US007523159B1

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Williams et al.

(10) **Patent No.: US 7,523,159 B1**
(45) **Date of Patent: Apr. 21, 2009**

(54) **SYSTEMS, METHODS AND DEVICES FOR A TELEMATICS WEB SERVICES INTERFACE FEATURE**

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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 924 days.

(21) Appl. No.: **10/823,478**

(22) Filed: **Apr. 13, 2004**

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/626,810, filed on Jul. 24, 2003, which is a continuation of application No. 09/808,690, filed on Mar. 14, 2001, now Pat. No. 6,611,740.

(51) **Int. Cl.**
G06F 15/13 (2006.01)

(52) **U.S. Cl.** **709/203**; 709/219; 709/222; 709/226; 709/250; 701/29; 701/213

(58) **Field of Classification Search** 709/203, 709/219, 222, 226, 250; 701/29, 213
See application file for complete search history.

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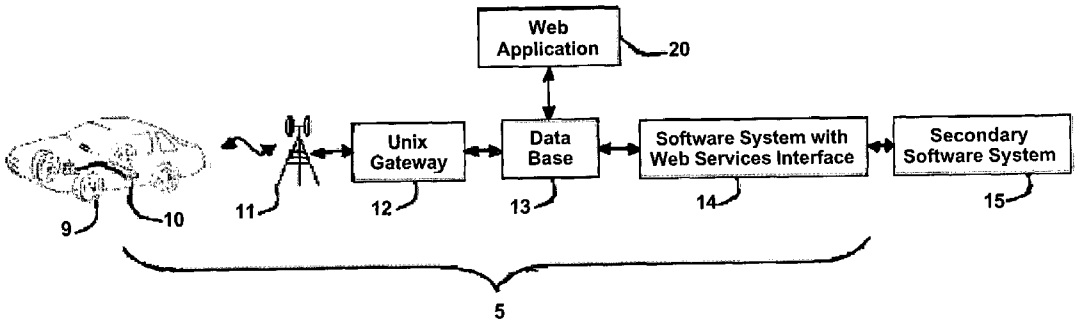
(Continued)

Primary Examiner—Jinsong Hu

(57) **ABSTRACT**

A telematics system is disclosed that includes a web services interface in communication with a secondary software system, wherein the web services interface comprises at least one processor configured to retrieve, receive, analyze and/or transmit data in response to a request from the secondary software system. In addition, the telematics system includes a gateway system configured to transmit data through a network to an in-vehicle telematics device and receive data from the in-vehicle telematics device, wherein the data comprises diagnostic data and/or location-based data associated with a host vehicle. The telematics system also includes a database in communication with the gateway system and the web services interface, wherein the database is configured to receive and store data transmitted from the gateway system and/or the web services interface.

10 Claims, 8 Drawing Sheets



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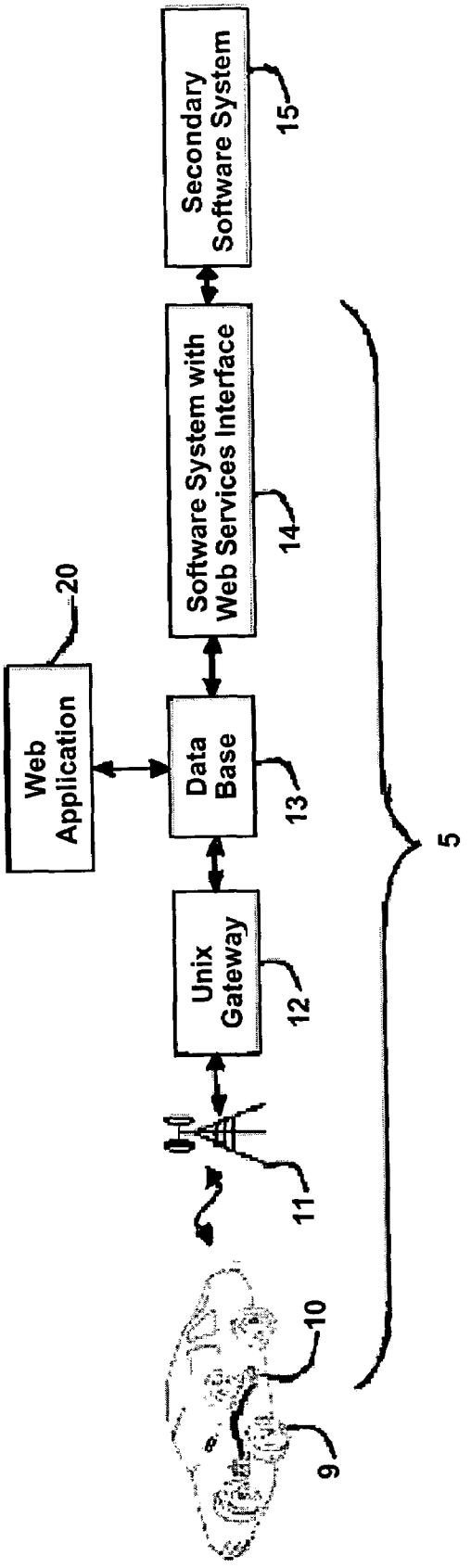
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Fig. 1


Secondary Software System
15
Software System with Web Services Interface
14
Web Application
20
Data Base
13
Unix Gateway
12
11
10
9
5

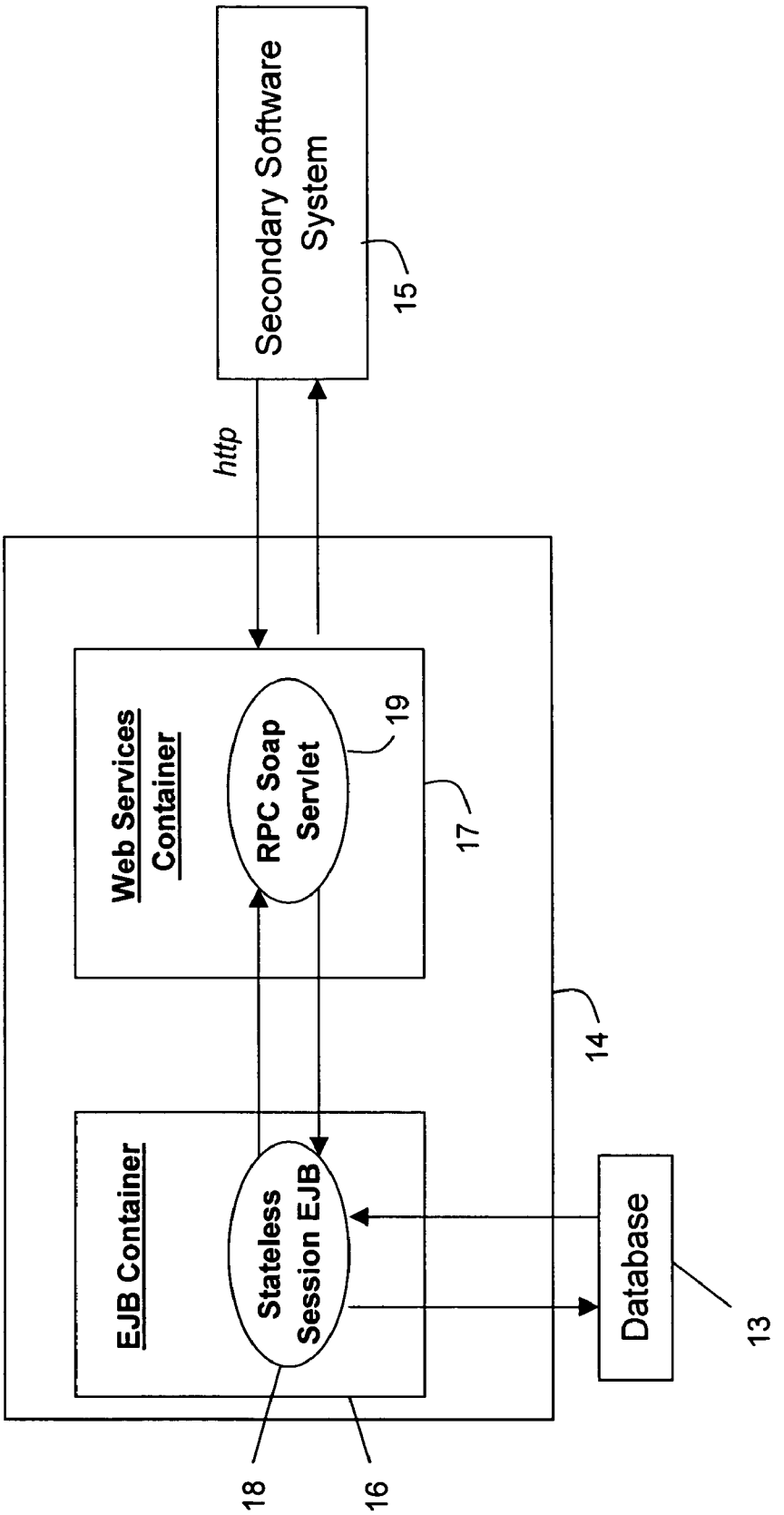

Secondary Software System
15
http
Web Services Container
RPC Soap Servlet
19
17
14
EJB Container
Stateless Session EJB
Database
13
18
16

