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MORGAN et al.

(54) METHODS AND SYSTEMS RELATED TO ASSET IDENTIFICATION TRIGGERED GEOFENCING

(71) Applicant: **Gordon*Howard Associates, Inc.**, Littleton, CO (US)

(72) Inventors: **Gerald A. MORGAN**, Littleton, CO (US); **Christopher M. MACHECA**, Centennial, CO (US); **Stanley G. SCHWARZ**, Indialantic, FL (US)

(73) Assignee: **Gordon*Howard Associates, Inc.**, Littleton, CO (US)

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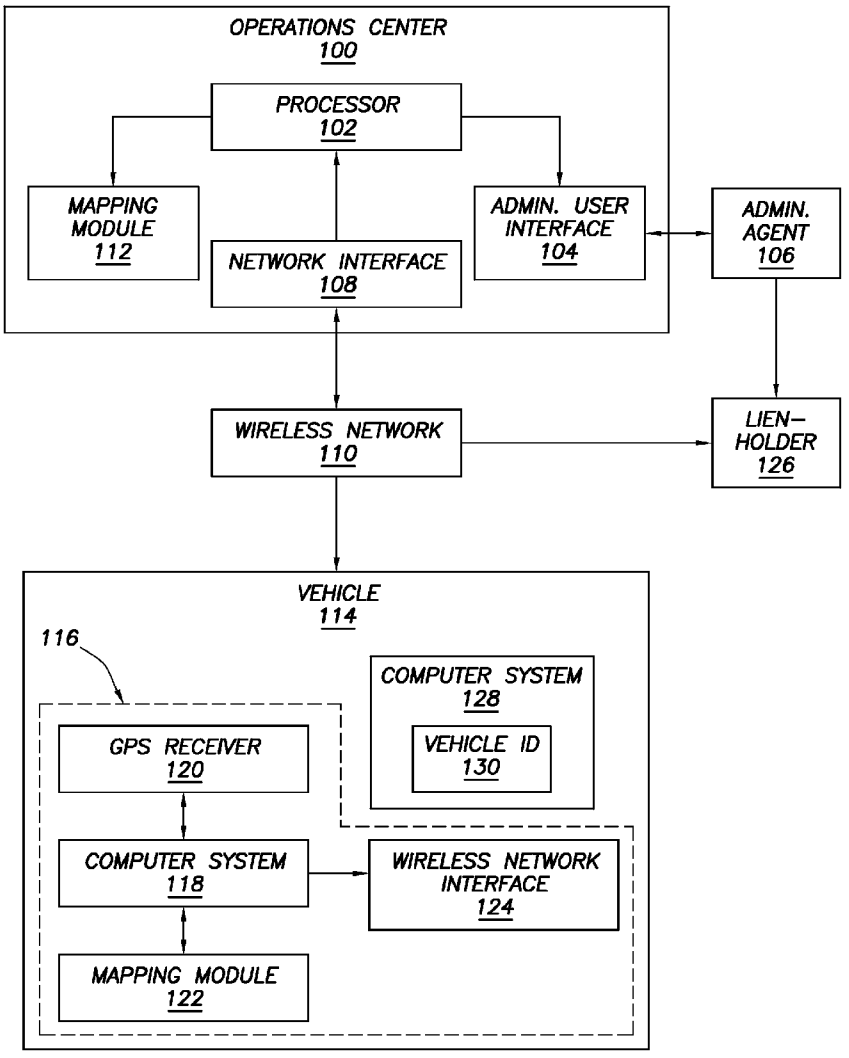
CPC *G06Q 10/087* (2013.01)
USPC **705/28**

(57) **ABSTRACT**

Asset Identification Trigged Geo-fencing. At least some of the example embodiments are methods including: coupling a tracking device to a vehicle being part of a dealer inventory, the vehicle having an identification number; associating the identification number with the tracking device; creating a geo-fence boundary containing a location of the vehicle; and sending a first message to a lien-holder indicating the vehicle has crossed the geo-fence boundary.



