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(54) **METHOD FOR UPDATING VEHICLE
DIAGNOSTICS SOFTWARE**

(75) Inventors: **Thomas A. Gawlik**, Rochester Hills,
MI (US); **Michael G. Zambo**, Warren,
MI (US)

(73) Assignee: **General Motors Corporation**, Detroit,
MI (US)

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702/182; 702/183; 702/184

(58) **Field of Classification Search** **701/29,**
701/33, 35; 702/182-184
See application file for complete search history.

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Primary Examiner—Thomas Black
Assistant Examiner—Wae Lenny Louie

(57) **ABSTRACT**

A method for updating vehicle diagnostics software via a telematics unit is based on the occurrence of a service event as detected by the telematics unit. Upon the connection of a vehicle diagnostics device to a vehicle, the telematics unit receives a scan tool configuration data and a vehicle code. The determination whether the scan tool configuration is current based on the vehicle code is made at the telematics unit. Based on the determination, the call center sends an updated scan tool configuration data to the telematics unit. The telematics unit offers the updated scan tool configuration data to the vehicle diagnostics device for reprogramming.

9 Claims, 3 Drawing Sheets

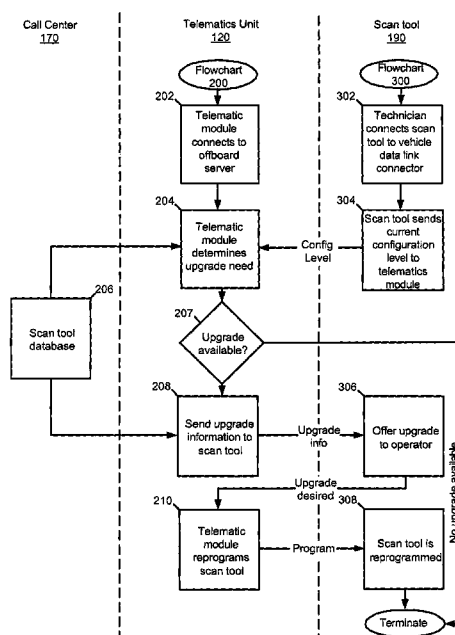
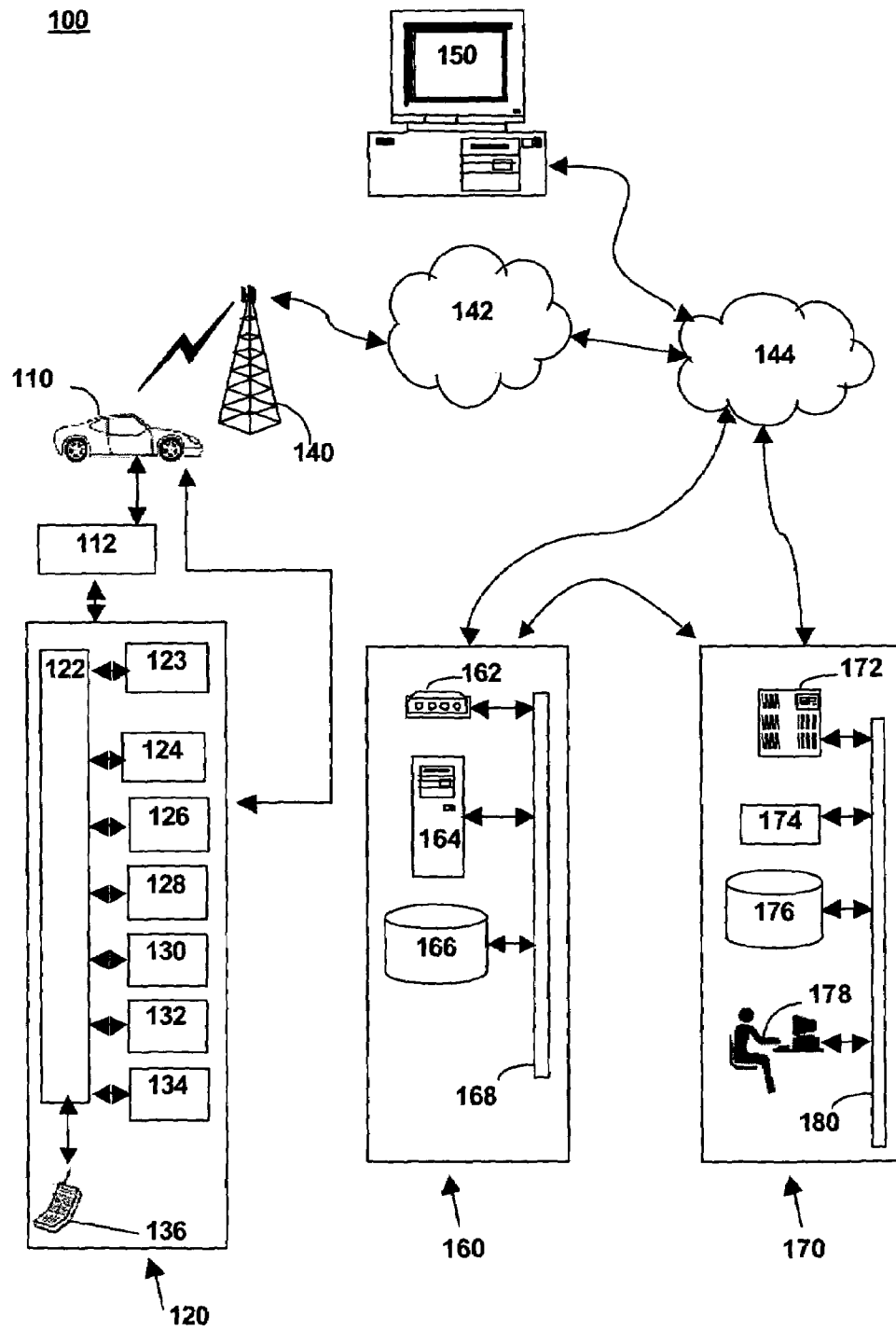
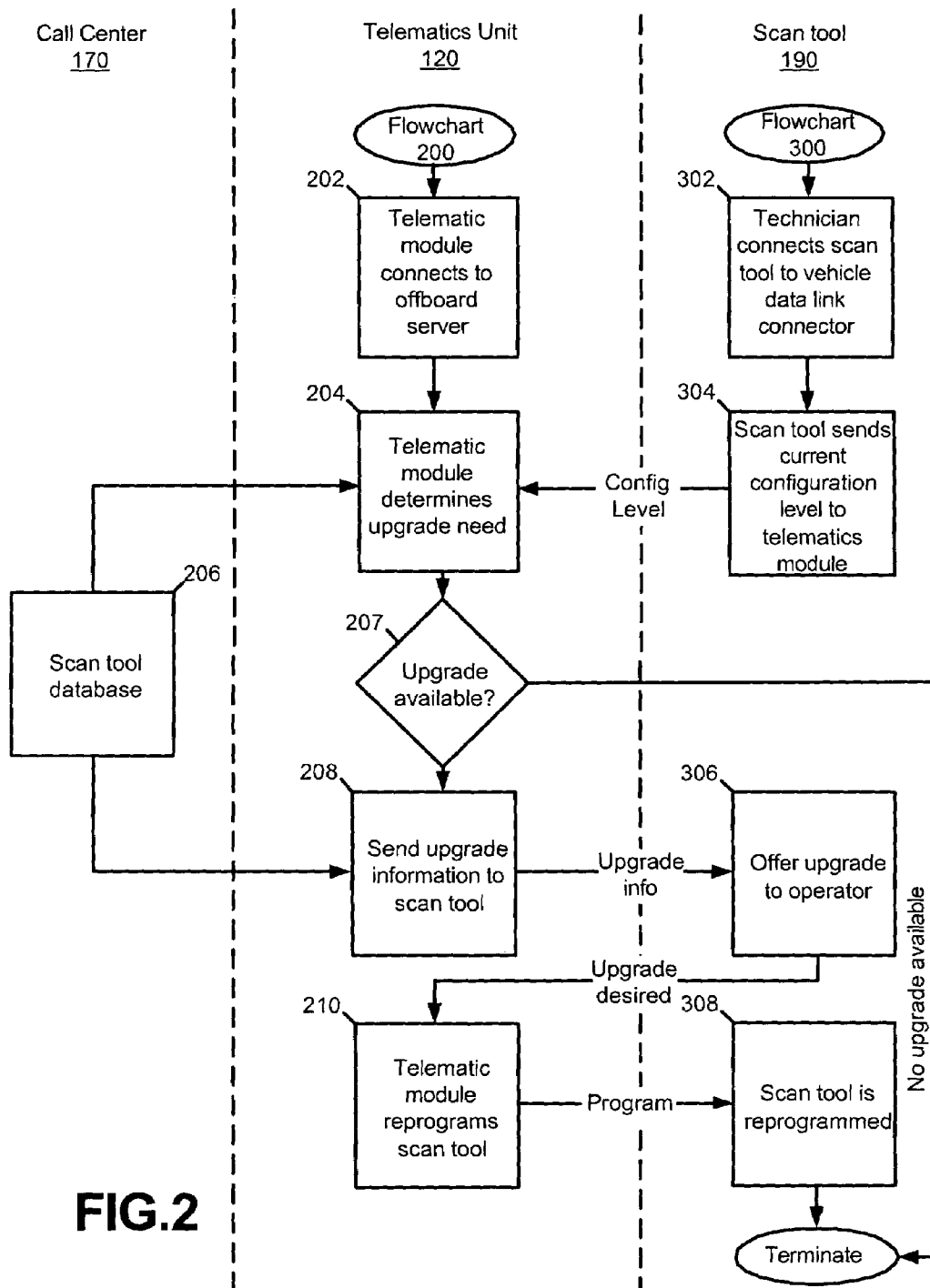