Fig. 2

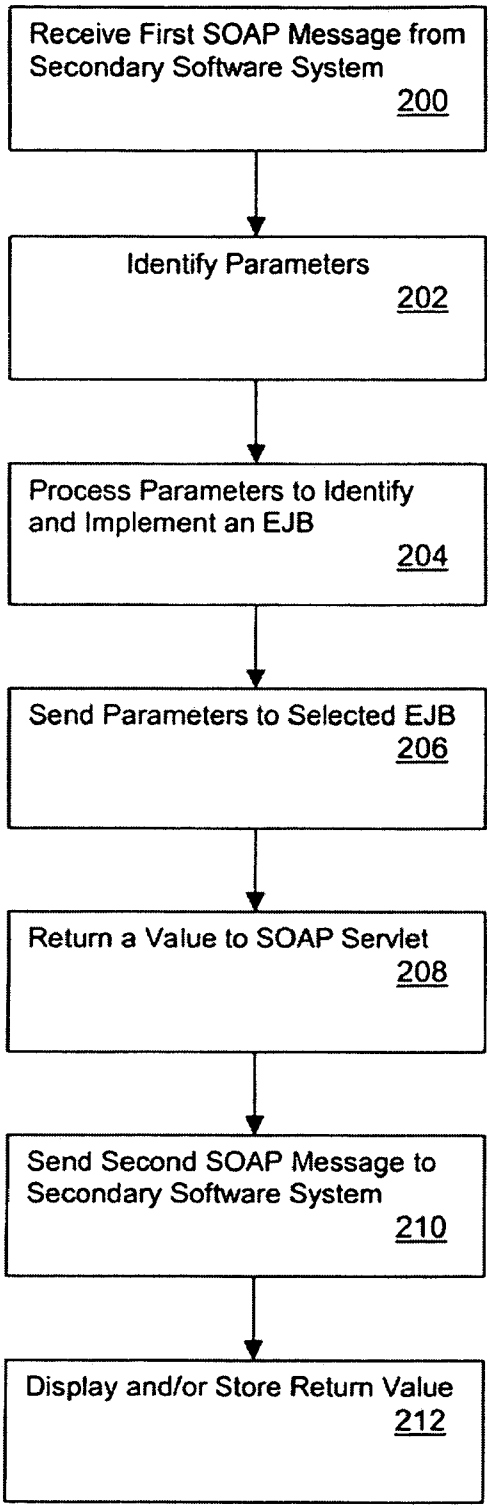

Receive First SOAP Message from Secondary Software System
200
Identify Parameters
202
Process Parameters to Identify and Implement an EJB
204
Send Parameters to Selected EJB
206
Return a Value to SOAP Servlet
208
Send Second SOAP Message to Secondary Software System
210
Display and/or Store Return Value
212

Fig. 3

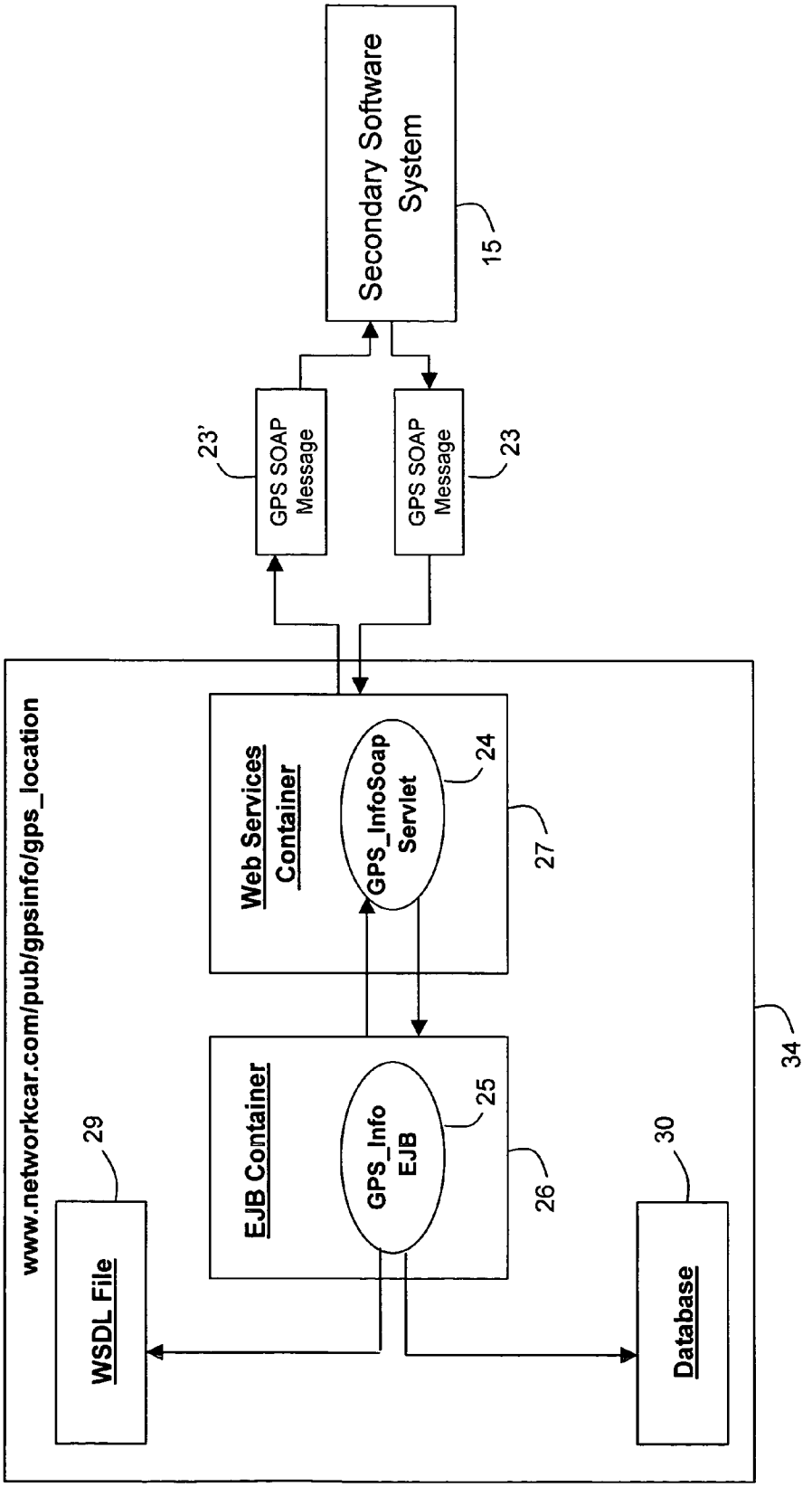

Secondary Software System
15
GPS SOAP Message
23'
GPS SOAP Message
23
www.networkcar.com/pub/gpsinfo/gps_location
Web Services Container
GPS_InfoSoap Servlet
24
27
EJB Container
GPS_Info EJB
25
26
WSDL File
29
Database
30
34

Fig. 4

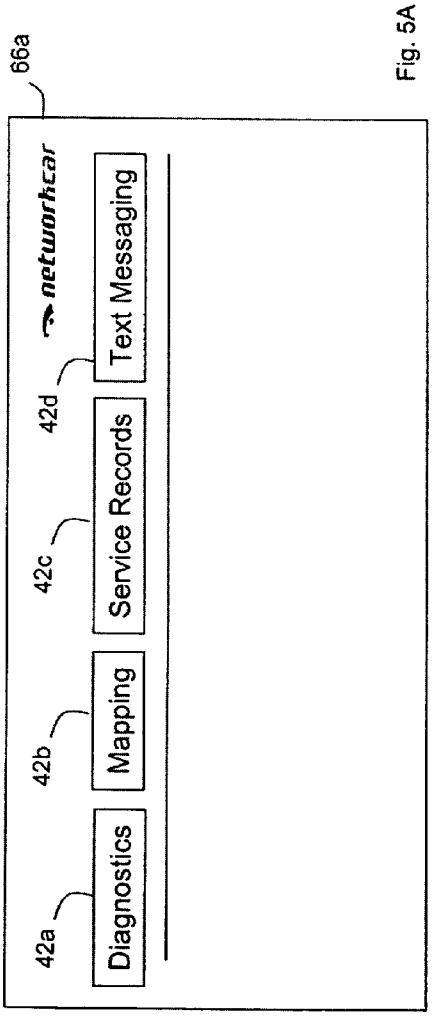

66a
networkcar
42a
Diagnostics
42b
Mapping
42c
Service Records
42d
Text Messaging

