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[54] **METHOD AND APPARATUS FOR DETERMINING EXPECTED TIME OF ARRIVAL**

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[51] **Int. Cl.^{6}** **G01Z 23/00**
[52] **U.S. Cl.** **701/204**; 701/208; 701/213; 340/994
[58] **Field of Search** 701/204, 206, 701/207, 208, 213, 117, 118, 119; 340/989, 990, 994, 995

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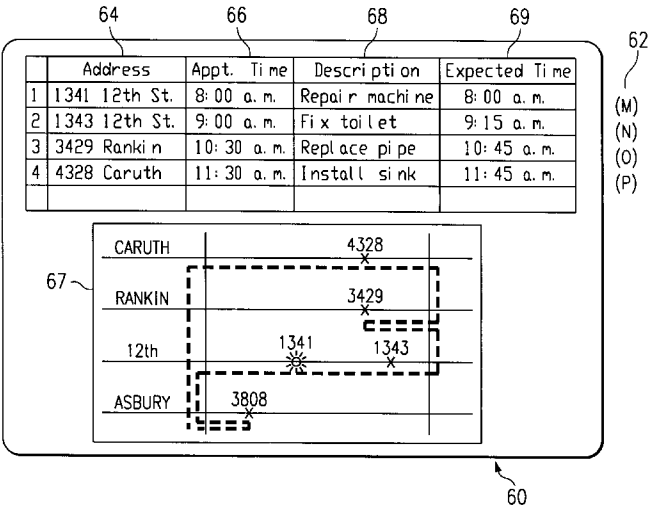
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[57] **ABSTRACT**

A system (**10**) for determining an expected time of arrival of a vehicle (**40**) equipped with a mobile unit (**42**) includes a dispatch (**20**) remotely located from the vehicle (**40**). The dispatch (**20**) generates destination information for the vehicle (**40**), the destination information specifying at least one destination. The mobile unit (**42**) includes a mobile communications device (**90**) to receive the destination information for the vehicle (**40**) generated by the dispatch (**20**). The mobile unit (**42**) also includes a positioning receiver (**80**) to determine a vehicle position. In response to the destination information received from the dispatch (**20**) and the vehicle position, the mobile unit (**42**) determines the expected time of arrival of the vehicle.