FIG. 1





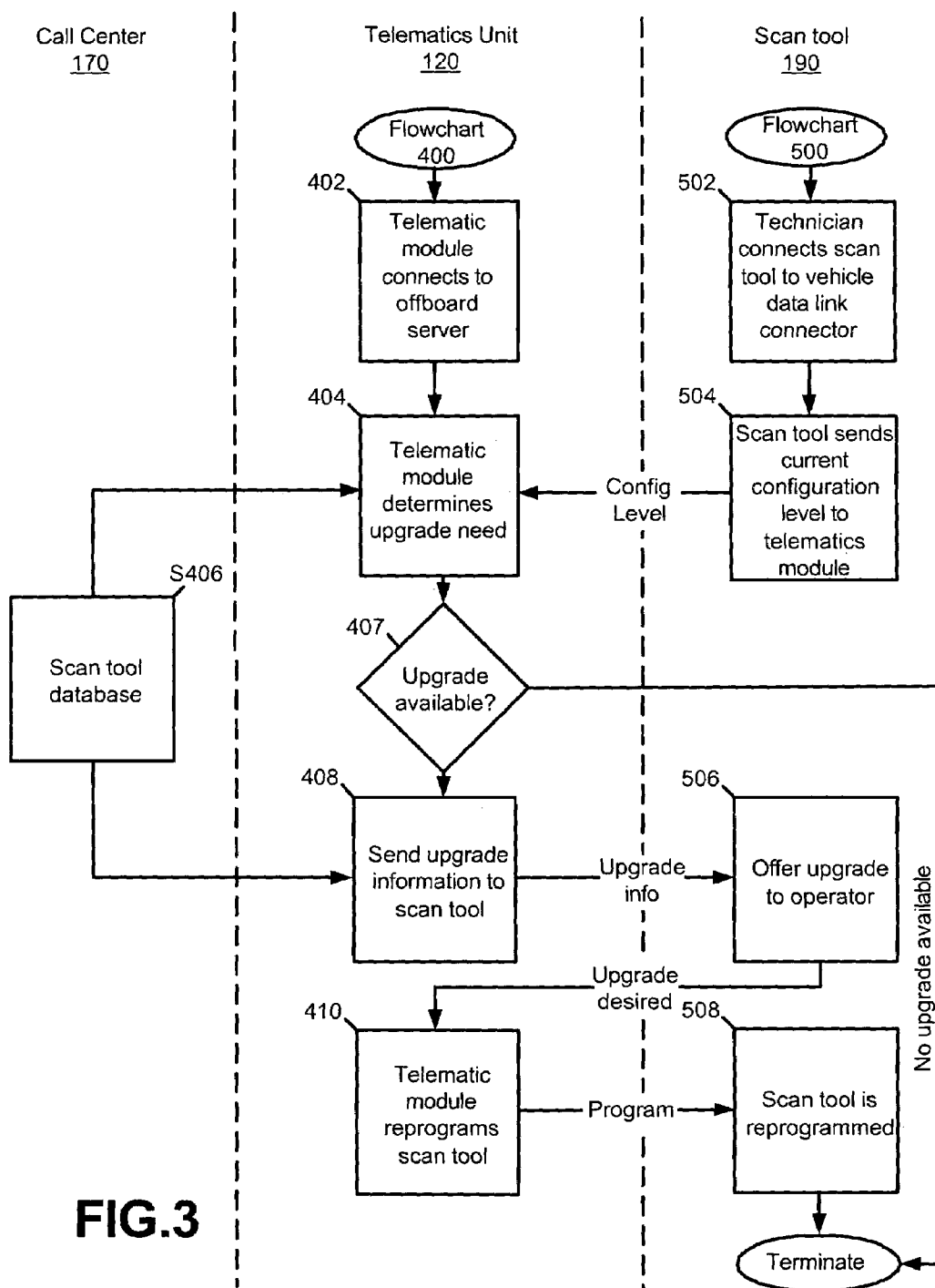


FIG.3

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METHOD FOR UPDATING VEHICLE DIAGNOSTICS SOFTWARE

FIELD OF THE INVENTION

In general, the invention relates to diagnostics application software in a vehicle diagnostics device. More specifically, the invention relates to a method for updating vehicle diagnostics software via a telematics unit.

