligently utilizing resources in a mobile device by determining when access to a GPS-information network is required as defined by a pre-determined user setting related to distance from the final destination. Upon arriving within the predetermined distance from the final setting, the GPS module will regularly access a GPS-information network to obtain location information and provide turn-by-turn directions. All GPS-information queries prior to providing turn-by-turn directions are limited to a determination of location as related to distance from the final location.

The present invention also provides a method for intelligently utilizing resources in a mobile device by determining when access to a GPS-information network is required as defined by speed of the mobile device. If a mobile device is traveling over a certain speed, the intelligent activation module will make a determination that turn-by-turn directions are not required and that information-intensive queries to a GPS-information network should be limited. If the mobile device is traveling under a certain speed, the intelligent activation module will make a determination that turn-by-turn directions are required and that information-intensive queries to a GPS-information network should be more frequent. The present invention also recognizes queries to a network (or lack thereof) dependent on the mobile device traveling at less than a particular speed.

DETAILED DESCRIPTION OF AN EXEMPLARY EMBODIMENT

FIG. **3**A illustrates an exemplary GPS-equipped mobile device **300**A. The mobile device **300**A comprises a mobile device housing **310** and antenna outcropping **320**A. The mobile device housing **310** is, generally, a lightweight and impact resistant plastic or other contoured molding designed for the ergonomic benefit of the user but also to protect necessary cellular components inside the mobile device housing **310**. These components, as illustrated in FIG. **3**B, often include, for example, analog-to-digital and digital-to-analog conversion chips **365**, a digital signal processor **370**, a microprocessor **375**, various RF **380** and power components **385**, and internal antenna support **320**B. The mobile device **300**B further comprises functional modules **390**, which will be discussed in more detail in connection with FIG. **5**. Depending on the particular manufacturer of the mobile device **300**, certain components might be absent or integrated with other components.

The mobile device housing **310** is, generally, also constructed to allow for the integration of a keypad **330** and display **340** as well as a speaker **350** (for listening to a phone conversation) and microphone **360** (for engaging in a phone conversation). Many mobile devices **300**A also comprise a

battery port (not shown) for providing D/C power to a mobile device **300**A. Various ports (not shown) may also be provided in the mobile device housing **310** whereby a 'hands-free' ear-piece and microphone can be connected to the mobile device **300**A in addition to, for example, an A/C power cord for recharging the mobile device **300**A.

Similar ports may be provided for connecting the mobile device **300**A with third-party devices designed to be complementary and compliant with the mobile device **300**A operating architecture. An example of a third-party device would be a flash memory card for storing, for example, photographs taken by a camera-phone. A port could also allow access to an automobile's on-board computer providing, for example, speed of the automobile as will be described in greater detail in this disclosure.

The antenna outcropping **320**A is, generally, utilized when a user makes a cellular phone call. Referring now to FIG. **10**, upon initiating the call, a signal is sent from the antenna outcropping **320**A of a cellular device **1010** to a base station antenna **1020**. The base station **1020**, in turn, assigns an available RF channel upon which voice information is transferred to the base station **1020**. These voice signals are then sent to a switching station **1030** which transfers the call to its destination **1040**. In some embodiments, the antenna outcropping **320**A is not necessary due to the power of the RF components housed inside the mobile device housing **310**. In some embodiments, like those utilizing GPS and receiving information from a GPS satellite **1050**, an antenna outcropping **320**A might be preferred to increase the transmission and receipt strength of various signals related to GPS or A-GPS.

FIG. **4** reflects an exemplary use of the GPS-equipped mobile device **300**A to provide turn-by-turn directions to a user. In FIG. **4**A, for example, the display **340**A reflects the present position **410**A of the user in addition to a desired destination **420** of the user. The display **340**A also reflects the present necessary direction (north) of travel **430**A as well as the distance **440**A (e.g., 0.4 miles) the user should travel in that particular direction. FIG. **4**B reflects a next 'segment' of travel for the user to arrive at their desired destination **420**, the user having completed traveling 0.4 miles in a northern direction as reflected in FIG. **4**A.