52 Claims, 5 Drawing Sheets

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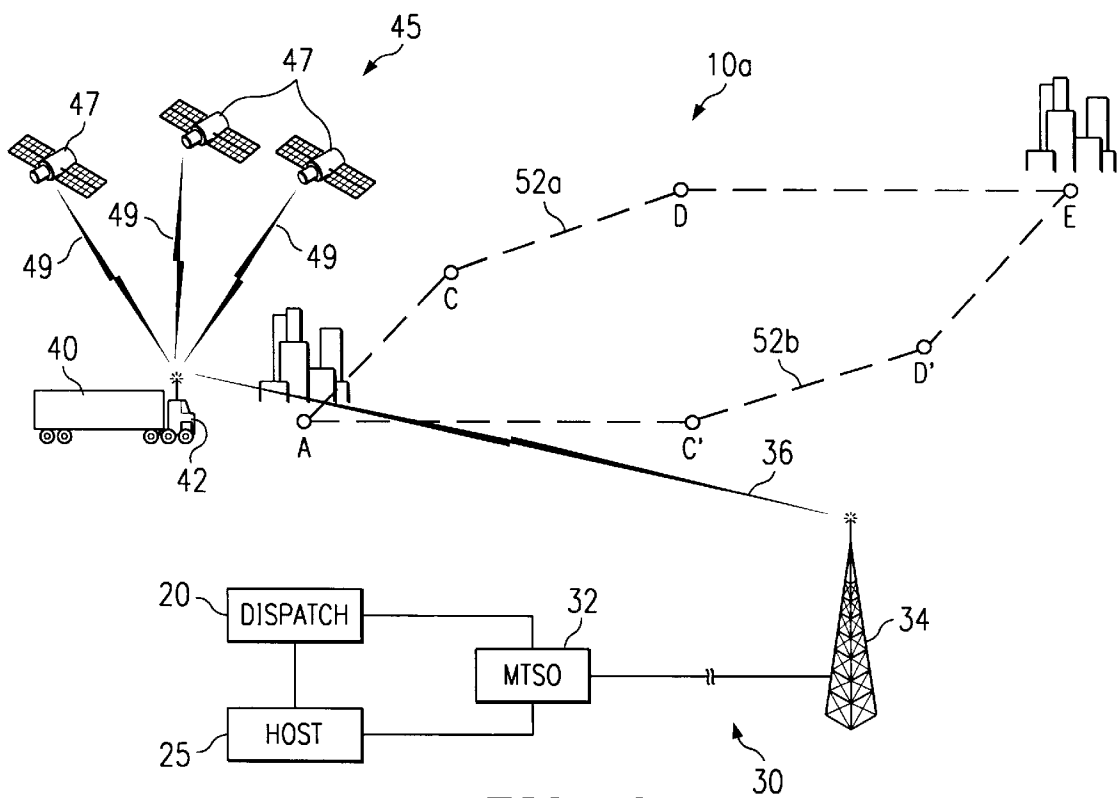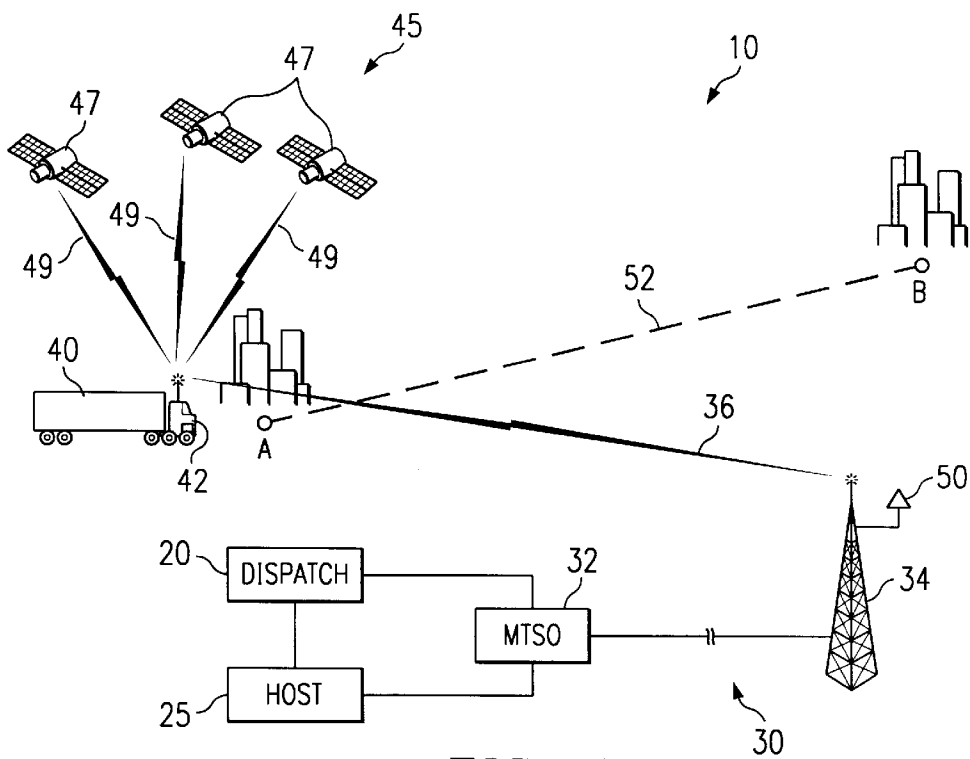
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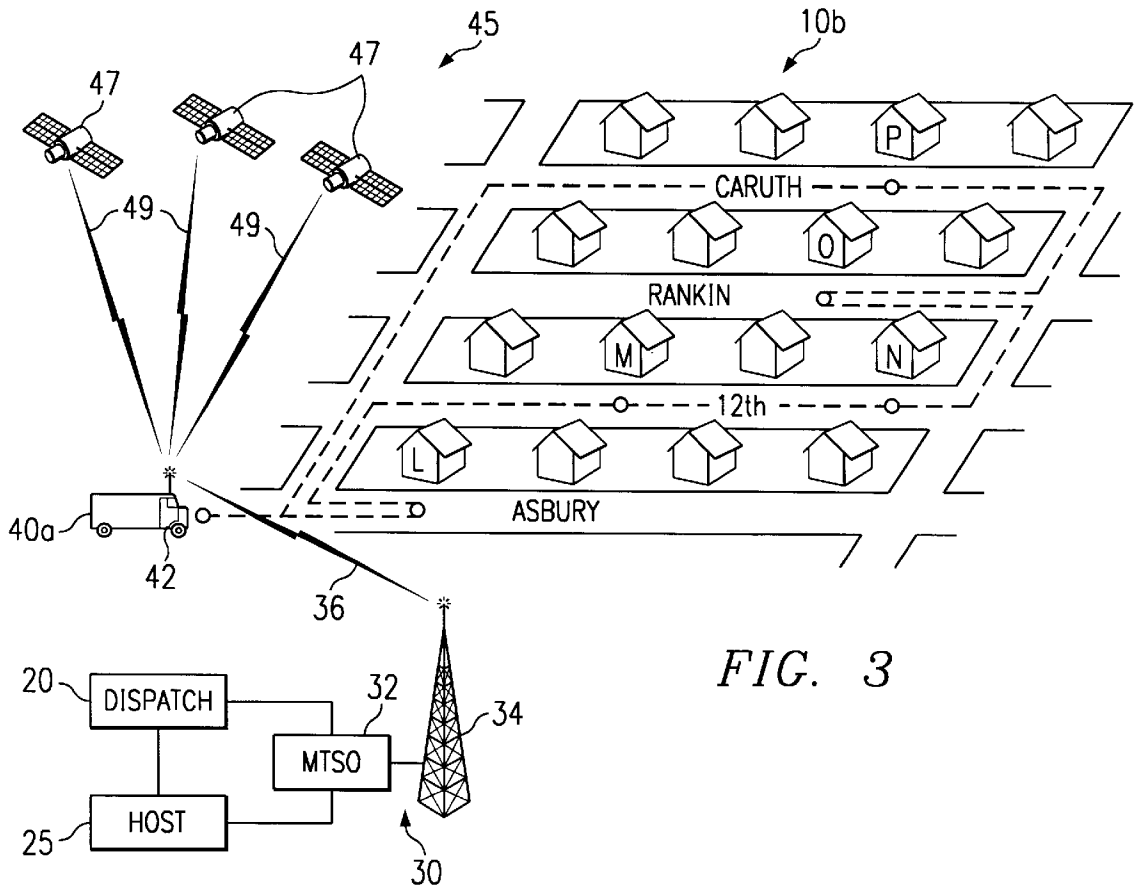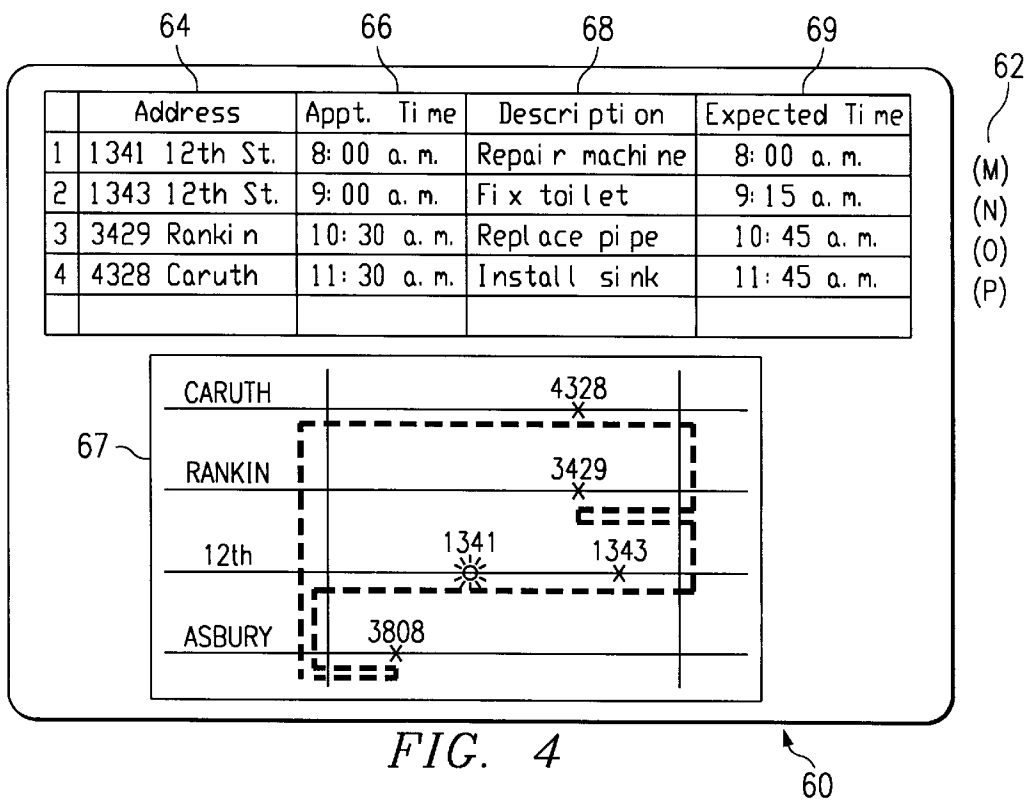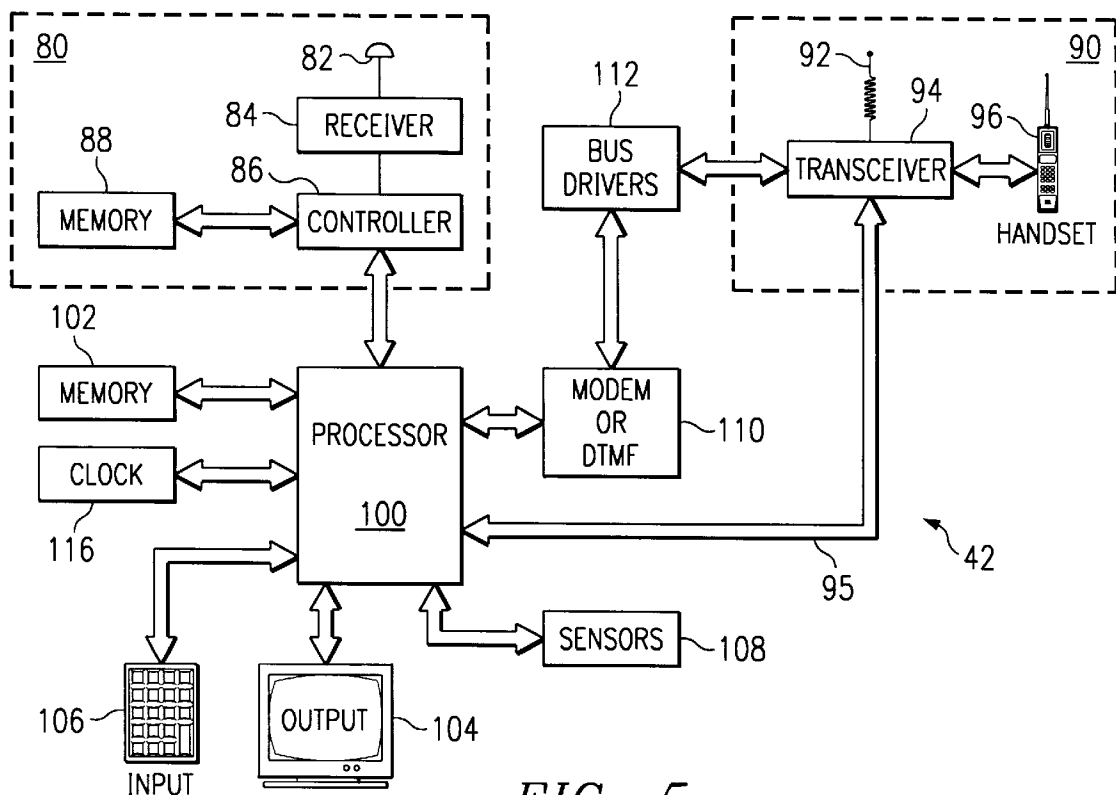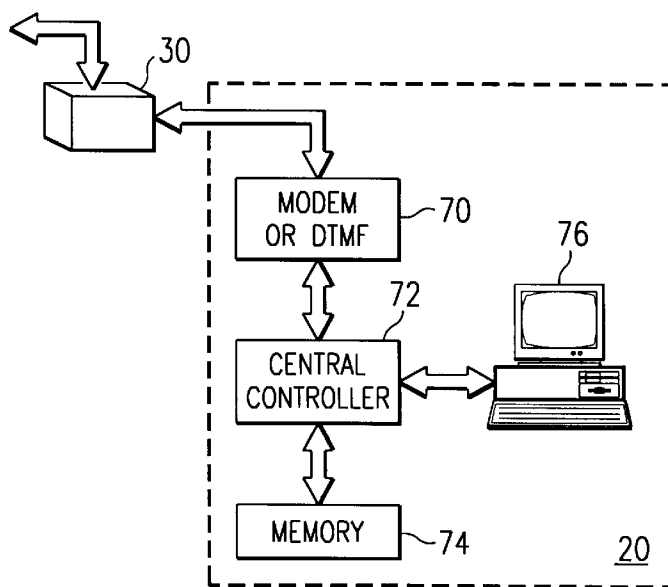
FIG. 1

FIG. 2

FIG. 3

	Address	Appt. Time	Description	Expected Time
1	1341 12th St.	8:00 a.m.	Repair machine	8:00 a.m.
2	1343 12th St.	9:00 a.m.	Fix toilet	9:15 a.m.
3	3429 Rankin	10:30 a.m.	Replace pipe	10:45 a.m.
4	4328 Caruth	11:30 a.m.	Install sink	11:45 a.m.