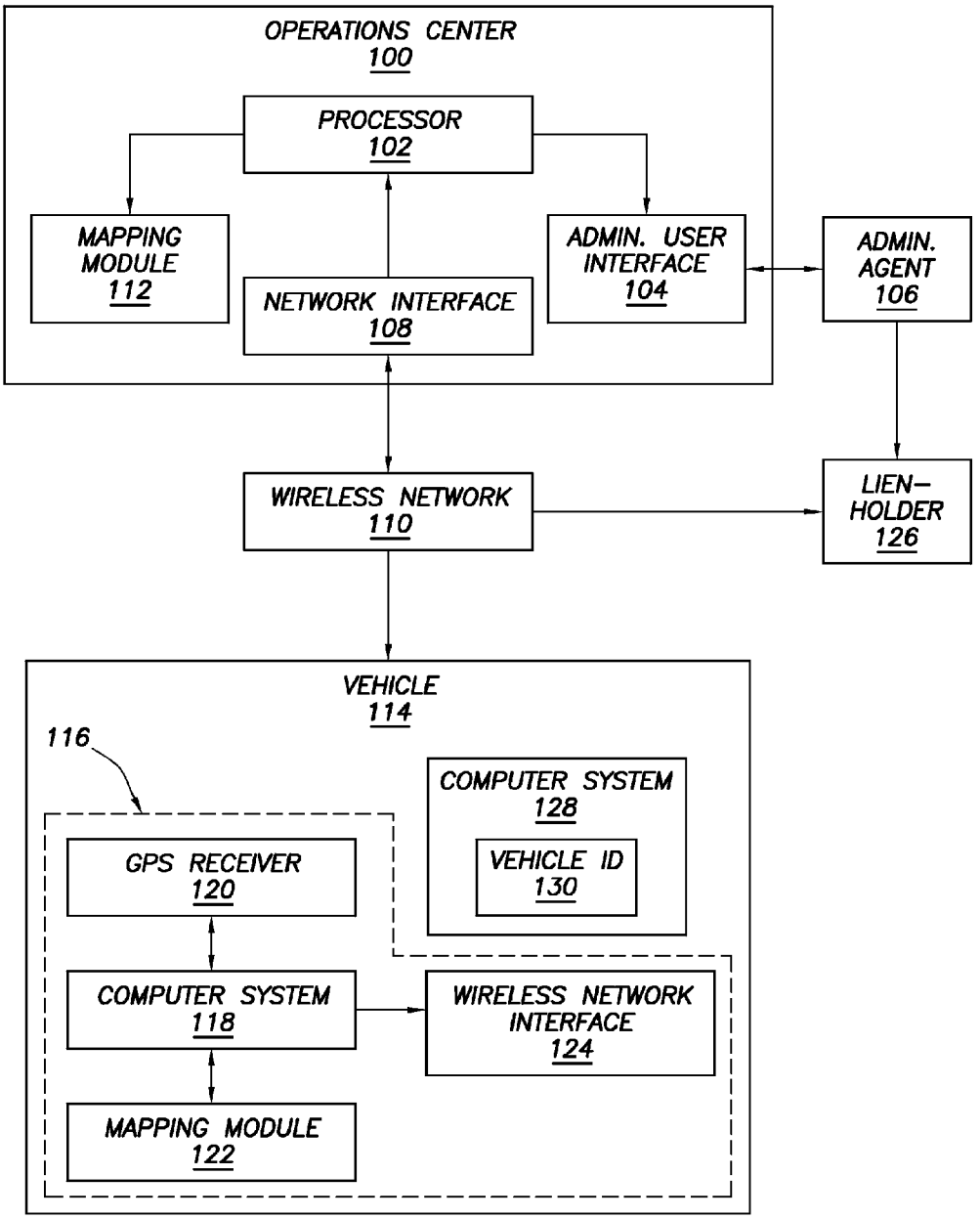

OPERATIONS CENTER
100
PROCESSOR
102
MAPPING MODULE
112
NETWORK INTERFACE
108
ADMIN. USER INTERFACE
104
ADMIN. AGENT
106
WIRELESS NETWORK
110
LIEN-HOLDER
126
VEHICLE
114
116
COMPUTER SYSTEM
128
VEHICLE ID
130
GPS RECEIVER
120
COMPUTER SYSTEM
118
WIRELESS NETWORK INTERFACE
124
MAPPING MODULE
122