As evidenced in FIG. **4**B, the user's present position **410**B has changed since the user traversed a distance and direction reflected in FIG. **4**A. Additionally, the user will be required to change their direction of travel **430**B, in this case, a right hand turn to the east in 0.9 miles as reflected by distance **440**B.

FIG. **4**C reflects a next 'segment' of travel, the user having traversed the direction and distance reflected in FIG. **4**B. In this example, now at a new location **410**C, the user is required to make another right hand turn to the east in 0.2 miles as reflected by direction **430**C and distance **440**C. FIG. **4**D continues the turn-by-turn direction example whereby the user now makes their final turn to their desired destination **420**.

A desired destination **420** can be provided through a variety of means. For example, a user may manually enter the desired destination **420** into the mobile device **300**A through the use of the keypad **330**A (FIG. **3**A) in response to a graphic user interface provided on the display **340**A (FIG. **3**A) of the mobile device **300**A by GPS or directional software installed on the mobile device **300**A. This software can be 'downloaded' to the mobile device **300**A or can be 'pre-installed' when a user purchases the mobile device **300**A.

Alternatively, the user can provide the desired destination **420** to the mobile device **300**A in response to voice prompts from the speaker **350**A (FIG. **3**A). In response to these prompts, the user can vocally provide information through the microphone **360**A whereby voice-recognition software analyzes utterances provided by the user to determine the desired destination **420**. The information provided by the user is analyzed by voice-recognition software, which may be installed on the mobile device **300**A or at a remote server housed at, for example, a base station may be subsequently confirmed by the user through prompts on the display **340**A and responses on the keypad **330**A or through prompts by the speaker **350**A and responses through the microphone **360**A (FIG. **3**A). Input related to the desired destination **420** initially provided via the keypad **330**A can be confirmed in a similar manner.

The desired destination **420** can also be provided from a remote location (not shown) such as a computer terminal whereby a user provides the necessary information to a user interface hosted by a particular cellular carrier. This information is, in turn, delivered to the mobile device **300**A via a wireless transmission. Such a means of providing the desired destination **420** allows for ease of use as the mobile device keypad **330**A or microphone **360**A may prove cumbersome in providing certain information. A particular starting point (e.g., a present position **410**A) can also be provided in any of these methods (e.g., keypad, voice, computer terminal) if the user knows they will be initiating a journey at a later point in time or location.

FIG. **5** illustrates the exemplary relationship between a GPS module **510**, an intelligent activation module **520**, and antenna module **530** of the functional modules **390**. The terminology 'GPS module' does not necessarily refer to a GPS-only module. References to a GPS module may also include any other type of location determination software, hardware or a combination of the two. The GPS module **510** comprises, at least, a chip for detecting location (e.g., GPS) signals. The GPS module **510** may also comprise additional hardware, software, or a combination of the two (e.g., software embedded in an ASIC chip) necessary to integrate the chip with the operational architecture of the mobile device **300**A (FIG. **3**A). Chips configured to detect location (e.g., GPS) signals can detect signals as low as approximately 153 dBm and have a TTFF around 5 seconds with A-GPS and approximately 35 seconds without any network assistance. These chips may have a footprint of approximately 7 square mm. The exact size, signal detection, and TTFF specifications of the chip are immaterial to the scope of the present invention. Any available chip may be utilized within the GPS module **510** of the present invention so long as it is capable of being integrated with the architecture of the mobile device **300**A. The exact locale of the GPS module **510** is equally immaterial so long as it is located within or coupled to the mobile device housing **310** as to make it an integrated part of the mobile device **300**A.

The exemplary GPS module **510** processes received location based information, be it directly from a GPS satellite or in conjunction with A-GPS, in order to make necessary determinations of location. The GPS module **510** will also interact with various elements of the mobile device **300**A such as the speaker **350**A (FIG. **3**A) and/or display **340**A (FIG. **3**A) in order to provide turn-by-turn directions as described in FIG. **4** visually and/or audibly. The GPS module **510**, in this regard, also comprises the necessary hardware and/or software to convert GPS signals and information into comprehensible information for the user. The GPS module **510** also utilizes information related to a

desired destination **420** in order to generate and provide the aforementioned turn-by-turn directions.