Fig. 5A

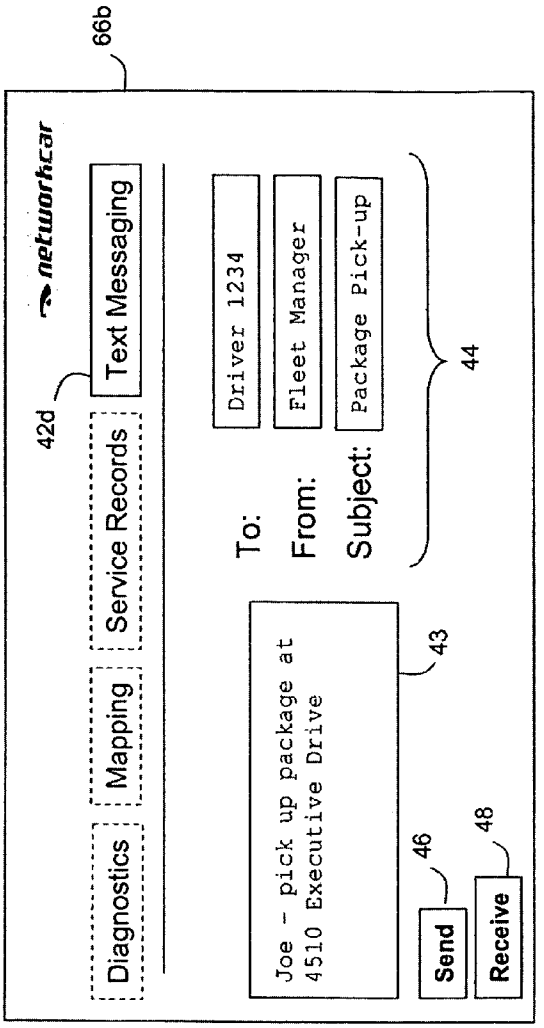

66b
networkcar
42d
Text Messaging
Diagnostics
Mapping
Service Records
To:
Driver 1234
From:
Fleet Manager
Subject:
Package Pick-up
44
Joe - pick up package at 4510 Executive Drive
43
Send
46
Receive
48

Fig. 5B

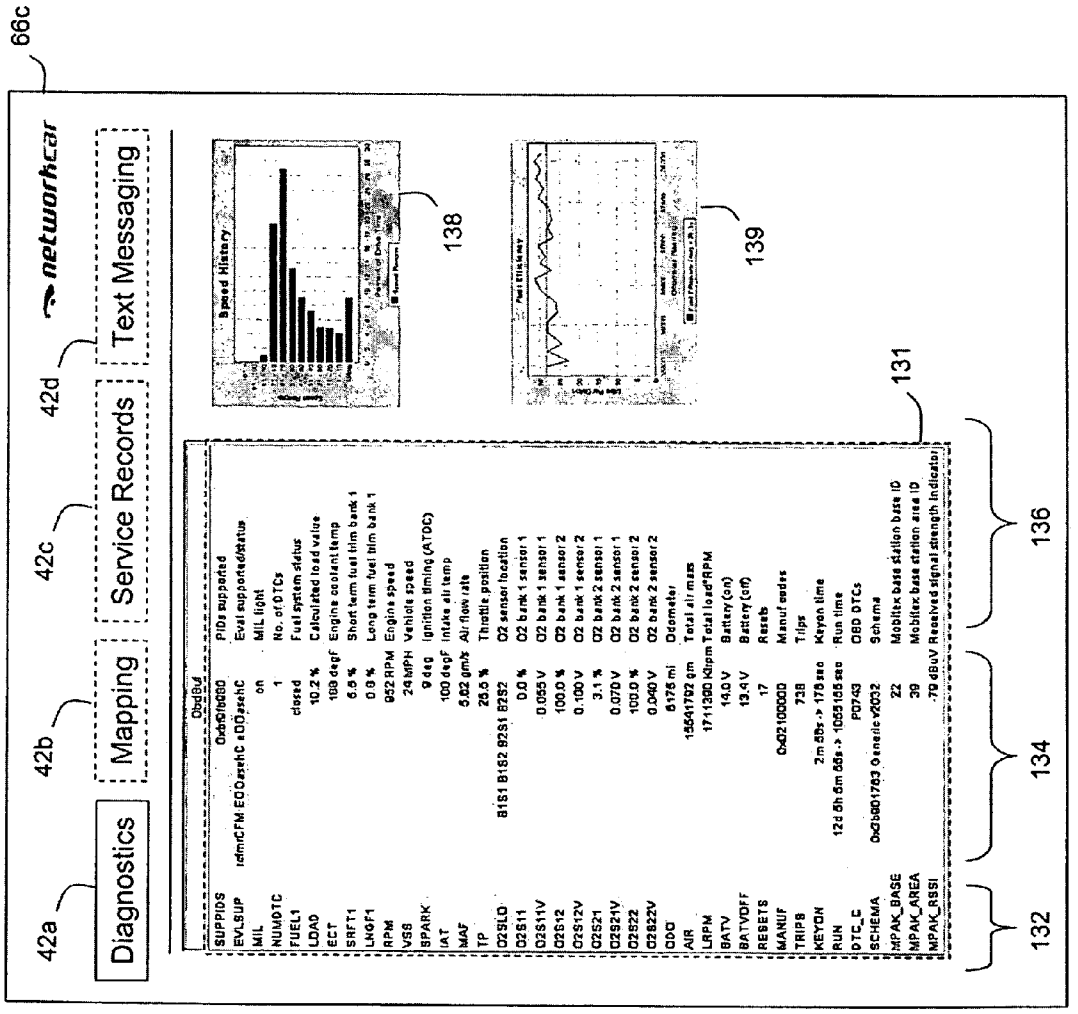

66c
42a
Diagnostics
42b
Mapping
42c
Service Records
42d
Text Messaging
networkcar
ObdSid
SUPPIDS 0x0f0f0f00 PIDs supported
EVLSUP rdmrCFM EGOzeshC aDOzeshC Eval supported/status
MIL on MIL light
NUMDTC 1 No. of DTCs
FUEL1 closed Fuel system status
LDA0 10.2 % Calculated load value
ECT 108 degF Engine coolant temp
SRFT1 6.6 % Short term fuel trim bank 1
LNGF1 0.0 % Long term fuel trim bank 1
RPM 952 RPM Engine speed
VSS 24 MPH Vehicle speed
SPARK 9 deg Ignition timing (ATDC)
IAT 100 degF Intake air temp
MAF 5.62 gm/s Air flow rate
TP 25.5 % Throttle position
O2SLO 8151 8152 8251 8252 O2 sensor location
O2S11 0.0 % O2 bank 1 sensor 1
O2S11V 0.055 V O2 bank 1 sensor 1
O2S12 100.0 % O2 bank 1 sensor 2
O2S12V 0.100 V O2 bank 1 sensor 2
O2S21 3.1 % O2 bank 2 sensor 1
O2S21V 0.070 V O2 bank 2 sensor 1
O2S22 100.0 % O2 bank 2 sensor 2
O2S22V 0.040 V O2 bank 2 sensor 2
ODO 6175 mi Odometer
AIR 15541792 gm Total air mass
LRPM 1711280 Klpm Total load*RPM
BATV 14.0 V Battery (on)
BATVOFF 13.4 V Battery (off)
RESETS 17 Resets
MANUF 0x02100000 Manuf codes
TRIPS 738 Trips
KEYON 2m 55s -> 178 sec Keyon time
RUN 12d 6h 6m 56s -> 1065185 sec Run time
DTC_C P0743 OBD DTCs
SCHEMA 0x03801783 Generic v2032 Schema
MPAK_BASE 22 Mobitex base station base ID
MPAK_AREA 39 Mobitex base station area ID
MPAK_RSSI -79 dBuV Received signal strength indicator
Speed History
Fuel Efficiency
138
139
131
132
134
136