(M)
(N)
(O)
(P)

CARUTH   4328

RANKIN   3429

12th   1341   1343

ASBURY   3808

FIG. 4

FIG. 5

FIG. 6

210 — GENERATE DESTINATION INFORMATION (INCLUDING APPOINTMENT TIME)

212 — TRANSMIT DESTINATION INFORMATION

213 — IS IT TIME TO DETERMINE VEHICLE POSITION ? — NO

YES

214 — DETERMINE VEHICLE POSITION

216 — DETERMINE EXPECTED TIME OF ARRIVAL

218 — IS EXPECTED TIME OF ARRIVAL LATER THAN APPOINTMENT TIME? — NO

YES

220 — GENERATE LATE INFORMATION

222 — TRANSMIT LATE INFORMATION

224 — DISPLAY LATE INFORMATION

FIG. 7

```
                    ┌──────────────────────────────────┐
                    │  GENERATE DESTINATION INFORMATION │─ 310
                    └──────────────────────────────────┘
                                   │
                    ┌──────────────────────────────────┐
                    │  TRANSMIT DESTINATION INFORMATION │─ 312
                    └──────────────────────────────────┘
                                   │
                 ┌────────────────────────────────────────┐
                 │  DISPLAY INFORMATION TO VEHICLE OPERATOR│─ 314
                 └────────────────────────────────────────┘
                                   │
               ┌──────────────────────────────────────────┐
               │  INITIALIZE DESTINATION AND APPOINTMENT TIME│─ 316
               └──────────────────────────────────────────┘
                                   │
                             ╱─────────────╲  318
              NO  ←─────────╱  IS IT TIME TO ╲
                            ╲ DETERMINE VEHICLE╱
                             ╲   POSITION?   ╱
                              ╲─────────────╱
                                   │ YES
                    ┌──────────────────────────────────┐
                    │     DETERMINE VEHICLE POSITION    │─ 320
                    └──────────────────────────────────┘
                                   │
                        322    ╱─────────────╲
                              ╱      HAS      ╲   NO
                             ╱ VEHICLE REACHED ╲─────→
                             ╲  DESTINATION    ╱
                              ╲      ?        ╱
                               ╲─────────────╱
                                   │ YES        324
                    ┌──────────────────────────────────┐
                    │     SET NEXT DESTINATION AND      │
                    │  CORRESPONDING APPOINTMENT TIME   │
                    └──────────────────────────────────┘
                                   │
                  ┌──────────────────────────────────────┐
                  │  DETERMINE EXPECTED TIME OF ARRIVAL   │─ 326
                  │    AT ONE OR MORE DESTINATIONS        │
                  └──────────────────────────────────────┘
                                   │
                               ╱─────────────╲  328
                              ╱  IS EXPECTED   ╲
              NO  ←──────────╱ TIME OF ARRIVAL LATER╲
                             ╲ THAN APPOINTMENT ╱
                              ╲     TIME?      ╱
                               ╲─────────────╱
                                   │ YES
                    ┌──────────────────────────────────┐
                    │     GENERATE LATE INFORMATION     │─ 330
                    └──────────────────────────────────┘
                                   │
                    ┌──────────────────────────────────┐
                    │    DISPLAYING LATE INFORMATION    │─ 332
                    └──────────────────────────────────┘
                                   │          333
                               ╱─────────────╲
              NO  ←───────────╱  REPORT LATE  ╲
                              ╲  INFORMATION   ╱
                               ╲      ?       ╱
                                ╲─────────────╱
                                   │ YES
                    ┌──────────────────────────────────┐
                    │     TRANSMIT LATE INFORMATION     │─ 334
                    └──────────────────────────────────┘
                                   │
                    ┌──────────────────────────────────┐
                    │     RECEIVE LATE INFORMATION      │─ 336
                    │       AT CENTRAL DISPATCH         │
                    └──────────────────────────────────┘
                                   │          338
                               ╱─────────────╲
              NO  ←───────────╱    UPDATE     ╲
                              ╲  DESTINATION   ╱
                               ╲  INFORMATION  ╱
                                ╲     ?       ╱
                                 ╲───────────╱
                                   │ YES
```

FIG. 8

METHOD AND APPARATUS FOR DETERMINING EXPECTED TIME OF ARRIVAL

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of Application Ser. No. 08/387,221, filed Feb. 10, 1995, now U.S. Pat. No. 5,724, 243, entitled "Method and Apparatus for Determining Expected Time of Arrival" by Kenneth R. Westerlage, Dale E. Beasley, William C. Kennedy III, William L. Hoag, and William C. Saunders, pending.-IN

BACKGROUND OF THE INVENTION

Mobile communications technology has enjoyed substantial growth over the past decade. Many cars, trucks, airplanes, boats, and other vehicles are equipped with devices that allow convenient and reliable mobile communications using a network of satellite-based or land-based transceivers. Advances in this technology have also led to widespread use of hand-held, portable mobile communications devices.

Many customers of mobile communications systems desire an accurate determination of their expected time of arrival at a particular destination, and perhaps reporting of this time to a remote location. For example, a cellular telephone in a vehicle or carried by a person offers a convenient communication link to report expected time of arrival information. One method to determine an expected time of arrival uses the average travel time from a point of origin to a destination. This approach, however, may not be suitable for particular applications that require more accuracy and more frequent updates of an expected time of arrival.

Furthermore, transportation systems would benefit from a dispatching function that monitors and directs the travel route and expected time of arrival of its carriers. For example, dispatchers of long-haul or local vehicles desire a system that allows access to expected time of arrival information to make routing and dispatching decisions.

SUMMARY OF THE INVENTION

In accordance with the present invention, the disadvantages and problems associated with previous techniques used to determine and report the expected time of arrival of a vehicle, person, or object at a particular destination have been substantially reduced or eliminated. One aspect of the present invention provides a system for determining an expected time of arrival that integrates positioning technology with an existing mobile communications infrastructure.

According to an embodiment of the present invention, a system for determining an expected time of arrival of a vehicle equipped with a mobile unit includes a dispatch remotely located from the vehicle. The dispatch generates destination information for the vehicle, specifying at least one destination. A communications link is coupled to the dispatch and receives the destination information for the vehicle from the dispatch. The mobile unit is coupled to the communications link and receives from the communications link the destination information for the vehicle generated by the dispatch. The mobile unit determines a vehicle position and, in response to the vehicle position, also determines the expected time of arrival of the vehicle at the destination identified by the destination information.

According to another embodiment of the present invention, a method for determining an expected time of

arrival of a vehicle includes generating destination information at a dispatch, specifying at least one destination and at least one appointment time. The destination information is transmitted to the vehicle. The vehicle position is determined at the vehicle. In response to the vehicle position, the expected time of arrival of the vehicle at the destination identified by the destination information is also determined at the vehicle.

Important technical features of the present invention include improving the accuracy of determining an expected time of arrival by using a positioning system. In particular, the positioning system provides information to a processor on the vehicle so that the processor may calculate the expected time of arrival based upon the actual position of the vehicle. Additionally, the expected time of arrival may be updated continuously throughout a trip. Another technical advantage includes sending information to the vehicle from a remote location, such as a dispatch. Such information may comprise one or more destinations and corresponding appointment times, route information, information regarding tasks to be performed or packages to be delivered at each destination specified, weather information, traffic updates, or other information. Other technical advantages of the present invention include generating late information when the vehicle determines it will not arrive at a destination at the corresponding appointment time. The present invention may also display this late information to the operator of the vehicle and transmit the late information to a remote location. Important technical advantages may also include reporting to the remote location that the vehicle is not being driven along a predetermined route. Other technical advantages are readily apparent to one skilled in the art from the following figures, description, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and for further features and advantages, reference is now made to the following description taken in conjunction with the accompanying drawing, wherein like reference numerals represent like parts, in which:

FIG. 1 illustrates a system for determining an expected time of arrival at a single destination.