The antenna module **530** is, in some embodiments of the present invention, an integrated part of the physical antenna outcropping **320**A (FIG. **3**A) as reflected in mobile device **300**A. Dependent upon the particular architecture of the mobile device **300**A and the chip utilized in the GPS module **510**, the antenna module **530** can also be an integrated part of the chip whereby the antenna module **530** and GPS module **510** are integrated into one module. In embodiments with an actual antenna outcropping **320**A, the antenna module **530** comprises software for processing signals received and transmitted by the antenna outcropping **320**A. The antenna outcropping **320**A is often comprised of a conical housing and UV-resistant material with a tubular mounting designed for weatherproofing so that the antenna outcropping **320**A can withstand various weather environments (e.g., rain or snow). GPS signals are received by the antenna module **530** and, in some embodiments, amplified and relayed to the GPS module **510** for processing. Some embodiments of the present invention might also comprise a timing module **540** to further enhance received GPS signals and improve determination and reliability of location by the chip embedded in the GPS module **510**. More specifically, the timing module **540** can readjust, reset, and compensate for any timing errors in a GPS and/or GSM network.

The exemplary intelligent activation module **520** works in conjunction with the GPS module **510** in order to intelligently utilize various GPS resources such as battery power and network bandwidth. The intelligent activation module **520** can be configured with any variety of settings whereby the module **520** will only activate the GPS module **510**, or allow for the activation of the GPS module **510**, to make a processing heavy inquiry of a GSM and/or GPS network as is absolutely necessary. Such settings include a 'final destination setting,' a 'delta setting,' a 'predetermined setting,' and a 'speed information setting,' each of which are described in greater detail below. Limiting frequency at which the GPS module **510** accesses a relevant network will result in less strain on the network thereby allowing for increased quality of service for other users in addition to less drain on the battery or other power component **385** (FIG. **3**B) of the mobile device **300**B.

Some of these settings, such as one utilizing speed information, will require periodic activation of the GPS module **510** to acquire information related to distance traveled since a prior query so that the intelligent activation module **520** can deduce the speed of the mobile device **300**A (e.g., distance/time=speed). Other settings, such as a predetermined setting, will only allow for activation of the GPS module **510** at a particular time (e.g., every 30 minutes) or following a particular event (e.g., following the conclusion of a telephone call).

The intelligent activation module **520** comprises the necessary hardware, software, and/or combinations to allow implementation of the various setting described in detail below. These settings can be hardwired into the intelligent activation module **520** as would be the case with an ASIC or be user-determined through pre- or as-needed installation, deletion, or optional utilization by the user. In addition, various algorithms are embodied in the intelligent activation module **520** to make necessary calculations, such as speed of the mobile device **300**A based on the provision of elapsed time and distance traveled as provided by various components of the mobile device **300**A including, but not limited to, the GPS module **510**. Additionally, the intelligent activation module **520** comprises the necessary hardware, software, and/or combination to integrate and interact with other necessary components of the mobile device **300**A as well as being able to activate or, as is necessary, suppress the operation of GPS module **510** whereby resources (e.g., battery power and network bandwidth) are conserved.

FIG. **6** reflects intelligent utilization of resources based on final destination information. FIG. **6**A reflects an exemplary map wherein a user may begin their journey at Point A **610** and arrive at their destination, Point B **620**. Between Point A and Point B are various highways, expressways, city streets, and neighborhood thoroughfares. A user of a GPS-equipped mobile device **300** (FIG. **3**) will have varying familiarity with these segments of roadway and will require varying degrees of information as it pertains to turn-by-turn directions for reaching their ultimate destination.

The fact that a user may rely on turn-by-turn directions provided by a GPS-equipped mobile device **300** indicates certain unfamiliarity with the route of their travels from Point A **610** to Point B **620**. There is a general presumption, however, that a user of a mobile device **300**A with GPS features will have a higher degree of familiarity with their point of origin **610** with regard to utilizing the final destination setting in the intelligent activation module **520** (FIG. **5**). The presumption continues that the user will have an increasing need for more detailed directions (e.g., turn-by-turn directions) as they come closer to their final destination **620**. In that regard, a user can identify a certain 'buffer' or radius **630** from their final destination in which detailed directions (e.g., turn-by-turn) will be required. Alternatively, the intelligent activation module **520** can make a determination of the 'buffer' radius dependent on the complexity of road, turns and so forth. Any location information provided prior to reaching that 'buffer' **630** can be more generalized in terms of the number of a highway or name of a street on which the user may be traveling in addition to being provided on a less frequent basis.