Fig. 6

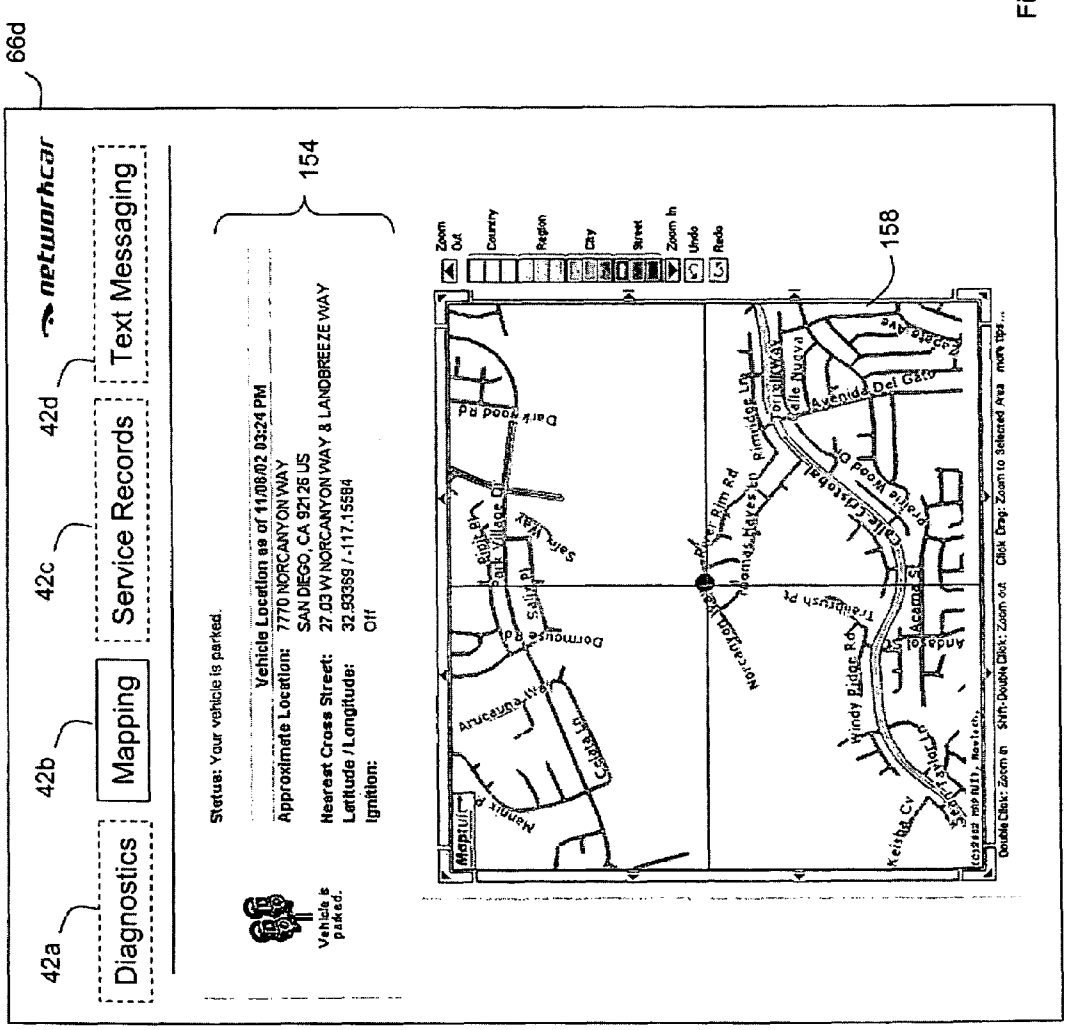

66d
42a
Diagnostics
42b
Mapping
42c
Service Records
42d
Text Messaging
networkcar
154
Status: Your vehicle is parked.
Vehicle Location as of 11/08/02 03:24 PM
Approximate Location: 7770 NORCANYON WAY
SAN DIEGO, CA 92126 US
Nearest Cross Street: 27.03 W NORCANYON WAY & LANDBREEZE WAY
Latitude / Longitude: 32.93359 / -117.15584
Ignition: Off
Vehicle is parked.
158
Zoom Out
Country
Region
City
Street
Zoom In
Undo
Redo

Fig. 7

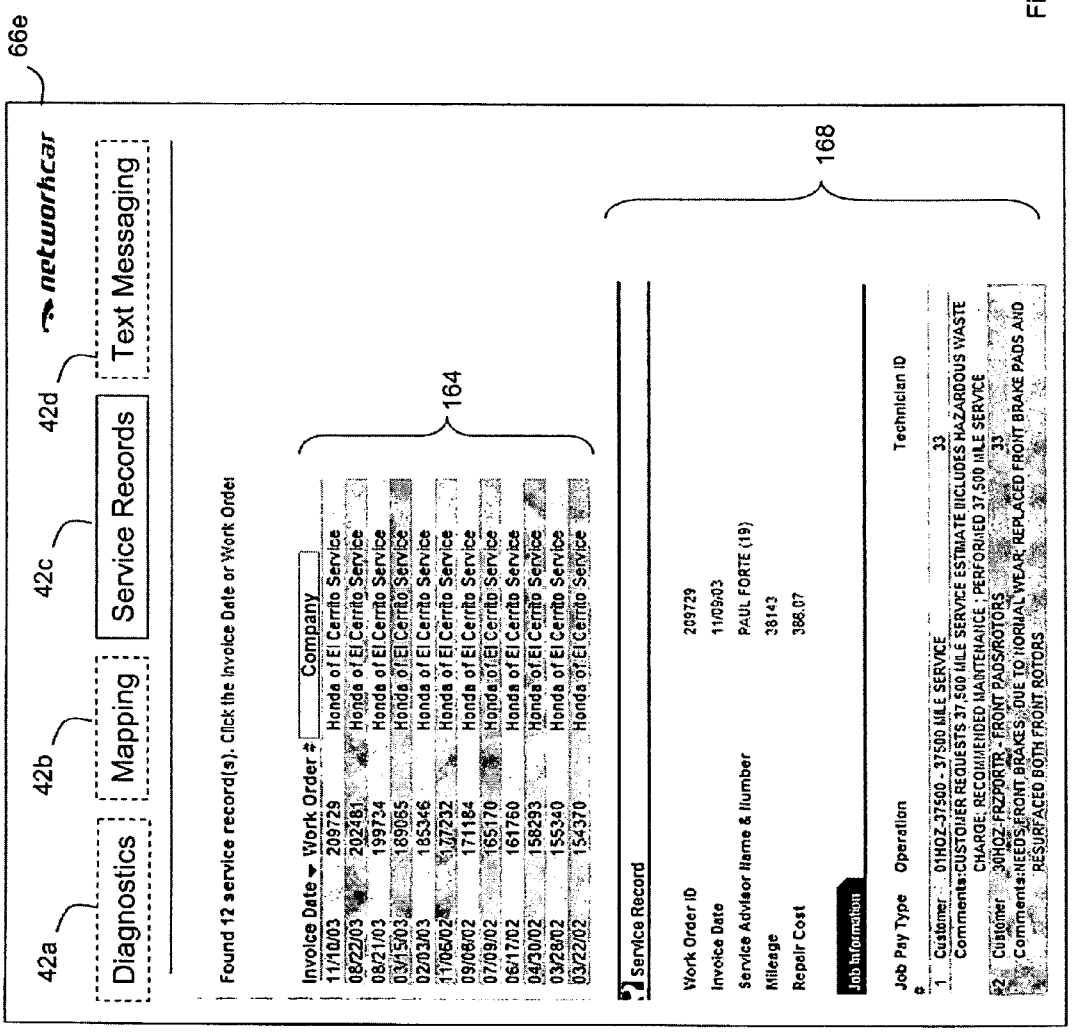

66e
42a
42b
42c
42d
networkcar
Diagnostics
Mapping
Service Records
Text Messaging
Found 12 service record(s). Click the Invoice Date or Work Order
Invoice Date
Work Order #
Company
11/10/03 209729 Honda of El Cerrito Service
08/22/03 202481 Honda of El Cerrito Service
08/21/03 199734 Honda of El Cerrito Service
03/15/03 189085 Honda of El Cerrito Service
02/03/03 185346 Honda of El Cerrito Service
11/06/02 177232 Honda of El Cerrito Service
09/06/02 171184 Honda of El Cerrito Service
07/09/02 165170 Honda of El Cerrito Service
06/17/02 161760 Honda of El Cerrito Service
04/30/02 158293 Honda of El Cerrito Service
03/28/02 155340 Honda of El Cerrito Service
03/22/02 154370 Honda of El Cerrito Service
164
Service Record
Work Order ID 209729
Invoice Date 11/09/03
Service Advisor Name & Number PAUL FORTE (19)
Mileage 38143
Repair Cost 388.07
168
Job Information
Job Pay Type Operation Technician ID
1 Customer 01HOZ-37500 - 37500 MILE SERVICE 33
Comments:CUSTOMER REQUESTS 37,500 MILE SERVICE ESTIMATE INCLUDES HAZARDOUS WASTE CHARGE; RECOMMENDED MAINTENANCE : PERFORMED 37,500 MILE SERVICE
2 Customer 30HOZ-FRZPORTR - FRONT PADS/ROTORS 33
Comments:NEEDS FRONT BRAKES; DUE TO NORMAL WEAR; REPLACED FRONT BRAKE PADS AND RESURFACED BOTH FRONT ROTORS

Fig. 8

SYSTEMS, METHODS AND DEVICES FOR A TELEMATICS WEB SERVICES INTERFACE FEATURE

This application is a continuation-in-part of prior application Ser. No. 10/626,810, filed Jul. 24, 2003, which is a continuation of prior application Ser. No. 09/808,690, filed Mar. 14, 2001, now U.S. Pat. No. 6,611,740 the contents of each prior application incorporated herein by reference.

BACKGROUND

Vehicles, such as light-duty cars and trucks and heavy-duty tractor/trailers, may include "telematics" systems that monitor information describing the vehicle's location and diagnostic condition. Such telematics systems may include a conventional global positioning system ("GPS") that receives signals from orbiting satellites and a processor that analyzes these signals to calculate a GPS "fix." The fix describes the vehicle's location with an accuracy of about 10 meters or better and may include data such as the vehicle's latitude, longitude, altitude, heading, and velocity.