FIG. 2 illustrates a system for determining expected times of arrival at a plurality of destinations;

FIG. 3 illustrates an alternative embodiment of the system for determining expected times of arrival at a plurality of destinations;

FIG. 4 illustrates a display on a vehicle;

FIG. 5 is a schematic representation of a mobile unit;

FIG. 6 is a schematic representation of a dispatch;

FIG. 7 is a flow chart for determining an expected time of arrival at a single destination; and

FIG. 8 is a flow chart for determining expected times of arrival at a plurality of destinations.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 illustrates a system 10 for determining an expected time of arrival of a vehicle 40 travelling from a point of origin A to a destination B. System 10 includes a dispatch 20, a host 25, a communications link 30, and vehicle 40 equipped with a mobile unit 42. System 10 provides an accurate expected time of arrival for vehicle 40 at destination B.

Dispatch 20 is remotely located from vehicle 40. One function of dispatch 20 is to generate destination informa-

tion for vehicle **40**. Such destination information may include one or more destinations, appointment information such as a corresponding appointment time for each destination specified, routing information, information regarding tasks to be performed at each destination specified, average travel time to each destination, rush hour and traffic information, and weather information. Destination information may be any information generated by dispatch **20** that facilitates the control or monitoring of vehicle **40**. As will be explained later in more detail, an important technical advantage of the present invention includes remotely sending information to vehicle **40** from dispatch **20**.

System **10** may also include one or more hosts **25** remotely located from vehicle **40**. In one embodiment, host **25** performs the management and control functions for one or more fleets of trucks. Therefore, system **10** may include many hosts **25** associated with trucking companies, delivery services, or other organizations with vehicles **40** equipped with mobile units **42**. Host **25** generates destination information and transmits this information over a communications link to dispatch **20**. Dispatch **20** collects destination information from several hosts **25** and transmits this information to vehicles **40**. Therefore, dispatch **20** can generate destination information or route destination information generated by host **25**. Alternatively, host **25** can transmit destination information to vehicles **40** over communications link **30**. In essence, some of the functions performed by dispatch **20** may be distributed among several hosts **25**. Host **25** can also receive communications, such as late information, from mobile unit **42** over communications link **30**. For clarity, this description will focus primarily on the functionality of dispatch **20**, but it is understood that host **25** can perform some or all of the functions performed by dispatch **20**.

Communications link **30** is coupled to dispatch **20** and host **25** and allows communication between dispatch **20**, host **25**, and mobile unit **42** on vehicle **40**. Communications link **30** may be any land-based or spaced-based communications system, such as a cellular telephone network. More specifically, communications link **30** comprises a mobile telecommunications switching office (MTSO) **32** coupled to dispatch **20** and host **25**, and at least one transmitter site **34** associated with the cellular telephone network. Dispatch **20** or host **25** generates destination information and sends this information to MTSO **32**. MTSO **32** routes the destination information to transmitter site **34**. Transmitter site **34** then transmits the destination information to mobile unit **42** over a destination information stream **36**. Destination information may be encoded using traditional data encoders, such as a modem or a dual tone multifrequency (DTMF) coder/decoder.

Communications link **30** may be one or a combination of dedicated telephone lines, switched telephone lines, microwave communications links, satellite-based communications links, specialized mobile radio (SMR), enhanced specialized mobile radio (ESMR), a personal communications service (PCS), a citizen's band (CB), a dedicated radio system, such as those used by police and fire fighters, or any other suitable communications link that allows dispatch **20** or host **25** to transmit data to or receive data from mobile unit **42**. Communications link **30** may also be an SS7 backbone link or similar network for linking land-line or cellular switches in a public switched telephone network (PSTN). Such a link allows components of the PSTN to share information for validation, roaming, billing, call routing, and other functions. Communications link **30** may also include intelligence to route information generated at dispatch **20**, host **25**, or mobile unit **42** to multiple selected sites.

Destination information stream **36** may be implemented in a control channel, paging channel, part of a seized voice or data channel, or overhead message stream currently implemented in cellular telephone technology. Presently, the control channel provides paging of incoming calls, hand-off instructions, and other features of the cellular telephone network, but may be modified by one skilled in the art to include transmission of destination information. Destination information stream **36** may also be implemented using any other analog or digital communications link between transmitter site **34** and mobile unit **42**, whether or not the communications link requires seizing of a voice or data channel, and whether or not a data encoder is used. For example, destination information stream **36** may be part of a separate channel requiring mobile unit **42** to re-tune to destination information stream **36** transmitted from transmitter site **34**.

Additionally, there are several developing technologies that may provide a convenient implementation of destination information stream **36**. For example, cellular digital packet data (CDPD) technology allows integration of data and voice using the existing cellular telephone infrastructure. In a CDPD system, digital packets of data and analog voice segments share the same channel. Other developments in digital cellular communications, such as code division multiple access (CDMA) and time division multiple access (TDMA), allow digital data and digital voice signals to be interspersed on a communications channel. These technologies integrate digital data transmission in a communications link **30**, and therefore provide a convenient implementation scheme for destination information stream **36**.

Transmitter site **34** may send destination information to mobile unit **42** in one large packet or in several smaller packets interspersed with other data used for mobile communications. For example, the destination information may be packaged in existing, but unused, bytes of the overhead message stream or in a dedicated protocol. One possible implementation would place destination information in the extended protocol described in the EIA/TIA-533 mobile communications standard, which provides for bidirectional communication between transmitter site **34** and mobile unit **42**.

Mobile unit **42** may continuously monitor destination information stream **36** transmitted from transmitter site **34**. Furthermore, mobile unit **42** may alternatively tune between several destination information streams **36** from several transmitter sites **34** to determine the strongest signal, usually relating to the nearest transmitter site **34**.

FIG. 1 shows mobile unit **42** on vehicle **40**. The present invention contemplates mobile unit **42** being carried by all types of vehicles, including cars, trucks, airplanes, boats, barges, rail cars, truck trailers, on a person's body, along with a package, or any other movable object for which it is desirable to calculate an expected time of arrival.

Because mobile unit **42** is coupled to communications link **30**, mobile unit **42** can communicate with dispatch **20**. Mobile unit **42** receives the destination information generated by dispatch **20** for vehicle **40** over communications link **30**. In particular, mobile unit **42** contains a mobile communications device **90** (FIG. 5) that receives destination information over destination information stream **36**.

Mobile unit **42** may comprise an output device **104** (FIG. 5) operable to present visually or audibly the destination information to an operator of vehicle **40** once the information has been received by mobile unit **42**. For example, referring to FIG. 1, output **104** displays destination infor-

mation that specifies a particular route **52** for vehicle **40** to follow from a point of origin A to a destination B. Once informed of this information, the operator may then drive along route **52**.

Using a positioning system **45**, mobile unit **42** determines the position of vehicle **40**. Specifically, mobile unit **42** comprises a mobile positioning receiver **80** (FIG. 5) operable to receive positioning information from positioning system **45**. Mobile unit **42** receives positioning information over positioning information streams **49** from a plurality of satellites **47**. Mobile unit **42** then determines its position using information from positioning information streams **49**. The positioning information comprises accurate satellite positioning information transmitted by satellites **47** and pseudorange data represented by the time of arrival of positioning information streams **49** to mobile unit **42**.

Positioning system **45** is illustrated as a satellite-based radio navigation system, such as the NAVSTAR global positioning system (GPS). The description uses the NAVSTAR GPS as a representative positioning system **45**, but any land-based or satellite-based system may be used. For example, positioning system **45** may be a land-based LORAN-C, a space-based GLONASS, a dead reckoning system, an inertial navigation system, or any other appropriate positioning technology. As shown in FIG. 1, positioning system **45** comprises a plurality of satellites **47**. In general, positioning system **45** comprises a plurality of space-based or land-based transmitters that emit positioning information.

Satellites **47** maintain accurate and synchronized time and simultaneously transmit positioning information that contains satellite specific and system information required by mobile unit **42** to determine the position of vehicle **40**. The positioning information transmitted by satellites **47** may include high precision clock and ephemeris data for a particular satellite, low precision clock and ephemeris data for every satellite in a constellation ("almanac data"), health and configuration status for all satellites, user text messages, and other parameters describing operation of positioning system **45**.

Positioning system **45** may also comprise additional satellites and one or more positioning receivers. The additional satellites may also communicate positioning information to mobile unit **42**. In one embodiment, a positioning receiver **50** may be mounted on transmitter site **34** to implement differential GPS techniques. Positioning receiver **50** generates correction data that enables mobile unit **42** to more accurately determine the position of vehicle **40**. Positioning receiver **50** transmits the correction data to mobile unit **42** over any suitable link, such as destination information stream **36**.

