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UNITED STATES DISTRICT COURT

FOR THE CENTRAL DISTRICT OF CALIFORNIA

WESTERN DIVISION

ARRIVALSTAR S.A. and MELVINO TECHNOLOGIES LIMITED, Plaintiffs, v. VISIONARY BUSINESS WORKS, INC. D/B/A FLEETRONIX, GEOMICRO, INC., MANNING NAVCOMP, INC., PEAK WIRELESS, INC., and DOES 1-10, inclusive. Defendants.	Case No.: SACV10-1035-JVS (RNBx) COMPLAINT FOR PATENT INFRINGEMENT DEMAND FOR JURY TRIAL

Plaintiffs ArrivalStar S.A. and Melvino Technologies Limited (collectively, "ArrivalStar" or "Plaintiffs"), by and through their undersigned attorneys, for their complaint against defendants Visionary Business Works, Inc. D/B/A Fleetronix ("Fleetronix"), GeoMicro, Inc. ("GeoMicro"), Manning NavComp, Inc. ("Manning NavComp"), Peak Wireless, Inc. ("Peak Wireless") and DOES 1-10 (Fleetronix, GeoMicro, Manning NavComp, Peak Wireless and DOES 1-10, inclusive are collectively referred to herein as "Defendants") hereby allege as follows:

NATURE OF LAWSUIT

1. This action involves claims for patent infringement arising under the patent laws of the United States, Title 35 of the United States Code. This Court has exclusive jurisdiction over the subject matter of the Complaint under 28 U.S.C. § 1338(a).

THE PARTIES

2. ArrivalStar S.A. is a corporation organized under the laws of Luxembourg and having offices at 67 Rue Michel, Welter L-2730, Luxembourg.

3. Melvino Technologies Limited is a corporation organized under the laws of the British Virgin Island of Tortola, having offices at P.O. Box 3152, RG Hodge Building, Road Town, Tortola, British Virgin Islands.

4. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,618,668 ("the '668 patent"), entitled "System and method for obtaining vehicle schedule information in an advance notification system," issued September 9, 2003. A copy of the '668 patent is annexed hereto as Exhibit A.

5. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,714,859 ("the '859 patent"), entitled "System and method for an advance notification system for monitoring and reporting proximity of a vehicle," issued March 30, 2004. A copy of the '859 patent is annexed hereto as Exhibit B.

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6. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,741,927 ("the '927 patent"), entitled "User-definable communications methods and systems," issued May 25, 2004. A copy of the '927 patent is annexed hereto as Exhibit C.

7. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,804,606 ("the '606 patent"), entitled "Notification systems and methods with user-definable notifications based upon vehicle proximities," issued October 12, 2004. A copy of the '606 patent is annexed hereto as Exhibit D.

8. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,904,359 ("the '359 patent"), entitled "Notification systems and methods with user-definable notifications based upon occurance of events," issued June 7, 2005. A copy of the '359 patent is annexed hereto as Exhibit E. The '359 patent was the subject of an Inter Partes reexamination at the United States Patent and Trademark Office. A Reexamination Certificate was issued on May 25, 2010 and is annexed hereto as Exhibit F.

9. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 6,952,645 ("the '645 patent"), entitled "System and method for activation of an advance notification system for monitoring and reporting status of vehicle travel," issued October 4, 2005. A copy of the '645 patent is annexed hereto as Exhibit G.

10. ArrivalStar owns all right, title and interest in, and has standing to sue for infringement of United States Patent No. 7,191,058 ("the '058 patent"), entitled "Notification systems and methods enabling user entry of notification trigger information based upon monitored mobile vehicle location," issued March 13, 2007. A copy of the '058 patent is annexed hereto as Exhibit H.

11. Defendant Fleetronix is an Arizona corporation with a place of business at 2350 East German Rd., Suite 37, Chandler, Arizona 85286. Fleetronix

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transacts business and has, at a minimum, offered to provide and/or provided in this judicial district and throughout the State of California services that infringe claims of the '859, '927, '606, '359, '645, and '058 patents.

12. Defendant GeoMicro is a California corporation with a place of business at 3200 El Camino Real, Suite 140, Irvine, California 92602. GeoMicro transacts business and has, at a minimum, offered to provide and/or provided in this judicial district and throughout the State of California services that infringe claims of the '668, '859, '606, '359, '645, and '058 patents.

13. Defendant Manning NavComp is a Texas corporation with a place of business at 13809 Research Blvd., Suite 735, Austin, Texas 78750. Manning NavComp transacts business and has, at a minimum, offered to provide and/or provided in this judicial district and throughout the State of California services that infringe claims of the '859, '927, '606, '645, and '058 patents.

14. Defendant Peak Wireless is a California corporation with a place of business at 1101 S. Escondido Blvd., Escondido, California 92025. Peak Wireless transacts business and has, at a minimum, offered to provide and/or provided in this judicial district and throughout the State of California services that infringe claims of the '859, '927, '606, '645, and '058 patents.

15. The true names and capacities of Defendants named herein as DOES 1 through 10, inclusive, are currently unknown to Plaintiff, who therefore sues said Defendants as DOES 1 through 10. Plaintiff will seek leave of this Court to amend its complaint to show their true names and capacities when known. Plaintiff is informed and believes and on that basis alleges that DOES 1 through 10 were responsible in some manner for the acts alleged herein and, therefore, are liable to Plaintiff.

16. Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b).

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DEFENDANT FLEETRONIX'S ACTS OF PATENT INFRINGEMENT

17. Defendant Fleetronix and Does 1-3 have infringed claims of the '859, '927, '606, '359, '645, and '058 patents through, among other activities, the use of Fleetronix's vehicle tracking system.

18. Defendants' infringement has injured and will continue to injure ArrivalStar unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further use of methods and systems that come within the scope of the '859, '927, '606, '359, '645, and '058 patents.

DEFENDANT GEOMICRO'S ACTS OF PATENT INFRINGEMENT

19. Defendant GeoMicro and Does 4-6 have infringed claims of the '668, '859, '606, '359, '645, and '058 patents through, among other activities, the use of GeoMicro's Tracking Server.

20. GeoMicro's tracking system receives location data from remote mobile vehicles.

21. GeoMicro's tracking system receives alert preferences associated with mobile vehicles from users who are located remote from the mobile vehicles.

22. GeoMicro's tracking system actively monitors the position of vehicles.

23. GeoMicro's vehicle tracking system enables a user to specify a location by entering a street address.

24. GeoMicro's vehicle tracking system transmits notifications to users that indicate a vehicle's current location.

25. GeoMicro's vehicle tracking system automatically converts street addresses into a format compatible with location data produced by a GPS tracking device aboard a vehicle.

26. GeoMirco' tracking system allows users to designate a geofence area around the current position of a vehicle.

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27. GeoMicro' tracking system allows users to specify circular geographic areas on a map with a radius extending from a point.

28. GeoMicro's vehicle tracking system provides a mapping application that enables a user to specify a location by placing a cursor on a graphical map.

29. GeoMicro's tracking system is configurable to transmit an advance notification alert to a customer when a service technician approaches within a specified distance of the customer.

30. GeoMicro's vehicle tracking system is configurable to automatically transmit a notification to a user when a vehicle is arriving at a location.

31. GeoMicro generates alerts when vehicles enter within geofence areas designated by a user.

32. GeoMicro transmits notifications when vehicles approach user assigned areas.

33. GeoMicro allows a user to specify a route to a destination for a vehicle, and the GeoMicro system allows the user to set a buffer zone around the route.

34. GeoMicro's systems are configured to optimize routes based on user specified origins, waypoints, and destinations.

35. GeoMicro's tracking system is configured to enable users to designate multiple circular areas around a geographic point.

36. GeoMicro's tracking allows users to assign multiple waypoint areas along a vehicle's corridor of travel.

37. GeoMicro's vehicle tracking system notifies users of impending arrivals of vehicles at destinations by monitoring the movement of the vehicles and transmitting email notifications to the users when the vehicles enter within vehicle assigned proximities of the destinations.

38. GeoMicro's vehicle tracking system provides users with a map that includes graphical representations of mobile assets and locations.

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39. GeoMicro's mapping systems display symbols that represent particular locations.

40. GeoMirco's tracking system is configured to assign unique Vehicle IDs to vehicles that are monitored.

41. GeoMirco's tracking system provides users with a linear distance between a mobile device and a location shown on a graphical map.

42. Defendants' infringement has injured and will continue to injure ArrivalStar unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further use of methods and systems that come within the scope of the '668, '859, '606, '359, '645, and '058 patents.

DEFENDANT PEAK WIRELESS' ACTS OF PATENT INFRINGEMENT

43. Defendant Peak Wireless and Does 7-8 have infringed claims of the '859, '927, '606, '645, and '058 patents through, among other activities, the use of Peak Wireless' VehicleTrack.com tracking system.

44. Peak Wireless provides users with an automatic vehicle location service.

45. Peak Wireless' systems are configured to enable a user to track vehicles to and from any destination at any time.

46. Peak Wireless' tracking systems receive location data from on board vehicle tracking modems, and transmit location information to user computers via internet connections.

47. Peak Wireless' tracking systems use cellular, satellite, and radio technology to provide users with real-time awareness of mobile assets.

48. Peak Wireless' tracking systems are configured to receive travel data from vehicles via a general packet radio service (GPRS) based system.

49. Peak Wireless' tracking systems notify users when vehicle alarm conditions occur.

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50. Peak Wireless' tracking systems notifies users of location-based events occurring concurrent with supervisory or alarm events.

51. Peak Wireless' tracking systems include geofence functionality.

52. Peak Wireless' systems are configured to send email notifications to users.

53. Peak Wireless' VehicleTrack.com tracking system transmits alert messages to users' personal communication devices through email.

54. Peak Wireless' tracking system transmits alert messages to users indicating a vehicle's proximity to a location.

55. Peak Wireless' tracking system automatically transmits an alert message to a user based upon a vehicle entering within a boundary area around a location.

56. Peak Wireless provides users with perimeter alerts that provide automatic notifications when vehicles cross pre-defined boundaries.

57. Peak Wireless' tracking system is configured to send email notifications to users when the tracking system receives travel data from a vehicle indicative of the vehicle entering within a user-defined area.

58. Peak Wireless' tracking systems provide users with a full-color display maps that indicate where vehicle are, and when the vehicles are likely to arrive at their destinations.

59. Peak Wireless' systems send logistical information to users that includes vehicle location, speed, direction, and estimated time of arrival at a location.

60. Peak Wireless' tracking system transmits notifications to users that indicate a vehicle's estimated time of arrival at a location.

61. Peak Wireless' tracking system notifies users of a vehicle delay with a revised estimated time of arrival at a location while the vehicle is in transit to the location.

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62. Peak Wireless' systems are configured to allow a user to poll a vehicle and receive an exact location update for the vehicle.

63. Peak Wireless' tracking system transmits graphical maps to a user device, wherein the graphical map indicates a vehicle's location.

64. Peak Wireless' provides real-time mapping of a vehicle and allows a user to view a vehicle's speed, direction and location on a street map in real-time 24 hours a day, 7 days a week.

65. Defendants' infringement has injured and will continue to injure ArrivalStar unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further use of methods and systems that come within the scope of the '859, '927, '606, '645, and '058 patents.

DEFENDANT MANNING NAVCOMP'S ACTS OF PATENT INFRINGEMENT

66. Defendant Manning NavComp and Does 9-10 have infringed claims of the '859, '927, '606, '645, and '058 patents through, among other activities, the use of Manning NavComp's RASTRAC tracking system.

67. Manning NavComp provides users with an automatic vehicle location service.

68. Manning NavComp's systems are configured to enable a user to track vehicles to and from any destination at any time.

69. Manning NavComp's tracking systems receive location data from on board vehicle tracking modems, and transmit location information to user computers via internet connections.

70. Manning NavComp's tracking systems use cellular, satellite, and radio technology to provide users with real-time awareness of mobile assets.

71. Manning NavComp's tracking systems are configured to receive travel data from vehicles via a general packet radio service (GPRS) based system.

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72. Manning NavComp's tracking systems notify users when vehicle alarm conditions occur.

73. Manning NavComp's tracking systems notifies users of location-based events occurring concurrent with supervisory or alarm events.

74. Manning NavComp's tracking systems include geofence functionality.

75. Manning NavComp's systems are configured to send email notifications to users.

76. Manning NavComp's RASTRAC tracking system transmits alert messages to users' personal communication devices through email.

77. Manning NavComp's tracking system transmits alert messages to users indicating a vehicle's proximity to a location.

78. Manning NavComp's tracking system automatically transmits an alert message to a user based upon a vehicle entering within a boundary area around a location.

79. Manning NavComp provides users with perimeter alerts that provide automatic notifications when vehicles cross pre-defined boundaries.

80. Manning NavComp's tracking system is configured to send email notifications to users when the tracking system receives travel data from a vehicle indicative of the vehicle entering within a user-defined area.

81. Manning NavComp's tracking systems provide users with a full-color display maps that indicate where vehicle are, and when the vehicles are likely to arrive at their destinations.

82. Manning NavComp's systems send logistical information to users that includes vehicle location, speed, direction, and estimated time of arrival at a location.

83. Manning NavComp's tracking system transmits notifications to users that indicate a vehicle's estimated time of arrival at a location.

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84. Manning NavComp's tracking system notifies users of a vehicle delay with a revised estimated time of arrival at a location while the vehicle is in transit to the location.

85. Manning NavComp's systems are configured to allow a user to poll a vehicle and receive an exact location update for the vehicle.

86. Manning NavComp's tracking system transmits graphical maps to a user device, wherein the graphical map indicates a vehicle's location.

87. Manning NavComp's provides real-time mapping of a vehicle and allows a user to view a vehicle's speed, direction and location on a street map in real-time 24 hours a day, 7 days a week.

88. Defendants' infringement has injured and will continue to injure ArrivalStar unless and until this Court enters an injunction prohibiting further infringement and, specifically, enjoining further use of methods and systems that come within the scope of the '859, '927, '606, '645, and '058 patents.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs ask this Court to enter judgment against the Defendants, and against each of their subsidiaries, affiliates, agents, servants, employees and all persons in active concert or participation with them, granting the following relief:

A. An award of damages adequate to compensate ArrivalStar for the infringement that has occurred, together with prejudgment interest from the date that Defendant's infringement of the ArrivalStar patents began;

B. Increased damages as permitted under 35 U.S.C. § 284;

C. A finding that this case is exceptional and an award to ArrivalStar of its attorneys' fees and costs as provided by 35 U.S.C. § 285;

D. A permanent injunction prohibiting further infringement, inducement and contributory infringement of the ArrivalStar patents; and

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E. Such other and further relief as this Court or a jury may deem proper and just.

Respectfully submitted,

DATED: July 7, 2010

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Michael K. Grace
Attorneys for Plaintiffs ArrivalStar S.A. and Melvino Technologies Limited

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JURY DEMAND

ArrivalStar demands a trial by jury on all issues so triable herein.

Respectfully submitted,

DATED: July 7, 2010

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and Melvino Technologies Limited

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EXHIBIT A

US006618668B1

(12) **United States Patent**
Laird

(10) **Patent No.: US 6,618,668 B1**
(45) **Date of Patent: Sep. 9, 2003**

(54) **SYSTEM AND METHOD FOR OBTAINING VEHICLE SCHEDULE INFORMATION IN AN ADVANCE NOTIFICATION SYSTEM**

(75) Inventor: **David Laird**, Fort Walton Beach, FL (US)

(73) Assignee: **Arrivalstar, Inc.**, Delray Beach, FL (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.: **09/558,508**

(22) Filed: **Apr. 26, 2000**

(51) **Int. Cl.**[7] **G08G 1/123**

(52) **U.S. Cl.** **701/204**; 701/213; 340/994

(58) **Field of Search** 701/200, 204, 701/207, 208, 209, 211, 213, 117; 340/988, 990, 994

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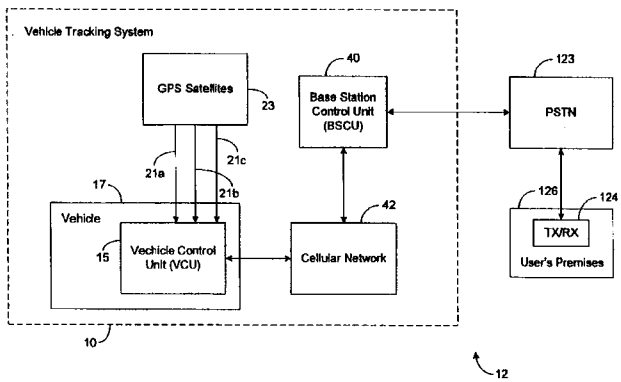
(List continued on next page.)

Primary Examiner—Gary Chin
(74) *Attorney, Agent, or Firm*—Thomas, Kayden, Horstemeyer & Risley, LLP

(57) **ABSTRACT**

A vehicle monitoring and notification system includes a mapping application and a data manager. The mapping application receives data identifying a particular location and automatically translates this data into a set of location values. The mapping application then stores the foregoing set of location values. The data manager retrieves the stored set of location values and monitors travel of a vehicle based on location values produced by a location sensor coupled to the vehicle. The data manager compares a set of location values produced by the sensor to the stored set of location values to determine when the vehicle is within a predefined proximity of the particular location. When the data manager determines that the vehicle is within the predefined proximity of the particular location, the data manager causes a notification message to be transmitted to a user communications device to notify a user of an impending arrival of the vehicle at the particular location.