Telematics systems may also include circuitry that monitors the host vehicle's diagnostic system. For example, light-duty automobiles and trucks beginning with model year 1996 may include an on-board diagnostic ("OBD-II") system as mandated by the Environmental Protection Agency ("EPA"). OBD-II systems may operate under one of the following communication protocols: J1850 VPW (Ford); J1850 VPWM (General Motors); ISO 9141-2 (most Japanese and European vehicles); Keyword 2000 (some Mercedes and Hyundai vehicles); and CAN (a newer protocol used by many vehicles manufactured after 2004).

OBD-II systems monitor the vehicle's electrical, mechanical and emissions systems and generate data such as vehicle speed ("VSS"), engine speed ("RPM"), engine load ("LOAD"), and mass air flow ("MAF"). This data may be processed by a vehicle's engine control unit ("ECU") to detect malfunctions or deterioration in vehicle performance. In processing such data, the ECU may generate diagnostic trouble codes ("DTCs"), which are 5-digit codes (e.g., "P0001") indicating electrical or mechanical problems with the vehicle. Most vehicles manufactured after 1996 make the information available through a standardized, serial 16-cavity connector located in the vehicle and referred to herein as an "OBD-II connector." The OBD-II connector provides a serial interface to the vehicle's ECU and passes data and diagnostic codes to diagnostic equipment located external to the vehicle.

Likewise, heavy-duty trucks may also include a diagnostic system referred to herein as a "truck diagnostic system," which is analogous to the OBD-II systems present in light-duty vehicles. Truck diagnostic systems may operate under a communication protocol such as J1708/J1587 or J1939 and may include a connector located in the truck's interior and referred to herein as the "truck diagnostic connector." The truck diagnostic connector, like the OBD-II connector, makes the diagnostic information available to diagnostic equipment located external to the vehicle.

SUMMARY

An aspect of the present invention is to provide a telematics system that monitors a vehicle's diagnostic and location-based data and utilizes a web services interface to send the data to a secondary software application. According to various embodiments, an in-vehicle telematics device may transmit the diagnostic and location-based data from the vehicle to a database for storage. According to further embodiments, the web services interface may be in communication with the database, and when instructed by the secondary software application, the web services interface may extract the diagnostic and location-based data from the database. In addition, the web services interface may also format the data into a simple object access protocol (SOAP) message and transmit the message to the secondary software application. As a result, a user of the secondary software application, who is remotely located from the vehicle, may view the diagnostic and location-based data and make informed decisions regarding the status and location of the vehicle.

In one embodiment, the present invention is directed to a telematics system. The telematics system includes a web services interface in communication with a secondary software system, wherein the web services interface comprises at least one processor, wherein the processor is configured to retrieve, receive, analyze and/or transmit data in response to a request from the secondary software system. In addition, the telematics system includes a gateway software system configured to transmit data through a network to an in-vehicle telematics device and receive data from the in-vehicle telematics device, wherein the data comprises diagnostic data and/or location-based data associated with a host vehicle. The telematics system also includes a database in communication with the gateway software system and the web services interface, wherein the database is configured to receive and store data transmitted from the gateway software system and/or the web services interface.

In another embodiment, the present invention is directed to a telematics system that includes a gateway software system configured to receive diagnostic data and/or location-based data associated with a host vehicle. In this embodiment the diagnostic and location-based data are transmitted from an in-vehicle telematics device. In addition, the telematics system includes a web services interface configured to transmit data to a secondary software system and/or the in-vehicle telematics device and receive data from the secondary software system and/or the in-vehicle telematics device. The telematics system also includes a database, in communication with the gateway software system and the web services interface, configured to receive and store the diagnostic data and/or the location-based data. The diagnostic and location-based data are transmitted from the gateway software system and/or the web services interface.

In another embodiment, the present invention is directed to a method of monitoring and communicating diagnostic data and/or location-based data concerning a host. The method includes transmitting data to an in-vehicle telematics device and/or receiving diagnostic data and/or location-based data from the in-vehicle telematics device. The method also includes receiving a first message from a secondary software system; processing the first message; storing data in a database; retrieving data from the database; processing data; processing a web services description language file; and transmitting a second message to the secondary software system.

In another embodiment, the present invention is directed to an apparatus. The apparatus includes means for transmitting data to an in-vehicle telematics device and/or receiving diagnostic data and/or location-based data from the in-vehicle telematics device. The apparatus also includes means for receiving a first message from a secondary software system; means for processing the first message; means for storing data in a database; means for retrieving data from the database; means for processing data; means for processing a web services description language file; and means for transmitting a second message to the secondary software system.

In another embodiment, the present invention is directed to a computer-readable medium. According to this embodiment, the computer readable medium has stored thereon instructions which, when executed by a processor, cause the processor to transmit data to an in-vehicle telematics device and/or receive diagnostic data and/or location-based data from the in-vehicle telematics device. Instructions stored on the computer-readable medium may also cause the processor to receive a first message from a secondary software system; process the first message; store data in a database; retrieve data from the database; process data; process a web services description language file; and transmit a second message to the secondary software system.

BRIEF DESCRIPTION OF DRAWINGS

Further advantages of the present invention may be understood by referring to the following descriptions taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a schematic drawing of a telematics system featuring a web services interface according to one embodiment of the present invention;

FIG. **2** is a schematic drawing of the web services interface of FIG. **1** according to one embodiment of the present invention;

FIG. **3** is a flowchart illustrating a process performed by the telematics system according to one embodiment of the present invention;

FIG. **4** is a schematic drawing of a telematics system featuring a web services interface according to one embodiment of the present invention;

FIG. **5**A is a schematic drawing of an Internet-accessible web site according to one embodiment of the present invention;

FIG. **5**B is a schematic drawing of an Internet-accessible web page according to one embodiment of the present invention;

FIG. **6** is a schematic drawing of an Internet-accessible web page displaying diagnostic data according to one embodiment of the present invention;

FIG. **7** is a schematic drawing of an Internet-accessible web page displaying location-based data according to one embodiment of the present invention; and

FIG. **8** is a schematic drawing of an Internet-accessible web page displaying service records according to one embodiment of the present invention.

DETAILED DESCRIPTION

It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention, while eliminating, for purposes of clarity, other elements of a conventional telematics system. For example, certain telematics systems may include multiple power supplies that are not described herein. Those of ordinary skill in the art will recognize, however, that these and other elements may be desirable in a typical telematics system. However, because such elements are well known in the art and because they do not facilitate a better understanding of the present invention, a discussion of such elements is not provided herein.

Also, in the claims appended hereto, any element expressed as a means for performing a specified function is to encompass any way of performing that function including, for example, a combination of elements that perform that function. Furthermore the invention, as defined by such means-plus-function claims, resides in the fact that the functionalities provided by the various recited means are combined and brought together in a manner as defined by the appended claims. Therefore, any means that can provide such functionalities may be considered equivalents to the means shown herein.

The term data is used herein generally to refer to any numbers, letters, symbols and/or analog quantities that function as an input to a device and/or an output from a device. The term "communication" is used herein generally to refer to any wireless and/or wireline transmission and/or reception of data including, but not limited to, voice, text and video data. Furthermore, the terms "send," "transmit" and "receive," or any conjugations thereof, are used herein generally to refer to all data communications over landline and/or wireless technologies including, but not limited to, point-to-point transfers and packet-switched networking. In addition, the term "user" is used herein generally to refer to a person and/or apparatus that operates, interfaces and/or communicates with a device or system such as, for example, a person operating a software system or a person interfacing with an Internet accessible website.

FIG. **1** shows a telematics system **5**, according to one embodiment of the present invention, that utilizes a web services interface **14** to monitor and analyze diagnostic and location-based data describing a vehicle **9**. The web services interface **14** may cause the vehicle **9** to be in communication with a secondary software system **15**, thereby enabling a user of the secondary software system **15** that is remotely located from the vehicle to view the diagnostic and location-based data and make informed decisions regarding the status and location of the vehicle.

In one embodiment, the telematics system **5** may include: (1) a telematic device **10** located in the vehicle **9**; (2) a gateway software system **12** configured to receive the diagnostic and location-based data wirelessly transmitted from the telematics device **10**; (3) a database **13** configured to receive the diagnostic and location-based data from the gateway software system **12** and store this data or derivatives thereof; and (4) a web services interface **14** configured to retrieve the diagnostic and location-based data or derivatives thereof from the database **13** in response to a request from the secondary software system **15**.

According to one embodiment, an OBD-II connector (not shown) may supply power and ground to the telematics device **10**. Additionally, the OBD-II connector may provide a serial interface between the telematics device **10** and the vehicle's engine computer (not shown), thus enabling the telematics system **5** to collect diagnostic data regarding the vehicle **9**. In another embodiment, the telematics device **10** may also include an internal GPS system configured to receive signals from overlying satellites and convert the signals into location-based data such as latitude, longitude, altitude, speed, and heading.