In response to the vehicle position, mobile unit **42** determines the expected time of arrival of vehicle **40** at the destination identified by the destination information received from dispatch **20** over communications link **30**. In calculating the expected time of arrival, mobile unit **42** may also consider such factors as the expected average speed of vehicle **40**, the actual average speed of vehicle **40**, the time of day during which vehicle **40** is traveling, the average time of a trip from origin A to destination B along route **52** based upon prior travel, weather conditions, and other information impacting the expected time of arrival calculation. Stationary intervals along the route may also impact the calculation of expected time of arrival. These stationary intervals may include mandatory driver rest periods, allocated time to perform tasks at a location, overnight stays, scheduled or

unscheduled maintenance, weigh-ins, or other intervals when vehicle **40** is not moving. The factors used to calculate expected time of arrival may be provided to mobile unit **42** from dispatch **20** or generated locally at vehicle **40**. For example, mobile unit **42** may factor in delays due to weather conditions or mandatory driver rest periods that dispatch **20** is unable to predict.

Dispatch **20** can configure the interval of time between calculations of expected time of arrival by mobile unit **42**. The calculation of expected time of arrival may also be continuous. As discussed below, this interval of time dictates how quickly dispatch **20** will be informed that vehicle **40** may be late in arriving at a particular destination. Furthermore, mobile unit **42** may transmit information on expected time of arrival even if it is determined that vehicle **40** will be on-time at the destination. For example, vehicle **40** may want to report to dispatch **20** a calculated expected time of arrival that is much earlier than the corresponding appointment time. In general, mobile unit **42** may initiate transmission of information to dispatch **20** based on calculation of late arrival, calculation of early arrival, a predetermined reporting interval, or other condition.

System **10** provides a more accurate estimate for expected time of arrival than currently available systems, and may provide these estimates near instantaneously or "on the fly." These estimates may consider the specifics of each trip, such as traffic, weather conditions, and the time of day during which vehicle **40** travels. In some applications, low frequency and low accuracy updates are sufficient. Other applications, however, require greater accuracy and higher frequency updates in near real-time. For example, the operator of a local delivery truck may require accurate, high frequency estimates of expected time of arrival to monitor scheduled activities. System **10** provides these high frequency updates without relying on off-vehicle computations. In addition, the same delivery truck may send lower frequency estimates of expected time of arrival or late information to a remote location, such as dispatch **20**. These estimates may be sent at fixed time intervals, on-demand, or as a result of a predetermined reporting event.

System **10** supports the remote sending of destination information to vehicle **40** from dispatch **20**. If destination information is only input into mobile unit **42** just prior to departure of vehicle **40** from its origin, mobile unit **42** only has available destination information that is current as of the moment of departure. Over a long-haul trucking route or an extended local delivery route, destination information may become outdated before vehicle **40** reaches its final destination. To remedy this problem, dispatch **20** can continuously update the destination information used by mobile unit **42** to calculate the expected time of arrival of vehicle **40** at one or more destinations. For example, at the moment of departure, destination information input into mobile unit **42** may include the preferred route for vehicle **40** and several destinations with corresponding appointment times. During the trip, the preferred route may be shut down, additional destinations and corresponding appointment times may be added to the route, existing destinations and appointment times may be modified or deleted, traffic and truck conditions may change, or any other event may compel dispatch **20** to send updated destination information to vehicle **40**.

Furthermore, destination information is sent directly to mobile unit **42**, rather than input by the operator of vehicle **40**. Since the operator of vehicle **40** is not distracted from his main duty of driving vehicle **40**, the risk of vehicle **40** being involved in an accident is reduced. Furthermore, any human error in inputting destination information into mobile unit **42** is substantially reduced.

Mobile unit **42** may also be configured to notify both dispatch **20** and an operator of vehicle **40** if there is a likelihood that vehicle **40** will be late in arriving at a destination. After mobile unit **42** has determined the expected time of arrival, mobile unit **42** compares this time to a corresponding appointment time specified in the destination information. If the expected time of arrival for vehicle **40** at the destination is later than the appointment time, mobile unit **42** generates late information that may include the expected time of arrival. The interval of time between expected time of arrival calculations dictates the accuracy of the late information. If the expected time of arrival is calculated more often, then dispatch **20** and the operator will more likely be notified sooner that vehicle **40** will be late. For example, suppose the interval between calculations is one hour. Further suppose that vehicle **40** breaks down just after mobile unit **42** has calculated an expected time of arrival. In this case, mobile unit **42** will not generate late information informing dispatch **20** that vehicle **40** will likely be late until almost a full hour has passed. Suppose, however, that the interval between calculations is fifteen minutes. In this case, dispatch **20** is informed sooner that vehicle **40** will probably be late.

The generation of late information is also configurable in several ways. Late information does not need to be generated in all instances where mobile unit **42** calculates the expected time of arrival to be later than the corresponding appointment time at a destination. For example, in most cases dispatch **20** should not be alerted if vehicle **40** will arrive at a destination one minute after the appointment time. Thus, dispatch **20** is operable to configure a delta time parameter, defined as the difference between the appointment time and a later expected time of arrival, based upon the importance of vehicle **40** arriving at a destination on or before the appointment time. Also, just because mobile unit **42** determines that the expected time of arrival of vehicle **40** is later than the appointment time after one calculation does not mean that vehicle **40** will definitely be late. Vehicle **40** may not be behind schedule the next time that mobile unit **42** calculates the expected time of arrival. Thus, dispatch **20** is operable to configure a failure count parameter, defined as the number of calculations of expected times of arrival in a row that are later than the appointment time. For instance, under a failure count of zero, late information will be sent to dispatch **20** the first time mobile unit **42** calculates that the expected time of arrival is later than the appointment time. Furthermore, dispatch **20** does not need to be notified continuously once vehicle **40** has fallen behind schedule. Rather, mobile unit **42** should only renotify dispatch **20** at intervals. Thus, a renotification interval parameter is configurable based upon how often dispatch **20** needs to be informed that vehicle **40** will probably be late. The delta time parameter, failure count parameter, renotification interval parameter, and other operating parameters can be sent from dispatch **20** to vehicle **40** as destination information.

System **10** allows parties to adjust for a late arrival. Mobile unit **42** transmits the late information to dispatch **20** over communications link **30**. Dispatch **20** may then act upon the late information. For example, dispatch **20** may inform parties at the destination that vehicle **40** will not make the appointment time, but rather will arrive at the expected time of arrival determined by mobile unit **42**. Mobile unit **42** may also transmit late information directly to the destination of vehicle **40**. Furthermore, mobile unit **42** may present the late information to the operator of vehicle **40** via output **104** (FIG. **5**). Once informed that vehicle **42** will not arrive at the destination at the corresponding appointment time, the operator may take corrective action, such as making less stops. Additionally, mobile unit **42** may be configured to determine and display the average speed of travel required of vehicle **40** to arrive at the destination at the appointment time.

Mobile unit **42** can be configured to generate late information only if the expected time of arrival at the destination is later than the corresponding appointment time. Other systems that are used for monitoring vehicles provide constant updates on the vehicles. Most dispatchers, however, are not concerned about the exact position of a vehicle at every moment in route to its destination. Rather, dispatchers may be concerned only when a vehicle cannot reach its destination at the appointed time. In such a manner, mobile unit **42** substantially reduces or eliminates the expense of additional personnel, equipment, and communications costs needed to monitor vehicle **40**.

In system **10**, dispatch **20** allows monitoring of at least one vehicle **40** equipped with mobile unit **42**. A large company may operate dispatch **20** to monitor a plurality of vehicles **40** equipped with mobile units **42**. Smaller companies with more limited resources could pool together to either jointly operate dispatch **20** or employ an independent firm to operate dispatch **20**. It should be understood that the present invention contemplates any number and arrangement of dispatches **20** to monitor one or more fleets of vehicles **40**.

FIG. **2** illustrates a system **10**_a_ for determining expected times of arrival at a plurality of destinations. More particularly, system **10**_a_ as shown provides accurate expected times of arrival for vehicle **40** at destinations C, D, and E along route **52**_a_ or destinations C', D', and E along route **52**_b_.