32 Claims, 6 Drawing Sheets



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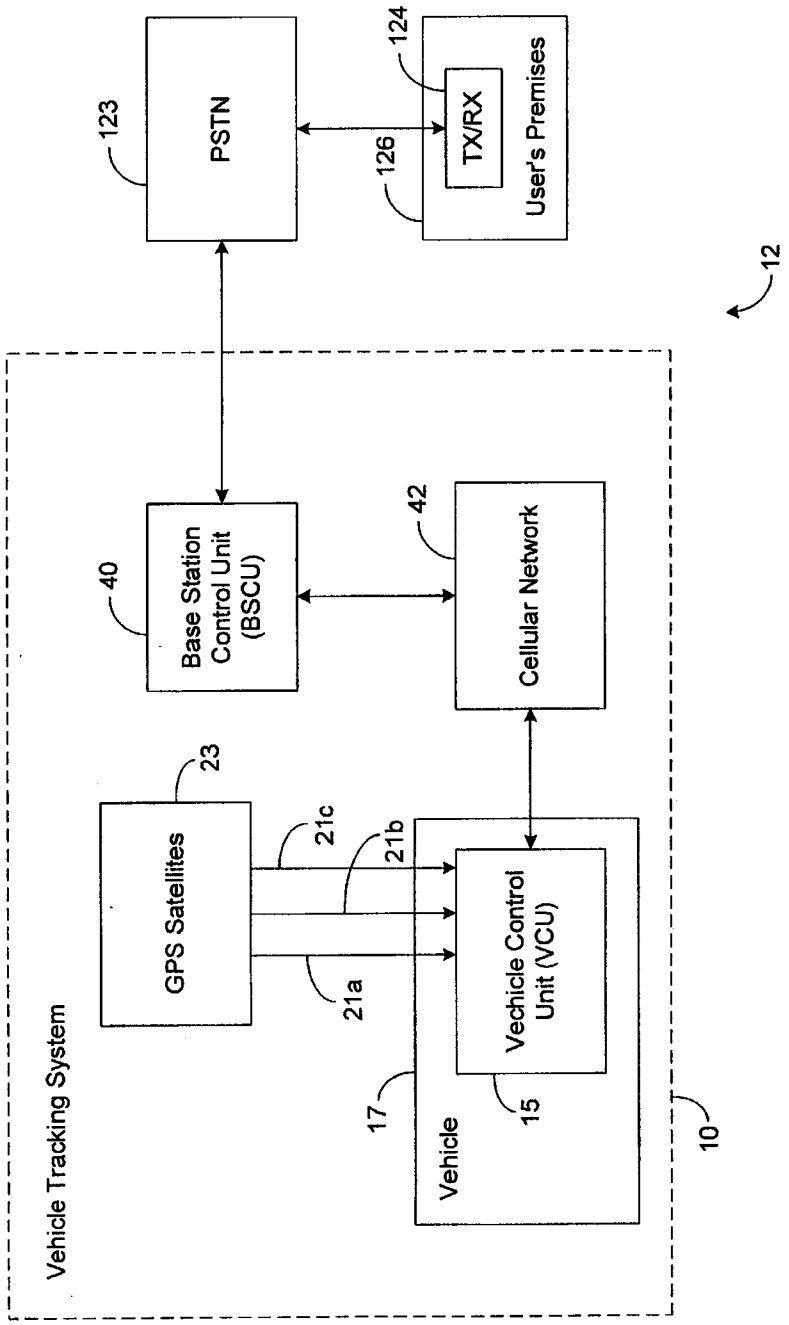
PSTN
123
124
TX/RX
126
User's Premises
12
Base Station Control Unit (BSCU)
40
42
Cellular Network
23
GPS Satellites
21c
21b
21a
Vechicle Control Unit (VCU)
17
15
Vehicle
10
Vehicle Tracking System

FIG. 1

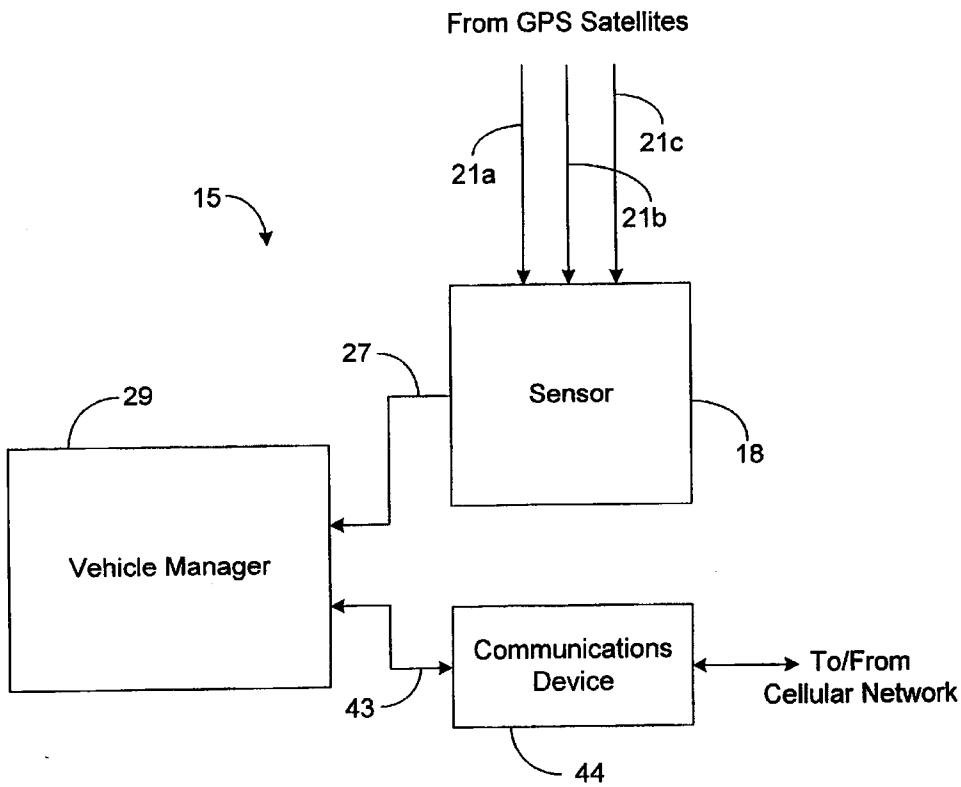
From GPS Satellites
21a
21b
21c
15
27
29
Sensor
18
Vehicle Manager
Communications Device
To/From Cellular Network
43
44

FIG. 2

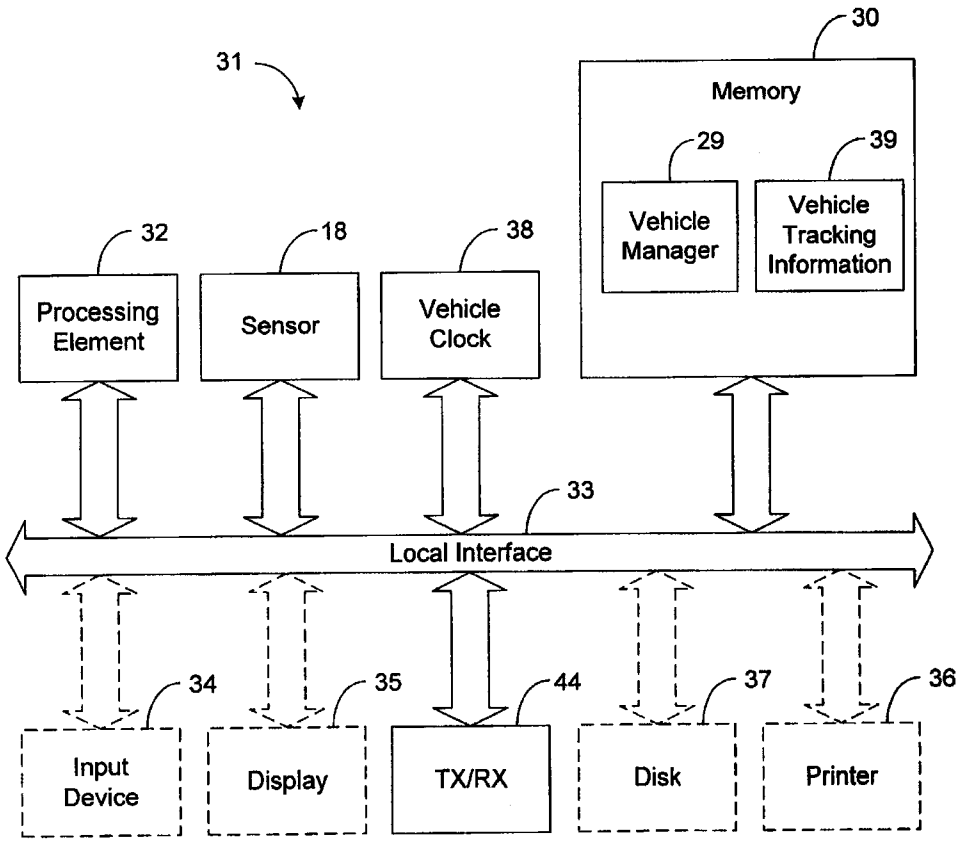
31
30
Memory
29
39
Vehicle Manager
Vehicle Tracking Information
32
18
38
Processing Element
Sensor
Vehicle Clock
33
Local Interface
34
35
44
37
36
Input Device
Display
TX/RX
Disk
Printer

FIG. 3

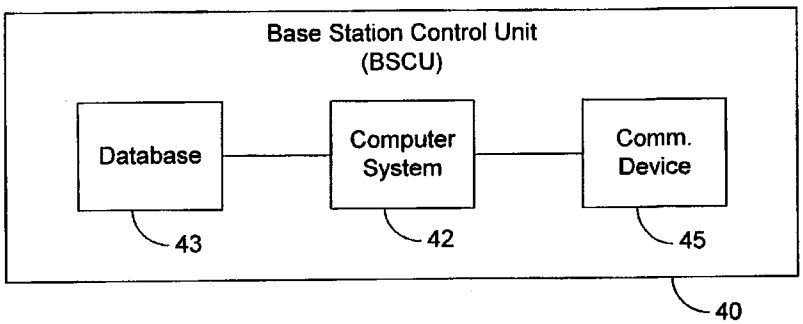
Base Station Control Unit
(BSCU)
Database
Computer System
Comm. Device
43
42
45
40

FIG. 4

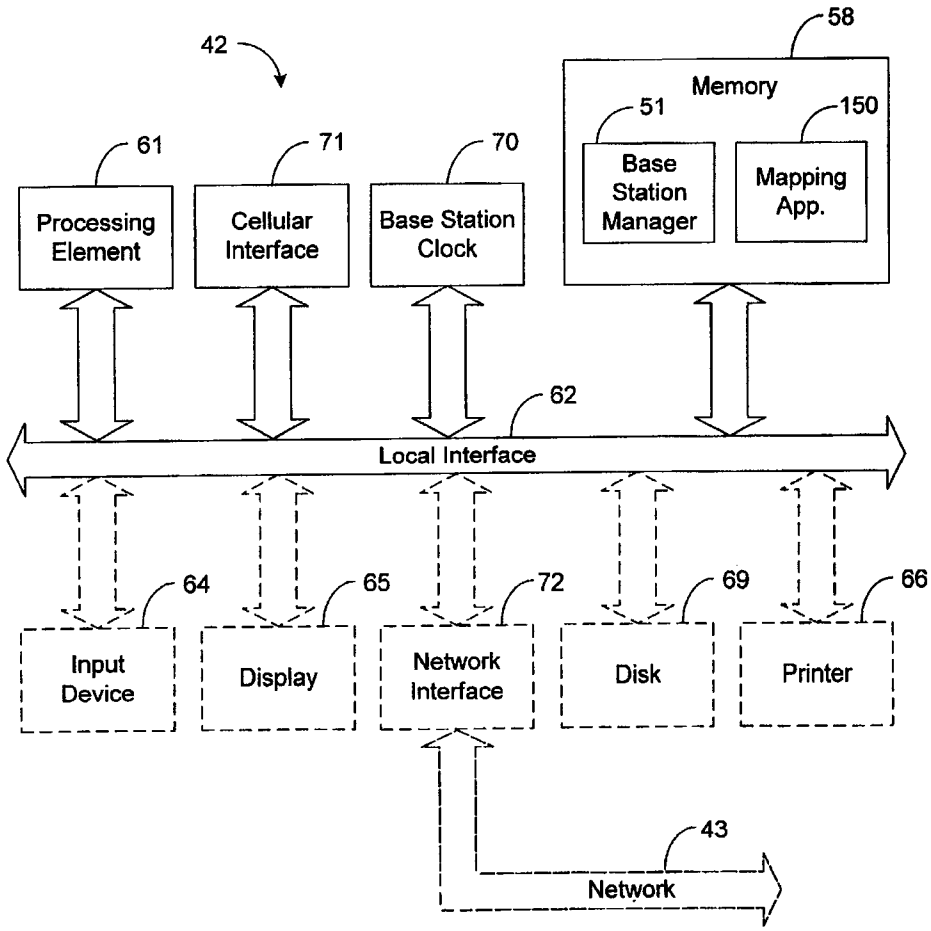
42
58
Memory
51
150
Base Station Manager
Mapping App.
61
71
70
Processing Element
Cellular Interface
Base Station Clock
62
Local Interface
64
65
72
69
66
Input Device
Display
Network Interface
Disk
Printer
43
Network

FIG. 5

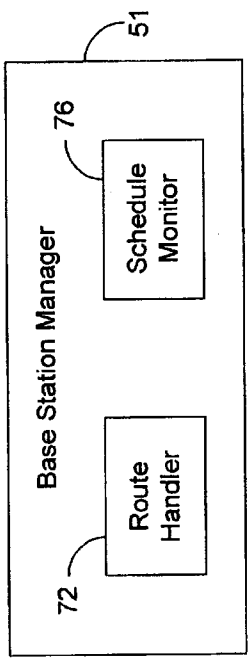

FIG. 6

81

	TIME	Contact Information	Vechicle ID
Entry 1	6:30	1235670987	1112
Entry 2	9:15	1235290945	2034
Entry 3	12:45	1235467867	1390
Entry 4	15:30	1234342313	0999

FIG. 7

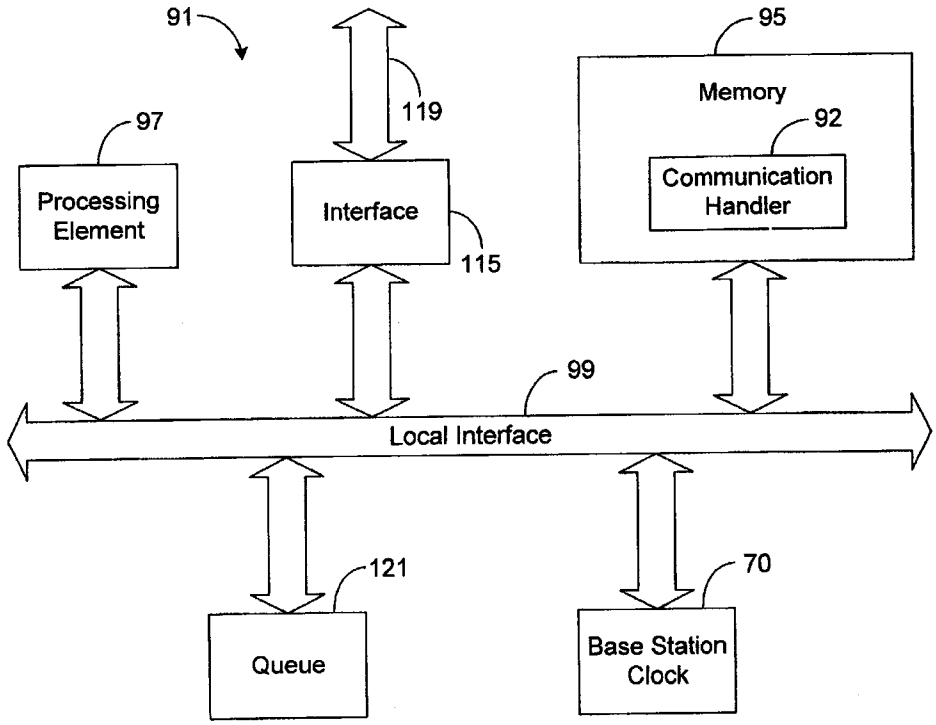
91
119
95
Memory
92
Communication Handler
97
Processing Element
Interface
115
99
Local Interface
121
Queue
70
Base Station Clock

FIG. 8

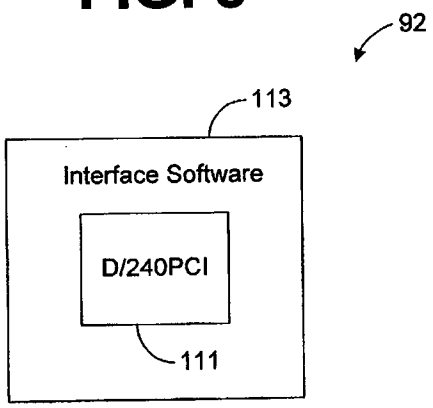
92
113
Interface Software
D/240PCI
111

FIG. 9

SYSTEM AND METHOD FOR OBTAINING VEHICLE SCHEDULE INFORMATION IN AN ADVANCE NOTIFICATION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of the claims priority to U.S. Utility Patent Application entitled "ADVANCE NOTIFICATION SYSTEMS AND METHODS UTILIZING A COMPUTER NETWORK," filed on May 6, 1997 by M. K. Jones and assigned Ser. No. 08/852,119, and which is incorporated herein in its entirety, where U.S. Utility Patent Application 08/852,119 is a continuation of and claims priority to the following U.S. applications:

(a) provisional application entitled, "ADVANCED NOTIFICATION SYSTEM AND METHOD UTILIZING A COMPUTER NETWORK," filed Mar. 7, 1997 by M. K. Jones and assigned Ser. No. 60/039,925;

(b) nonprovisional application entitled, "ADVANCED NOTIFICATION SYSTEM AND METHOD UTILIZING PASSENGER-DEFINABLE NOTIFICATION TIME PERIOD," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/434,049, now U.S. Pat. No. 5,623,260 that issued on Apr. 22, 1997;

(c) nonprovisional application entitled, "ADVANCED NOTIFICATION SYSTEM AND METHOD UTILIZING VEHICLE PROGRESS REPORT GENERATOR," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/432,898, now U.S. Pat. No. 5,657,010 that issued on Aug. 12, 1997; and

(d) nonprovisional application entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING PASSENGER CALLING REPORT GENERATOR," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/432,666, now U.S. Pat. No. 5,668,543 that issued on Sep. 16, 1997;

where documents (b), (c), and (d) are each a continuation-in-part of the application entitled "ADVANCED NOTIFICATION SYSTEM AND METHOD UTILIZING A DISTINCTIVE TELEPHONE RING," filed Mar. 20, 1995 by M. K. Jones and assigned Ser. No. 08/407,319, now abandoned, which in turn is a continuation-in-part of an application entitled "ADVANCE NOTIFICATION SYSTEM AND METHOD" filed May 18, 1993 by M. K. Jones et al. and assigned Ser. No. 08/063,533, now U.S. Pat. No. 5,400,020 that issued on Mar. 21, 1995.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to vehicle monitoring and messaging systems and, in particular, to a vehicle monitoring system and method capable of efficiently obtaining and maintaining vehicle schedule information that is used to monitor travel of a vehicle.

2. Related Art

U.S. Pat. No. 5,400,020, entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD," which is incorporated herein by reference, describes an advance notification system that provides users with notice of an impending arrival of a vehicle at a particular location. In this regard, a location sensor, such as a global positioning system (GPS) sensor, is attached to a vehicle associated with the system. Based on the output of the location sensor, the location of the vehicle is monitored by a control unit or control units located on the vehicle and/or at a stationary base station remotely located from the vehicle. When it is determined that the vehicle is within a predefined proximity (i.e., a particular time or distance) from a particular location of interest to a user (e.g., a vehicle stop), a notification message is transmitted to the user to notify the user of the impending arrival of the vehicle. The user may then prepare for the impending arrival of the vehicle in response to the notification message.

There are a variety of passenger and/or package transportation services pickup and/or delivery applications that may utilize the advance notification system. However, as the number of users and/or vehicle stops associated with the services being offered increases, the complexity of the advance notification can increase dramatically. For example, a regional package transportation service that services a major metropolitan city may deliver tens of thousands of packages per day. Likewise, passenger transportation services servicing a metropolitan area or a county-wide school system may transport many thousands of passengers per day as well.

Therefore, the process of producing the vehicle schedules (i.e., the routes and times that the vehicle should travel) required to transport the packages or passengers can be quite burdensome and complicated. Furthermore, when an advance notification system is employed, schedules should indicate not only the route for each vehicle but should also indicate when notification messages should be transmitted for each transported package or passenger. The information indicating when the users are to be notified or where a delivery or pick-up is to occur may be provided by each individual user. Needless to say, obtaining and maintaining the necessary information to provide users with advance notification of arrivals of vehicles can be quite burdensome and complicated in many applications.

Further adding to the complexity of the advance notification system, the data necessary for producing the appropriate vehicle schedules is not always readily available. For example, when the location sensor used to monitor a vehicle is a GPS sensor, the location values produced by sensor are coordinate values (e.g., longitude and latitude values). These coordinate values should be compared to the location values defining the vehicle's schedule to determine when notification messages should be transmitted. Therefore, the location values produced by the sensor should be compatible with the location values of the vehicle schedule to enable accurate comparisons. However, the data input into the system that is used to define the vehicle schedule is not necessarily compatible with the location values produced by the sensor. For example, when a user would like to be picked-up or to receive delivery at a particular location, the user often knows the address of the location but does not know the coordinate values of the location. Therefore, the user may only provide address information, which is incompatible with the location values produced by the sensor, and additional steps must be taken to enable accurate comparisons.