FIG. 1

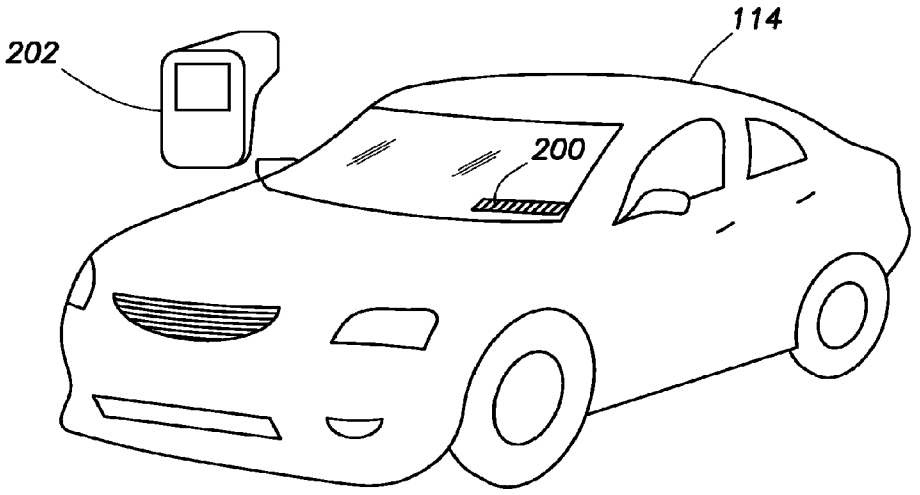


FIG.2A

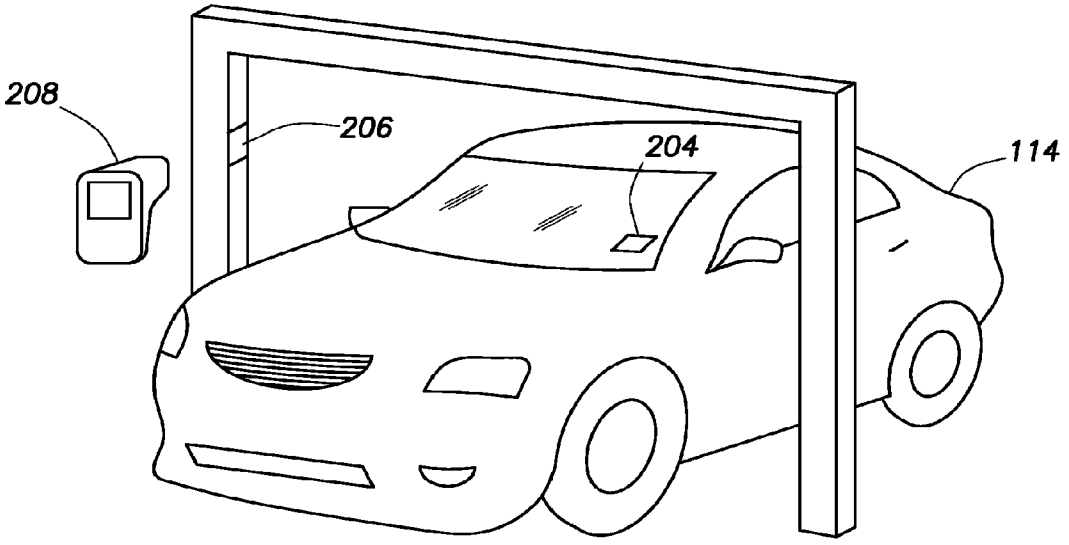


FIG.2B

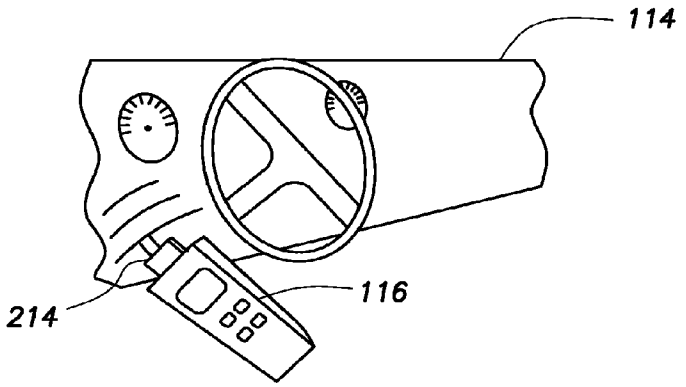


FIG.2C

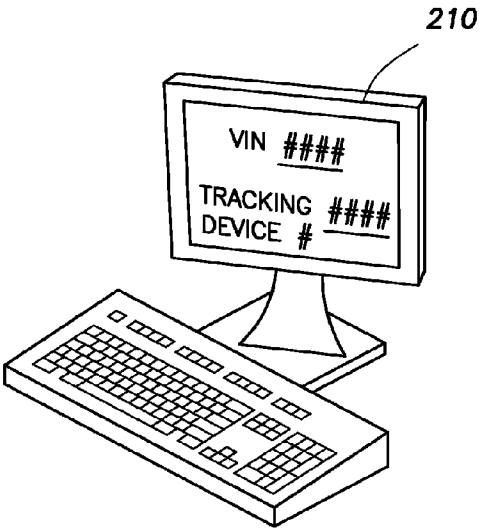


FIG.2D

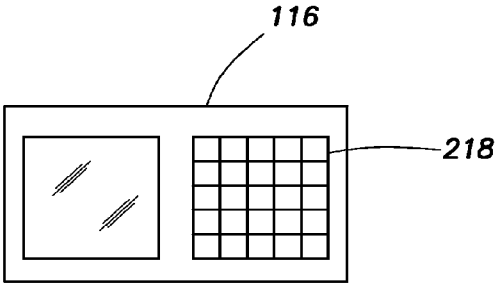


FIG.2E

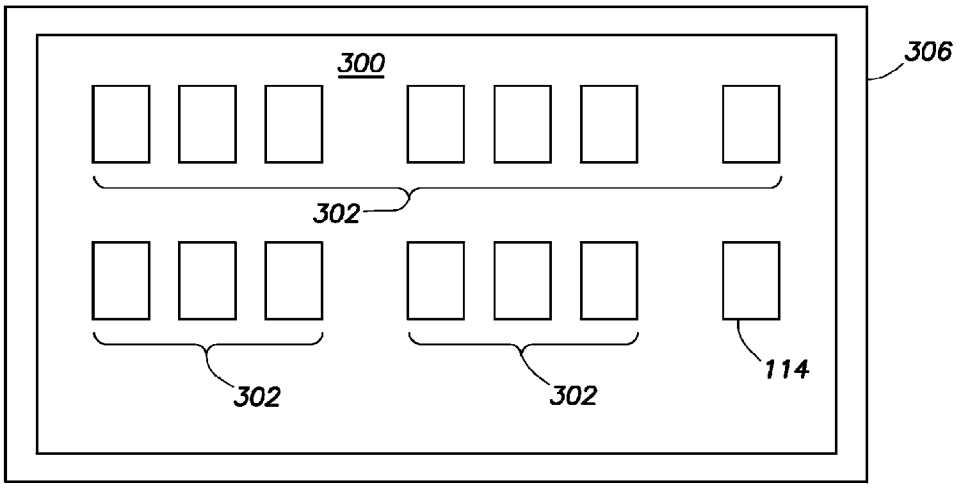


FIG.3

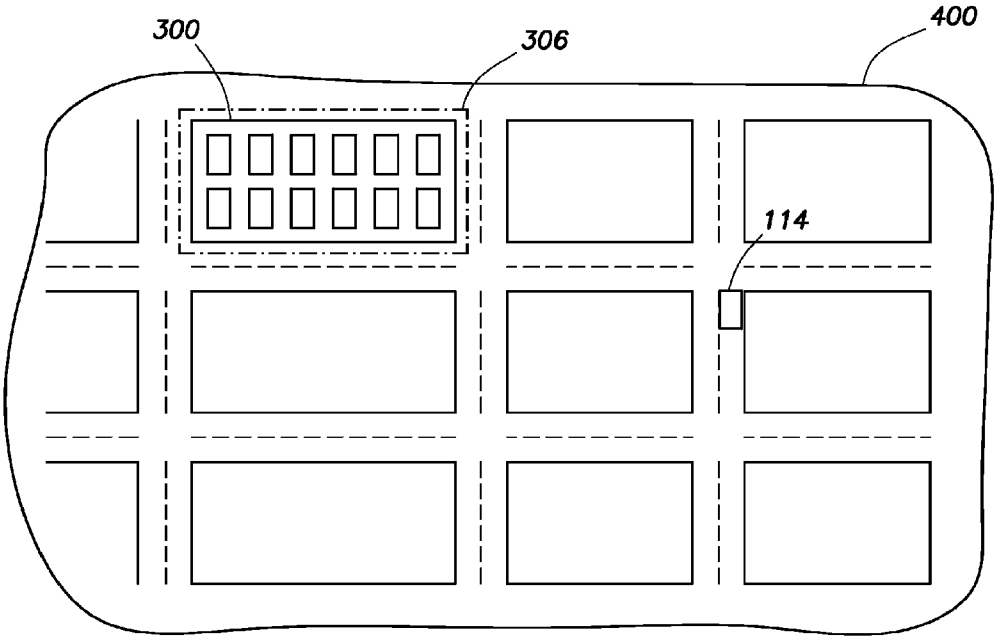


FIG.4

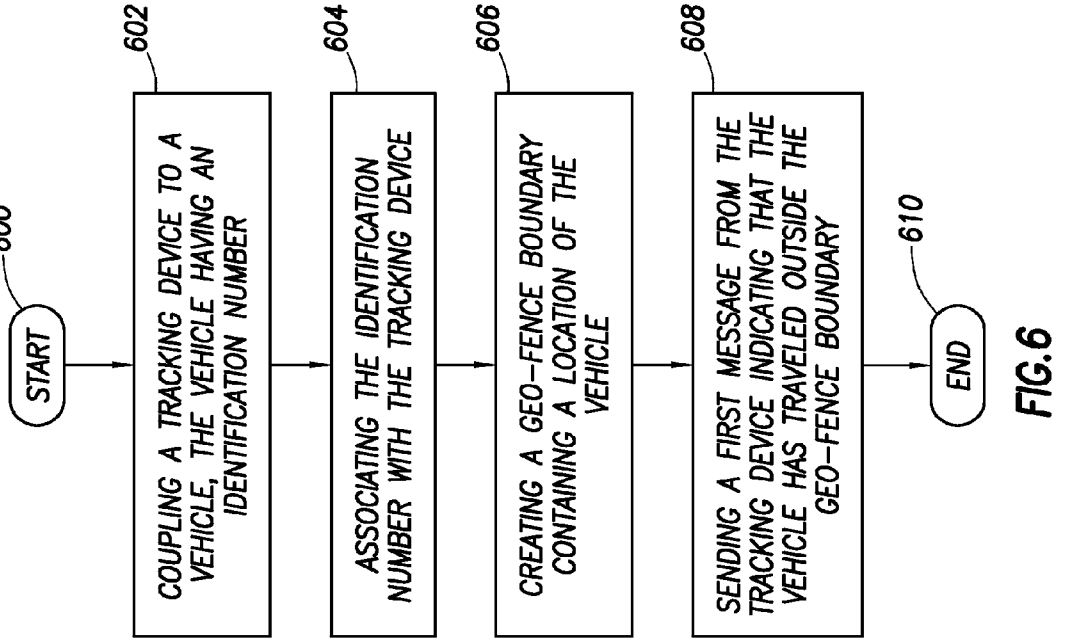

600
START
602
COUPLING A TRACKING DEVICE TO A VEHICLE, THE VEHICLE HAVING AN IDENTIFICATION NUMBER
604
ASSOCIATING THE IDENTIFICATION NUMBER WITH THE TRACKING DEVICE
606
CREATING A GEO-FENCE BOUNDARY CONTAINING A LOCATION OF THE VEHICLE
608
SENDING A FIRST MESSAGE FROM THE TRACKING DEVICE INDICATING THAT THE VEHICLE HAS TRAVELED OUTSIDE THE GEO-FENCE BOUNDARY
610
END