BACKGROUND OF THE INVENTION

Vehicle diagnosis pertains to self-diagnosis of an abnormality of an engine, a transmission, and the like. The on-board diagnosis (OBD) system is one example of this vehicle diagnostic system. The development of the OBD system was encouraged by the U.S. Environmental Protection Agency (EPA) as a means to better monitor engine and fuel management performance for cleaner exhaust emissions. Beginning with model year 1996, the EPA has required vehicle manufacturers to install OBD systems for monitoring the vehicle's electrical and mechanical systems. Currently, intelligence in the vehicle alerts the driver that repairs or scheduled maintenance is needed. In other words, these OBD systems are designed to perform diagnostics onboard the vehicle as it drives down the road and determine likely problem area possibilities. The diagnostic information of the vehicle is stored in memory as code corresponding to the failure or alert. At authorized service centers, these failures or alerts can be read by connecting an external engine diagnostic tool, commonly called a scan tool, to the vehicle via a diagnosis connector. Scan tools reveal what is stored within the vehicle. Today, scan tools can access data stream information, diagnostic trouble codes (DTCs), perform some functional tests, and capture freeze frame data, and so on. In the authorized service center, repair in response to the failure code is performed.

The rate of change in automotive systems is creating new and more difficult problems to tackle. For example, as vehicle computer systems, like the OBDs, become more and more complex there exists a need to continuously update the scan tool devices used to diagnose vehicle faults. Currently, the method of updating scan tool devices consists of mailing CDs to authorized service centers on regular intervals. Each of these authorized centers has to manually update each of the scan tools they possess. This introduces scheduling and human error, and will not always result in the most recent scan tool software being utilized during the diagnosis process.

Thus, there is a significant need for a method and system for updating vehicle scan tool devices diagnostics software such that human error is minimized. It is an object of this invention to provide such a method and system.

SUMMARY OF THE INVENTION

One aspect of the present invention provides a method for updating vehicle diagnostics software. The method includes receiving a scan tool configuration data from a scan tool device and sending a vehicle code to a call center. A determination is made, at the telematics unit, whether the scan tool configuration is current based on the vehicle code at the call center. Additionally, the method includes the call center sending an updated scan tool configuration data to the telematics unit based on the determination.

Another aspect of the present invention provides a computer usable medium including computer program code for

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updating vehicle diagnostics software. The medium includes computer program code for a telematics unit receiving a scan tool configuration data from a scan tool device and sending a vehicle code to a call center. The medium further includes computer program code for determining at the telematics unit, whether the scan tool configuration is current based on the vehicle code at the call center. Additionally, the medium includes computer program code for sending an updated scan tool configuration data from the call center to the telematics unit based on the determination. The computer usable medium further comprises computer program code for updating the scan tool vehicle diagnostics software.

Another aspect of the present invention provides a system including means for updating vehicle diagnostics software. The system includes means for receiving a scan tool configuration data from a scan tool device and sending a vehicle code to a call center. The system further includes means for determining, at the telematics unit, whether the scan tool configuration is current based on the vehicle code at the call center. Additionally, the system includes means for sending an updated scan tool configuration data from the call center to the telematics unit based on the determination. The system further comprises means for updating the scan tool vehicle diagnostics software.

The foregoing forms and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiment, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of one embodiment of a system for updating vehicle diagnostics software in accordance with the present invention;

FIG. 2 is a flowchart representative of one embodiment of a method for updating vehicle diagnostics software in accordance with the present invention; and

FIG. 3 is a flowchart representative of one embodiment of a method for updating vehicle diagnostics software in accordance with the present invention.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

FIG. 1 illustrates one embodiment of a motor vehicle communication system (MVCS) for updating vehicle diagnostics software in accordance with the present invention at 100. MVCS 100 includes a mobile vehicle communication unit (MVCU) 110; a vehicle communication network 112; a telematics unit 120; one or more wireless carrier systems 140; one or more communication networks 142; one or more land networks 144; one or more client, personal, or user computers 150; one or more web-hosting portals 160; and one or more call centers 170. In one embodiment, MVCU 110 is implemented as a mobile vehicle equipped with suitable hardware and software for transmitting and receiving voice and data communications. In an example, a display is embedded in MVCU 110. The display is a dialed digital display such as a radio unit, radio head or an instrument panel. MVCS 100 may include additional components not relevant to the present discussion.

MVCU 110 is referred to as a mobile vehicle in the discussion below. In operation, MVCU 110 may be implemented as a motor vehicle, a marine vehicle, or as an aircraft. MVCU 110 may include additional components not relevant to the present discussion.