Thus, a heretofore unaddressed need exists in the industry for a vehicle monitoring system and method for efficiently obtaining and maintaining vehicle schedule information that may be used to monitor the travel of vehicles.

SUMMARY OF THE INVENTION

The present invention overcomes many inadequacies and deficiencies of the prior art, as discussed hereinbefore. In general, the present invention provides a vehicle monitoring system and method for obtaining and maintaining vehicle schedule information and for monitoring vehicles based on the vehicle schedule information so that a notification mes-

sage may be transmitted to notify at least one user when a particular vehicle is within a predefined proximity of a particular location.

In a broad sense, the system of the present invention includes a mapping application and a data manager. The mapping application receives data identifying a particular location and automatically translates this data into a set of location values. The mapping application then stores the foregoing set of location values. The data manager retrieves the stored set of location values and monitors travel of a vehicle based on location values produced by a location sensor coupled to the vehicle. The data manager compares a set of location values produced by the sensor to the stored set of location values to determine when the vehicle is within a predefined proximity of the particular location. When the data manager determines that the vehicle is within the predefined proximity of the particular location, the data manager causes a notification message to be transmitted to a user communications device to notify a user of an impending arrival of the vehicle at the particular location.

In accordance with another feature of the present invention, the mapping application produces a map displaying symbols representing various locations. The user selects from the map the particular location that is to be used to determine when the notification message is to be generated.

In accordance with another feature of the present invention, the mapping application receives data identifying a plurality of locations where items are to be delivered or picked-up by one of the vehicles being monitored by the system or method of the present invention. Based on this data, the mapping application automatically defines a set of routes that are to be driven by the foregoing vehicles. The mapping application then outputs the routes that are to be driven by each of the vehicles and, if desired, which items are to be transported by each vehicle.

The present invention can also be viewed as providing a method for tracking vehicles.

The method can be broadly conceptualized by the following steps: receiving data identifying a particular location from said user interface device; automatically translating the data received in the receiving step into a set of location values; storing the set of location values; monitoring travel of a vehicle based on location values produced by a location sensor coupled to the vehicle; comparing the set of the location values produced by the location sensor to the set of location values stored in the storing step; determining when the vehicle is within a predefined proximity of the particular location based on the comparing step; causing a notification message to be transmitted to a user communications device in response to a determination in the determining step that the vehicle is within the predefined proximity of the particular location; and notifying a user of an impending arrival of the vehicle at the location via the notification message.

Other features and advantages of the present invention will become apparent to one skilled in the art upon examination of the following detailed description, when read in conjunction with the accompanying drawings. It is intended that all such features and advantages be included herein within the teachings of the present invention, as set forth herein and as sought to be protected by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale relative to each other, emphasis instead being placed upon clearly illustrating the principles of the invention. Furthermore, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a block diagram illustrating a vehicle tracking system employed within the context of an advance notification system in accordance with the preferred embodiment of the present invention.

FIG. **2** is a block diagram illustrating a more detailed view of a vehicle control unit depicted in FIG. **1**.

FIG. **3** is a block diagram illustrating a computer system implementing the functionality of the vehicle control unit of FIG. **2** in accordance with the preferred embodiment of the present invention.

FIG. **4** is a block diagram illustrating an implementation of a base station control unit depicted in FIG. **1**.

FIG. **5** is a block diagram illustrating a computer system depicted in FIG. **4**.

FIG. **6** is a block diagram illustrating a more detailed view of a base station manager depicted in FIG. **5**.

FIG. **7** is a schematic illustrating an exemplary list of notification events generated by a route handler depicted in FIG. **6**.

FIG. **8** is a block diagram illustrating a computer system implementing the functionality of the communications device depicted in FIG. **4**.

FIG. **9** is a block diagram illustrating a more detailed view of a communication handler depicted in FIG. **8**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** depicts an automated vehicle tracking system **10** illustrating the principles of the present invention. As shown by FIG. **1**, the vehicle tracking system **10** is preferably employed within the context of an automated advance notification system **12** that automatically provides advance notice of impending arrivals of vehicles at destinations or other locations.

As depicted in FIG. **1**, a vehicle control unit (VCU) **15** is disposed on a mobile vehicle **17**, which is capable of transporting the VCU **15** over various distances. U.S. Patent application entitled, "System and Method for an Advance Notification System for Monitoring and Reporting Proximity of a Vehicle," assigned Ser. No. 09/163,958, and filed on Sep. 30, 1998, which is incorporated herein by reference, describes an exemplary VCU **15** that may be used to implement the principles of the present invention.

In the preferred embodiment, the vehicle **17** is a delivery vehicle for delivering items to a destination or for picking up items at a destination. Note that items can include many various types of packages or goods to be delivered or picked up. Furthermore, items can also include persons to be picked up or delivered, such as when a bus picks up and/or delivers passengers at different bus stops. Preferably, the vehicle **17** travels along a predetermined route in making its deliveries, and the vehicle **17** may make numerous stops along its route in order to deliver or pick up different items at different locations.

In the context of this document, a "vehicle" is any structure capable of moving across or through the Earth's surface and/or atmosphere. Examples of a "vehicle" include, but are not limited to, an automobile, an aircraft, a train, or a boat. A "vehicle" may also be a person that carries the VCU **15** while walking or running.

Vehicle Control Unit

A more detailed view of the VCU **15** is depicted in FIG. **2**. A sensor **18** within VCU **15** is configured to determine the

location of the sensor **18** relative to a predetermined reference point. In the preferred embodiment, sensor **18** is a global positioning system (GPS) sensor, although other types of positioning systems and/or sensors can be utilized. For example, other types of sensors **18** that may be used to implement the principles of the present invention include, but are not limited to, an odometer or sensors associated with Glonass, Loran, Shoran, Decca, or Tacan. The GPS sensor **18** of the preferred embodiment is configured to receive signals **21***a*–**21***c* from a plurality of GPS satellites **23**, and as known in the art, sensor **18** is designed to analyze signals **21***a*–**21***c* to determine the sensor's location or coordinate values relative to a predetermined reference point.

For example, in the preferred embodiment where sensor **18** is a GPS sensor, the sensor **18** determines the sensor's location values relative to the Earth's zero degree latitude and zero degree longitude reference point, which is located at the intersection of the Equator and the Prime Meridian. U.S. Pat. No. 5,781,176 entitled, "GPS Receiver and Method for Processing GPS Signals" and filed on Apr. 23, 1997 by Krasner, which is incorporated herein by reference, discusses the processing of GPS signals **21***a*–**21***c* received from GPS satellites **23** in order to determine the sensor's location values. Since the sensor **18** is located on or within the vehicle **17**, the location values determined by the sensor **18** are assumed to match the location values of the vehicle **17** and the VCU **15**.

It should be noted that the term "location value" shall be defined herein to mean any value or set of values that may be used to determine a location of a point on the Earth or within the Earth's atmosphere. This value may be a distance value, a coordinate value (i.e., grid value), polar value, vector value, or any other type of value or values known in the art for indicating locations of points.

Sensor **18** is designed to periodically transmit a signal **27** to vehicle manager **29** indicating the vehicle's current location values. Vehicle manager **29** is configured to receive signal **27** and to monitor the location of the vehicle **17** over time by processing multiple signals **27**. The vehicle manager **29** can be implemented in software, hardware, or a combination thereof. In the preferred embodiment, as illustrated by way of example in FIG. **3**, the vehicle manager **29** of the present invention along with its associated methodology is implemented in software and stored in computer memory **30** of a computer system **31**.

Note that the vehicle manager **29** can be stored and transported on any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In the context of this document, a"computer-readable medium" can be any means that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer readable medium can be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a nonexhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (magnetic), a read-only memory (ROM) (magnetic), an erasable programmable read-only memory (EPROM or Flash memory) (magnetic), an optical fiber (optical), and a portable compact disc read-only memory (CDROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance optical scanning of the paper or other medium, then compiled, interpreted or otherwise processed in a suitable manner if necessary, and then stored in a computer memory. As an example, the vehicle manager **29** may be magnetically stored and transported on a conventional portable computer diskette.

The preferred embodiment of the computer system **31** of FIG. **3** comprises one or more conventional processing elements **32**, such as a digital signal processor (DSP), that communicate to and drive the other elements within the system **31** via a local interface **33**, which can include one or more buses. Furthermore, an input device **34** can be used to input data into the system **31**, and screen display **35** or a printer **36** can be used to output data to the user. A disk storage mechanism **37** can be connected to the local interface **33** to transfer data to and from a nonvolatile disk (e.g., magnetic, optical, etc.). Furthermore, a vehicle clock **38** may be connected to the computer system **31** so that components of the system **31** may utilize data from the clock **38** to determine time through conventional techniques. It should be noted that input device **34**, display **35**, printer **36**, and disk **37** are optional and are not necessarily a part of the preferred embodiment.

The vehicle manager **29** is preferably configured to maintain a predefined schedule, referred to herein as "vehicle tracking information **39**," within memory **30**. The predefined vehicle tracking information **39** corresponds with a route of travel for the vehicle **17**. In this regard, the predefined vehicle tracking information **39** stored in memory **30** includes data defining locations or "checkpoints" along the vehicle's intended route of travel. Furthermore, each checkpoint is associated with a particular time value indicating when the vehicle **17** is expected to pass the associated checkpoint. Each checkpoint along with its associated time value may define an entry in the vehicle tracking information **39**.

In the preferred embodiment, the time value associated with a checkpoint corresponds to a time of day that the vehicle **17** is expected to pass the checkpoint. For example, the time value associated with a checkpoint may define the hour and minute that the vehicle **17** is expected to pass the checkpoint. Consequently, when the vehicle **17** reaches the location defined by the checkpoint, the time of day, as defined by vehicle clock **38**, can be compared with the time value in the vehicle tracking information **39** associated with the checkpoint to determine whether the vehicle **17** is early, late, or on time. It should be noted that other data and other methodologies may be employed to determine whether or not the vehicle **17** is on schedule, without departing from the principles of the present invention.

As the vehicle **17** travels along its route, the vehicle manager **29** determines when the vehicle **17** passes a checkpoint by comparing the data received from sensor **18** with the checkpoint data stored in vehicle schedule **39**. When the vehicle manager **29** determines that a checkpoint has been passed, the vehicle manager **29** is configured to determine a time value indicating the time of day by analyzing vehicle clock **38**, and the vehicle manager **29** is configured to compare this time value with the time value in the vehicle tracking information **39** associated with the checkpoint.

The vehicle **17** is considered to be off schedule if the value for the time of day from clock **38** differs from the time value in the vehicle tracking information **39** by a predetermined

amount. Otherwise the vehicle **17** is considered to be on schedule. For example, assume that the vehicle **17** is to be considered off schedule if the vehicle **17** is early or late by more than two minutes and assume that the vehicle **17** is scheduled to pass a checkpoint at 6:30 a.m. If the vehicle **17** passes the checkpoint between 6:28 a.m. and 6:32 a.m., the vehicle **17** is on schedule. If the vehicle **17** passes the checkpoint before 6:28 a.m., the vehicle is off schedule and is early. If the vehicle **17** passes the checkpoint after 6:32 a.m., the vehicle **17** is off schedule and is late.

If the vehicle manager **29** determines that the vehicle **17** is off schedule, the vehicle manager **29** is configured to transmit a status message to a base station control unit (BSCU) **40** (FIG. 1) indicating how much the vehicle is off schedule, and the vehicle manager **29** is also configured to update the entries in the tracking information **39**. For example, assume that the vehicle **17** passes the aforementioned checkpoint at 6:25 a.m. In this example, the vehicle **17** is off schedule and five minutes early. Therefore, the vehicle manager **29** transmits a status message to BSCU **40** via cellular network **42** indicating that the vehicle **17** is five minutes early and decreases the expected times stored in the tracking information **39** by five minutes. As a result, the schedule **39** is adjusted to account for the vehicle's earliness, and the vehicle **17** will not be deemed off schedule when the vehicle **17** passes the other checkpoints, provided that the rate of travel of the vehicle **17** continues as expected for the remainder of the route. Similarly, if the vehicle **17** passes the aforementioned checkpoint at 6:35 a.m., then the vehicle manager **29** is configured to transmit a status message indicating that the vehicle **17** is five minutes late and is configured to increase the times stored in the tracking information **39** by five minutes.

It should be noted that updating the vehicle tracking information **39** is not necessary in implementing the present invention. However, if the vehicle **17** is early or late at one checkpoint, the vehicle **17** will likely be respectively early or late at other checkpoints, causing the vehicle manager **29** to make an off schedule determination and to transmit a status message at each of the remaining checkpoints in the route. By updating the times in the vehicle tracking information **39**, the number of status messages transmitted to the BSCU **40** may be reduced in monitoring the travel of the vehicle **17**.

It should be further noted that the status message transmitted by VCU **15** may be communicated via any suitable technique and that utilization of the cellular network **42** is not necessary. In this regard, other types of networks may be used to communicate the status message, or the status message may be communicated directly to the base station control unit **40** without the use of any type of communication network. For example, the status message may be communicated via short wave radio.

Base Station Control Unit

Referring to FIG. **4**, the base station control unit (BSCU) **40** preferably comprises a computer system **42** interfaced with a database **43** and a communications device **45**. The communications device **45** may be a computer system separate to system **42** or may be a component (e.g., peripheral device) of the computer system **42**. A suitable communications device **45** is described in U.S. Patent Application entitled, "Base Station System and Method for

Monitoring Travel of Mobile Vehicles and Communicating Notification Messages," (atty. dockect no. 51404-1070), which is incorporated herein by reference. Furthermore, database **43** may be separate from system **24**, as shown by FIG. **4**, or may be employed by memory within system **42**.

Referring to FIG. **5**, the computer system **42** includes a base station manager **51**. The base station manager **51** can be implemented in software, hardware, or a combination thereof In the preferred embodiment, as illustrated by way of example in FIG. **5**, the base station manager **51** of the present invention along with its associated methodology is implemented in software and stored in memory **58**.

Further shown by FIG. **5**, the computer system **42** may include one or more processing elements **61**, such as a DSP, that communicate to and drive the other elements within the system **42** via a local interface **62**, which may include one or more buses. Furthermore, an input device **64**, for example, a keyboard or a mouse, can be used to input data from a user of the system **42**, and screen display **65** or a printer **66** can be used to output data to the user. A disk storage mechanism **69** can be connected to the local interface **62** to transfer data to and from a nonvolatile disk (e.g., magnetic, optical, etc.). Furthermore, a base station clock **70** may be connected to the computer system **42** so that components of the system **42** may utilize data from the clock **70** to determine time through conventional techniques. The system **42** may also be connected to a cellular interface **71**, or other type of suitable interface, for communicating with VCU **15**. It may also be desirable for computer system **42** to include a network interface **72** that allows the system **42** to exchange data with a network **73**. It should be noted that input device **64**, display **65**, printer **66**, disk **69**, network interface **72**, and network **73** are optional and are not necessarily a part of the preferred embodiment.

The database **43** shown by FIG. **4** preferably stores data defining the route schedule of one or more vehicles **17**. For example, the database **43** may include entries that are correlated with a vehicle **17** of the system **10** (FIG. **1**), wherein each entry includes sufficient data to define a checkpoint that may be used to monitor the travel of the vehicle **17**. The checkpoints defined in the database **43** for a particular vehicle **17** are preferably the same checkpoints defined in vehicle tracking information **39** (FIG. **3**) for the particular vehicle **17**. Furthermore, the entry may also include data to indicate the time of day that the vehicle **17** is expected to reach the checkpoint defined by the entry. Therefore, the database **43** includes sufficient data to define the checkpoints used to monitor the vehicles **17** associated with the system **10** and the times that the vehicles **17** should respectively pass the checkpoints.

The database **43** of the preferred embodiment also includes data indicating when different users are to be notified of an impending arrival of at least one of the vehicles **17** associated with the system **10**. For example, the database **43** may include data indicating that a user should be notified a certain amount of time before or after a particular vehicle **17** passes a particular checkpoint. Therefore, at any time, the database **43** can be queried to determine which checkpoints are to be passed by a particular vehicle **17** and when the particular vehicle **17** is expected to pass each of the checkpoints. The database **43** also can be queried to determine when users are to be notified of an impending arrival of a particular vehicle. To facilitate querying of the database **43**, the entries of the database **43** may be keyed by vehicle numbers used to identify the vehicles associated with the system **10**.

To illustrate the configuration and use of the database **43**, assume that a user would like to be notified when a particular vehicle **17** is two minutes from a particular location, such as the user's house or a scheduled vehicle stop. Assume further that the vehicle **17** is scheduled to pass a checkpoint every five minutes after starting its route and that the particular

location is expected to be reached seventeen minutes after the vehicle **17** starts its route. In this scenario, the database **43** should include data that defines each of the checkpoints along the vehicle's route and that indicates the time that the vehicle **17** is expected to pass each of the checkpoints. The database **43** should also indicate that the individual is to be notified when the vehicle **17** passes the third checkpoint, since the vehicle **17** is expected to pass the third checkpoint fifteen minutes into the route (i.e., two minutes before the vehicle **17** is expected to reach the particular location).

In the preferred embodiment, the database **43** also includes sufficient information to enable the individual to be automatically notified once a determination is made that the user should be notified. For example, the database **43** may include the individual's telephone number, pager number, e-mail address, or other type of contact information, depending on the methodology used to notify the individual.

As shown by FIG. **6**, the base station manager **51** preferably includes a route handler **72** and a schedule monitor **76**. The schedule monitor **76** will be discussed in further detail hereinafter. The route handler **72** is configured to query the database **43** to build a list of notification events that are expected to occur during a specified time period. A "notification event" is the generation of a notification message to be transmitted to a user to notify the user of an impending arrival of a vehicle **17** associated with the system **10**. For example, the route handler **72** may query the database **43** at the beginning of a day to determine each notification event that should occur during the course of the day, and the route handler **72** then builds a list of these events. The list should not only indicate what notification events are to occur but also should indicate at what time each notification event is expected to occur. The list may also include contact information (e.g., telephone numbers, pager numbers, e-mail addresses etc.) to facilitate the process of contacting the users associated with the notification events in the list.

FIG. **7** shows an exemplary list **81** that may be produced by the route handler **72**. The list **81** depicts four entries, although any number of entries may be included in the list **81**. Each entry of the list **81** is associated with a respective notification event and indicates: (1) the time at which the respective notification event is expected to occur, (2) the contact information (e.g., telephone number, pager number, e-mail address etc.) associated with the particular user, and (3) a vehicle number identifying the particular vehicle **17** associated with the notification event. For example, assume that "entry **1**" is associated with a notification event for a user that would like to be notified when a particular vehicle (vehicle number "**1112**") is five minutes from a particular location. Based on the information stored in database **43**, assume that the route handler **72** determines that the notification event should occur at 6:30 a.m. (five minutes before the particular vehicle **17** is scheduled to arrive at the particular location). As a result, "entry **1**" of the list **81** indicates that the notification event associated with the entry is to occur at 6:30 a.m. "Entry **1**" also provides the user's contact information and the vehicle number (**1**"**112**") of the vehicle **17** that is to arrive at the particular location. Each of the other entries can be similarly configured based on the information associated with the notification events indicated by the other entries. Once the route handler **72** has defined the list **81**, the route handler **72** transmits the list **81** to schedule monitor **76**.