In this embodiment of the present invention, the destination information generated by dispatch **20** includes several destinations and corresponding appointment times. For example, the destination information may specify that vehicle **40** must be at: (1) destination C at 1:00 p.m., Feb. 1, 1995; (2) destination D at 4:00 p.m., Feb. 1, 1995; and (3) destination E at 10:00 a.m., Feb. 2, 1995. Based upon this and other destination information received from dispatch **20** over communications link **30** and from positioning information received from positioning system **45**, mobile unit **42** determines the expected times of arrival of vehicle **40** at destinations C, D, and E.

The operator of vehicle **40** may be required to perform some task, such as dropping off a delivery, at each of destinations C, D, and E. Vehicle **40** is scheduled to arrive at each destination by the corresponding appointment time specified in the destination information; otherwise, mobile unit **42** generates late information for each destination that vehicle **40** will not reach by the corresponding appointment time. For example, assume vehicle **40** arrived at the appointed time at destination C, but is now running late by an hour for destination D. Based on current vehicle position and other factors, mobile unit **42** determines the expected time of arrival at destination D and may also determine an expected time of arrival at destination E. If one or both of these expected times of arrival are after the corresponding appointment time, then mobile unit **42** generates late information for display to the operator and/or transmission to dispatch **20**. Dispatch **20** may then inform parties at destinations D and E that vehicle **40** will arrive at the expected times of arrival determined by mobile unit **42** for those destinations.

A problem that trucking companies have often faced is that operators of trucks, either intentionally or

unintentionally, drive considerable distances from their assigned routes. Because trucking companies must pay for the additional fuel and maintenance expenses associated with the increased mileage, these out-of-route miles are extremely costly to trucking companies. To alleviate this problem, destinations C and D may be used as way points to determine whether the operator of vehicle 40 has driven out of route 52a specified in the destination information generated by dispatch 20. Referring to FIG. 2, dispatch 20 generates destination information specifying that vehicle 40 is to proceed to destination E along route 52a, thus passing through way points C and D.

Mobile unit 42 may be configured to update dispatch 20 when vehicle 40 has reached a way point. In this way, dispatch 20 may be notified that vehicle 40 is still in route. Suppose, however, that instead of following route 52a specified by the destination information, the operator of vehicle 40 drives along route 52b passing through points C' and D'. Based upon the position information received from positioning system 45 and the destination information received from dispatch 20, mobile unit 42 determines that the expected time of arrival of vehicle 40 at way point C will be later than the corresponding appointment time. This will occur at some point along the path between A and C', and most likely at the beginning of the path near A. Therefore, shortly after vehicle 40 takes the wrong route, mobile unit 42 generates late information, including the position of vehicle 40, to inform dispatch 20 and the operator of vehicle 40 of the out-of-route condition. Regardless of the operator's intentions, he may now correct his route in order to minimize the out-of-route mileage. At this point, dispatch 20 may update the destination information for mobile unit 42.

Besides reducing out-of-route mileage, the use of intermediate way points improves the calculation of expected time of arrival. Specifically, the actual distance between the position of vehicle 40 and the destination may not be the road distance. Way points may be used as intermediate points between the position of vehicle 40 and the destination in order to more accurately calculate actual road distance. If used for more accurate distance calculation, way points do not need an associated appointment time and mobile unit 42 need not calculate an expected time of arrival at these way points. Way points may be generated locally at mobile unit 42 using, for example, routing software or databases.

FIG. 3 illustrates an alternative embodiment of system 10a for determining expected times of arrival at a plurality of destinations, with particular application to local delivery or repair services. System 10b provides expected times of arrival for vehicle 40a at destinations L, M, N, O, and P, which define the expected route of vehicle 40a shown by the dotted line. Mobile unit 42 receives destination information generated by dispatch 20 through communications link 30. The operation of system 10b illustrated in FIG. 3 is best understood in reference to both FIGS. 3 and 4.

FIG. 4 illustrates a display 60 on vehicle 40a. Address column 64 includes at least one destination, appointment time column 66 includes at least one corresponding appointment time, and description column 68 includes at least one task to be performed at a destination. The letters in parentheses under column 62, not included in display 60, disclose the corresponding destinations in FIG. 3. Specifically, lines 1, 2, 3, and 4 in display 60 of FIG. 4 correspond to destinations M, N, 0, and P, respectively, shown in FIG. 3. In addition, expected time column 69 displays at least one expected time of arrival calculated by mobile unit 42. Display 60 may also display a map 67 showing the location of vehicle 40a relative to one or more destinations, a

predetermined route for vehicle 40a to follow, and any other information that may be useful to the operator.

In operation, dispatch 20 generates destination information for vehicle 40a. The destination information defines, for example, the delivery schedule for a local delivery service or an appointment schedule for a local service provider. The destination information may be based in part on an allocated amount of time to perform a task at a destination and the expected travel time between destinations. For example, dispatch 20 may allocate fifty-five minutes to repair a machine at destination M and five minutes to travel between destinations M and N. Thus, as shown on line 2 of display 60 in FIG. 4, dispatch 20 generates destination information for vehicle 40a that includes an appointment time of 9:00 a.m. at destination N by adding fifty-five minutes work time plus five minutes travel time to the 8:00 a.m. appointment time at destination M.

Dispatch 20 transmits the destination information to vehicle 40a over communications link 30. Destination information may also be loaded into mobile unit 42 using any suitable input device, such as a keyboard, a direct connection, or any suitable removable storage media.

In a particular example, the operator of vehicle 40a is a plumber who is at destination M, shown on line 1 of display 60. Destination N, shown on line 2 of display 60, is five minutes away from destination M, the time is now 9:10 a.m., and the operator has just finished repairing the machine, as shown under description column 68 of line 1. Mobile unit 42 determines the expected time of arrival of vehicle 40a at destination N to be 9:15 a.m. (as shown in expected time column 69 of line 2), based upon the destination information and the vehicle position. The appointment time for destination N, however, is 9:00 a.m. (as shown in appointment time column 66 of line 2). The late expected time of arrival is displayed to the operator, which may be highlighted, blinking, or in a different color to alert the operator. Moreover, mobile unit 42 has calculated the expected times of arrival at destinations O and P to be 10:45 a.m. and 11:45 a.m., respectively, (as shown in expected time column 69 of lines 3 and 4, respectively) based upon the estimated late arrival at destination N.

Mobile unit 42 generates late information and transmits it to dispatch 20. Dispatch 20 may inform the party at destination N that vehicle 40a will be late, or the operator of vehicle 40a may do so over mobile communications device 90 (FIG. 5). Dispatch 20 may modify the route for vehicle 40a in response to receiving late information, and transmit new destination information with updated routing information and appointment information.

FIG. 5 is a schematic representation of mobile unit 42. Mobile unit 42 includes mobile positioning receiver 80, mobile communications device 90, and other associated hardware and software, described below. Mobile positioning receiver 80 includes antenna 82, receiver 84, controller 86, and memory 88. In operation, mobile positioning receiver 80 receives positioning information from satellites 47 over positioning information streams 49 at antenna 82. Receiver 84 processes the positioning information to extract ephemeris, almanac, and clock correction data. Controller 86 receives the positioning information and computes a vehicle position. These calculations performed by controller 86 may use data stored in memory 88.

Mobile communications device 90 includes antenna 92, transceiver 94, and handset 96. In operation, mobile communications device 90 receives destination information at antenna 92 over destination information stream 36. The

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destination information may be transmitted from dispatch **20** through communications link **30**. More particularly, mobile communications device **90** receives destination information over destination information stream **36** transmitted from transmitter site **34** associated with the cellular telephone network. As described above, the destination information may be in a variety of forms, including one or more destinations, appointment information such as corresponding appointment times, routing information, weather information, average travel time between destinations, tasks to be performed at each destination, operating parameters, and other information. Destination information received by transceiver **94** may be passed to processor **100** over a link **95** or over any other appropriate path, such as through bus drivers **112** and a modem or dual tone multifrequency (DTMF) coder/decoder **110**. Handset **96** provides traditional voice or data communications using mobile communications device **90**.

Processor **100** manages the communicating, calculating, locating, and reporting features of mobile unit **42**. In operation, processor **100** receives a vehicle position from controller **86** and destination information from transceiver **94**. Processor **100** generates an expected time of arrival for vehicle **40** at a particular destination based on the vehicle position and the destination information.

Coupled to processor **100** is memory **102** which may contain programs, maps, databases, and other information required by processor **100** to perform its functions. Memory **102** may be random access memory (RAM), read-only memory (ROM), CD-ROM, removable memory devices, or any other device that allows storage or retrieval of data. Processor **100** and controller **86**, as well as memory **102** and memory **88**, may be separate or integral components of mobile unit **42**. Mobile unit **42** contemplates any arrangement, processing capability, or task assignment between mobile positioning receiver **80**, mobile communications device **90**, and processor **100**.