Vehicle communication network 112 routes signals between various units or modules of equipment and systems (detailed below) within MVCU 110 to perform various functions such as unlocking a door, opening the trunk, setting personal comfort settings, and calling from telematics unit 120. In facilitating interactions among the various communication and electronic modules, vehicle communication network 112 utilizes network interfaces such as controller-area network (CAN), International Organization for Standardization (ISO) Standard 9141, ISO Standard 11898 for high-speed applications, ISO Standard 11519 for lower speed applications, and Society of Automotive Engineers (SAE) Standard J1850 for high-speed and lower speed applications.

MVCU 110 is connected to a vehicle diagnostics device, known in the art as a scan tool device 190, to reveal fault code stored within the vehicle memory. In one embodiment of the invention, the MVCU 110 is connected to a scan tool device 190 via a data link connector. In another embodiment, scan tool device 190 communicates with the MVCU 110 via serial bus interface. In one embodiment, a scan tool device 190 is a device configured to communicate and interact with vehicle components or modules to determine the existence of any reported Diagnostic Trouble Code ("DTC") or other data relating to module performance or behavior.

MVCU 110, via telematics unit 120, sends and receives radio transmissions from wireless carrier system 140. Wireless carrier system 140 is implemented as any suitable system for transmitting a signal from MVCU 110 to communication network 142.

Telematics unit 120 includes a processor 122 connected to an in-vehicle audio speech-generating source 123, a wireless modem 124, a global positioning system (GPS) unit 126, an in-vehicle memory 128, a microphone 130, one or more speakers 132, source device 134, and an embedded or in-vehicle mobile phone 136. In other embodiments, telematics unit 120 may be implemented without one or more of the above listed components such as, for example, speakers 132. Telematics unit 120 may include additional components not relevant to the present discussion. In one embodiment, source device 134 is a CD player, terrestrial radio receiver, satellite radio receiver, DVD player, MP3 player, a media player, or other entertainment device. In one embodiment, source device 134 is within MVCU 110. In yet another embodiment, source input is remote from the MVCU 110, and is in communication with MVCU 110 via a wireless connection.

In one embodiment, processor 122 is implemented as a microcontroller, microprocessor, controller, host processor, or vehicle communications processor. In an example, processor 122 is implemented as an application-specific integrated circuit (ASIC). In another embodiment, processor 122 is implemented as a processor working in conjunction with a central processing unit (CPU) performing the function of a general purpose processor. GPS unit 126 provides longitude and latitude coordinates of the vehicle responsive to a GPS broadcast signal received from one or more GPS satellite broadcast systems (not shown). In-vehicle mobile phone 136 is a cellular-type phone such as, for example, an analog, digital, dual-mode, dual-band, multi-mode or multi-band cellular phone.

Processor 122 executes various computer programs that control programming and operational modes of electronic and mechanical systems within MVCU 110. Processor 122 controls communications (e.g., call signals) between telematics unit 120, wireless carrier system 140, and call center 170. In one embodiment, a voice-recognition application is installed in processor 122 that can translate human voice input through microphone 130 to digital signals. Processor 122 generates and accepts digital signals transmitted between telematics unit 120 and a vehicle communication network 112 that is connected to various electronic modules in the vehicle. In one embodiment, these digital signals activate the programming mode and operation modes, as well as provide for data transfers.

Communication network 142 includes services from one or more mobile telephone switching offices and wireless networks. Communication network 142 connects wireless carrier system 140 to land network 144. Communication network 142 is implemented as any suitable system or collection of systems for connecting wireless carrier system 140 to MVCU 110 and land network 144.

Land network 144 connects communication network 142 to computer 150, web-hosting portal 160, and call center 170. In one embodiment, land network 144 is a public-switched telephone network (PSTN). In another embodiment, land network 144 is implemented as an Internet protocol (IP) network. In other embodiments, land network 144 is implemented as a wired network, an optical network, a fiber network, other wireless networks, or any combination thereof. Land network 144 is connected to one or more landline telephones. Communication network 142 and land network 144 connect wireless carrier system 140 to web-hosting portal 160, and call center 170.

Client, personal, or user computer 150 includes a computer usable medium to execute Internet browser and Internet-access computer programs for sending and receiving data over land network 144 and, optionally, wired or wireless communication networks 142 to web-hosting portal 160. Computer 150 sends user preferences to web-hosting portal 160 through a web-page interface using communication standards such as hypertext transport protocol (HTTP), and transport-control protocol and Internet protocol (TCP/IP). In one embodiment, the data includes directives to change certain programming and operational modes of electronic and mechanical systems within MVCU 110. In operation, a client utilizes computer 150 to initiate setting or re-setting of user preferences for MVCU 110. User-preference data from client-side software is transmitted to server-side software of web-hosting portal 160. User-preference data is stored at web-hosting portal 160.