When the BSCU **40** receives a status message from one of the VCUs **15** indicating that one of the vehicles **17** is early or late, the route handler **72** transmits an update request based on the received status message. In response to the update request, the schedule monitor **76** is designed to update the list **81**, if the list **81** includes an entry associated with a notification event pertaining to the one vehicle **17**.

For example, assume that the route handler **72** receives a status message indicating that the vehicle **17** associated with "entry **1**" (i.e., vehicle number "**1112**") is seven minutes late. In response, the route handler **72** transmits an update request to schedule monitor **76**. The update request preferably includes information indicating which vehicle **17** is off schedule and how much the vehicle **17** is off schedule. Based on this update request, the schedule monitor **76** determines that the vehicle **17** associated with the update request (i.e., vehicle number "**1112**") is seven minutes late. The schedule monitor **76** is designed to traverse the list **81** to identify each entry associated with the vehicle number "**1112**" and is configured to increase the time values stored in the identified entries by seven minutes to account for the tardiness of vehicle number "**1112**." Therefore, in the list **81** depicted by FIG. **7**, the schedule monitor **76** changes the time value in "entry **1**" from "6:30" to "6:37." As a result, the notification event associated with "entry **1**" should not occur until 6:37 a.m.

Upon receiving a status message, the route handler **72** is also designed to update the database **43**. Therefore, in the example described hereinbefore, the route handler **72** is designed to input data into the database **43** indicating that vehicle number "**1112**" is seven minutes late. As a result, the database **43** can be consulted at any time to determine not only the scheduled route of any vehicle **17** but also to determine the status of the vehicle **17** as the vehicle **17** is traveling its route. In this regard, if the database **43** does not indicate that a particular vehicle **17** is early or late, then it can be assumed that the vehicle **17** should arrive at its future checkpoints on schedule. However, if the database **43** indicates that the vehicle **17** is early or late, then it can be assumed that the vehicle **17** will arrive at its future checkpoints off schedule by the amount indicated by the database **43**.

The schedule monitor **76** is configured to periodically scan the list **81** to determine if a notification event should occur (i.e., if a notification message should be transmitted to a user). In this regard, when the time of the day, as determined from base station clock **70**, corresponds to (e.g., matches) the time indicated by one of the entries in the list **81**, the schedule monitor **76** determines that the notification event associated with the corresponding entry should occur. Therefore, to initiate the occurrence of the notification event, the schedule monitor **76** is designed to transmit a notification request to the communications device **45** (FIG. **4**), which transmits a notification message in response to the notification request, as will be described in more detail hereinbelow.

Referring to FIG. **8**, a computer system **91** may be employed to implement the communications device **45**. The system **91** may include a communication handler **92** to control the operation of the system **91**. The communication handler **92** may be implemented in software, hardware, or a combination thereof In the preferred embodiment, as depicted by FIG. **8**, the communication handler **92** is implemented in software and stored in memory **95**.

Further shown by FIG. **8**, the computer system **92** may include one or more processing elements **97**, such as a DSP, that communicate to and drive the other elements within the system **92** via a local interface **99**, which may include one or more buses. Furthermore, the base station clock **70** may be connected to the computer system **91** so that components of the system **91** may utilize data from the clock **70** to

determine time through conventional techniques. The computer system **91** of the preferred embodiment also includes an interface **115**, such as a telephone interface, for example, coupled to a plurality of communication connections **119** that enables the communication handler **92** to transmit the notification messages across the connections **119**. As an example, the interface **115** may be coupled to a T1 trunk or a plurality of T1 trunks that, as known in the art, are capable of placing up to twenty-four telephone calls each. Various devices may be employed to implement the interface **115** depending on the type of communication used to transmit the notification messages. For example, the interface **115** may be a telephone interface, a cellular interface, a modem, or other type of device or devices for communicating notification messages.

The communication handler **92** is preferably capable of processing multiple notification requests and of simultaneously communicating multiple notification messages to users to warn the users of impending arrivals of vehicles **17**. For example, in one embodiment, the communication handler **92** is implemented by a D/240PCI card **111** manufactured by Dialogic Corp., as shown by FIG. **9**. Other software **113** may be implemented to interface the notification messages with the Dialogic card. This other software **113** may include Visual Voice software, which is a well known set of software commonly used to interface data with the Dialogic card **111**. Furthermore, in other embodiments, the communication handler **92** may be configured to transmit notification messages one at a time, if desired.

As shown by FIG. **1**, the notification messages may be routed to one or more users via a communication network, such as the publicly switched telephone network (PSTN) **123**. In this regard, the network **123** routes each notification message transmitted by communication handler **92** to a communication device **124**, such as a telephone, for example, at a premises **126** of a user that is to receive the notification message. Upon receiving the notification message from network **123**, the communication device **124** communicates the notification message to the user. It should be noted that it is not necessary for notification messages to be communicated via telephone calls and that the communication device **124** may be any device capable of communicating a notification message. For example, the communication device **124** may be pager in one embodiment. In another embodiment, the communication handler **92** transmits a notification message to the device **124** via the Internet. For example, the communication handler **92** may transmit an e-mail message to the device **124**, which in this example is a computer capable of reading the message and displaying the message to the user.

If the communication handler **92** cannot immediately transmit a notification message in response to a notification request, then the communication handler **92** is designed to store the notification request into a queue **121** (FIG. **8**). The communication handler **92** then services the notification requests stored in the queue **121** on a first in, first out (FIFO) basis. Therefore, the communication handler **92** services the notification requests in the order in which they were received by the communication handler **92**.

As stated hereinbefore, each notification request is generated in response to a determination that a user should be warned of an impending arrival of a particular vehicle **17** at a particular location. Therefore, each notification request preferably includes contact information to enable the communication handler **92** to send a notification message to the particular user associated with the notification request or includes other information to enable the communication handler **92** to retrieve such contact information from the database **43**. As a result, the communication handler **92** is configured to utilize contact information included in the notification request or stored in the database **43** to automatically transmit a notification request to the user associated with the notification request.

It should be noted that the list **81** is not a necessary feature of the present invention. In this regard, the database **43** can be repeatedly searched to determine when to generate notification requests (i.e., where a notification event should occur). However, repeatedly searching the database **43** could result in the unnecessary processing of a vast amount of data, depending on the amount of data and entries stored in database **43**. Utilization of the list **81** enables a much smaller amount of data to be searched in identifying whether notification requests should be generated during a particular time interval.

Furthermore, it is possible for the functionality of the VCU **15** and the BSCU **40** to be divided differently. In this regard, it is possible for some of the functionality performed by the BSCU **40** to be performed by the VCU **15** instead and for some of the functionality of the VCU **15** to be performed by the BSCU **40** instead. For example, it is possible to periodically transmit the location values from the sensor **18** to the BSCU **40**. The BSCU **40** may then determine whether the vehicle **17** is on or off schedule based on these location values rather than the status messages transmitted by the VCU **15** in the preferred embodiment. Furthermore, it is possible for the BSCU **40** to be eliminated by having the VCU transmit notification messages directly to the users, similar to the techniques described in U.S. Pat. No. 5,444,444, which is incorporated herein by reference. It is further possible to utilize various other techniques for tracking vehicles and/or notifying users of impending arrivals, such as the techniques described in U.S. Pat. No. 5,400,020.

However, in any embodiment, at least one vehicle schedule, such as the schedule defined by vehicle tracking information **39**, should be provided that includes the location values that should be compared with the values produced by the sensor **18** in determining when notification messages should be transmitted to users. These location values in the vehicle schedule may be the values indicating the vehicle stops that the vehicle **17** is expected to make and/or may be the values indicating checkpoints along the vehicle's route. Alternatively, the location values may indicate other reference locations in other embodiments.

As described in the Background section, obtaining and maintaining the foregoing location values for a vehicle schedule may be difficult and burdensome, especially when the advance notification system **12** is utilized to service a large number of vehicles **17** and/or users.

Obtaining Vehicle Schedule Information

There are various methodologies that may be employed to obtain the data defining the vehicle schedule that is used to monitor the travel of a vehicle. U.S. pat. application having Ser. No. 09/395,501 and entitled "BASE STATION APPARATUS AND METHOD FOR MONITORING TRAVEL OF A MOBILE VEHICLE," which is incorporated herein by reference, describes a process of obtaining the vehicle schedule information during an initial traversal of the route. In this regard, the vehicle **17** drives the route and the location values from the sensor **18** are stored in the VCU **15** and/or the BSCU **40** when the vehicle **17** is at each vehicle stop point and/or other checkpoint that is to be used to monitor the vehicle **17**. Therefore, upon completing the route, the VCU **15** and/or the BSCU **40** should contain sufficient data for monitoring the vehicle **17** the next time the vehicle **17** drives the same route.

In another embodiment, an operator may enter into the system **10** the data that is to be used to monitor the vehicle **17**. For example, the operator may obtain the coordinate values of each checkpoint that is to be used to monitor the vehicle and may enter these values into the BSCU **40** via input device **64**.

However, entering the coordinate values, or other types of location values, into the system **10** can be tedious and burdensome. Furthermore, in applications where the route frequently changes, the foregoing methodologies may be impractical since the coordinate values for each new route would need to be entered into the system **12**. Therefore, a mapping application **150** (FIG. **5**) is preferably used to facilitate the process of entering the route data into the system **10**. The mapping application **150** may be implemented in hardware, software, or a combination thereof. As shown by FIG. **5**, the mapping application **150** may be implemented in software and stored within memory **58** of the BSCU **40** or other computer-readable medium.

The mapping application **150** may be configured similar to conventional mapping software programs that receive an address and produce a display of a map showing directions to the address. Most conventional mapping software programs convert the input data (e.g., the input address) into geographical coordinate values before further processing the input data. The mapping application **150** of the present invention similarly converts input data into coordinate values, which can then be automatically stored in an entry of the database **43** or the vehicle tracking information **39**. Therefore, an operator can input the addresses or other location information that define the vehicle stop points and/or other checkpoints of the vehicle's route, and the mapping application **150** automatically converts this information into coordinate values, which can then be provided to and used by the system **10** to monitor the travel of the vehicle **17**.

For example, a user may enter data that identifies a location where a delivery or a pickup is to take place. This data is translated into a set of coordinate values by the mapping application, and these coordinate values are then used to define at least one checkpoint and/or to indicate when at least one notification message should be transmitted. For example, based on the foregoing coordinate values, a checkpoint and/or other data may be defined such that a notification message is transmitted when a particular vehicle **17** reaches the checkpoint.

Delivery services have conventionally stored in a database, such as database **43**, the address or other location information of where items are to be delivered and/or picked up. The base station manager **51**, or some other control mechanism, can be configured to transmit the stored addresses to mapping application **150**, which automatically converts or translates the addresses into coordinate values and provides the coordinate values to the base station manager **51**. These coordinate values can then be used by the base station manager **51** to define the vehicle's checkpoints that are used to monitor the vehicle **17** and/or to indicate when a notification message should be transmitted, as described above. Therefore, the current computer systems utilized by many delivery services for tracking items can be easily modified to implement the vehicle tracking system **10** of the present invention.

Furthermore, the mapping application **150** may be configured to display a map having symbols representing various locations. The map may be displayed locally at the premises of the BSCU **40** via display **65** or may be displayed remotely by transmitting mapping data to a remote device, such as a computer at user's premises **126** via the Internet or other data communications network. A user may then select one of the displayed locations by utilizing a mouse to click on the symbol representing the location or by identifying the location via other suitable techniques (e.g., entering inputs via a keyboard). The mapping application **150** may be configured to provide the coordinate values of the selected location to the base station manager **51**. These coordinate values may then be transmitted to database **43** by the base station manager **51** and used to define at least one checkpoint for a vehicle **17** and/or to indicate when at least one notification message should be transmitted, as described above. Therefore, the mapping application **150** may enable users to efficiently and easily provide the system **10** with data that defines vehicle schedule information.

Note that the data defining the checkpoints and/or other vehicle schedule information may be transmitted to the VCU **15** by the BSCU **40**. This data may then be used to define the vehicle tracking information **39** (FIG. **3**). Furthermore, the foregoing data and/or information based on the foregoing data may also be displayed to the driver of the vehicle **17** so that the driver is aware of the route that is to be driven.

The mapping application **150** may be configured to perform additional functionality for further simplifying the process of obtaining and managing the data used to monitor the vehicles associated with the system **10**. In this regard, when a large number of items are to be delivered or picked up by a large number of vehicles **17** at various locations, it can be difficult to define routes for each of the vehicles **17** so that the items can be efficiently distributed among the vehicles **17**. Therefore, conventional software programs, such as MapNet developed by Ecotran, have been developed that efficiently and automatically define routes for transporting items and that assign each of the items to a particular route. The routes are created based on locations of the vehicle stops. For example, in utilizing MapNet for a bus service, data identifying each passenger and the location where each passenger is to be delivered or picked-up is entered. Based on this information, the MapNet defines a route for each bus and assigns each passenger to the bus that is scheduled to stop at the delivery or pick-up point associated with the passenger. The MapNet is configured to efficiently define the routes such that the total number of buses and the delays associated with delivering or picking up the passengers are minimized.

In performing the above-described functionality, MapNet utilizes coordinate values, similar to the coordinate values produced by the sensor **18** in the preferred embodiment. In this regard, MapNet converts the input data identifying each bus stop location into coordinate values. Furthermore, to select and define the routes, MapNet includes coordinate values of the streets that may be used to transport the passengers. To select the optimal routes, MapNet defines different sets of routes for the buses, and determines how many buses would be required to transport the items and how far each bus must travel for each set of routes. The set of routes that provides optimal performance in terms of the number of buses required and the distance and/or delay associated with driving the routes is selected by MapNet. MapNet then outputs data indicating the selected routes. This data is usually in a form easily readable by a user. For example, instead of outputting the coordinate values of a route, MapNet outputs the street name or names that define the route and provides directions in terms of street names. For example, the output data may indicate that a bus, in driving the selected route for the bus, should turn onto Johnson Street, proceed to 5th Avenue, turn left on 5th Avenue, etc.

By modifying the MapNet software such that MapNet outputs coordinate values, MapNet may be used to implement the mapping application **150**. In this regard, the mapping application **150** may be configured to receive, as input, data identifying each item to be transported and the location where the item is to be delivered or picked-up. Like MapNet, the mapping application **150** can then be configured to select an optimal set of routes for delivering and/or picking up the items based on the data received by the mapping application **150**. The mapping application **150** then may output via display **65** or printer **66** data defining the routes and data indicating which items are assigned to which vehicle **17** or route. Furthermore, the mapping application **150** is preferably configured to store in database **43** the coordinate values defining the vehicle checkpoints used by the system **10** to monitor the vehicles **17**. Therefore, once the data identifying each item to be transported and the location where the item is to be delivered or picked up is input into the system **10**, the system **10** is configured to generate the necessary data for defining the routes that are to be used in delivering and/or picking up the items and for monitoring the vehicles **17** as the vehicles **17** travel the routes.

By utilizing the aforementioned techniques it is possible to efficiently obtain and maintain vehicle schedule information that can then be used to monitor the status of vehicle **17** and to transmit notification messages for notifying users of impending arrivals of the vehicles **17**. It should be noted, however, that there are various methodologies for determining when notification events should occur, and the present invention should not be limited to the particular embodiment or embodiments disclosed herein. In this regard any method of scheduling notification events and for determining when notification events should occur may be implemented without departing from the principles of the present invention.

It should be noted that the present invention has been described herein as tracking vehicles **17** and determining when to generate a notification message to a user based on time values. However, other types of values may be used to monitor the travel of the vehicle **17**. For example, a notification message could be generated when a particular vehicle comes within a certain distance of a particular location. U.S. Patent Application entitled, "Base Station Apparatus and Method for Monitoring Travel of a Mobile Vehicle," assigned Ser. No. 09/395,501, and filed on Sep. 14, 1999, which is incorporated herein be reference, describes how distance values may be used to determine when to transmit notification messages.

It should be emphasized that the above-described embodiments of the present invention, particularly, any "preferred" embodiments, are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiment(s) of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of the present invention and protected by the claims.

Now, therefore, the following is claimed:

1. A vehicle tracking system, comprising:

a mapping application module configured to receive data identifying a particular location from a user interface in one of a plurality of formats and to automatically translate said data identifying said particular location into a set of location values, in a format compatible with the location values produced by a location sensor said mapping application module further configured to store said set of location values; and

a data manager configured to retrieve said set of location values stored by said mapping application module and to monitor travel of a vehicle based on a set of location values produced by said location sensor coupled to said vehicle, said data manager configured to determine, by comparing said set of location values produced by said location sensor to said set of location values retrieved by said data manager, when said vehicle is within a predefined proximity of said particular location, said data manager further configured to cause a notification message to be transmitted to a user communications device for notifying a user of an impending arrival of said vehicle at said particular location when said data manager determines that said vehicle is within said predefined proximity of said particular location.

2. The system of claim **1**, wherein said data manager is remotely located from said vehicle.

3. The system of claim **1**, wherein said mapping application module is configured to receive data identifying a plurality of locations, to define a plurality of routes based on said data identifying said plurality of locations, and to associate each of said plurality of locations with one of said routes.

4. The system of claim **1**, wherein said mapping application module is configured to produce a map displaying symbols representing various locations including said particular location.

5. The system of claim **4**, wherein said mapping application module is configured to transmit data defining said map across the Internet to a computer remotely located from said mapping application module, said mapping application module further configured to receive said data identifying said particular location from said computer.

6. The system of claim **5**, wherein said computer is configured to enable a user to select said particular location based on said data defining said map.

7. The system of claim **1**, wherein said data manager includes a database configured to store a route schedule of said vehicle.

8. The system of claim **7**, wherein said database is further configured to store data indicating when different users are to be notified of an impending arrival of said vehicle.

9. The system of claim **8**, wherein said data manager is further configured to query the database to build a list of notification events that are expected to occur during a specified time period, and wherein said data manager is further configured to scan the list to determine if a notification event should occur.

10. The system of claim **9**, wherein said data manager is further configured to update said list upon determining that said vehicle is off schedule.

11. The system of claim **1**, wherein said predefined proximity is based on time values.

12. The system of claim **1**, wherein said predefined proximity is based on distance values.

13. The system of claim **1**, wherein said data identifying a particular location is a street address.

14. The system of claim **1**, wherein said location values are coordinate values.

15. The system of claim **1**, wherein said location sensor is a GPS sensor.

16. A method for tracking vehicles, comprising the steps of:

receiving data identifying a particular location from a user interface device in one of a plurality of formats;

automatically translating said data received in said receiving step into a set of location values in a format

compatible with the location values produced by a location sensor;

storing said set of location values;

monitoring travel of a vehicle based on a set of location values produced by said location sensor coupled to said vehicle;

comparing said set of said location values produced by said location sensor to said set of location values stored in said storing step;

determining when said vehicle is within a predefined proximity of said particular location based on said comparing step;

causing a notification message to be transmitted to a user communications device in response to a determination in said determining step that said vehicle is within said predefined proximity of said particular location; and

notifying a user of an impending arrival of said vehicle at said particular location via said notification message.

17. The method of claim **16**, further comprising the step of displaying, via said user interface, a map including symbols representing various locations, said particular location associated with a symbol displayed in said displaying step.

18. The method of claim **17**, further comprising the step of transmitting data defining said map across the Internet to said user interface.

19. The method of claim **17**, further comprising the steps of:

selecting said symbol associated with said particular location; and

transmitting said data identifying said particular location in response to said selecting step.