The expected time of arrival is sent to output device **104**, such as display **60** in FIG. **4**, to generate a table of destinations and corresponding expected times of arrival or, alternatively, a map displaying vehicle **40** and the destinations. Output device **104** also produces audible information, such as expected time of arrival updates or a late announcement, to the operator of vehicle **40**.

Processor **100** is also coupled to input device **106**, which may be a keypad or touch screen, as well as voice recognition software and hardware that can accept audible commands and information. Furthermore, both output device **104** and input device **106** may include fixed or removable storage media, such as magnetic computer discs, CD-ROM, or other suitable media to both receive output from and provide input to processor **100** or memory **102**. Destination information may be provided to mobile unit **42** using input device **106**. This can be accomplished by a direct connection with dispatch **20**, audible or keypad input, or through removable storage media.

A feature of the present invention is that the operator of vehicle **40** may input information into mobile unit **42** when vehicle **40** is at one of its destinations. Using input device **106**, the operator logs information about the load of vehicle **40**, the weight of vehicle **40**, the bill of lading, and any other item for which it is desirable to have a record. The operator may also enter the position of the particular destination based upon the position of vehicle **40** determined by mobile positioning receiver **80**. The position of the destination may be stored in memory **102** along with an identification of that

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destination. Dispatch **20** can then use the accurate position information for that destination in generating destination information for future trips. Also on future trips, mobile unit **42** can use this position information to more accurately calculate an expected time of arrival for that destination.

Processor **100** generates information for transmission to dispatch **20** using mobile communications device **90**. The information may include late information, such as the expected time of arrival of vehicle **40** at a particular destination, the time of reporting, and the vehicle position, or information input by the vehicle operator, as well as any other information collected by processor **100** from various sensors **108**. For example, sensors **108** may include various engine sensors, truck trailer sensors, security monitors, or other devices generating information on the status or condition of mobile unit **42**, vehicle **40**, or its operator. The generation and transmission of this information may be based on a late expected time of arrival, an elapsed time, movement of mobile unit **42**, sensor readings, or any other piece of information that may necessitate reporting to a remote location. The information is sent from processor **100** through modem or DTMF coder/decoder **110** to bus drivers **112**, and then to transceiver **94** for transmission over antenna **92** to a remote location, such as dispatch **20** (FIG. **6**). Information may also be sent directly to transceiver **94** over link **95**. Mobile unit **42** may also include a clock **116** coupled to processor **100** that may be used to synchronize the vehicle position received from controller **86** with destination information received from transceiver **94**.

Components of mobile unit **42** shown in FIG. **5** may be packaged into one or more housings. Mobile unit **42** may be mounted to vehicle **40** or an object to be tracked. Mobile unit **42** may also be packaged as a portable, handheld device that provides personal timing, locating, communicating, and reporting functions. For example, a portable, hand-held mobile unit **42** may be used by police, fire fighters, rescue teams, service and delivery personnel, individuals that may change forms of transportation, or in any other application requiring portability of mobile unit **42**.

FIG. **6** is a schematic representation of dispatch **20**. Dispatch **20** includes a modem or DTMF coder/decoder **70**, a central controller **72**, a memory **74**, an input/output device **76**, and other associated hardware and software. Memory **74** may be RAM, ROM, CD-ROM, removable memory devices, or any other device that allows storage or retrieval of data. Input/output device **76** includes any variety of output devices, such as a display, a speaker to provide audible information, removable storage media, or any other appropriate output device. Input/output device **76** may also include a variety of input devices, such as a keyboard, mouse, touch screen, removable storage media, or any other appropriate input device.

Dispatch **20** generates destination information for one or more vehicles **40** carrying mobile units **42**. In particular, destination information may be input into central controller **72** by a person manually using input/output device **76**, by removable storage media, such as magnetic computer discs or CD-ROM, or any other suitable means to input information into central controller **72**. The destination information may include one or more destinations, corresponding appointment times for each destination, predetermined routes, average travel times from one destination to another, tasks to be performed at each destination, operating parameters, and other information. The destination information is sent from central controller **72** through modem or DTMF coder/decoder **70** to communications link **30** for transmission by transmitter site **34** to mobile unit **42**.

Alternatively, transmission of destination information from dispatch **20** may not require a data encoder.

Central controller **72** also receives information from mobile unit **42** and processes this information to determine expected time of arrival, locate, track, dispatch, and communicate with mobile unit **42**. For example, central controller **72** can maintain a database in memory **74** of all mobile units **42** with their current expected times of arrival, location, status, and relevant sensor readings. This database can also be used to initiate communication with mobile unit **42**. Furthermore, central controller **72** may perform a call delivery function that routes incoming calls to mobile unit **42** through communications link **30**.

FIG. 7 is a flow chart for determining an expected time of arrival at a single destination. Initially, central controller **72** of dispatch **20** generates destination information (at **210**), comprising a destination and corresponding appointment time, for vehicle **40** carrying mobile unit **42**. The destination can be in a variety of forms, such as latitude/longitude, as well as a street address, town or city identifier, highway crossing, or other geographic monument or identifier that can be correlated with a latitude/longitude or other positional coordinate used by mobile positioning receiver **80**. The destination information is sent from central controller **72** through modem or DTMF coder/decoder **70** to communications link **30**, which transmits the destination information (at **212**) to mobile unit **42** on vehicle **40**. Mobile unit **42** receives the destination information via mobile communications device **90**. Receiver **84** of mobile positioning receiver **80** processes positioning information received from satellites **47**, and controller **86** determines a vehicle position (at **214**).

Processor **100** receives the destination information from mobile communications device **90** and the vehicle position from mobile positioning receiver **80**. Based upon this information and other information that may be contained within memory **102**, processor **100** determines the expected time of arrival (at **216**) of vehicle **40** at the destination specified in the destination information.

Processor **100** next determines (at **218**) whether the expected time of arrival is later than the appointment time specified in the destination information received from dispatch **20**. If the expected time of arrival is not later than the appointment time, mobile unit **42** will return to the step of determining vehicle position (at **214**).

If the expected time of arrival is later than the appointment time, processor **100** generates late information (at **220**). Processor **100** transmits the late information (at **222**) to dispatch **20** using mobile communications device **90** and communications link **30**. Processor **100** also displays late information (at **224**) on vehicle **40** using output device **104** to inform the operator.

FIG. 8 is a flow chart for determining expected times of arrival at a plurality of destinations. Initially, central controller **72** of dispatch **20** generates destination information (at **310**), comprising at least two destinations and corresponding appointment times, for vehicle **40** equipped with mobile unit **42**. The destination information is sent from central controller **72** through modem or DTMF coder/decoder **70** to communications link **30**, which transmits the destination information (at **312**) to mobile unit **42** on vehicle **40**. Mobile unit **42** receives the destination information via mobile communications device **90**.

Processor **100** receives the destination information from mobile communications device **90**. Processor **100** displays this information to the operator of vehicle **40** (at **314**) using output device **104**. Using the destination information, processor **100** initializes a destination and an appointment time (at **316**) and resets a late flag (at **318**). Receiver **84** of mobile positioning receiver **80** processes positioning information received from satellites **47**, and controller **86** determines a vehicle position (at **320**).

Processor **100** receives the vehicle position from mobile positioning receiver **80**. By comparing the vehicle position to the destination, processor **100** determines whether vehicle **40** has reached the destination (at **322**). If vehicle **40** has reached the destination, processor **100** sets the next destination and corresponding appointment time (at **324**) specified in the destination information received from dispatch **20**. If vehicle **40** has not reached the destination, processor **100** skips the step (at **324**) of setting the next destination and corresponding appointment time. Based upon the vehicle position, the destination information, and other information that may be contained within memory **102**, processor **100** determines an expected time of arrival (at **326**) of vehicle **40** at one or more destinations. Processor **100** may generate multiple expected times of arrival for multiple destinations based on the current vehicle position.

Processor **100** next determines (at **328**) whether the expected time of arrival is later than the corresponding appointment time. If the expected time of arrival is not later than the appointment time, mobile unit **42** will return to the step of determining vehicle position (at **320**). If the expected time of arrival is later than the appointment time, processor **100** generates late information (at **330**). Processor **100** displays late information (at **332**) on vehicle **40** using output device **104** to inform the operator. Late information may be generated if any of the multiple expected times of arrival are later than their corresponding appointment times.

Processor **100** next determines (at **333**) whether it should report the late information to dispatch **20**, based upon a number of configurable operating parameters, such as the delta time parameter, failure count parameters, and renotification interval parameters. If late information is not reported, processor **100** returns to the step of resetting the late flag (at **318**). If late information is reported, processor **100** transmits the late information (at **334**) to dispatch **20** using mobile communications device **90** and communications link **30**.