Web-hosting portal 160 includes one or more data modems 162, one or more web servers 164, one or more databases 166, and a network system 168. Web-hosting portal 160 is connected directly by wire to call center 170, or connected by phone lines to land network 144, which is connected to call center 170. In an example, web-hosting portal 160 is connected to call center 170 utilizing an IP network. In this example, both components, web-hosting portal 160 and call center 170, are connected to land network 144 utilizing the IP network. In another example, web-hosting portal 160 is connected to land network 144 by one or more data modems 162. Land network 144 sends digital data to and receives digital data from modem 162, data that is then transferred to web server 164. Modem 162 can reside inside web server 164. Land network 144 transmits data communications between web-hosting portal 160 and call center 170.

Web server **164** receives user-preference data from user computer **150** via land network **144**. In alternative embodiments, computer **150** includes a wireless modem to send data to web-hosting portal **160** through a wireless communication network **142** and a land network **144**. Data is received by land network **144** and sent to one or more web servers **164**. In one embodiment, web server **164** is implemented as any suitable hardware and software capable of providing web services to help change and transmit personal preference settings from a client at computer **150** to telematics unit **120** in MVCU **110**. Web server **164** sends data transmissions to or receives data transmissions from one or more databases **166** via network system **168**. Web server **164** includes computer applications and files for managing and storing personalization settings supplied by the client, such as door lock/unlock behavior, radio station preset selections, climate controls, custom button configurations, and theft alarm settings. For each client, the web server potentially stores hundreds of preferences for wireless vehicle communication, networking, maintenance, and diagnostic services for a mobile vehicle.

In one embodiment, one or more web servers **164** are networked via network system **168** to distribute user-preference data among its network components such as database **166**. In an example, database **166** is a part of or a separate computer from web server **164**. Web server **164** sends data transmissions with user preferences to call center **170** through land network **144**.

Call center **170** is a location where many calls are received and serviced at the same time, or where many calls are sent at the same time. In one embodiment, the call center is a telematics call center, facilitating communications to and from telematics unit **120** in MVCU **110**. In an example, the call center is a voice call center, providing verbal communications between an advisor in the call center and a subscriber in a mobile vehicle. In another example, the call center contains each of these functions. In other embodiments, call center **170** and web-hosting portal **160** are located in the same or different facilities.

Call center **170** contains one or more voice and data switches **172**, one or more communication services managers **174**, one or more communication services databases **176**, one or more communication services advisors **178**, and one or more network systems **180**. In one embodiment, communication services databases **176** are implemented as scan tool databases.

Switch **172** of call center **170** connects to land network **144**. Switch **172** transmits voice or data transmissions from call center **170** and receives voice or data transmissions from telematics unit **120** in MVCU **110** through wireless carrier system **140**, communication network **142**, and land network **144**. Switch **172** receives data transmissions from and sends data transmissions to one or more web-hosting portals **160**. Switch **172** receives data transmissions from or sends data transmissions to one or more communication services managers **174** via one or more network systems **180**.

Communication services manager **174** is any suitable hardware and software capable of providing requested communication services to telematics unit **120** in MVCU **110**. Communication services manager **174** sends data transmissions to or receives data transmissions from one or more communication services databases **176** via network system **180**. Communication services manager **174** sends data transmissions to or receives data transmissions from one or more communication services advisors **178** via network system **180**. Communication services database **176** sends data transmissions to or receives data transmissions from communi-

cation services advisor **178** via network system **180**. Communication services advisor **178** receives from or sends to switch **172** voice or data transmissions.

Communication services manager **174** provides one or more of a variety of services, including enrollment services, navigation assistance, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance. Communication services manager **174** receives service-preference requests for a variety of services from the client via computer **150**, web-hosting portal **160**, and land network **144**. Communication services manager **174** transmits user-preference and other data to telematics unit **120** in MVCU **110** through wireless carrier system **140**, communication network **142**, land network **144**, voice and data switch **172**, and network system **180**. Communication services manager **174** stores or retrieves data and information from communication services database **176**. Communication services manager **174** can provide requested information to communication services advisor **178**.

In one embodiment, communication services database **176** is a scan tool database. In an example, a scan tool database sends data transmissions to or receives data transmissions from telematics unit **120** in MVCU **110**. Scan tool configuration data and/or vehicle code is transmitted to telematics unit **120**.

In one embodiment, communication services advisor **178** is implemented as a real advisor. In an example, a real advisor is a human being in verbal communication with a user or subscriber (e.g., a client) in MVCU **110** via telematics unit **120**. In another embodiment, communication services advisor **178** is implemented as a virtual advisor. In an example, a virtual advisor is implemented as a synthesized voice interface responding to requests from telematics unit **120**.