In yet another embodiment, the telematics device **9** may also transmit and/or receive diagnostic and location-based data through a wireless network **11**. The wireless network **11** connects to a gateway software system **12**, e.g. a Unix gateway system. The wireless network **11** may involve a conventional circuit, or packet-switched network, e.g. CDMA networks (e.g., networks operated by Sprint and Verizon), GSM/GPRS networks (e.g., networks operated by ATT and Cingular), data-only networks (e.g., Mobitex and DataTac) and/or satellite networks. According to this embodiment, the gateway software system **12** may process the diagnostic and location-based data and store the data in the database **13**. Furthermore, the secondary software system **15** may also

utilize the web services interface **14** to access the diagnostic and location-based data stored in the database **13**.

In one embodiment, the web services interface **14** may be based on Extensible Markup Language ("XML"), a computer language that encloses data in "documents" that are portable between software applications. According to this embodiment, XML may be utilized as a system-independent language for representing data transmitted across the web services interface **14**. This transmission of data may be in the form of simple object access protocol ("SOAP") messages, which are XML-based messages that are communicated through standard Internet protocols such as, for example, Hypertext Transfer Protocol ("HTTP").

In another embodiment, the web services interface **14** may communicate with the secondary software system **15**, wherein the secondary software system **15** may be an end-user application such as, for example, a web site and/or a software system capable of providing web services. According to this embodiment, the secondary software system **15** may process the diagnostic and location-based data by itself or combine and process these data with other information, which may be stored directly on the secondary software system **15** or may be accessed by the secondary software system **15** using the web services interface **14**.

In one embodiment, the web services may be implemented with software, such as BEA WebLogic Server. According to this embodiment, the software may contain a software application, called a "servlet module," which sends and/or receives XML-based SOAP messages to and/or from the secondary software system **15**. According to this embodiment, the servlet module may implement remote procedure calls ("RPCs") between the web services interface **14** and the secondary software system **15**. In one embodiment, a user of the secondary software system **15** may utilize a keyboard, mouse or other input device to instruct the secondary software system **15** to poll data from the database **13** using the web services interface **14**. In other embodiments, the secondary software system **15** may receive an automated HTTP request to initiate the data polling.

In another embodiment, the secondary software system **15** may interpret XML messages transmitted by the web services interface **14**. According to this embodiment, the XML messages may be used to code web pages by enclosing data in "tags" that define the enclosed information. XML messgages may also be extensible, meaning a user may develop application-specific tags to disclose a wide range of data. In addition, with XML, the user may create a "schema" that describes the structure of the XML document, such as the definitions and locations of the tags used therein.

According to one embodiment of the present invention, the web services interface **14** may send diagnostic and location-based data formatted in a SOAP message from the database **13** to the secondary software system **15**. In this embodiment, the web services interface **14** may "pull" (e.g., extract) the data from the database **13** in response to a query from the secondary software system **15** rather than "push" data to the secondary software system **15**. In addition, the data may be formatted independent from the secondary software system **15** query or any other query that may result from any "downstream" processing.

In one embodiment, the secondary software system **15** may be designed on a software platform that supports web services, such as the Java 2 Platform, Enterprise Edition (J2EE™) or Microsoft's Net platform. The secondary software system **15** that may be built on J2EE™, may connect to other software applications through web services and include essential features such as security, distributed transaction management, and connection pool management. In other embodiments, data may be displayed using a conventional web application **20** that does not utilize a web service.

In one embodiment, the data transfer executed by the web services interface **14** may operate independently from the secondary software system **15**, the data format of the secondary software system **15** or any processing performed by the secondary software system **15**. Therefore, according to this embodiment, the telematics system **5** may function as a "data provider" to numerous secondary software systems **15**, wherein each secondary software system **15** may be configured to execute different functions. For example, a vehicle-leasing company may employ a secondary software system **15** that utilizes the diagnostic and location data in combination with other data to perform a leasing transaction, such as authorizing a leased vehicle in need of repair. Using a web site that relies on the web services interface **14**, a user at the vehicle-leasing company may access a web page that displays the vehicle's diagnostic data, previous service records, and a description of the type of repair that may be required. With this information, combined with data describing the vehicle's location, owner, and leasing program, the user may authorize the repair.

In another embodiment, the telematics system **5** may transmit the vehicle's location-based data through the web services interface **14** to a web-based secondary software system **15** operated by a call center that recovers stolen vehicles. According to this embodiment, a customer, whose vehicle was stolen, may call an operator located at a call center that has access to the web-based software system. Using the web services interface **14**, the web-based secondary software system **15** retrieves the vehicle's most recent GPS-determined locations from the database **13**. Armed with this information, the call center operator may then contact the local police to recover the stolen vehicle.

Alternatively, the telematics system **5** may transmit data and/or instructions from the secondary software system **15** to the in-vehicle telematics device **10** via the web services interface **14**. The in-vehicle telematics device **10** may then display the data, or process and execute the instructions to perform a function. Such functions may include opening the vehicle's doors, sending diagnostic and/or location data, changing an update rate in which these data are transmitted, or downloading new firmware into the in-vehicle telematics device **10**. In other embodiments, the data and/or instructions transmitted from the secondary software system **15** to the in-vehicle telematics device **10**, or the data and/or instructions transmitted from the in-vehicle telematics device **10** to the secondary software system **15**, may be used alone or in combination with other data to perform a given function.

In yet another embodiment, the telematics system **5** may provide wireless, real-time transmission and analysis of diagnostic and location-based data by one or more peripheral devices in communication with the in-vehicle telematics device **10**. According to this embodiment, the telematics system **5** may characterize the vehicle's performance and determine the vehicle's location in real-time from any remote location that is in communication with a network, such as, for example, the Internet. In addition, the diagnostic and location information are complementary and, when analyzed together, may improve conventional services such as roadside assistance, vehicle theft notification and recovery, and remote diagnostics analysis. For example, the information may, according to one embodiment, indicate a vehicle's location, the vehicle's fuel level and battery voltage, and whether or not the vehicle **9** has any active diagnostic trouble codes ("DTCs"). Using such information, a call center, for example,

may dispatch a tow truck equipped with the appropriate materials to properly service the vehicle **9** such as, for example, extra gasoline or tools required to repair a specific problem.

In another embodiment, one or more secondary software systems **15** are in communication with the web services software interface **14**. The secondary software systems **15** may communicate simultaneously or sequentially with the web services software interface.

Further embodiments of the present invention may also be used in servicing a wide range of vehicles. In one embodiment, the telematics system **5** may, for example, cause the secondary software system **15** and/or the Web application **20** to be in communication with vehicles **9**, including but not limited to: (1) automobiles, (2) commercial equipment, (3) light, medium and heavy-duty trucks, (4) construction vehicles such as, for example, front-end loaders, bulldozers and forklifts, (5) powered sport vehicles such as, for example, motorboats, motorcycles, all-terrain vehicles, snowmobiles and jet skis, (6) collision repair vehicles, (7) marine vehicles, and (8) recreational vehicles. Further, embodiments may also be useful in the vehicle care industry.

Now referring to FIG. **2**, the illustrated embodiments depict a telematics system **5** involving the web services interface **14** in communication with the secondary software system **15**. In one embodiment, the web services interface **14** may comprise one or more processors having stored thereon instructions which, when executed by the processor, cause the processor to communicate with the secondary software system **15** and the database **13**. According to this embodiment, the instructions may include a web services container **17** that may be a software application written, for example, in Java, and developed on a platform such as BEA WebLogic. The web services container **17** may execute an RPC SOAP servlet module **19** that communicates over HTTP with the secondary software system **15**. In another embodiment, the instructions, which are stored on the web services interface processor, may also include an enterprise java bean (EJB) container **16**. The EJB container **16** may be a software application configured to execute one or more stateless session enterprise java beans (EJB) **18** that communicate with the RPC SOAP servlet module **19**. According to this embodiment, the servlet module **19** functions as a remote object that performs a well-defined function concerning the secondary software system **15**.

In one embodiment, the RPC SOAP servlet module **19** in the web services interface **14** may be configured to process messages coded in an application-independent format such as an XML and/or SOAP format. According to this embodiment, the RPC SOAP servlet module **19** may include computer code that instructs the web services interface **14** to receive a SOAP message sent from the secondary software system **15**, process the SOAP message, and extract at least one parameter from the message. In addition, the extracted parameter(s) may be transmitted to the stateless session EJB **18**, wherein the stateless session EJB **18** is configured to transmit information to the database **13** and extract information from the database **13**.

In other embodiments, the stateless session EJB **18** may include computer code that instructs the web services interface **14** to process a web services description language (WSDL) file and send at least one parameter of the WSDL file to the RPC SOAP servlet module **19**. According to this embodiment, the WSDL file may be an XML document that specifies the location (e.g., web address) of the web service and the operations that the web service conducts. In still other embodiments, the web services interface **14** may further include computer code that sends the diagnostic and location-based data in the form of an XML or SOAP message to the secondary software system **15**. In further embodiments, the web services interface **14** may include a software interface configured to receive information such as service records from the secondary software system **15**. In these embodiments, the secondary software system **15** may, for example, be a data-management software (DMS) system and/or an enterprise resource planning (ERP) software system.