As more generalized and less frequent information is required outside the buffer **630**, the user might be content with location information provided only by a GPS receiver in the mobile device **300**A. Due to Doppler Shift and processing power of a mobile device **300**A, acquiring location information solely though the mobile device's **300** GPS receiver will be more time consuming (possibly a minute or more) and less accurate. This generalized information, however, will likely be sufficient for extended highway driving or in areas of increased familiarity. As such, outside the buffer region **630**, the intelligent activation module **520** can instruct the GPS module **510** (FIG. **5**) to utilize only its GPS receiver and/or suppress utilization of available A-GPS features.

Upon approaching their final destination **620** and, more specifically, the 'buffer' region **630** around that final destination **620**, the user will need more rapidly provided and increasingly accurate information to make turns on, for example, unfamiliar city and neighborhood streets. The delay and decreased accuracy of the GPS-only receiver on a mobile device **300**A will no longer suffice for this purpose. As such, upon arrival at the buffer region **630**, the intelligent activation module **520** instructs the GPS module **510** to begin utilizing A-GPS features and to otherwise terminate any suppression of such features that may have existed. With the GPS receiver operating in conjunction with A-GPS, the result is increased accuracy of location information in addition to more rapid provision of that information to the GPS module **510** that, in turn, provides detailed turn-by-turn directions to the user.

In some embodiments of the present invention, the 'buffer' region **630** may only exist around the final destination **620**. In other embodiments, there may be a plurality of 'buffer' regions **630**. For example, if a user is on an extended journey from their home in California to New York to see family, the user might wish to make a brief stop in Illinois to see friends or other persons of interest.

As such, turn-by-turn directions will also be necessary in the Illinois region. An embodiment providing multiple 'buffer' regions **630** would allow for a 'buffer' region **630** around not only the final destination **620** in New York but also around certain intermediate destinations (e.g., Chicago) where the user is requires detailed driving directions. The buffer region **630** may also be at a starting point **610** (e.g., details as to finding a freeway entrance).

FIG. **6**B details an exemplary process for instructing the intelligent activation module **520** (FIG. **5**) to operate on a final destination setting. Through use of this setting, less network and battery resources are used prior to arriving at a final destination buffer **630** than will be used after arriving at that buffer **630** when A-GPS resources are utilized that consume more network bandwidth and battery power. A user, utilizing the final destination method, will provide the intelligent activation module **520** with information concerning point of origin and destination in step **640**. The user may also provide the intelligent activation module **520** with information pertaining to the size of a final destination buffer **630** in optional step **650**; that is, at what point will more detailed turn-by-turn directions be required. As noted, alternative embodiments allows the 'buffer' **630** to be determined by the intelligent activation module **520**.

After providing this information and initiating their journey, the GPS module **510** of the user's mobile device **300**A will make periodic queries of the GPS network to determine generalized location information in step **660**. If, after making a GPS network query, the intelligent activation module **520** recognizes the mobile device **300** to be within the final destination buffer **630**, the intelligent activation module **520** will instruct the GPS module **510** to begin utilizing available A-GPS resources to acquire and provide more accurate and more frequent location information that will result in increased frequency and accuracy of turn-by-turn instructions in step **680**.

If, however, the intelligent activation module **520** determines that the mobile device **300** is still outside the predetermined final destination buffer **630**, the intelligent activation module **520** will continue suppression of A-GPS resources and/or instruct the GPS module **510** to continue making queries solely on the GPS network and not in conjunction with any GSM of A-GPS features. Directions and location will, at this point, be provided based upon a GPS only determination in step **690**. The process will then continue with the GPS module making a query of the GPS network (step **660**) followed by a determination of whether the location of the device falls within the predetermined buffer region **630** in step **670**.