Dispatch **20** receives late information from mobile unit **42** (at **336**) through communications link **30**. Late information enters dispatch **20** through modem or DTMF coder/decoder **70** and passes to central controller **72**. Central controller **72** may decide to update the destination information (at **338**) and return to the step of generating destination information (at **310**). If central controller **72** does not update the destination information, mobile unit **42** resets the late flag (at **318**), either autonomously or in response to a signal from dispatch **20**. The method continues by determining the vehicle position (at **320**).

Although the present invention has been described with several embodiments, various changes and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes and modifications as fall within the scope of the appended claims.

What is claimed is:

1. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

    a dispatch remotely located from the vehicle, the dispatch operable to generate destination information for the vehicle, the destination information specifying a plurality of way points;

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a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the communications link comprises a cellular telephone network.

2. The system of claim **1**, wherein the communications link comprises a cellular telephone network.

3. The system of claim **1**, wherein the way points comprise highway crossings.

4. The system of claim **1**, wherein the destination information further comprises an expected travel speed along a predetermined route specified by the way points, the mobile unit further operable to determine the expected time of arrival of the vehicle in response to the expected travel speed.

5. The system of claim **1**, wherein the destination information further comprises traffic or weather information associated with a predetermined route specified by the way points, the mobile unit further operable to determine the expected time of arrival of the vehicle in response to the traffic or weather information.

6. The system of claim **1**, wherein the mobile unit comprises a GPS receiver to determine the vehicle position for use in determining the expected time of arrival.

7. The system of claim **1**, wherein the mobile unit is further operable to select a next way point if the vehicle reaches a present way point.

8. The system of claim **7**, wherein the mobile unit is further operable to communicate audibly information regarding the next way point.

9. The system of claim **1**, wherein the mobile unit is further operable to display the way points on a map.

10. The system of claim **1**, wherein the mobile unit is operable to communicate audibly the expected time of arrival.

11. The system of claim **1**, wherein the destination information comprises an appointment time for each way point, the mobile unit further operable to compare the expected time of arrival to the appointment time.

12. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points;

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the communications device comprises a cellular telephone.

13. The apparatus of claim **12**, wherein the communications device comprises a cellular telephone.

14. The apparatus of claim **12**, wherein the way points comprise highway crossings.

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15. The apparatus of claim **12**, wherein the destination information further comprises an expected travel speed along a predetermined route specified by the way points, the processor further operable to determine the expected time of arrival of the vehicle in response to the expected travel speed.

16. The apparatus of claim **12**, wherein the destination information further comprises traffic or weather information associated with a predetermined route specified by the way points, the processor further operable to determine the expected time of arrival of the vehicle in response to the traffic or weather information.

17. The apparatus of claim **12**, wherein the positioning device comprises a GPS receiver.

18. The apparatus of claim **12**, wherein the processor selects a next way point if the vehicle reaches a present way point.

19. The apparatus of claim **18**, further comprising a speaker to communicate audibly information regarding the next way point.

20. The apparatus of claim **12**, further comprising a speaker to communicate audibly the expected time of arrival.

21. The apparatus of claim **12**, further comprising a display to display the way points on a map.

22. The apparatus of claim **12**, wherein the destination information comprises an appointment time for each way point, the processor further operable to compare the expected time of arrival to the appointment time.

23. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the step of transmitting the destination information to the vehicle is performed using a cellular telephone network.

24. The method of claim **23**, wherein the step of transmitting the destination information to the vehicle is performed using a cellular telephone network.

25. The method of claim **23**, wherein the step of determining at the vehicle the vehicle position is performed using a GPS receiver.

26. The method of claim **23**, wherein the way points comprise highway crossings.

27. The method of claim **23**, wherein:

the destination information further comprises an expected travel speed along a predetermined route specified by the way points; and

determining the expected time of arrival comprises determining the expected time of arrival in response to the expected travel speed.

28. The method of claim **23**, wherein:

the destination information further comprises traffic or weather information associated with a predetermined route specified by the way points; and

determining the expected time of arrival comprises determining the expected time of arrival in response to the traffic or weather information.

29. The method of claim **23**, further comprising the step of selecting a next way point if the vehicle reaches the way point.

30. The method of claim **29**, further comprising the step of communicating audibly information regarding the next way point.

31. The method of claim **23**, further comprising the step of communicating audibly the expected time of arrival.

32. The method of claim **23**, further comprising the step of displaying the way points on a map.

33. The method of claim **23**, wherein the destination information comprises an appointment time for each way point, and further comprising the step of comparing the expected time of arrival to the appointment time.

34. The method of claim **23**, further comprising:

transmitting late information to the dispatch;

generating updated destination information at the dispatch in response to the late information; and

transmitting the updated destination information to the vehicle.

35. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

a dispatch remotely located from the vehicle, the dispatch operable to generate destination information for the vehicle, the destination information specifying a plurality of way points;

a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the way points comprise highway crossings.

36. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

a dispatch remotely located from the vehicle, the dispatch operable to generate destination information for the vehicle, the destination information specifying a plurality of way points;

a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the destination information further comprises traffic or weather information associated with a predetermined route specified by the way points, the mobile unit further operable to determine the expected time of arrival of the vehicle in response to the traffic or weather information.

37. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

a dispatch remotely located from the vehicles the dispatch operable to generate destination information for the vehicle, the destination information specifying a plurality of way points;

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a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the mobile unit is further operable to select a next way point if the vehicle reaches a present way point and to communicate audibly information regarding the next way point.

38. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

a dispatch remotely located from the vehicle, the dispatch operable to generate destination information for the vehicle, the destination information specifying a plurality of way points;

a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the mobile unit is operable to communicate audibly the expected time of arrival.

39. A system for determining an expected time of arrival of a vehicle equipped with a mobile unit, comprising:

a dispatch remotely located from the vehicle, the dispatch operable to generate destination information for the vehicles the destination information specifying a plurality of way points;

a communications link coupled to the dispatch, the communications link operable to receive the destination information for the vehicle from the dispatch; and

the mobile unit coupled to the communications link, the mobile unit operable to receive from the communications link the destination information for the vehicle generated by the dispatch, the mobile unit further operable to determine a vehicle position, the mobile unit further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the destination information comprises an appointment time for each way point, the mobile unit further operable to compare the expected time of arrival to the appointment time.

40. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points;

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications

device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the way points comprise highway crossings.

41. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points:

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the destination information further comprises traffic or weather information associated with a predetermined route specified by the way points, the processor further operable to determine the expected time of arrival of the vehicle in response to the traffic or weather information.

42. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points,

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the processor selects a next way point if the vehicle reaches a present way point.

43. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points;

a positioning device operable to determine a vehicle position;

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information, the processor operable to select a next way point if the vehicle reaches a present way point; and;

a speaker operable to communicate audibly information regarding the next way point.

44. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points;

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning devices the processor operable to receive destination information from the communications device and the vehicle position from the positioning devices the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and further comprising a speaker to communicate audibly the expected time of arrival.

45. An apparatus on a vehicle for determining an expected time of arrival of the vehicle, comprising:

a communications device operable to receive destination information from a dispatch, the destination information specifying a plurality of way points;

a positioning device operable to determine a vehicle position; and

a processor coupled to the communications device and the positioning device, the processor operable to receive destination information from the communications device and the vehicle position from the positioning device, the processor further operable to determine in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the destination information comprises an appointment time for each way point, the processor further operable to compare the expected time of arrival to the appointment time.

46. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information and wherein the way points comprise highway crossings.

47. A method for determining an expected time of arrival of a vehicles comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points and traffic or weather information associated with a predetermined route specified by the plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position,

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information in response to the traffic or weather information.

48. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information; and,

selecting a next way point if the vehicle reaches the way point.

49. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information

selecting a next way point if the vehicle reaches the way point; and,

communicating audibly information regarding the next way point.

50. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information; and, communicating audibly the expected time of arrival.

51. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points and an appointment time for each way point, transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position;

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information; and,

comparing the expected time of arrival to the appointment time.

52. A method for determining an expected time of arrival of a vehicle, comprising:

generating destination information at a dispatch, the destination information specifying a plurality of way points;

transmitting the destination information to the vehicle;

determining at the vehicle the vehicle position,

determining at the vehicle in response to the vehicle position the expected time of arrival of the vehicle at a way point identified by the destination information

transmitting late information to the dispatch;

generating updated destination information at the dispatch in response to the late information; and

transmitting the updated destination information to the vehicle.

*   *   *   *   *