FIG.6

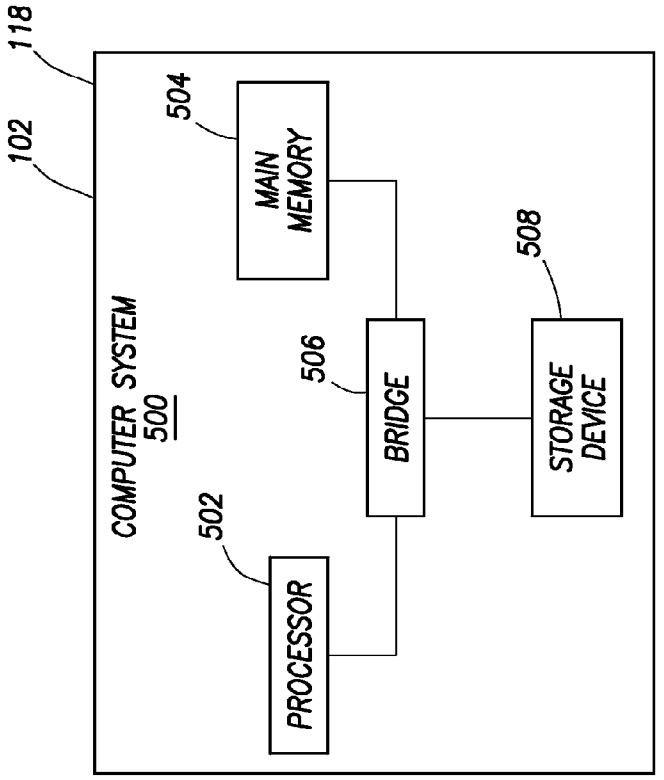

118
102
COMPUTER SYSTEM
500
504
MAIN MEMORY
506
BRIDGE
508
STORAGE DEVICE
502
PROCESSOR

FIG.5

METHODS AND SYSTEMS RELATED TO ASSET IDENTIFICATION TRIGGERED GEOFENCING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. application Ser. No. 13/827,652, filed Mar. 14, 2013, titled "Methods and Systems Related to Asset Identification Triggered Geofencing," the disclosure of which is incorporated herein by reference as if reproduced in full below.

BACKGROUND

[0002] In situations where a financing institution has provided funds for a dealership to purchase items for inventory, the financing institution may have an interest in protecting its investment by maintaining records on the inventory of the assets over time. Taking multiple physical inventories over time to maintain the records may be time consuming and prone to human counting error. Thus, any technology which provides a more accurate and easier way to inventory assets is beneficial.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] For a detailed description of exemplary embodiments, reference will now be made to the accompanying drawings in which:

[0004] FIG. **1** shows, in block diagram form, a system in accordance with at least some embodiments;

[0005] FIG. **2**A shows a perspective view of an identification system in accordance with at least some embodiments;

[0006] FIG. **2**B shows a perspective view of an identification system in accordance with at least some embodiments;

[0007] FIG. **2**C shows a perspective view of an identification system in accordance with at least some embodiments;

[0008] FIG. **2**D shows an elevation view of an identification system in accordance with at least some embodiments;

[0009] FIG. **2**E shows an elevation view of an identification system in accordance with at least some embodiments;

[0010] FIG. **3** shows an overhead view of an established and/or activated geo-fence in accordance with at least some embodiments;

[0011] FIG. **4** shows an overhead view of an established and/or activated geo-fence in accordance with at least some embodiments;

[0012] FIG. **5** shows a computer system in accordance with at least some embodiments; and

[0013] FIG. **6** shows, in block diagram form, a method in accordance with at least some embodiments.