FIG. **7** reflects an exemplary intelligent utilization of map resources utilizing deltas in map information. Utilizing the delta setting allows the GPS module **510** (FIG. **5**) to continually query a GPS or GSM network but at varying periods of frequency. For example, when a user and their mobile device **300** (FIG. **3**) depart an initial location, there is a presumption of familiarity with their surroundings. As such, it is not necessary for the user to have up-to-the-minute or real time directions. Updates in location via the GPS module **510** may be appropriate at intervals of, for example, 30 minutes to an hour. As the user gets closer to their destination, which is often an unfamiliar area, there will be an increasing need for more up-to-date (real-time) turn-by-turn directions. For example, a user may now require directions at intervals of anywhere from 1 minute to every few seconds.

The GPS module **510**, in conjunction with the intelligent activation module **520**, will recognize the mobile device coming in closer proximity of its final destination through deltas in map information. As the delta changes (i.e., proximity to the final destination decreases or, alternatively, the proximity to the initial point of departure increases) as recognized by the GPS module **510**, the intelligent activation module **520** will instruct the GPS module **510** to make more frequent queries of the GPS or GSM network in order to obtain the most up-to-date positional information.

For example, and as reflected in FIG. **7**, a user will provide a point of origin and a point of destination in step **710**. As the user and their GPS-equipped mobile device **300** (FIG. **3**) begin traveling from their point of origin to their desired destination, a delta will develop between the user and both their point of origin and their point of destination; increasing and decreasing, respectively. Depending on whether the intelligent activation module **520** (FIG. **5**) is programmed to focus on the increasing or decreasing delta, which will result in identical albeit conversely resultant frequency of queries by the GPS module **510** (FIG. **5**), the GPS module **510** will begin to make queries of a GPS and/or GSM network in step **720** as is appropriate.

These queries may initially be, for example, every 30 minutes as may be determined by the user or some other pre-setting (e.g., minimal deltas provide for 1 hour queries whereas significant deltas provide for 30 second queries). The intelligent activation module **520**, using location information provided by the GPS module **510**, will calculate the delta-change in location-relative to their point of origin or ultimate destination in step **730**.

As the delta continues to change (i.e., as the user further distances themselves from their point of origin and decreases the distance to their final destination), the intelligent activation module **520** will interpret the delta to determine whether to allow for increased access of the GPS module **510** to make location intensive queries of the relevant informational network in step **740**. Less frequent queries of the network provide less accurate location information. More frequent queries provide for more accurate information and resulting more accurate turn-by-turn directions but at the cost of increased network bandwidth consumption and drain on a battery (i.e., power component **385**).

If the determination of the delta shows that the mobile device **300** is becoming increasingly close to its final destination (or, alternatively, increasingly distant from its point of origin), the intelligent activation module will, as noted, allow for increased access to the network in step **750**. If the delta is insignificant or does not meet a predetermined setting that will allow for increased access, the intelligent activation module **520** will allow the GPS module **510** to query the network in accordance with its previously determined frequency.

FIG. **8** reflects an exemplary operational setting whereby a user can preprogram the intelligent activation module **520** (FIG. **5**) to activate the GPS module **510** (FIG. **5**) for periodic location information (e.g., every 10 minutes, 30 minutes, 1 hour or at whatever time period the user might choose). This setting proves useful if the user recognizes they will be on roads not requiring directions for long periods of time whereby a user uses, for example, a 1 hour

period for allowing the GPS module **510** to activate and check for location information.

In this predetermined setting, the user can pre-program the intelligent activation module **520** to permit the GPS module **510** activation and subsequent network access at periods to coincide with time of day (as might be provided by the GSM network) or, in another example, distance traveled (as might be provided by an onboard computer in a vehicle). For instance, if a user knows he will not be needing directions, at least, until 100 miles into their journey, the user can preprogram the intelligent activation module **520** to allow the GPS module **510** to make a GPS locality check only after a certain distance has been traveled or passage of time has expired.