20. The method of claim **19**, further comprising the step of utilizing a mouse to perform said selecting step.

21. The method of claim **16**, wherein said predefined proximity is based on time values.

22. The method of claim **16**, wherein said predefined proximity is based on distance values.

23. The method of claim **16**, wherein said data identifying a particular location is a street address.

24. The method of claim **16**, wherein said location values are coordinate values.

25. The method of claim **16**, wherein said location sensor is a GPS sensor.

26. A method for tracking vehicles, comprising the steps of:

receiving data identifying a plurality of locations from a user interface in one of a plurality of formats;

automatically defining a plurality of routes based on said data identifying a plurality of locations;

associating each of said plurality of locations with one of said routes;

automatically translating said data identifying said plurality of locations into location values in a format compatible with the location values producted by a location sensor;

storing a set of said location values, said set of location values identifying a particular location;

monitoring travel of a vehicle based on a set of location values produced by said location sensor coupled to said vehicle;

comparing said set of said location values produced by said location sensor to said set of location values stored in said storing step;

determining when said vehicle is within a predefined proximity of said particular location based on said comparing step;

causing a notification message to be transmitted to a user communications device in response to a determination in said determining step that said vehicle is within said predefined proximity of said particular location; and

notifying a user of an impending arrival of said vehicle at said particular location via said notification message.

27. The method of claim **26**, further comprising the steps of:

displaying a map including at least one symbol, said one symbol representing said particular location; and

enabling a user to select said one symbol,

wherein said data received in said receiving step includes data transmitted in response to a user selection of said one symbol.

28. The method of claim **26**, wherein said predefined proximity is based on time values.

29. The method of claim **26**, wherein said predefined proximity is based on distance values.

30. The method of claim **26**, wherein said data identifying a plurality of locations is a plurality of street addresses.

31. The method of claim **26**, wherein said location values are coordinate values.

32. The method of claim **2**, wherein said location sensor is a GPS sensor.

* * * * *

EXHIBIT B

US006714859B2

(12) **United States Patent**
Jones

(10) **Patent No.: US 6,714,859 B2**
(45) **Date of Patent: *Mar. 30, 2004**

(54) **SYSTEM AND METHOD FOR AN ADVANCE NOTIFICATION SYSTEM FOR MONITORING AND REPORTING PROXIMITY OF A VEHICLE**

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

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 09/163,958, filed on Sep. 30, 1998, now Pat. No. 6,278,936, which is a continuation-in-part of application No. 08/852,119, filed on May 6, 1997, and a continuation-in-part of application No. 08/432,898, filed on May 2, 1995, now Pat. No. 5,657,010, and a continuation-in-part of application No. 08/432,666, filed on May 2, 1995, now Pat. No. 5,668,543, and a continuation-in-part of application No. 08/434,049, filed on May 2, 1995, now Pat. No. 5,623,260, and a continuation-in-part of application No. 08/407,319, filed on Mar. 20, 1995, now abandoned, which is a continuation-in-part of application No. 08/063,533, filed on May 18, 1993, now Pat. No. 5,400,020.

(60) Provisional application No. 60/039,925, filed on Mar. 10, 1997.

(51) **Int. Cl.**[7] **G01C 21/26**; H04Q 7/20

(52) **U.S. Cl.** **701/201**; 701/117; 701/202; 340/989; 340/994; 340/995.12; 340/825.49; 342/357.07; 342/357.09; 342/357.1; 455/456.1; 455/456.2; 455/456.5; 455/456.6

(58) **Field of Search** 701/201, 207, 701/208, 209, 211, 213, 117, 202, 116, 118; 342/357.06, 357.07, 357.11, 357.09, 357.1, 357.13, 357.01; 340/990, 995, 988, 903, 905, 989, 994, 995.12, 995.13, 991, 825.36, 825.49; 455/412.1, 412.2, 456.1, 456.6, 456.5, 456.3, 457

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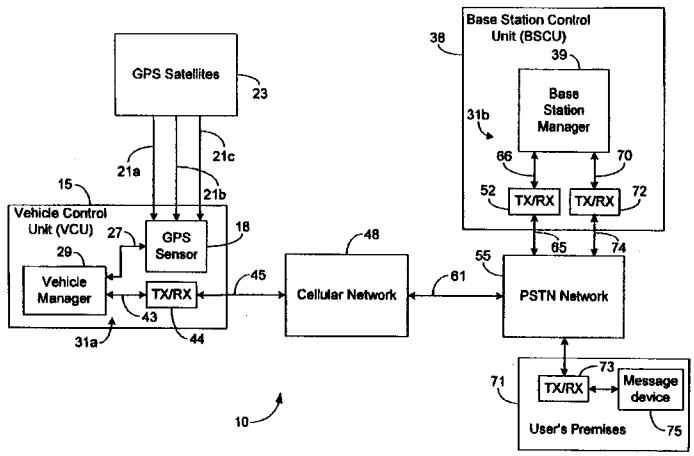
(57) **ABSTRACT**

Generally, the present invention monitors and communicates travel data transmitted from vehicles being monitored by the system to users requesting travel information on a particular vehicle. A travel data storage unit receives and stores the travel data. When a user desires to view some or all of this travel data, the user submits a request to a data manager. In response, the data manager retrieves the appropriate information from the travel data stored in the travel data storage unit and transmits this information to the user. The data manager may communicate the information in a variety of mediums and preferably contact information is predefined that enables the data manager to determine which medium is preferable and how to establish communication once the medium is determined.

40 Claims, 7 Drawing Sheets



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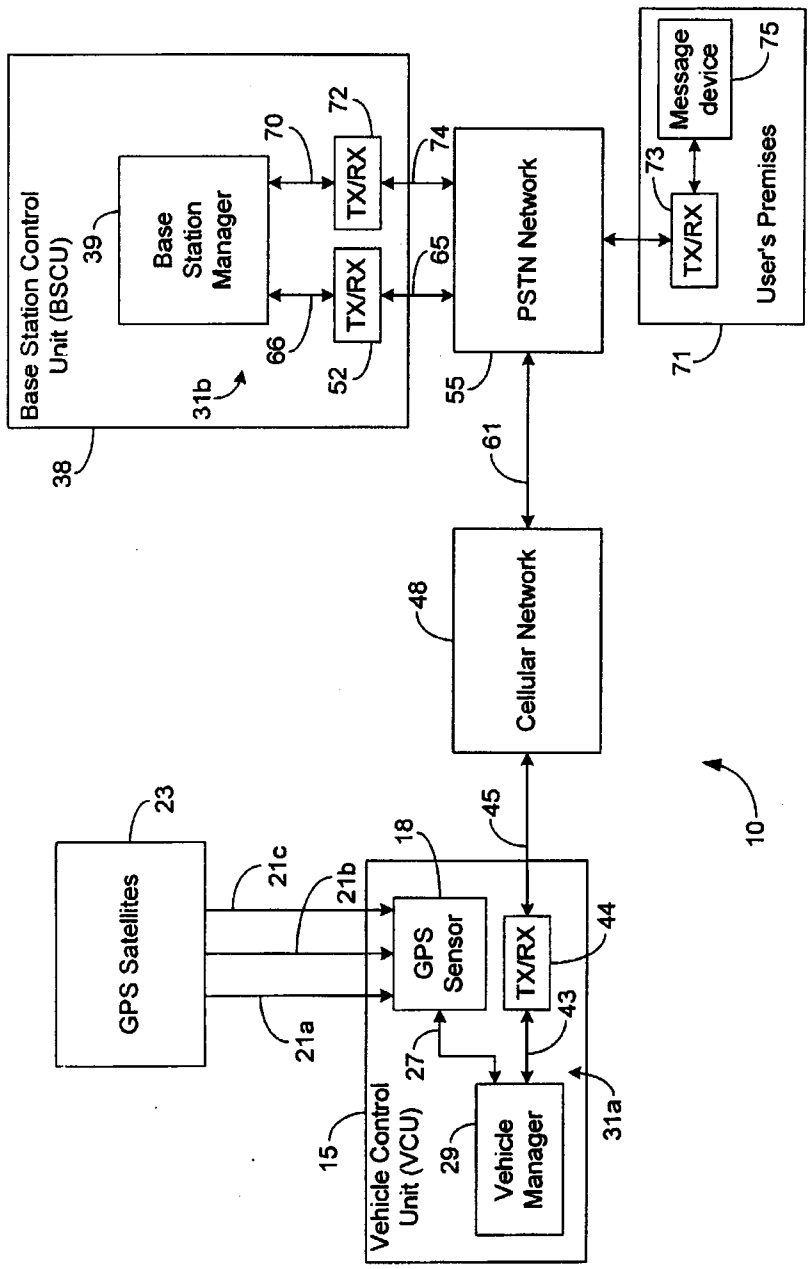
Base Station Control Unit (BSCU)
38
Base Station Manager
39
31b
70
66
72
52
TX/RX
TX/RX
74
65
PSTN Network
55
61
Message device
75
73
TX/RX
User's Premises
71
Cellular Network
48
GPS Satellites
23
21c
21b
21a
18
GPS Sensor
45
TX/RX
44
43
27
Vehicle Control Unit (VCU)
15
29
Vehicle Manager
31a
10

Fig. 1

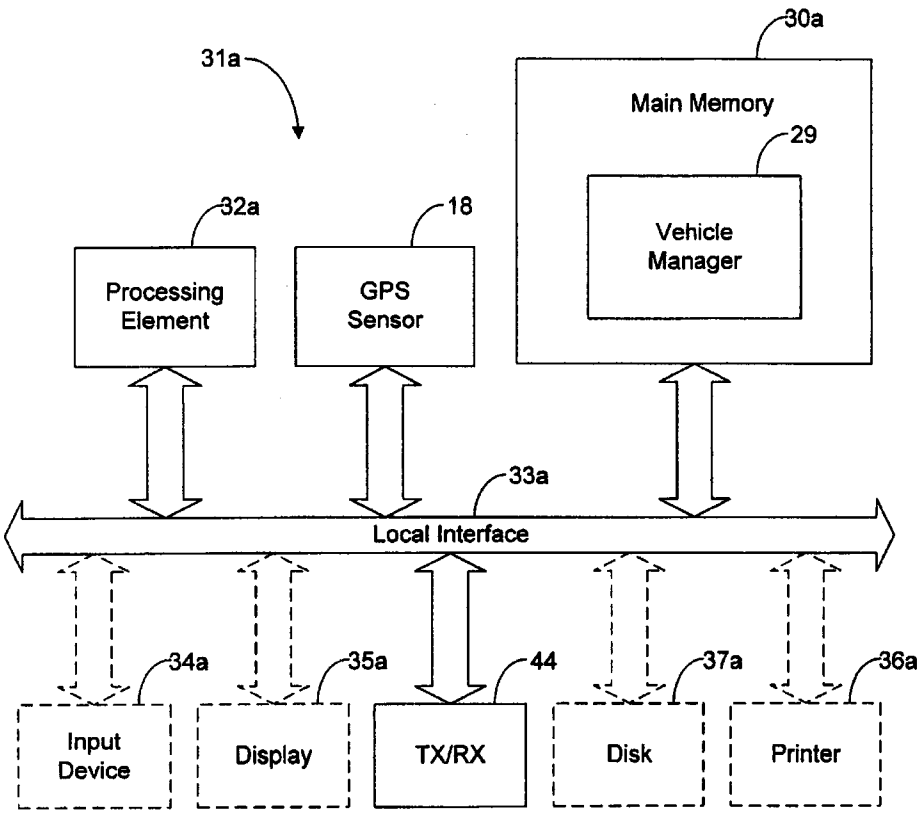
30a
31a
Main Memory
29
Vehicle Manager
32a
18
Processing Element
GPS Sensor
33a
Local Interface
34a
35a
44
37a
36a
Input Device
Display
TX/RX
Disk
Printer

Fig. 2

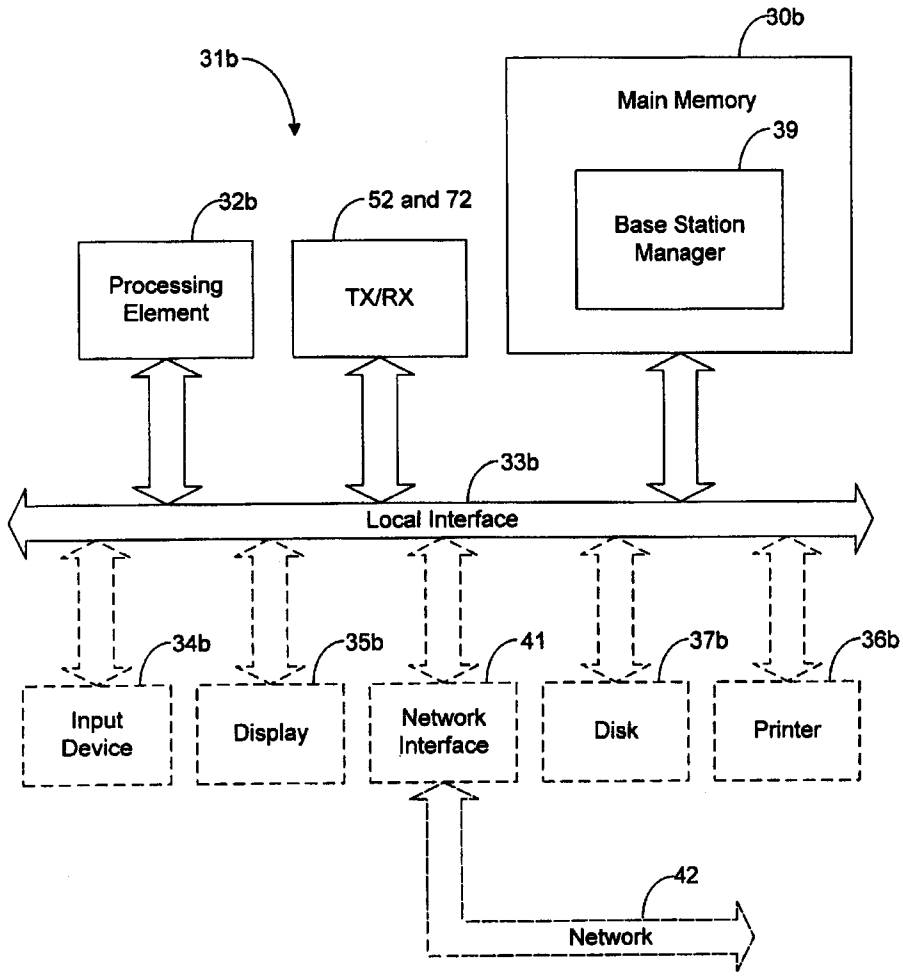
30b
31b
Main Memory
39
Base Station Manager
32b
52 and 72
Processing Element
TX/RX
33b
Local Interface
34b
35b
41
37b
36b
Input Device
Display
Network Interface
Disk
Printer
42
Network

Fig. 3

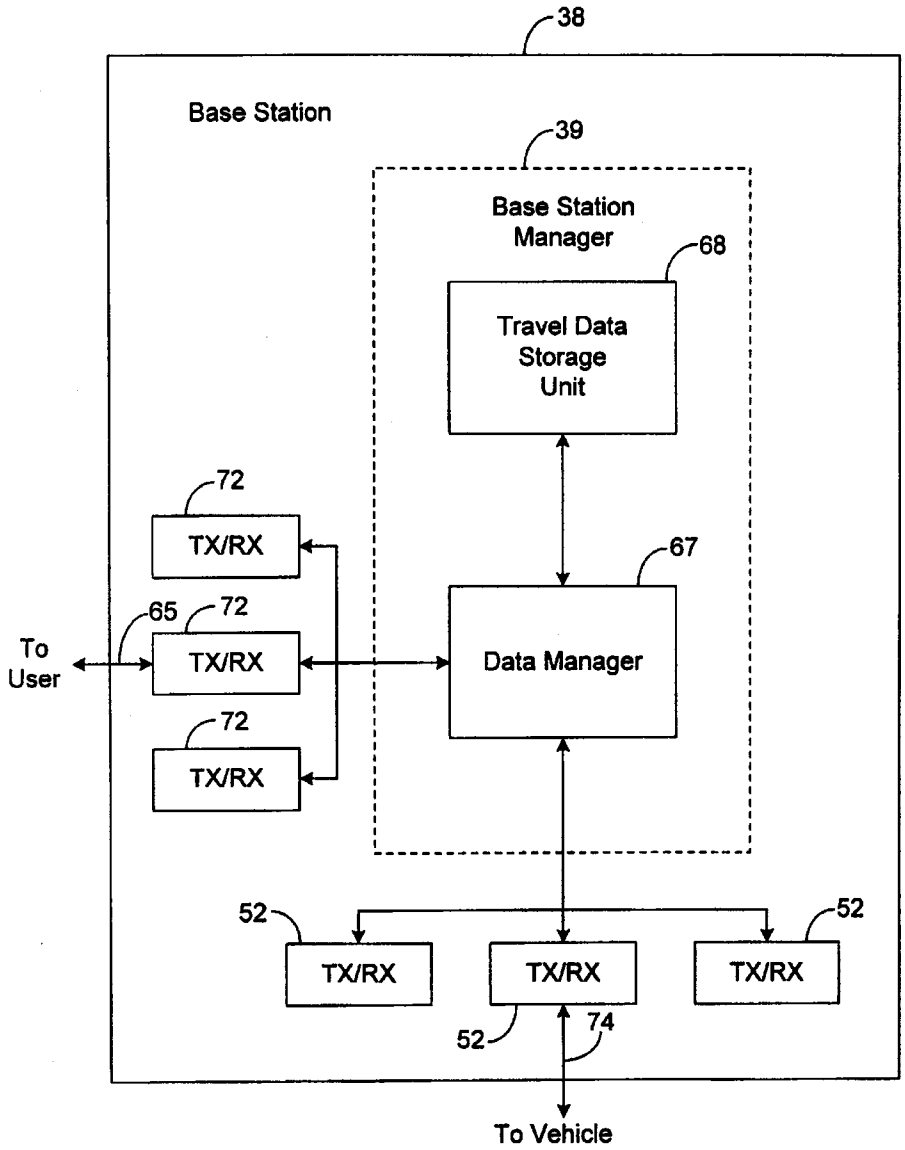
38
Base Station
39
Base Station Manager
68
Travel Data Storage Unit
72
TX/RX
67
65
72
TX/RX
To User
Data Manager
72
TX/RX
52
52
TX/RX
TX/RX
TX/RX
52
74
To Vehicle