Communication services advisor **178** provides services to telematics unit **120** in MVCU **110**. Services provided by communication services advisor **178** include enrollment services, navigation assistance, real-time traffic advisories, directory assistance, roadside assistance, business or residential assistance, information services assistance, emergency assistance, and communications assistance. Communication services advisor **178** communicates with telematics unit **120** in MVCU **110** through wireless carrier system **140**, communication network **142**, land network **144**, and web-hosting portals **160** using voice transmissions. In an alternative embodiment, communication services manager **174** communicates with telematics unit **120** in MVCU **110** through wireless carrier system **140**, communication network **142**, land network **144**, and web hosting portals **160** using voice transmissions. Switch **172** selects between voice transmissions and data transmissions.

Scan tool device **190**, telematics unit **120**, and call center **170** are configured to implement the updated diagnostics software methods of the present invention as will be described in connection with FIGS. **2** and **3**. In one embodiment, scan tool device **190** has a preference setting to auto-accept or to require operator input to accept diagnostics software upgrades. In another embodiment, the diagnostics software upgrades is specific to MVCU **110** being serviced or is the diagnostics software upgrades is for multiple vehicle applications.

FIG. **2** illustrates a flowchart **200** and a flowchart **300** that are executed by telematics unit **120** and scan tool device **190**, respectively, in implementing an automated diagnostics software update method of the present invention. While in practice, diagnostic software update process can be initiated

by telematics unit **120** or scan tool device **190**, flowcharts **200** and **300** will be described herein as if telematics unit **120** has initiated the service event. Flowchart **200** begins at step **202**.

At step **202**, flowchart **200** monitors a wireless connection between a telematics module or telematics unit (e.g. telematics unit **120** of FIG. **1**) and an off board server or a call center (e.g. call center **170** of FIG. **1**) for a data input. The wireless connection may be established by sending a connection request from the telematics unit to the call center, or by sending a connection request from the call center to the telematics unit. The wireless connection uses wireless carrier system **140** in one embodiment. In another embodiment, monitoring the wireless connection is initiated at the telematics unit in response to an established connection. In another embodiment, monitoring the wireless connection is initiated by a monitor request issued by a user in MVCU **110** or an advisor (e.g. advisor **168**). In yet another embodiment, the wireless connection is monitored in response to a button push.

At step **302**, flowchart **300** connects a scan tool device (e.g. scan tool device **190** of FIG. **1**) and a MVCU (e.g. MVCU **110** of FIG. **1**) via a data link connector, or the like. At step **304**, scan tool device **190** sends current configuration level to telematics unit **120**. In one embodiment, the configuration level contains specific, up-to-date parameters required to correctly communicate with and interpret specific vehicle component behaviors and messages. In another embodiment, the configuration level includes hardware and/or software part numbers. In another embodiment, the configuration level includes software revision information.

At step **204**, telematics unit **120** receives vehicle code information from call center **170**. At step **206**, telematics unit **120** queries scan tool database (e.g. scan tool database **176**) for recent vehicle code information. In one embodiment, the vehicle code information is software specific to MVCU **110**. In another embodiment, the vehicle code information is base software applicable to any vehicle. At step **204**, telematics unit **120** determines whether a diagnostics software upgrade is needed based on a comparison between the current configuration level data received from scan tool device **190** and vehicle code received from call center **170** scan tool database **176**.

At step **207**, telematics unit **120** determines whether a diagnostics software upgrade is available. If no diagnostics software upgrade is available, flowchart **200** terminates. At step **208**, if a diagnostics software upgrade is available, telematics unit **120** sends an upgraded scan tool configuration data to scan tool device **190**. In one embodiment, the upgraded scan tool configuration data is specific to the vehicle being serviced. In another embodiment, the upgraded scan tool configuration data is for more than one vehicle applications. For example, upgraded scan tool configuration data includes data that applies to a predetermined make or model, such as a line of pick-up trucks. In another example, upgraded scan tool configuration data includes data that applies to those vehicles of a particular make or model featuring a predetermined combination of options, such as pickup trucks with a V6 engine.

At step **306**, an upgraded scan tool configuration data is offered to a technician or operator for scan tool device **190**. At step **210**, if the upgrade is accepted by a technician or operator, telematics unit **120** reprograms scan tool device **190**. At step **308**, scan tool device **190** is reprogrammed. Scan tool device **190** terminates flowchart **300** until another service event.