If the intelligent activation module **520**, in conjunction with the GPS module **510**, then recognizes that the vehicle and mobile device **300** (FIG. **3**) are approaching the final destination and that turn-by-turn directions will soon be necessary, the intelligent activation module **520** will instruct, or permit, activation of the GPS module **510** that will, in turn, provide the necessary turn-by-turn directions. A determination that turn-by-turn directions will be, or presently are, necessary is an additional predetermined setting that can be provided by the user (e.g., provide turn-by-turn directions when within 30 miles of the final destination).

For example, and as reflected in FIG. **8**, the user can preprogram the intelligent activation module **520** with certain predetermined settings in step **810**. Thus, for example, the settings may allow the GPS module **510** to activate and access the GSM/GPS network every 30 minutes and to recognize that turn-by-turn directions will be required when the mobile device **300** is within 25 miles of the final destination.

Upon the expiration of 30 minutes, that is, the occurrence of a predetermined setting in step **820**, the intelligent activation module **520** will allow the GPS module **510** to make a periodic location check in step **830**. If the location of the vehicle and mobile device **300** coincides with a predetermined setting as to when turn-by-turn directions will be necessary in step **840** (e.g., the vehicle and mobile device **300**A are within 25 miles of the final destination), then the intelligent activation module **520** will further allow the GPS module **510** to make regular and unhindered queries of the relevant network to provide such directions in step **850**.

Similar queries can be made with regard to distance traveled as may be determined by the GPS module **510** and intelligent, activation module **520** or as may be more directly reflected by on-board computer information from the vehicle.

Referring now to FIG. **9**, an exemplary embodiment of the present invention is depicted whereby GPS resources are intelligently utilized using speed information. Activation of the GPS module **510** (FIG. **5**) can be made subject to the speed of the mobile device **300**A (FIG. **3**A) containing the GPS module **510**. That is, a vehicle in which the mobile device **300**A is located and its speed of travel can affect the regularity at which the GPS module **510** is activated or, alternatively, the time at which it is suppressed and prevented from accessing a GPS and/or GSM network.

For example, if a vehicle is traveling at 70 miles per hour, it is likely that the vehicle (and the mobile device **300** traveling therein) is traveling on a highway **990** as is reflected in FIG. **9**B. Highway travel, generally, will not require turn-by-turn directions as can be offered by the GPS module **510** as the vehicle is traveling in a mostly direct route from point A to point B. As such, the intelligent activation module **520** in the mobile device **300** can recognize a high speed of travel being equivalent to highway driving, and make an intelligent determination that the user does not require continuous turn-by-turn directions or, at least, providing of location and/or direction at a more sporadic interval. Through the less regular activation of the GPS module **510**, there is a resulting less drain on the battery (i.e., power component **385**) and network bandwidth resources.

A determination of speed can be made in a variety ways. In an exemplary embodiment, the mobile device **300** containing the GPS module **510** can interface directly with the vehicle through an on-board computing device **920** providing information such as speed. This intelligent activation module **520**, based on that speed information, makes a determination **930** of when the GPS module **510** should be activated to make regular and resource intensive queries of the relevant GSM and/or GPS networks. In this instance, the determination **930** will be based on whether the vehicle and mobile device **300** are exceeding a certain speed equated to highway travel therein reflecting the lack of a need for turn-by-turn directions **940** as would be offered through activation of the GPS module **510**.

In another embodiment, the GPS module **510** can be activated on a pre-determined schedule or on some other dynamic basis, as might be programmed into the intelligent activation module **520**, to make a quick-determination of location since the previous GPS module **510** activation and locale determination to, in turn, allow for deduction of distance traveled and, based on time elapsed, the average speed for traversing that distance. Based on that speed, the intelligent activation module **520** will determine if regular queries to a GSM and/or GPS network are necessary for turn-by-turn directions.