Fig. 4

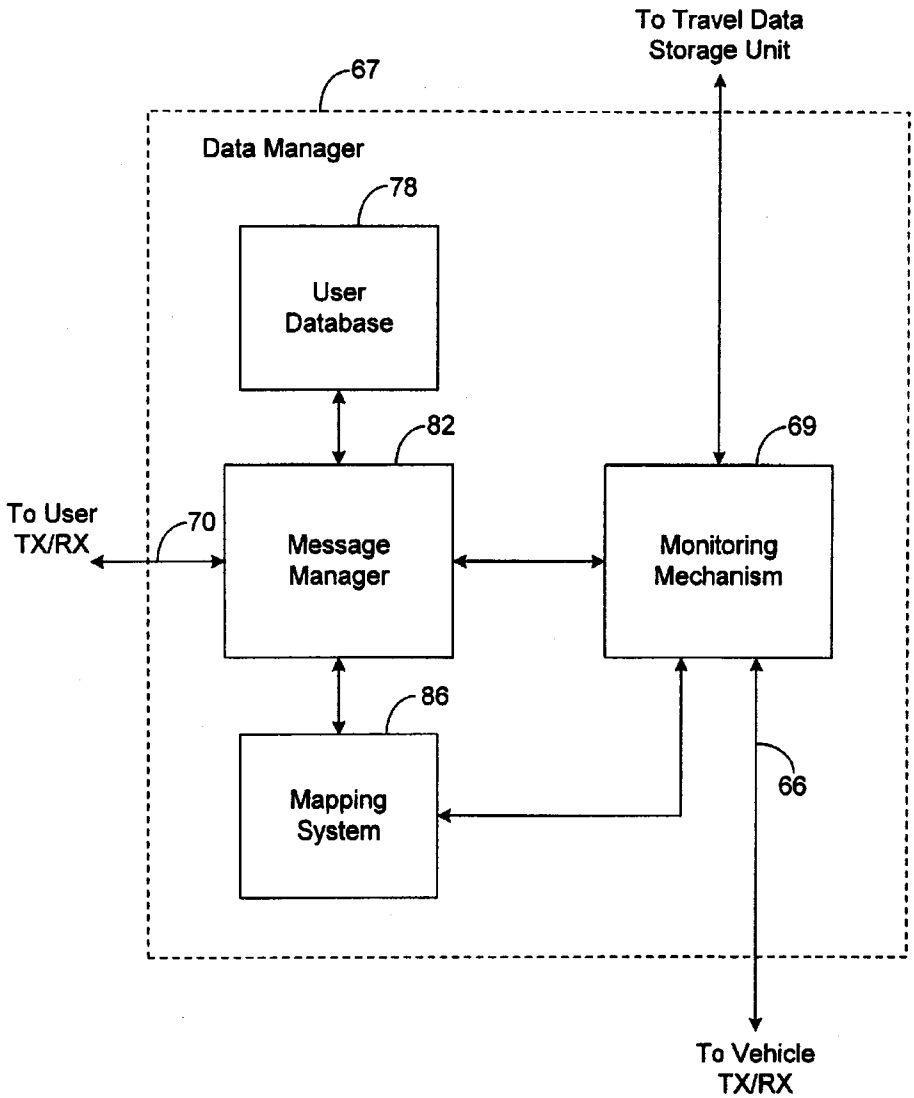
To Travel Data
Storage Unit
67
Data Manager
78
User
Database
82
69
To User
TX/RX
70
Message
Manager
Monitoring
Mechanism
86
Mapping
System
66
To Vehicle
TX/RX

Fig. 5

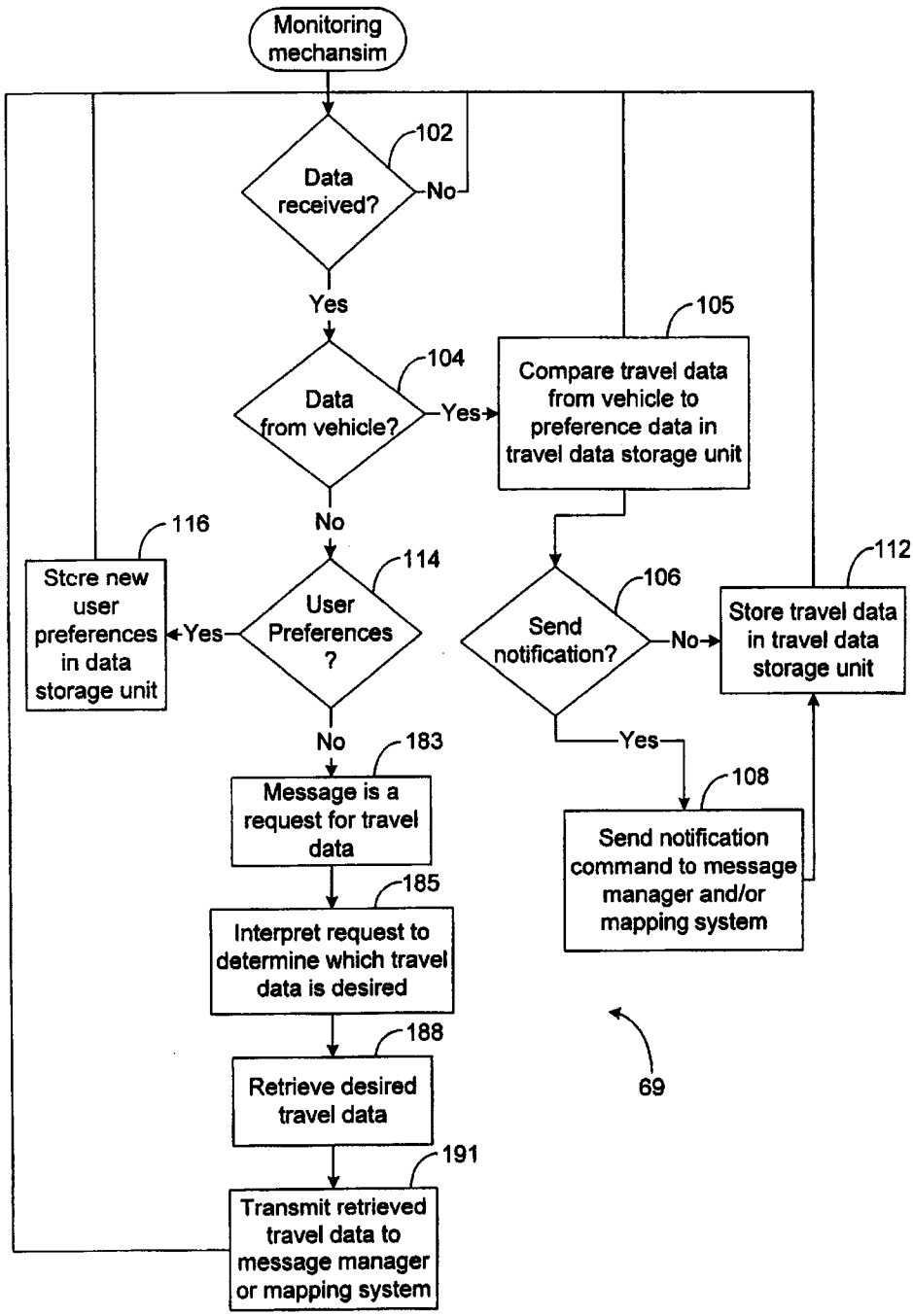
Monitoring mechansim
Data received?
102
No
Yes
Data from vehicle?
104
Yes
105
Compare travel data from vehicle to preference data in travel data storage unit
No
116
Store new user preferences in data storage unit
Yes
User Preferences ?
114
Send notification?
106
No
112
Store travel data in travel data storage unit
Yes
No
183
Message is a request for travel data
108
Send notification command to message manager and/or mapping system
185
Interpret request to determine which travel data is desired
188
Retrieve desired travel data
191
Transmit retrieved travel data to message manager or mapping system
69

Fig. 6

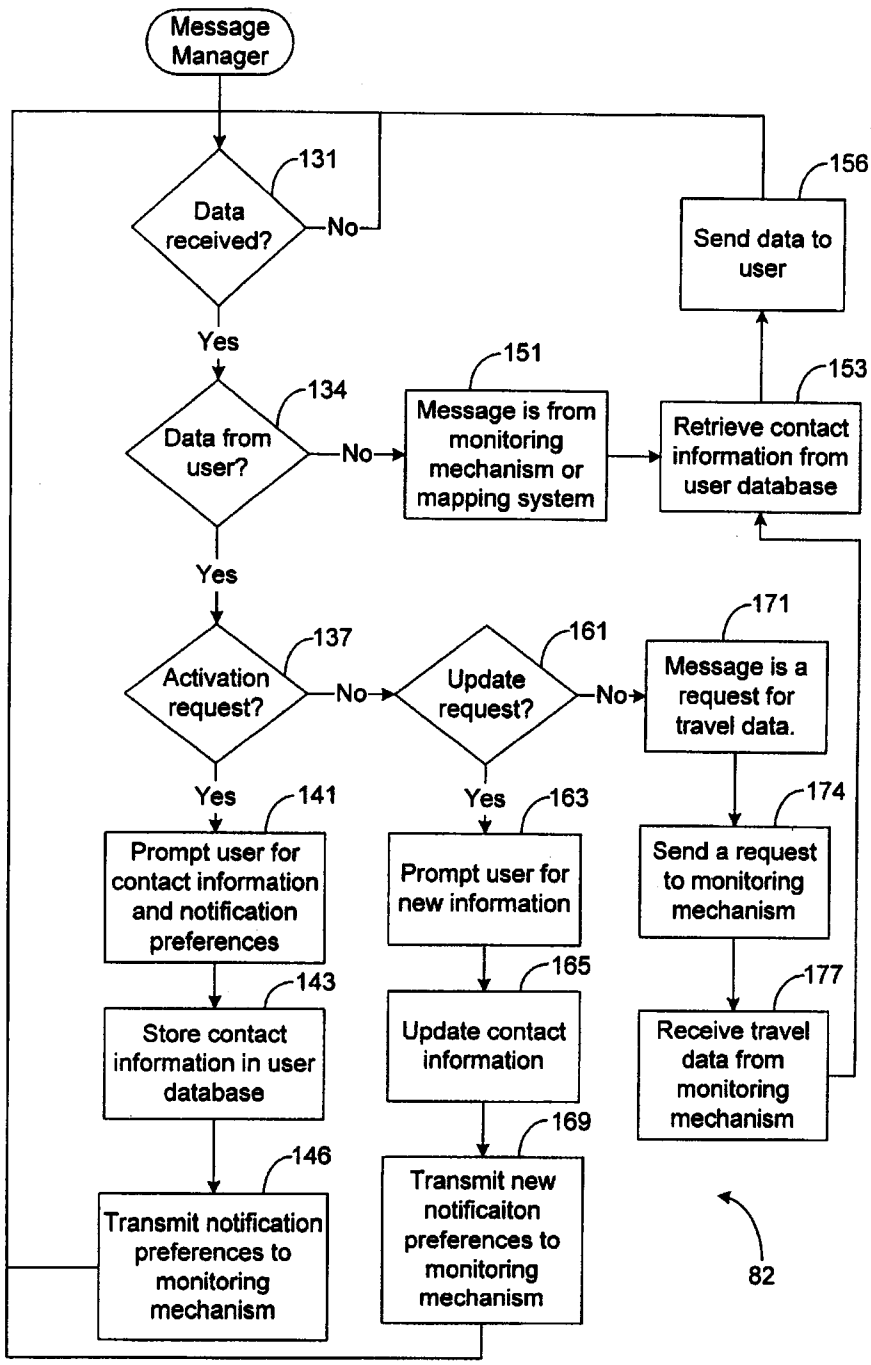
Message Manager
131
Data received?
No
Yes
134
Data from user?
No
151
Message is from monitoring mechanism or mapping system
Yes
137
Activation request?
No
161
Update request?
No
Yes
141
Prompt user for contact information and notification preferences
143
Store contact information in user database
146
Transmit notification preferences to monitoring mechanism
Yes
163
Prompt user for new information
165
Update contact information
169
Transmit new notificaiton preferences to monitoring mechanism
171
Message is a request for travel data.
174
Send a request to monitoring mechanism
177
Receive travel data from monitoring mechanism
153
Retrieve contact information from user database
156
Send data to user
82

Fig. 7

SYSTEM AND METHOD FOR AN ADVANCE NOTIFICATION SYSTEM FOR MONITORING AND REPORTING PROXIMITY OF A VEHICLE

RELATED APPLICATIONS/PATENTS

This document claims priority to and is a continuation of copending U.S. Patent Application entitled "SYSTEM AND METHOD FOR AN ADVANCE NOTIFICATION SYSTEM FOR MONITORING AND REPORTING PROXIMITY OF A VEHICLE," assigned Ser. No. 09/163,958, and filed on Sep. 30, 1998 now U.S. Pat. No. 6,278,936. This document also claims priority to and is a continuation-in-part of copending U.S. Patent Application entitled "ADVANCE NOTIFICATION SYSTEMS AND METHODS UTILIZING A COMPUTER NETWORK," assigned Ser. No. 08/852,119, and filed on May 6, 1997, which claims priority to (a)–(d) hereafter, and which is a continuation-in-part of (b)–(d) hereafter:

(a) provisional application entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING A COMPUTER NETWORK," filed Mar. 10, 1997 by M. K. Jones and assigned Ser. No. 60/039,925;

(b) nonprovisional application entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING PASSENGER-DEFINABLE NOTIFICATION TIME PERIOD," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/434,049, now U.S. Pat. No. 5,623,260 to M. K. Jones that issued on Apr. 22, 1997;

(c) nonprovisional application entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING VEHICLE PROGRESS REPORT GENERATOR," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/432,898, now U.S. Pat. No. 5,657,010 to M. K. Jones that issued on Aug. 12, 1997; and

(d) nonprovisional application entitled, "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING PASSENGER CALLING REPORT GENERATOR," filed May 2, 1995 by M. K. Jones and assigned Ser. No. 08/432,666, now U.S. Pat. No. 5,668,543 to M. K. Jones that issued on Sep. 16, 1997;

where documents (b), (c), and (d) are each a continuation-in-part of the application entitled "ADVANCE NOTIFICATION SYSTEM AND METHOD UTILIZING A DISTINCTIVE TELEPHONE RING," filed Mar. 20, 1995 by M. K. Jones and assigned Ser. No. 08/407,319, now abandoned, which in turn is a continuation-in-part of an application entitled "ADVANCE NOTIFICATION SYSTEM AND METHOD" filed May 18, 1993 by M. K. Jones et al. and assigned Ser. No. 08/063,533, now U.S. Pat. No. 5,400,020 to M. K. Jones et al. that issued on Mar. 21, 1995.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to data communications and information systems and, in particular, to an automated system and method for monitoring travel of a vehicle and for communicating vehicle travel information to a user at a remote location regarding the proximity of the vehicle relative to a predefined destination.

2. Related Art

There are many situations when it is desirable to know the actual arrival time of a particular vehicle at a particular destination or other location. With this information, adjustments can be made to avoid waiting for a particular vehicle to reach the particular destination. For example, a person picking up a friend or relative at a commercial bus station usually either calls the bus station to find out the approximate arrival time (information which is oftentimes unavailable or unreliable) and/or arrives at the bus station prior to the scheduled arrival time of the bus hoping that the bus is not significantly delayed.

Another example involves school children that ride school buses. The arrival times of school buses at scheduled stops can be significantly affected by many factors such as maintenance problems, rush hour traffic, and congested urban/suburban conditions. As a result, school children typically wait at bus stops for long periods of time, oftentimes in adverse weather conditions, on unlit street corners, or in hazardous conditions near busy or secluded streets. A system informing the students of the school bus' proximity is desirable in order for the students to avoid waiting on the school bus at the school bus stop for extended times.

Yet another example is in the commercial overnight package delivery industry, wherein packages are delivered on a tight schedule. Customers oftentimes wait on delivery of important time-critical packages not knowing precisely when the delivery will occur. A system informing the customer of the precise arrival time is desirable in order to improve customer service and to allow the customer to better rely on the estimated arrival time of the delivery.

Thus, generally, it is desirable to know when a vehicle (such as a bus, truck, train, plane, user, or the like) is (a) a particular time period (for example, a certain number of minutes or seconds) away from arriving at a destination, (b) a particular distance (for example, number of feet or miles) away from the destination, or (c) at a particular location among a set of predetermined location points.

In order to alleviate the arrival time problem in the context of school buses, student notification systems in the past have been employed that use a transmitter on each bus and a receiver inside each student home. U.S. Pat. No. 4,713,661 to Boone et al. and U.S. Pat. No. 4,350,969 describe systems of this type. When the school bus and its on-board transmitter come within a certain range of a particular home receiver, the transmitter sends a signal to notify the student that the school bus is nearby. While such notification systems work satisfactorily under certain circumstances, nevertheless, these systems are limited by the range of the transmitters and require the purchase of relatively expensive receivers for each student. In addition, such systems provide little flexibility for providing additional information to the students, such as notifying them of the delayed arrival of a bus, alternative bus route information, or information regarding important school events.

Thus, a heretofore unaddressed need exists in the industry for a system and method for monitoring travel of a vehicle and for providing desirable travel information, such as, for example, an updated location of the vehicle.

SUMMARY OF THE INVENTION

The present invention overcomes the inadequacies and deficiencies of the prior art as discussed herein. In general, the present invention provides an automated system and method for monitoring travel of a vehicle and for communicating vehicle travel information to a user located at a remote location in response to a request by the user.

In a broad sense, the present invention utilizes a storage mechanism, a data manager, and communications devices. The storage mechanism receives and stores travel informa-

tion transmitted from a vehicle at a remote location. The travel information preferably includes data that indicates a location of the vehicle, such as the coordinates of the vehicle relative to a predefined reference point, but the travel information may include various other information in lieu of or in combination with the location data. When a user at another remote location wishes to view all or some of this the travel information transmitted by the vehicle, the user establishes communication with the data manager and submits a request. In response to the request, the data manager retrieves the desired information and transmits a message containing the information from a communications device at associated with the data manager to another communications device associated with the user. By analyzing this retrieved information, the user can monitor the travel of a particular vehicle.

In accordance with another feature of the present invention, a mapping system is designed to receive the travel data retrieved by the data manager and to generate mapping data based on the retrieved travel data. The mapping data is transmitted to a device at the user's location which renders the mapping data as a graphical display indicating the location of the vehicle on a map. By viewing the map, the user can monitor the travel of the vehicle.

In accordance with another feature of the present invention, the data manager compares predefined preference data to travel data associated with a particular vehicle. When a comparison of the predefined preference data to the travel data associated with the particular vehicle indicates that there is an impending arrival of the vehicle at a particular location, the data manager transmits a notification message to the user.

In accordance with another feature of the present invention, the particular vehicle includes a sensor for determining a location of the particular vehicle relative to a predefined reference point. A communications device associated with the particular vehicle transmits travel data indicating the location of the particular vehicle to the storage mechanism. Preferably, the communications device associated with the particular vehicle transmits the travel data through a cellular network or some other wireless communications system.

In accordance with another feature of the present invention, contact information is retrieved by the data manager in order to enable communication between the communications devices. The contact information is preferably predefined by the user and indicates a preferred medium of communication with which to transmit the travel data to the user.

The present invention can also be viewed as providing a method for communicating travel data associated with a particular vehicle. Briefly described, the method can be broadly conceptualized by the following steps: receiving travel data transmitted from vehicles located at remote locations; storing the travel data; receiving a request from a user located at a remote location; retrieving travel data associated with a particular vehicle in response to the request; forming a message corresponding with the travel data retrieved in the retrieving step; and transmitting the message to a communications device associated with the user.

The present invention has many advantages, a few of which are delineated hereafter, as mere examples.

An advantage of the present invention is that a particular vehicle associated with the system can be monitored, and a user can be notified when an arrival of the vehicle at a predefined destination is imminent. As a result, the user can prepare for the arrival of the vehicle knowing the precise time of arrival of the vehicle.

Another advantage of the present invention is that a user at a remote location can monitor the travel of a particular vehicle by gaining access to the travel data used to monitor the vehicle.

Another advantage of the present invention is that a user at a remote location can receive, on demand, updated information pertaining to the travel or status of a particular vehicle.

Another advantage of the present invention is that it can be implemented in software, hardware, or a combination thereof.

Other features and advantages of the present invention will become apparent to one skilled in the art upon examination of the following detailed description, when read in conjunction with the accompanying drawings. It is intended that all such features and advantages be included herein within the scope of the present invention, as is defined by the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale relative to each other, emphasis instead being placed upon clearly illustrating the principles of the invention. Furthermore, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a block diagram illustrating a vehicle monitoring system in accordance with the preferred embodiment of the present invention.

FIG. **2** is a block diagram illustrating an implementation of the vehicle manager of FIG. **1** in accordance with the preferred embodiment of the present invention.

FIG. **3** is a block diagram illustrating an implementation of the base station manager of FIG. **1** in accordance with the preferred embodiment of the present invention.