FIG. **3** illustrates a flowchart **400** and a flowchart **500** that are executed by telematics unit **120** and scan tool device **190**, respectively, in implementing an automated diagnostics software update method of the present invention. While in practice, diagnostic software update process can be initiated by telematics unit **120** or scan tool device **190**, flowcharts **400** and **500** will be described herein as if scan tool device **190** has initiated the service event. Flowchart **500** begins at step **502**. In one embodiment, steps **502** and **504** are implemented as in steps **302** and **304** of FIG. **2**.

At step **402**, flowchart **400** monitors a wireless connection between a telematics module or telematics unit (e.g. telematics unit **120** of FIG. **1**) and an off board server or call center (e.g. call center **170** of FIG. **1**) for a data input. Monitoring a wireless connection is implemented as in step **202**.

At step **404**, telematics unit **120** receives vehicle code information from call center **170**. At step **406**, telematics unit **120** queries scan tool database (e.g. scan tool database **176**) for recent vehicle code information. In one embodiment, steps **404** and **406** are implemented as in steps **204** and **206**. At step **404**, telematics unit **120** determines whether a diagnostics software upgrade is needed based on a comparison between the current configuration level data received from scan tool device **190** and vehicle code received from call center **170** scan tool database **176**.

At step **407**, telematics unit **120** determines whether a diagnostics software upgrade is available. If no diagnostics software upgrade is available, flowchart **400** terminates as implemented in step **207**. At step **408**, if a diagnostics software upgrade is available, telematics unit **120** sends an upgraded scan tool configuration data to scan tool device **190**. Sending an upgraded scan tool configuration data is implemented as in step **208**.

In one embodiment, steps **504** and **508** are implemented as in steps **304** and **308** of FIG. **2**. At step **506**, an upgraded scan tool configuration data is sent to scan tool device **190**. Scan tool device **190** detects preferences is set to automatically accept upgraded scan tool configuration data. At step **410**, telematics unit **120** reprograms scan tool device **190** as implemented in step **210**. Scan tool device **190** terminates flowchart **500** until another service event.

From the preceding descriptions herein of flowcharts **200-500** as illustrated in FIGS. **2** and **3**, those having ordinary skill in the art will appreciate various advantages of the present invention, such as, for example an elimination of a need for a technician or operator at service centers to manually upgrade scan tool devices from CDs mailed monthly. Furthermore, those having ordinary skill in the art will appreciate that, in practice, the automated method of updating vehicle diagnostics software with operator input to accept and the automated method of updating vehicle diagnostics software with automatic accept preference settings can be executed as described and illustrated herein, or merged into single diagnostics software update method.

While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.

We claim:

1. A method of updating a scan tool, comprising the steps of:
 - receiving a scan tool configuration level supplied to a vehicle from a scan tool connected to the vehicle;

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wirelessly connecting to a call center from the vehicle using a telematics unit on the vehicle;
 accessing a scan tool database at the call center and determining whether a diagnostics software upgrade is needed by comparing the scan tool configuration level with information obtained from the scan tool database; and
 in response to determining that the diagnostics software upgrade is needed:
 providing the diagnostics software upgrade from the call center to the vehicle via the telematics unit; and reprogramming the scan tool using the diagnostics software upgrade.
 2. The method of claim 1, wherein the receiving step further comprises receiving the scan tool configuration level as data transmitted to the telematics unit from the scan tool via a data link connector.
 3. The method of claim 1, wherein the accessing step further comprises sending the information to the telematics unit from the call center and determining whether the diagnostics software upgrade is needed by comparing the information and scan tool configuration level at the telematics unit.
 4. The method of claim 1, wherein the reprogramming step further comprises querying a service technician about the diagnostics software upgrade via the scan tool and upgrading the scan tool if the technician accepts.
 5. A method of updating a scan tool, comprising the steps of:
 connecting a scan tool to a vehicle telematics unit via a data link connector;

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sending current scan tool configuration level data from the scan tool to the vehicle telematics unit;
 establishing a wireless connection between the telematics unit and a call center;
 accessing information from a scan tool database at the call center;
 sending the information from the call center to the telematics unit;
 determining whether a diagnostics software upgrade is needed by comparing, at the telematics unit, the information with the current scan tool configuration level data;
 providing the diagnostics software upgrade from the call center to the vehicle if the diagnostics software upgrade is determined to be needed; and
 reprogramming the scan tool using the diagnostics software upgrade.
 6. The method of claim 5, wherein the sending step is initiated by the scan tool.
 7. The method of claim 5, wherein the sending step is initiated by the telematics unit.
 8. The method of claim 5, wherein the scan tool configuration level further comprises software revision information.
 9. The method of claim 5, wherein the reprogramming step further comprises querying a service technician about the diagnostics software upgrade via the scan tool and upgrading the scan tool if the technician accepts.

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