For example, if the GPS module **510** is first activated **950** (e.g., at 1:00 PM) and makes a determination that the mobile device **300** is at one locale and, later, is re-activated **960** (e.g, at 2:00 PM) and determines the mobile device **300** to be at a second locale, the intelligent activation module **520**, through any variety of mathematical algorithms for measuring distance or, alternatively, acquiring such information from, for example, a map database can determine that the distance between the two query points is 75 miles. As the mobile device **300** traveled that 75 mile distance in one hour, the intelligent access module **520** can then determine that the average speed **970** for the mobile device **300** is 75 miles per hour (75 miles/1 hour=75 miles per hour). Recognizing this speed to be indicative of highway travel **980**, the intelligent activation module **520** will instruct the GPS module **510** that turn-by-turn directions are not presently necessary thereby causing the GPS module **510** to shut down (or remain in that state) or to otherwise enter a 'sleep' or 'hibernation' mode whereby the GPS module **510** will not unnecessarily consume battery power or network bandwidth. If the speed does not exceed a predetermined speed, then the intelligent activation module **520** will permit activation of the GPS module **510** to provide turn-by-turn directions **940**.

The intelligent activation module **520**, in this operational setting, can be programmed with a variety of variables. For example, the speed to be equated with highway driving can be determined by the user **910**. That is, the user can program the intelligent activation module **520** to equate travel over a speed of 55 miles per hour with highway or some other locale of travel not requiring regular GPS module activation **520** and providing of turn-by-turn directions.

The speed can be set to any speed as, for example, a driver might be generally familiar with city streets in a certain area where the user might travel at speeds of approximately

30–45 miles per hour. The user, however, might be unfamiliar with a certain neighborhood **995** where the user would travel at a speed of only, for example 10–15 miles per hour. In this example, the user might preprogram the intelligent activation module **520** to only activate the GPS module **510** for turn-by-turn directions when the speed is not in excess of 15 miles per hour (that is, the user is on unfamiliar neighborhood streets and requires detailed directions).

In an alternative embodiment, the frequency at which queries are made by the GPS module **510** can be made inverse to speed. That is, the slower a vehicle travels, the more frequent the queries of the relevant information network.

All of the aforementioned settings and programming of the intelligent activation module **520** can be achieved either by voice instruction, through keypad entry or via a remote terminal that subsequently provides module programming instructions via a wireless transmission.

The above-described embodiments are exemplary. One skilled in the art will recognize and appreciate various applications of the disclosed invention beyond those presently described here. This disclosure is not meant to be limiting beyond those limitations as expressly provided in the claims.

What is claimed is:

1. A method for intelligently utilizing resources in a mobile device, comprising:

receiving destination information;

determining a first delta associated with proximity of the mobile device to a destination as defined by the destination information;

accessing location based information over at least one network at a first frequency of time to obtain location information;

determining a second delta associated with proximity of the mobile device to the destination as reflected by the location information;

comparing the first delta with the second delta to determine a change between the first delta and the second delta;

determining a second frequency of time for accessing location based information over the at least one network, the second frequency of time being associated with the significance of the change between the first delta and the second delta; and

accessing location based information over the at least one network at the second frequency of time.

2. The method of claim **1**, wherein the location based information is GPS-related information.

3. The method of claim **1**, wherein the significance of the change between the first delta and the second delta thereby resulting in the determination of an associated second frequency of time is determined by the intelligent activation module.

4. The method of claim **1**, wherein the significance of change between the first delta and the second delta thereby resulting in the determination of an associated second frequency of time is determined in accordance with a predetermined user setting.

5. A method for intelligently utilizing resources in a mobile device, comprising:

receiving a first frequency of time at which a GPS module is to access location based information over at least one network;

receiving destination information;

receiving a distance from a final destination as defined by the destination information;

accessing location based information over the at least one network at the first frequency of time to obtain location information;

determining whether the mobile device is within the distance from the final destination as reflected by the location information; and

if the mobile device is within the distance from the final destination, accessing location based information over the at least one network at a more frequent frequency of time as is necessary to provide turn-by-turn directions to a user of the mobile device.

6. The method of claim **5**, wherein the location based information is GPS-related information.

7. The method of claim **5**, wherein the first frequency of time is determined by an intelligent activation module.

8. The method of claim **5**, wherein the first frequency of time is determined in accordance with a predetermined user setting.

9. The method of claim **5**, further comprising determining whether the mobile device is within a certain distance from an intermediate destination as reflected by location based information accessed over the at least one network at the first frequency of time; and accessing over the at least one network at a different frequency of time to provide turn-by-turn directions to the intermediate destination.

* * * * *