FIG. **4** is a detailed block diagram of the base station of FIG. **1**.

FIG. **5** is a detailed block diagram of the data manager of FIG. **4**.

FIG. **6** is a flowchart illustrating the functionality of the monitoring mechanism of FIG. **5**.

FIG. **7** is a flowchart illustrating the functionality of the message manager of FIG. **5**.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** depicts an automated monitoring system **10** illustrating the principles of the present invention. Vehicle control unit (VCU) **15** can be attached to any mobile structure or vehicle capable of carrying or moving a sensor **18** over various distances. For example, VCU **15** can be attached to an automobile, an airplane, a train, a boat or any other structure capable of moving across or through the Earth's surface and/or atmosphere. VCU **15** can also be carried by a person while walking or running.

The sensor **18** within VCU **15** is configured to determine the location of VCU **15** relative to a predetermined reference point. For example, in the preferred embodiment, sensor **18** is a global positioning system (GPS) sensor coupled to VCU **15**, although other types of positioning systems and/or sensors are also possible. The GPS sensor **18** is configured

to receive signals **21***a*–**21***c* from a plurality of GPS satellites **23**, and as known in the art, sensor **18** is designed to analyze signals **21***a*–**21***c* in order to determine the sensor's coordinate values relative to a predetermined reference point. For example, in the preferred embodiment where sensor **18** is a GPS sensor, the sensor **18** determines the sensor's coordinate values relative to the Earth's zero degree latitude and zero degree longitude reference point, which is located at the intersection of the Equator and the Prime Meridian. U.S. Pat. No. 5,781,156 entitled "GPS Receiver and Method for Processing GPS Signals" and filed on Apr. 23, 1997 by Krasner, which is incorporated herein by reference, discusses the processing of GPS signals **21***a*–**21***c* received from GPS satellites **23** in order to determine the coordinate values. Since the sensor **18** is located within VCU **15**, the coordinate values determined by the sensor **18** are assumed to match the coordinate values of the vehicle or other structure attached to the VCU **15**.

It should be noted that the term "coordinate value" shall be defined herein to mean any value or set of values that may be used to determine a location of a point on the Earth. These values may be grid values, polar values, vector values, or any other type of value or values known in the art for indicating locations of points.

Sensor **18** is designed to transmit a signal **27** to vehicle manager **29** indicating the VCU's current coordinate values. Vehicle manager **29** is configured to receive signal **27** and to monitor the location of the VCU **15** over time by processing multiple signals **27**. The vehicle manager **29** can be implemented in software, hardware, or a combination thereof In the preferred embodiment, as illustrated by way of example in FIG. **2**, the vehicle manager **29** of the present invention along with its associated methodology is implemented in software and stored in computer memory **30***a* of a computer system **31***a*.

Note that the vehicle manager **29** can be stored and transported on any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In the context of this document, a "computer-readable medium" can be any means that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The computer readable medium can be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a nonexhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (magnetic), a read-only memory (ROM) (magnetic), an erasable programmable read-only memory (EPROM or Flash memory) (magnetic), an optical fiber (optical), and a portable compact disc read-only memory (CDROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance optical scanning of the paper or other medium, then compiled, interpreted or otherwise processed in a suitable manner if necessary, and then stored in a computer memory. As an example, the vehicle manager **29** may be magnetically stored and transported on a conventional portable computer diskette.

The preferred embodiment of the computer system **31***a* of FIG. **2** comprises one or more conventional processing elements **32***a*, such as a digital signal processor (DSP), that communicate to and drive the other elements within the system **31***a* via a local interface **33** a, which can include one or more buses. Furthermore, an input device **34***a*, for example, a keyboard or a mouse, can be used to input data from a user of the system **31***a*, and screen display **35***a* or a printer **36***a* can be used to output data to the user. A disk storage mechanism **37***a* can be connected to the local interface **33***a* to transfer data to and from a nonvolatile disk (e.g, magnetic, optical, etc.). It should be noted that input device **34***a*, display **35***a*, printer **36***a*, and disk **37***a* are optional and are not a part of the preferred embodiment, although other embodiments may include these features.

The vehicle manager **29** is preferably configured to maintain a database of travel data. The travel data includes the vehicle location information as well as any other desirable information. For example, when VCU **15** is attached to a delivery vehicle, vehicle manager **29** can be configured to include a list of items to be delivered and to indicate which deliveries have been successfully attempted, which deliveries have been unsuccessfully attempted, and which deliveries remain to be attempted. Vehicle manager **29** can also be configured to include the time that particular deliveries or other types of stops (e.g. bus stops) have been made and/or attempted. The travel data stored in vehicle manager **29** may include other desirable information not mentioned herein without departing from the principles of the present invention.

When desired, vehicle manager **29** is configured to transmit certain travel data (preferably including the location of VCU **15** and other desirable information) to base station control unit (BSCU) **38**, which is remotely located from the VCU **15**. Co-pending U.S. Patent Application entitled "System and Method for Enciphering and Communicating Vehicle Tracking Information" filed by Jones of even date herewith (Express Mail No. EL068353584US), which is incorporated herein by reference, describes a system and method for transmitting the vehicle data to BSCU **38**.

BSCU **38** preferably includes a base station manager **39** designed to monitor the travel data of each VCU **15** associated with the system **10**. The base station manager **39** can be implemented in software, hardware, or a combination thereof In the preferred embodiment, as illustrated by way of example in FIG. **3**, the base station manager **39** of the present invention along with its associated methodology is implemented in software and stored in computer memory **30***b* of a computer system **31***b*. The computer system **31***b* can be similar to computer system **31***a*, as can be seen by comparing FIG. **2** to FIG. **3**. In this regard, the computer system **31***b* may include memory **30***b* for storing monitoring mechanism **39**, and the computer system **31***b* may also include processing element **32***b*, local interface **33***b*, input **34***b*, display **35***b*, printer **36***b*, and storage disk **37***b*. It may also be desirable for computer system **31***b* to include a network interface **41** that allows the system **31***b* to exchange data with a network **42**. It should be noted that input device **34***b*, display **35***b*, printer **36***b*, disk **37***b*, network interface **41**, and network **42** are optional.

Vehicle manager **29** is configured to transmit travel data, via signal **43** (FIG. **1**), to a communications device **44**, which is capable of transmitting and receiving data to and from devices outside of VCU **15**. In this regard, communications device **44** is preferably a cellular modem configured to transmit and receive wireless signals to and from a cellular network **48**.

The communications device **44** can transmit the travel data over the voice channels associated with the cellular network **48**, as is done by most cellular modems of the prior art. However; in order to reduce the cost associated with transmitting the travel data through the cellular network **48**, the travel data may be communicated through the cellular network **48** via a data or control channel. In this regard, the travel data can be encoded by altering indentifiers of communications device **44**, such as the mobile identification number (MIN) or electronic serial number (ESN), transmitted over a data channel of the cellular network **48**. Alternatively, travel data can be appended to a feature request transmitted over the data channel. U.S. Pat. No. 5,771,445 entitled "Data Messaging in a Communications Network using a Feature Request," filed on Dec. 15, 1995, by Kennedy, III, et al., and U.S. Pat. No. 5,546,444 entitled "Methods and Apparatus for Communicating Data Via a Cellular Network Control Channel" filed on Mar. 11, 1994, by Roach, Jr., et al., which are both incorporated herein by reference, discuss the transmission of travel data over a data or control channel associated with cellular network **48** in further detail.

In order to transmit the travel data through a data channel by manipulating identifiers of the communications device **44**, the MIN of communications device **44** is altered to include travel data, but the ESN remains fixed to be used as an identifier of the communications device **44**. Therefore, after transmitting the identifiers through the data channel, the communications device **44** can be identified by the ESN, and the travel data can be determined from the MIN. Alternatively, the ESN of communications device **44** can be altered while the MIN is kept constant. It should be understood that the invention contemplates modification of the MIN, ESN, both the MIN and ESN, or other identifiers of the communications device **44** to accomplish the dual task of transmitting travel data and identifying the communications device **44**.

Alternatively or in combination with the manipulation of the identifiers of the communications device **44**, travel data can be communicated through the data channel by appending travel data to feature requests that are transmitted through the data channel. In this regard, most feature requests are generated by automatically or manually dialing the star key ("*") followed by a two-digit feature request identification code, and **29** digits of data. Therefore, for each feature request generated, **29** digits of travel data can be appended to the two-digit feature request identification code and sent over the data channel of the cellular network **48**. Other embodiments may transmit different amounts of travel data following the feature request. By utilizing the manipulation of identifiers or the appendage of travel data to feature requests, less data is transmitted through the voice channels of the cellular network **48**, thereby reducing the cost of transmitting data through the cellular network **48**.

Cellular network **48** is designed to transmit the travel data to a vehicle communications device **52** at the BSCU **38**. Although not necessary for implementation of the present invention, cellular network **48** is preferably designed to transmit to vehicle communications device **52** via a public switched telephone network (PSTN) **55**. In this regard, PSTN **55** establishes a link between communications device **52** and cellular network **48**, whereby cellular network **48** and communications device **52** can communicate via signals **61** and **65**. Therefore, communications device **52** is preferably designed as a PSTN modem capable of communicating signals **65** between base station manager **39** and PSTN network **55**.

Although the preferred embodiment utilizes a cellular network **48** and a PSTN network **55** to communicate travel data to base station manager **39**, one ordinarily skilled in the art should realize that other configurations are possible. For example, communications device **52** can be configured as a cellular modem capable of communicating signals directly with cellular network **48**. Alternatively, utilization of communication networks **48** and **55** can be completely circumvented by configuring communications device **44** to communicate directly with communications device **52**, for example. Any embodiment capable of communicating data between vehicle manager **29** and base station manager **39** should be suitable for implementing the principles of the present invention.

Base Station Manager

Base station manager **39** is designed to receive the travel data transmitted from vehicle manager **29** and to monitor the travel of the vehicle attached to the VCU **15** by monitoring the travel of the VCU **15**. In this regard, base station manager **39** is designed to include a data manager **67** configured to receive the travel data via signal **66** from communications device **52**, as depicted by FIG. **4**. Data manager **67** is designed to store the travel data for each VCU **15** being monitored into a travel data storage unit **68**. Preferably, travel data storage unit **68** is a database configured to store travel data associated with each VCU **15** being monitored by the system **10**. The travel data storage unit **68** is configured to include a relational parameter (i.e., a unique identification value correlated with the VCU **15** and, therefore, the travel data associated with the VCU **15**) that enables determination of which travel data is associated with which VCU **15**. For example, travel data storage unit **68** can be configured as a data table with each entry in the data table assigned an identification number unique to a particular VCU **15**. Furthermore, each entry can include all of the travel data associated with the particular VCU **15**. For example, each entry can include information such as, but not limited to, the VCU's coordinate values (i.e., the VCU's **15** location relative to a predetermined reference point), information regarding delivery status of items to be delivered, and/or the times that the VCU **15** reached particular locations or stops. The travel data storage unit **68** can be configured to contain all of the desirable information to monitor the status of each VCU **15** associated with the system **10**.

Referring to FIG. **5**, data manager **67** is configured to include a monitoring mechanism **69**. The functionality of monitoring mechanism **69** is depicted in FIG. **6**. As shown by blocks **102–112** of FIG. **6**, monitoring mechanism **69** is configured to receive travel data from VCU **15** and to compare the travel data with predefined preference data stored in travel data storage unit **68**. Preference data, as used herein, is data that defines the preferred parameters indicating when to notify a user of the impending arrival of the VCU **15** at a particular location. For example, preference data can be coordinates of a desired location whereby a notification message is sent to a user when the coordinates of the VCU **15** pass the coordinates of the desired location. In this context, the desired location defined by the preference data can, for example, represent a location that is a predetermined distance from the user's house, place of delivery/pick-up, or other particular location. Therefore, when the user receives the notification message, the user is aware of the approximate location of the VCU **15** or of the distance of the VCU **15** from a predetermined point (i.e., of the proximity of the VCU **15** from a predetermined point or location). Consequently, the user can prepare for the arrival

of the VCU **15**, since the user knows that arrival of the VCU **15** is imminent.

Alternatively, the preference data can define a certain time before the VCU **15** reaches a destination or other particular location (i.e., a proximity of the VCU **15** from the predetermined point). In this regard, the monitoring mechanism **69** is designed to determine the location of the VCU **15** from the travel data stored in travel data storage unit **68**. The monitoring mechanism **69** is then designed to calculate the time it will take for the VCU **15** to reach the location specified by the preference data based on the location of the VCU **15** and the location of the desired destination. In calculating the travel time, the monitoring mechanism **69** can be configured to make assumptions about the time necessary to travel to the specified location. For example, if the route of the VCU **15** is through congested areas, the monitoring mechanism **69** can assume a certain delay time for traveling certain distances, and if the route of the VCU **15** is through less congested areas, the monitoring mechanism **69** can assume another delay time that is less than the delay time assumed for the congested areas. Alternatively, the monitoring mechanism **69** can use an average of the times it has previously taken for vehicles **15** to travel over the same route during other deliveries. Therefore, by comparing the travel data transmitted from VCU **15** with preference data, the monitoring mechanism **69** can determine when to send a notification message to a user.

As depicted by blocks **102**, **104**, **114**, and **116** of FIG. **6**, the preference data can be stored in travel data storage unit **68** (FIG. **5**). As stated hereinbefore, the travel data storage unit **68** is preferably configured to store the travel data associated with each VCU **15** in a respective entry uniquely identified with the associated VCU **15**. Accordingly, each data entry can also include the preference data associated with each VCU **15** that corresponds with the entry, or the preference data can be stored in separate entries which are correlated with corresponding VCU entries.

Once the monitoring mechanism **69** determines that a notification message should be sent to a user, the data manager **67** is designed to communicate a message to a user at a remote location **71**, such as a user's premises, via PSTN network **55** and communications devices **72** and **73** (FIGS. **1**, **4**, and **5**). In this regard, communications devices **72** and **73** are preferably PSTN modems capable of communicating with PSTN network **55**. Data manager **67** is designed to transmit the message as signal **70** to user communications device **72**, which communicates the message with PTSN network **55** via signal **74**. PTSN network **55** then communicates the message to communications device **73**, which is preferably configured to communicate the message to a message device **75**. Message device **75** is configured to notify the user of the impending arrival of the VCU **15**. Preferably, message device **75** is a computer capable of displaying the notification through e-mail or some other communications software. Alternatively, message device **75** can be a telephone, a pager or any other device capable of notifying a user at location **71**.

Although the preferred embodiment utilizes a PSTN network **55** to communicate a notification message to message device **75**, one ordinarily skilled in the art should realize that other configurations are possible. For example, other communication networks can be utilized or utilization of communication networks can be completely circumvented by configuring communications device **72** to communicate directly with communications device **73**. Any embodiment capable of communicating data between data manager **67** and message device **75** should be suitable for implementing the principles of the present invention.

User Activation

In order for data manager **67** to transmit a notification message to a user at user premises **71**, data manager **67** should be aware of certain contact information enabling data manager **67** to contact the message device **75**. In this regard, data manager **67** is configured to include a user database **78** (FIG. **5**) containing contact information pertaining to each user that is to receive a notification message from the data manager **67**. The user database **78** is preferably a database capable of uniquely identifying each user of the system **10**. In the preferred embodiment, the user database **78** is a data table having entries that specify contact information associated with each user. Each entry preferably includes a user identification number unique to each user that identifies the information in the entry as relating to a particular user.

Each entry preferably includes a value specifying the medium through which the user has specified to be contacted. For example, the value can indicate that the user is to be contacted through e-mail, in which case the entry should also include the user's e-mail address. Alternatively, the value can indicate that the user is to be contacted through a telephone call or a page. In these situations, the entry should also include the user's telephone number or pager number. The value can also indicate multiple methods of notification. For example, the value can indicate that the user is to be first contacted via telephone. If there is no answer when the data manager **67** attempts to deliver a notification message, then the data manager **67** can be configured to attempt notification via paging. If paging fails, then the data manager **67** can be configured to attempt notification through e-mail or other computer oriented messaging system. Accordingly, the order of notification media should be indicated by the data in the user database **78**, and the contact information necessary for each method selected (e.g., the telephone number, pager number, and e-mail address of the user) should also be included in the entry. It should be noted that various other communications media and combinations of communications media can be employed without departing from the principles of the present invention.

The contact information (and preference data, which will be discussed in further detail hereinafter) can be manually entered or downloaded into the user database **78** in order to activate a user for the system **10**. In this regard, a system operator can receive the contact information (and preference data) via a telephone call or e-mail, for example, and manually enter the information into the system **10**.

However, in the preferred embodiment, the contact information is automatically entered into the user database **78** via a message manager **82**, which is depicted by FIG. **5**. The functionality of the message manager **82** is shown in FIG. **7**. The message manager **82** (FIG. **5**) is configured to receive, via communications device **72** (FIG. **1**), an activation request from a user at user premises **71**, as shown by blocks **131**–**137** of FIG. **7**. In this regard, the request can be transmitted to user communications device **72**, via any suitable technique known in the art, and the BSCU **38** can be configured to include a plurality of user communications devices **72**, as depicted by FIG. **4**.

Each of these user communications devices **72** can be configured to simultaneously communicate with a respective user of the system **10**. The information received by the user communications devices **72** can be transmitted to message manager **82** (FIG. **5**) via any suitable technique, such as time division multiplexing, for example. Each user communications device **72** can also be designed to communicate with different communications media. For example, one user communications device **72** can be designed as a modem to

communicate with a modem at user premises **71**. This user communications device **72** can be designed to send data configured to prompt the user to return data pertaining to contact information. An example of such a prompt, could be a template or web page where the user's message device **75** (i.e., a computer in this case) displays the template, and the user can fill in fields of the template with the appropriate contact information. Alternatively, another one of the user communications devices **72** can be designed to receive a telephone call from a user at user premises **71** and to prompt the user to enter data through touch-tone signaling. Other user communications devices **72** can be designed to communicate with other types of communications media known in the art.

Once the message manager **82** (FIG. **5**) receives the request from the user, the message manager **82** is designed to determine that the request is a request for activation (i.e., a request for the user to be entered into the system **10**). In response, the message manager **82** transmits data to the user, via user communications device **72**, in order to prompt the user to transmit the necessary contact information, as shown by block **141** of FIG. **7**. In this regard, the message manager **82** is configured to determine the type of medium used by the user to communicate the request for activation and to transmit a prompt to the user that is compatible with this medium. For example, when the user is communicating via a modem, the message manager **82** is configured to transmit signals compatible with the user's modem in order to prompt the user to enter the appropriate contact information. This data could be in the form of a web page transmitted through the Internet, or the prompt could simply be messages transmitted through e-mail or some other data communications system.

When the user is communicating via a telephone, the message manager **82** is preferably designed to transmit recorded messages to the user. The user can then select or enter data by transmitting touch-tone signals in response to the prompting messages, as is commonly known in the art. The message manager **82** may be configured to communicate with the user in other formats and media known in the art.

Once the message manager **82** receives the contact information from the user, the message manager **82** is designed to store the contact information as an entry in the user database **78**, as depicted by block **143** of FIG. **7**. When the monitoring mechanism **69** determines that a user should be notified of an impending arrival of a VCU **15**, the monitoring mechanism **69** is designed to send a notification command to message manager **82**. The notification command may include travel data to be sent to the user, such as data indicating that a particular vehicle is a certain proximity from the destination defined by the preference data. In response, the message manager **82** is designed to retrieve the contact information associated with the user from the user database **78** and to determine how to contact the user based on the retrieved contact information, as depicted by blocks **151** and **153** of FIG. **7**.