According to yet another embodiment of the present invention, the secondary software system **15** may instruct a web service to transmit parameter values in the form of a SOAP message to the web services container **17**, which in turn may instruct the RPC SOAP servlet module **19** to return data to the secondary software system **15** in the form of a second SOAP message.

FIG. **3** is a flowchart illustrating an embodiment of a process performed by the telematics system according to the present invention, wherein the web services container may include multiple SOAP servlet modules that are configured to manage different requests formatted in SOAP messages. According to this embodiment, one or more SOAP servlet modules may, at step **200**, receive a first SOAP message from the secondary software system and, at step **202**, "unwrap" the message to identify parameters contained within the message. At step **204**, the SOAP servlet modules may process the parameters to identify and implement the stateless session EJB within the EJB container. The process may then proceed to step **206** where the SOAP servlet modules may send the parameters to the selected stateless session EJB. In response, the stateless session EJB may process the parameters and return a value to the SOAP servlet module at step **208**, thereby triggering step **210** where the SOAP servlet module generates and sends to the secondary software system a second SOAP message that includes the return value. The process may then proceed to step **212** where the secondary software system displays the return value using a web site, for example, and/or stores the return value into a database located within the secondary software system.

FIG. **4** depicts an embodiment wherein the secondary software system **15** performs a "GPS_Info web service." In this embodiment the secondary software system **15** requests GPS information, such as a vehicle's latitude and longitude from a software system **34**. In one embodiment, the software system **34** may be a component of a larger software system such as a telematics system. In addition, the software system **34** may be identified by a web address such as—"www.networkcar.com/pub/gpsinfo/gps_location." According to this embodiment, the software system **34** may include a web services container **27** and an EJB container **26**, similar to those described above with reference to FIG. **2**. During operation, the web services container **27** may receive a request in the form of a first GPS SOAP message **23** from the secondary software system **15**. In response, the web services container **27** may instruct a GPS_Info SOAP servlet module **24** to unwrap the first GPS SOAP message **23** and extract parameters. In one embodiment, these parameters may identify that a GPS_Info EJB **25** needs to be implemented.

In another embodiment, the GPS_Info web service may be defined by a web services description language (WSDL) file **29**, which is dynamically served through the GPS_Info EJB **25**. According to this embodiment, the WSDL file **29** may be an XML document that specifies the location (e.g., web address) of the web service and the operations that the web service conducts, for example, a web service for retrieving location-based data.

In one embodiment of the present invention, the GPS_Info SOAP servlet module **24** may instruct the GPS_Info EJB **25** to execute a task and provide the GPS_Info EJB **25** with the necessary information to carry out the task. This information

may include: an identification of the in-vehicle telematics device hat measures the GPS-determined location; the VIN of the vehicle that hosts the in-vehicle telematics device; and the name, username, and password of the customer associated with the vehicle. According to this embodiment, the GPS_Info EJB **25** may query a database **30** to authorize the request by ensuring that the requesting user has a valid username and password. In another embodiment, the GPS_Info EJB **25** may query the database **30** to generate a response "string" in the form of an XML document that includes either the requested GPS data or an "error statement" indicating that the GPS data is not available. In addition, the GPS_Info EJB **25** may return the XML document as a "payload" to the SOAP servlet module **24**, wherein the SOAP servlet module **24** is configured to return the payload information to the secondary software system **15** in the form of a second SOAP message **23'**.

According to one embodiment, the secondary software system **15** may complete the web service by receiving and processing the second SOAP message **23'**. According to this embodiment, the secondary software system **15** may parse the XML payload within the second SOAP message **23'** and incorporate the location-based data therein into an application such as a web site that features a mapping application; however, if the XML payload includes an error statement then the web site may then render an error message.

FIG. **5**A-FIG. **8** illustrate Internet-accessible web pages, according to several embodiments of the present invention, wherein the Internet-accessible web pages are supported by the secondary software system. In these embodiments, the secondary software system may utilize the web services interface as described above, and may also display, receive and transmit data in more detail below.

FIG. **5**A illustrates an Internet-accessible web page **66***a* according to one embodiment of the present invention. According to this embodiment, the web page **66***a* may enable a fleet manager, for example, to view GPS and diagnostic information and text messages for each vehicle in the fleet. The web page **66***a* may be also connected to a text messaging-processing component configured to process information received from a host vehicle, comprising a telematics device and a peripheral device such as an LCD/keyboard.

In other embodiments, the web page **66***a* may feature tabs **42***a-d* that are capable of connecting to secondary web pages that display vehicle diagnostic information (**42***a*), GPS information and mapping (**42***b*), service records (**42***c*) and text messaging (**42***d*). Each of these web pages **42***a-d* is described below with reference to FIG. **5**B-FIG. **8**.

FIG. **5**B is a block diagram of a web page **66***b* according to one embodiment of the present invention. The web page **66***b* may be rendered when a user selects the tab **42***d* labeled "Text Messaging" in the website **66***a* shown in FIG. **5**A. The web page **66***b* may include a window **43** wherein a user (for example, a fleet manager) may type a text message that is sent through a wireless network and displayed on an LCD attached to the in-vehicle telematics device. The web page **66***b* may also include a field **44** that lists standard components of the text message such as the destination of the text message, the sender, and the subject of the message. In one embodiment, a fleet manager may type a message in the window **43** and wirelessly transmit the message to the driver of the host vehicle **9** by selecting the "Send" button **46**. Similarly, the fleet manager may receive incoming text messages in the window **43** by clicking the "Receive" button **48**. According to various embodiments of the present invention, the text messages may be sent to and received from the in-vehicle telematics device using the web services interface as described above.

In another embodiment, the web page **66***b* may include text messaging software that enables the web page **66***b* to communicate with additional web pages that include software systems for managing text messages. According to this embodiment, these software systems may include file-management systems for storing and managing incoming and outgoing messages; systems for sending messages to multiple vehicles in the fleet; systems for tracking the status of a message; systems for storing draft and standard, formatted messages such as, for example, maps, directions, and standard responses; systems for sending standard messages; systems for porting information from messages to other applications; and other message-processing systems.

FIG. **6** depicts a web page **66***c* that renders when a user selects the "Diagnostics" tab **42***a* on the web page **66***a* shown in FIG. **5**A. In one embodiment, the web page **66***c* may display diagnostic data collected from the ECU of a particular vehicle as described above. The web page **66***c* may also involve a set of diagnostic data **131** that includes fields listing an acronym **132**, value and units **134**, and a brief description **136** for each datum. In other embodiments, the web page **66***c* may include graphs **138**, **139** that plot selected diagnostic data **131** in time-dependent (graph **139**) and histogram (graph **138**) formats.

In one embodiment, the in-vehicle telematics device may automatically transmit a set of diagnostic data **131** at a periodic interval such as, every 20 to 40 minutes. In other embodiments, the telematics device may transmit similar data sets at random time intervals in response to a query from the secondary software system, sometimes referred to as a "ping." Detailed descriptions of these data and how such data can be further analyzed and displayed are provided in the following U.S. patents, the contents of which are incorporated herein by reference: WIRELESS DIAGNOSTIC SYSTEM AND METHOD FOR MONITORING VEHICLES (U.S. Pat. No. 6,636,790) and INTERNET-BASED VEHICLE-DIAGNOSTIC SYSTEM (U.S. Pat. No. 6,611,740).

FIG. **7** illustrates a web page **66***d*, according to one embodiment, that renders when a user selects the "Mapping" tab **42***b* on the web page **66***a* shown in FIG. **5**A. In one embodiment, the web page **66***d* may display, GPS data **154** and a map **158** that together indicate a vehicle's location. According to this embodiment, the GPS data **154** may include the time and date, the vehicle's latitude, longitude, a "reverse geocode" of these data indicating a corresponding street address, the nearest cross street, and the status of the vehicle's ignition such as, for example, "on" or "off" and whether the vehicle is parked or moving. In addition, the map **158** may display these coordinates in a graphical form relative to an area of a few square miles. In one embodiment, the secondary software system **15** may render the web page **66***d* each time the GPS data **154** are periodically transmitted from the in-vehicle telematics device **10**, for example, every 1-2 minutes.

Both the map **158** and a database that translates the latitude and longitude into a reverse geocode may be hosted by an external computer server and may be accessible though an Internet-based protocol such as XML, Web Services, or TCP/IP. Companies such as MapTuit, MapQuest, and NavTech host software that provides maps and databases such as these. Methods for processing location-based data, taken alone or in combination with diagnostic data, are described in the following U.S. patent application, the contents of which are incorporated herein by reference: WIRELESS, INTERNET-

BASED SYSTEM FOR TRANSMITTING AND ANALYZING GPS DATA (U.S. Ser. No. 10/301,010).

FIG. **8** depicts a web page **66***e* that renders when a user selects the "Service Records" tab **42***c* on the web page **66***a* shown in FIG. **5**A. In one embodiment, the web page **66***e* may display a list of service records **164** for a particular vehicle and an individual service record **168** that provides details of a service performed on the vehicle. The list of service records **164** may include: 1) the date of the service; 2) a work order number; and 3) the company providing the service. In addition, the individual service record **168** may describe: 1) the type of service; 2) the mechanic that completed the service; 3) the cost of the service; 4) the mileage on the vehicle at the time of the service; and 5) one or more comments describing the service.

To display the list of service records **164** or the individual service record **168**, the secondary software system may communicate through the web services interface to a data-management system ("DMS") that operates in conjunction with a computer system at an automotive dealership. In another embodiment, the DMS may be, for example, an "Entity Relationship Attribute" (ERA) software system. According to this embodiment, the ERA system may transfer service records to the secondary software system through a variety of means such as, for example, XML, XML-based Web Services, file transfer protocol (FTP), and email. In one embodiment, the web page **66***e* may also include service records describing service performed by organizations other than an automotive dealership. These include services performed by the vehicle owner or another non-dealership entities such as, for example, Jiffy Lube™. In other embodiments, the service records may also be entered by hand into the web page **66***e*.

In still other embodiments, the above-described telematics system may communicate with a wide variety of secondary software systems via the web services interface. These secondary software systems may, for example, include systems that analyze diagnostic and location-based data, alone or in combination, for: (1) stolen-vehicle recovery; (2) vehicle-manufacturers (e.g., Ford, GM); (3) insurance applications; (4) emissions-control applications; (5) general fleet-management applications; (6) roadside assistance; (7) concierge services (e.g., directions); (8) product development and testing; (9) mapping applications; (10) toll collections; and (11) traffic management.

In further embodiments, the secondary software system may utilize the web services interface to implement additional performance features for the in-vehicle telematics device, for example, (1) alteration of data-transmission rates; (2) firmware downloads; (3) immediate transmission of diagnostic or location-based data; (4) investigation of the in-vehicle unit's hardware or software status; (5) network properties; (6) vehicle performance statistics; (7) GPS properties; and (8) ECU diagnostics and other vehicle properties.

According to other embodiments, the web services interface may feature a suite of "loosely coupled" web services that are "message" based and/or asynchronous in nature. In this embodiment, the loosely coupled web service may replace the above-described systems using the RPC SOAP servlet module as described in FIG. **2**. In one embodiment, the loosely coupled web service may permit a "conversation" to occur between the secondary software system and a software system involving the web services interface. For example, the loosely coupled web service may send a first message to the vehicle that causes the in-vehicle telematics device to unlock the doors of the vehicle. According to this embodiment, the first message may also be followed by a second message that requests the in-vehicle telematics device to provide a status report with respect to the operation of unlocking the doors.

In one embodiment, the web services interface may also include security measures such as, for example, authentication, authorization, encryption, credential presentation, and digital signature resolution. In other embodiments, the web services interface may be modified to conform to industry-mandated, XML schema definitions, while remaining "backwards compatible" with any existing XML schema definitions such as XML schema definitions that may be used by an ERP system. In still other embodiments, the web services interface may be designed to be interoperable with other web services implementations, such as, for example, Microsoft .Net and IBM Websphere.

According to further embodiments, web pages hosted by the secondary software system may take on many different forms. For example, the display of the data, the nature and format of the data, and the computer code used to generate the web page and/or data may incorporate a variety of formats without deviating from the spirit of the present invention. In addition, a web page may also be formatted using standard wireless access protocols (WAP) thereby enabling the web page to be accessed by wireless devices such as, for example, cellular telephones, personal digital assistants (PDAs), and other related devices. In addition, these wireless devices may also display text messages that are transmitted using the above-described systems. In still other embodiments, the above-described systems may be used to locate vehicles or items other than cars and trucks, such as, for example, industrial equipment and/or shipping containers.

In general, it will be apparent to one of ordinary skill in the art that some of the embodiments as described hereinabove may be implemented in many different embodiments of software, firmware, and hardware in the entities illustrated in the figures. The actual software code or specialized control hardware used to implement some of the present embodiments is not limiting of the present invention. For example, the embodiments described hereinabove may be implemented in computer software using any suitable computer software language type such as, for example, C or C++ using, for example, conventional or object-oriented techniques. Such software may be stored on any type of suitable computer-readable medium or media such as, for example, a magnetic or optical storage medium. Thus, the operation and behavior of the embodiments are described without specific reference to the actual software code or specialized hardware components. The absence of such specific references is feasible because it is clearly understood that artisans of ordinary skill would be able to design software and control hardware to implement the embodiments of the present invention based on the description herein with only a reasonable effort and without undue experimentation.

Moreover, the processes associated with the present embodiments may be executed by programmable equipment, such as computers. Software that may cause programmable equipment to execute the processes may be stored in any storage device, such as, for example, a computer system (non-volatile) memory, an optical disk, magnetic tape, or magnetic disk. Furthermore, some of the processes may be programmed when the computer system is manufactured or via a computer-readable medium. Such a medium may include any of the forms listed above with respect to storage devices and may further include, for example, a carrier wave modulated, or otherwise manipulated, to convey instructions that may be read, demodulated/decoded and executed by a computer.

It can also be appreciated that some process aspects described herein may be performed using instructions stored on a computer-readable medium or media that direct a computer system to perform the process aspects. A computer-readable medium may include, for example, memory devices such as diskettes, compact discs of both read-only and read/write varieties, optical disk drives, and hard disk drives. A computer-readable medium may also include memory storage that may be physical, virtual, permanent, temporary, semi-permanent and/or semi-temporary. A computer-readable medium may further include one or more data signals transmitted on one or more carrier waves.

A "computer" or "computer system" may be, for example, a wireless or wireline variety of a microcomputer, minicomputer, laptop, personal data assistant (PDA), wireless e-mail device (e.g., BlackBerry), cellular phone, pager, processor, or any other programmable device configured to transmit and receive data over a network. Computer devices disclosed herein may include memory for storing certain software applications used in obtaining, processing and communicating data. It can be appreciated that such memory may be internal or external to the disclosed embodiments. The memory may also include any means for storing software, including a hard disk, an optical disk, floppy disk, ROM (read only memory), RAM (random access memory), PROM (programmable ROM), EEPROM (electrically erasable PROM), and other computer-readable media.

While several embodiments of the invention have been described, it should be apparent, however, that various modifications, alterations and adaptations to those embodiments may occur to persons skilled in the art with the attainment of some or all of the advantages of the present invention. For example, in some embodiments of the present invention disclosed herein, a single component may be replaced by multiple components, and multiple components may be replaced by a single component, to perform a given function or functions. Except where such substitution would not be operative to practice embodiments of the present invention, such substitution is within the scope of the present invention. The disclosed embodiments are therefore intended to include all such modifications, alterations and adaptations without departing from the scope and spirit of the present invention as defined by the appended claims.

What is claimed is:

1. A telematics system comprising:

a web services interface in communication with a secondary system, wherein the web services interface comprises at least one processor configured to at least one of retrieve, receive, analyze and transmit data in response to a request from the secondary system, wherein the at least one processor is configured to:

process at least one servlet module stored thereon to at least one of:

receive a first message sent through the web services interface from the secondary system;

process the first message;

extract at least one parameter from the first message; and

transmit the at least one parameter to at least one enterprise Java bean; and

process the at least one enterprise Java bean to communicate with at least one of the database and a web services description language file, wherein the at least one enterprise Java bean, which when executed by the processor, causes the processor to at least one of:

extract data from the database;

transmit data to the database;

process the web services description language file;

transmit at least one parameter of the web services description language file to the at least one servlet module; and

transmit data extracted from the database to the at least one servlet module;

a gateway system configured to at least one of transmit data through a network to an in-vehicle telematics device and receive data from an in-vehicle telematics device, wherein the data comprises at least one of diagnostic data and location-based data associated with a host vehicle; and

a database in communication with the gateway system and the web services interface, wherein the database is configured to receive and store data from at least one of the gateway system and the web services interface.

2. The telematics system of claim **1**, wherein the at least one servlet module, which when executed by the processor, causes the processor to transmit a second message to the secondary system.

3. The telematics system of claim **2**, wherein the at least one enterprise Java bean is a stateless session bean.

4. The telematics system of claim **1**, wherein the web services interface is configured to transmit at least one of the diagnostic data and the location-based data to the secondary system.

5. The telematics system of claim **4**, wherein the web services interface is configured to transmit to the secondary system an Extensible Markup Language message, wherein the Extensible Markup Language message comprises at least one of the diagnostic data and location-based data.

6. The telematics system of claim **4**, wherein the web services interface is configured to transmit to the secondary system a simple object access protocol message, wherein the simple object access protocol message comprises at least one of the diagnostic data and location-based data.

7. The telematics system of claim **1**, wherein derivatives of at least one of the diagnostic data and the location-based data are at least one of stored, retrieved, received, analyzed and transmitted.

8. The telematics system of claim **1**, wherein the web services interface is configured to process at least one message, wherein the message is coded in an application-independent format.

9. The telematics system of claim **8**, wherein the application-independent format is an Extensible Markup Language format.

10. The telematics system of claim **8**, wherein the application-independent format is a simple object access protocol format.

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