The message manager **82** is then designed to transmit a message compatible with the medium previously selected by the user for notification, as depicted by block **156** of FIG. **7**. The message can include any travel data sent to the message manager **82** from the monitoring mechanism **69**. For example, when the contact information indicates that a phone call is the preferred medium for notification, the message manager **82** can send a recorded telephone message to the telephone number that is indicated by the contact information retrieved from the user database **78**. If the monitoring mechanism **69** included travel data indicating the time of arrival in the command to message manager **82**, then message manager **82** can be configured to include a message indicating the expected time of arrival at a particular location. Alternatively, the same information can be sent via e-mail, facsimile, page or other type of communications medium to the user, depending on the preferences selected by the user during activation.

During activation, the message manager **82** can be further configured to prompt for and receive preference data (i.e., data pertaining to when the user is to be notified) from the user, as shown by block **141** of FIG. **7**. In this regard, the message manager **82** can be designed to prompt the user to return information indicating which VCU **15** is to be monitored on behalf of the user and when the notification is to be sent to the user. For example, the user can be prompted to select a VCU **15**, a destination (or other particular location), and a notification preference to indicate a time or distance that the VCU **15** should be from the selected destination or other particular location when a notification is to be sent to the user. In response, the user specifies, through any known suitable communications technique, which VCU **15** the user wishes the system **10** to monitor and how the user wishes to be notified of an impending arrival of the selected VCU **15** at the selected destination. If the user knows the coordinate values of the destination, the user can simply transmit the coordinate values to the data manager **67**. If the user selects the destination without supplying the coordinates of the destination (e.g., the user selects a destination from a list of locations) then the data manager **67** is preferably designed to determine the coordinate values transparently.

In some instances, the user may be aware of the vehicle number and stop number used by the system **10** to identify a particular VCU **15** and destination. For example, many buses are associated with a commonly known bus number, and the stops along the bus' route are associated with commonly known bus stop numbers. The data manager **67** can be configured to recognize the VCU **15** and destination associated with the bus number and stop number entered by the user in order to register the user with the system **10**.

As depicted by block **146** of FIG. **7**, the message manager **82** is preferably designed to automatically transmit to monitoring mechanism **69** the preferences selected by the user that pertain to when the user is to be notified. The monitoring mechanism **69** is designed to store this preference information in the travel data storage unit **68** in the entry associated with the selected VCU **15**.

Once a user becomes activated with the system **10**, the user may make changes to the preferences specified by the user, as shown by blocks **161–169** of FIG. **7**. The message manager **82** is configured to receive the request for changes from the user. The message manager **82** can be configured to request the user to resubmit all contact information and preference data, as updated, or can be configured to request the user to only submit desired changes to the contact information or preference data. After receiving the new data, the message manager **82** is configured to update the contact information in user database **78** and to send a request to monitoring mechanism **69** to update the preference data relating to the monitoring of travel data. In response, monitoring mechanism **69** is designed to update the preference data in the travel data storage unit **68**, as shown by blocks **114** and **116** of FIG. **6**.

It should be further noted that as described hereinabove, the preference data and travel data can be automatically received and stored in travel data storage unit **68** and selected vehicles **15** can be automatically monitored by the

system **10**. As used herein, the term "automatic" shall be defined to mean without interruption or interference from a human operator. However, it is possible to implement the system **10** such that interference and interruption from a human operator is required.

Requests for Travel Data

In addition to providing the user with automatic advance notification of an impending arrival of a VCU **15**, the system **10** can also be used to provide the user with travel data on demand, as depicted by blocks **171–177**, **153** and **156** of FIG. **7**. In this regard, the user communications device **72** is designed to receive a request for travel data from a user. For example, the user may call the communications device **72** on a telephone and through touch-tone signaling select, among other options, an option to discover the distance and/or time a particular VCU **15** is from the destination specified by the user's preference data or specified by the user during the request for travel data. The user communications device **72** is designed to transmit the user's selections to message manager **82**. Based on the selections, the message manager **82** is designed to determine that the user message is a request for travel data. In response, the message manager **82** sends a request to monitoring mechanism **69** to retrieve the requested data from travel data storage unit **68**.

The monitoring mechanism **69** is designed to receive the request for travel data from message manager **82** and to interpret the request in order to determine which travel information from the travel data in travel data storage unit **68** is desired by the user, as depicted by blocks **183** and **185** of FIG. **6**. The monitoring mechanism **69** is then designed to retrieve from travel data storage unit **68** the desired travel data and to transmit the retrieved travel data to message manager **82**, as shown by blocks **188** and **191** of FIG. **6**.

In the case where the user desires to know the time and/or distance the selected VCU **15** is from the selected location, the monitoring mechanism **69** is designed to retrieve from travel data storage unit **68** the coordinates of the destination specified by the user (if not provided in the request for travel data) and the current coordinates of the VCU **15** of interest to the user. Prior to retrieving this data, the monitoring mechanism **69** can be configured to update the travel data for the VCU **15** by transmitting an update request to the VCU **15** via vehicle communications device **52**. Similar to the user communications devices **72**, a plurality of vehicle communications devices **52** may be located at the BSCU **38** in order for multiple vehicles **15** to simultaneously communicate with the monitoring mechanism **69**, as depicted by FIG. **5**. The vehicle communications devices **52** are configured to communicate with the monitoring mechanism **69** through any suitable technique, such as time division multiplexing, for example.

After receiving the update request via communications devices **52** and **44**, the vehicle manager **29** is designed to transmit the current values of the vehicle travel data to the monitoring manager **69**. By updating the vehicle travel data before responding to the user's request for travel data, the monitoring mechanism **69** can ensure the accuracy of the response transmitted to the user.

After retrieving the coordinate values from the travel data storage unit **68**, the monitoring mechanism **69** is designed to calculate the distance that the VCU **15** is from the selected destination based on the coordinate values of the VCU **15** and the coordinate values of the destination. If the preference data and/or request for travel data indicates that the user is to be notified when the VCU **15** is a certain time from the selected destination, the monitoring mechanism **69** is then designed to determine the estimated time of arrival of the VCU **15** at the destination based on this distance. As described previously, the monitoring mechanism **69** is designed to either assume that certain distances will take a certain amount of time to travel based on the type of traffic conditions usually encountered on the route or to calculate an average time previously required for vehicles **15** of the system to travel the route. To increase the accuracy of the calculations, the route should be divided into sections where the time required to travel each section is independently calculated. Furthermore, time delays associated with scheduled stops or deliveries can be factored into the calculations by assuming a delay time for each stop or delivery depending on the type of stop or delivery expected.

After calculating the distance and, if requested, the time the VCU **15** is from the destination, the monitoring mechanism **69** is configured to transmit the calculated values to the message manager **82**. In response, the message manager **82** is designed to transmit the calculated information to the user via user communications device **72**. Since the user already has an established communications connection with user communications device **72** when requesting travel data, there is no need for the message manager **82** to consult the contact information in the user database **78**. The message manager **82** can simply transmit the data over the same connection. However, if desired, the message manager **82** may consult the contact information in the user database **78** to determine the user preferences in notification and notify the user of the distance and/or time accordingly.

The monitoring mechanism **69** can also be configured to transmit a command to a mapping system **86** (FIG. **5**) to transmit mapping data to the message manager **82**, if the user's request for travel data or user's preference data in data storage unit **68** includes a request for a mapping. The mapping system **86** may be any system known in the art for supplying a user with mapping data for rendering a display of a map. The command to the mapping system **86** preferably includes the coordinate values of the VCU **15** and the destination. In response, the mapping system **86** transmits to message manager **82** mapping data sufficient for forming a display map with the locations of the VCU **15** and the destination graphically displayed by the display map. The message manager **82** is designed to retrieve the contact information for the user requesting the travel data and is further configured to determine an address (e.g., an IP address or other type of address indicating how the mapping data is to be routed to user) associated with the user for sending the mapping data. The message manager **82** is then designed to transmit the mapping data to the retrieved address, which preferably identifies a computer at the user's premises **71**. When the user's message device **75** (i.e., a computer in this case) receives the mapping data, the user's computer is configured to render a graphical display depicting a map that shows the vehicle's location relative to the destination on the map.

If desired, the monitoring mechanism **69** can be configured to transmit the coordinate values of the VCU **15** to the mapping system **86** each time the coordinate values are updated. The user's request for travel data can request this feature or the user can indicate this desire in the preference data submitted during activation. Accordingly, for each update, the mapping system **86** is designed to transmit updated mapping data to the user's computer **75** via message manager **82**, as previously described. As a result, the position of the VCU **15** is updated, and the user can monitor the progress of the VCU **15** on the display map rendered by the computer **75**.

Although the preferred embodiment illustrates the requests for travel data by determining the distance the VCU

15 is from a particular location or by determining the time the VCU **15** is from the particular location, other information can be used to indicate the proximity of the VCU **15** from the particular location. For example, the message transmitted to the user in response to a request for travel data can indicate that the VCU **15** is currently at another particular location or landmark, preferably known to the user. Any other information indicating the proximity of the VCU **15** from a particular location can be used in implementing the principles of the present invention.

Operation

The preferred use and operation of the tracking system **10** and associated methodology are described hereafter with specific reference to FIGS. **1**, **4** and **5**.

Establishing User Preferences

Initially, a user at remote location **71** establishes communication with the message manager **82** via communications devices **72** and **73**. As used herein, the term "remote location" shall refer to any location off the site of the BSCU **38**. The user can establish communication via a telephone, an e-mail message, the Internet, or any other suitable communication medium. The message manager **82** preferably transmits a list of options to the user, such as whether the user would like to activate a monitoring of a particular vehicle, to retrieve travel data for a particular vehicle or to modify preferences previously selected by the user in an earlier communication session with the message manager **82**. In response, the user selects the activation option.

The message manager **82** then prompts the user to select certain preferences. For example, the message manager **82** can request the user to identify a particular VCU **15** that the user wishes the system **10** to track and a particular destination for the selected VCU **15**. If the user knows the identification number of the VCU **15** or vehicle stop number used by the system **10** to identify the particular VCU **15** and/or destination, the user can simply transmit a message including this information. As an example, the bus numbers and/or bus stops of commercial and state operated buses are usually available to the public. Therefore, the user may be aware of the bus number and/or stop number of a particular bus that the user wishes to ride, and the user can simply transmit the bus number and/or stop number to the message manager **82**. Also, the user should be able to specify other identifying information such as the day or days of desired travel and the time of day of desired travel.

In the embodiment where the user is expecting to receive a package from a particular delivery vehicle, the user may be aware of the package number or delivery number used by the system **10**. Therefore, by specifying the package number and the address that the vehicle is to deliver the package, the particular VCU **15** of the vehicle that is to deliver the package can be located by the system **10**. In this regard, a database should be defined by the operators of the system **10** that relates package numbers to VCU **15** numbers.

Alternatively, if the user is unable to identify a particular vehicle or VCU **15**, the message manager **82** can send information to the user that can be used to help the user identify a particular VCU **15**. For example, the message manager **82** can transmit to the user a list of buses or a list of vehicle stops to the user. The user can use this information to select a particular VCU **15** that is suitable to the user.

Also, the message manager **82** can send map data from mapping system **86** to the user. The user can then view the map and select points on the map where the user would like to know when the VCU **15** reaches the selected point. The points available for selection can be predetermined, such as scheduled bus stops or other types of vehicle stops, or the user can be allowed to freely select any point on the map. In either case, the mapping logic preferably transmits the coordinates of the selected points to the message manager **82**, which can use this information to not only identify the selected destination, but to also choose an appropriate VCU **15**.

The message manager **82** also prompts the user to enter contact information such as how the user would like to be notified of an impending arrival of the selected VCU **15** at the selected destination. In response, the user selects a notification medium or combinations of media to be used to notify the user and supplies the necessary information to enable communication of the notification. For example, if the user selects a telephone as a notification medium, then the user provides a telephone number. In addition, if the user selects a computer as the notification medium, then the user provides a suitable address for the computer, such as an e-mail address or IP address. If the user selects a pager as the notification medium, then the user provides a pager number. It should be apparent to one skilled in the art when reading this disclosure that other types of notification media are possible without departing from the principles of the present invention. After receiving the desired contact information from the user, the message manager **82** stores the contact information in the user database **78**.

The message manager **82** also prompts the user to transmit travel data preferences, which is information pertaining to when the user would like to be notified. For example, the user can select to be notified a certain time before the selected VCU **15** is to arrive at the selected destination. Also, the user can choose to be notified when the selected VCU **15** is within a certain distance of the destination, and the user can choose to be notified when the selected VCU **15** is a certain number of deliveries or stops away from the destination.

Since the monitoring mechanism **69** should have access to the travel data preferences in order to determine when a notification is appropriate, the message manager **82** preferably transmits the travel data preferences to the monitoring mechanism **69** along with a unique identification number that identifies the user and a unique identification number identifying the selected VCU **15**. The unique identification number identifying the selected VCU **15** can be the vehicle number entered by the user provided that the number entered by the user identifies the VCU **15** to be monitored. In turn, the monitoring mechanism **69** stores this information as an entry in the travel data storage unit **68**. All of the entries associated with a particular VCU **15** are preferably arranged together (based on the unique identification number) in the travel data storage unit **68**. For example, each entry associated with a particular VCU **15** can be stored within a certain area of memory, or each of the entries can have a pointer pointing to another one of the entries associated with the particular VCU **15**. Therefore, all of the entries associated with a particular VCU **15** can be easily located. Other methods known in the art for categorizing the entries and correlating the entries with a particular vehicle or with the travel data of a particular vehicle are also possible.

Once the message manager **82** has received the desired contact information and travel data preferences from the user, the communication between the message manager **82** and the user can be terminated. The base station manager **39** should now have sufficient information to monitor the selected VCU **15**. If the user wishes to change the contact information and/or the travel data preferences, the user can reestablish communication with the message manager **82**.

The message manager **82** preferably recognizes the user's requests as an update rather than an activation and prompts the user to transmit the new information. In this regard, the message manager **82** can prompt the user for all of the desired contact information and/or preference data, similar to the activation session, and simply replace the previously stored contact information and/or preference data, or the message manager **82** can prompt the user for only the information to be updated and then merely update the previously stored information.

It should be noted that the information transferred between the user and the message manager **82** can be interfaced with the message manager **82** through a human operator during the activation session or update session described hereinabove and during other sessions, which will be described further hereinbelow. The human operator can prompt the user for certain information through a telephone call or other suitable medium of communication and can enter the response of the user into the message manager **82**.

Monitoring the Vehicle

GPS satellites **23** transmit wireless signals **21***a*–**21***c* to VCU **15** that can be analyzed through techniques well known in the art to determine a position of the VCU **15** relative to a particular reference point. For example, in GPS systems, the intersection of the Equator and the Prime Meridian is typically used as the reference point. Sensor **18** receives the signals **21***a*–**21***c* and determines coordinate values representing the position of the VCU **15** relative to the reference point and transmits these values to vehicle manager **29**.

The vehicle manager **29** stores the coordinate values received from sensor **18**. The vehicle manager **29** also stores any other desired information as travel data. For example, the vehicle manager **29** can maintain a list of scheduled stops and/or packages to be delivered. This information can be updated as the stops are reached and/or the packages are delivered. Other types of desirable information may also be monitored by the vehicle manager **29** as travel data.

At desired times, the vehicle manager **29** transmits, via communications device **44**, the stored travel data to cellular network **48**. In this regard, the vehicle manager **29** can transmit the travel data continuously or at predetermined times (e.g., every five minutes or predetermined times of the day). Also, the base station manager **39** can transmit a request for an update to vehicle manager **29** via communication devices **44** and **52**. In response to this request, the vehicle manager **29** can retrieve the current set of stored travel data and transmit it to the base station manager **39**. In addition, the vehicle manager **29** can transmit the travel data to the base station manager **39** when scheduled stops or deliveries are reached or when other predetermined locations are passed.

Also, the base station manager **39** can assume that the VCU **15** is proceeding along a predetermined route at a predetermined rate, and the vehicle manager **29** can transmit vehicle data only when the VCU **15** is off schedule by a predetermined amount. Accordingly, the base station manager **39** can assume that the proximity of the VCU **15** is changing according to the predetermined schedule unless the base station manager **39** receives travel data from the vehicle manager **29**, at which point the base station manager **39** updates the travel data storage unit **68** with the received travel data.

For example, an entry correlated with the VCU **15** in the travel data storage unit **68** can include a plurality of coordinate values representing locations along the VCU's route of travel. When the monitoring mechanism **69** desires to know the current location of the VCU **15**, the monitoring mechanism **69** retrieves one of the coordinate values in the entry, depending on the amount of time that has elapsed since the VCU **15** began the route. For example, each successive coordinate value in the entry can correspond to the assumed location of the VCU **15** after a predetermined time interval (e.g., five minutes) of travel since the previous assumed location of the VCU **15**. Therefore, the first coordinate value represents the starting point of the route. The second coordinate value represents the assumed location of the VCU **15** after the predetermined time interval (e.g., five minutes) from the start of the trip, the third coordinate value represents the assumed location of the VCU **15** after two times the predetermined time interval (e.g., ten minutes) of travel from the start of the trip, and so on.

When the vehicle associated with VCU **15** starts its route of travel, the current time period from a clock (e.g., an internal clock associated with BSCU **38**) is stored into the entry in the travel data storage unit **68** correlated with the VCU **15**. Therefore, the amount of time elapsed since the start of the route can be determined by comparing the current time period with the start time period stored in the travel data storage unit **68**. To retrieve the current coordinate value of the VCU **15**, the monitoring mechanism **69** retrieves the coordinate value corresponding with the amount of time that has elapsed since the start of the route. For example, assuming that the predetermined time interval between assumed locations is five minutes, the monitoring mechanism **69** retrieves the second coordinate value if approximately five minutes have elapsed since the start of the route and retrieves the third coordinate value if approximately ten minutes have elapsed since the start of the route.

However, if the VCU **15** is off schedule by a predetermined amount (e.g., one mile or two minutes from the assumed location or, in other words, is outside of a predetermined proximity from said assumed location), then the VCU **15** transmits its true coordinate values to the monitoring mechanism **69**. In response, the monitoring mechanism **69** stores the true coordinate values in the entry corresponding with the VCU **15**. Therefore, if a true coordinate value has been stored in the entry within the last five minutes (or some other threshold amount), then the monitoring mechanism **69** retrieves the last stored true coordinate value from VCU **15** instead of one of the assumed coordinate values.

The vehicle manager **29** can determine whether or not it is off schedule by comparing the coordinate values of the VCU's true location, as indicated by the GPS sensor **18**, against the coordinate values of an assumed location. In this regard, the vehicle manager **29**, like the monitoring mechanism **69** described hereinabove, maintains a list of coordinate values representing locations along the VCU's route of travel and determines the amount of time elapsed since the start of the route via a clock (such as an internal clock associated with the VCU **15**). Like the monitoring mechanism **69**, the vehicle manager **29** can retrieve the coordinate values of the assumed location of the VCU **15** depending on the amount of time elapsed since the start of the trip. Therefore, the coordinate values retrieved by the vehicle manager **29** for comparison with the current coordinate values indicated by the GPS sensor **18** represent the current location of the VCU **15**, assuming the VCU **15** is on schedule. If the coordinate values of the assumed location differ from the coordinate values of the GPS sensor **18** by a predetermined amount, then the VCU **15** is off schedule, resulting in the transmission of the VCU's true location to monitoring mechanism **69**.

Alternatively, the VCU **15** can transmit a value (such as a time period or distance) that the VCU **15** is off schedule,