NOTATION AND NOMENCLATURE

[0014] Certain terms are used throughout the following description and claims to refer to particular system components. As one skilled in the art will appreciate, different companies may refer to a component and/or method by different names. This document does not intend to distinguish between components and/or methods that differ in name but not in function.

[0015] In the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to . . . . " Also, the term "couple" or "couples" is intended to mean either an indirect or direct connection. Thus, if a first device couples to a second device that connection may be through a direct connection or through an indirect connection via other devices and connections.

[0016] "Remote" shall mean one kilometer or more.

[0017] "Portable computing device" shall mean a handheld device having the ability to execute software instructions running on the device and communicate over a wireless data network. The portable computing device configured to operate exclusively from power derived from an internal battery for an hour or more.

[0018] "Dealer inventory" shall mean a group of assets owned or equitably owned by a dealership and offered for sale as the primary product offering of the dealer.

[0019] "Lien-holder" shall mean a person or institution who has provided financing for an asset and having a lien on the asset.

DETAILED DESCRIPTION

[0020] The following discussion is directed to various embodiments of the invention. Although one or more of these embodiments may be preferred, the embodiments disclosed should not be interpreted, or otherwise used, as limiting the scope of the disclosure, including the claims. In addition, one skilled in the art will understand that the following description has broad application, and the discussion of any embodiment is meant only to be exemplary of that embodiment, and not intended to intimate that the scope of the disclosure, including the claims, is limited to that embodiment.

[0021] Various embodiments are directed to systems and methods of associating a tracking device with a specific asset, such as a vehicle, and subsequently tracking location of the asset. The developmental context is location tracking of vehicles in dealer inventory, and thus the specification will be based on the development context; however, the developmental context shall not be read as a limitation as to the applicability of the various embodiments. The specification first turns to a high level system overview.

[0022] FIG. **1** shows, in block diagram form, a system in accordance with at least some embodiments. In particular, the system comprises an operations center **100** communicatively coupled to a vehicle **114** by way of a wireless network **110**. The operations center **100** comprises a processor **102**. In some embodiments, the processor **102** may be a stand-alone computer system, or the processor may comprise a plurality of computer systems communicatively coupled and performing the functions of the operations center **100**, the functions discussed more thoroughly below. The processor **102** may couple to an administrative user interface **104**. The administrative user interface **104** may enable an administrative agent **106** to control or configure the operation of the system.

[0023] In one embodiment, in order to communicate with vehicle **114**, the operations center **100** may further comprise a network interface **108** communicatively coupled to the processor **102**. By way of the network interface **108**, the processor **102**, and any programs executing thereon, may communicate with vehicle **114**, such as by wireless network **110**. Wireless network **110** is illustrative of any suitable communications network, such as a cellular network, a Wireless Fidelity (Wi-Fi) network, or other mechanism for transmitting information between the operations center **100** and the vehicle **114**.

[0024] In accordance with at least some embodiments, the operations center **100** is remotely located from the vehicle

114. In some cases, the operations center **100** and vehicle **114** may be located within the same city or state. In other cases, the operations center **100** may be many hundreds or thousands of miles from vehicle **114**, and thus the illustrative wireless network **110** may span several different types of communication networks.

[0025] Still referring to FIG. **1**, the system further comprises a vehicle **114** communicatively coupled to operations center **100** by way of the illustrative wireless network **110**. The vehicle **114** may comprise tracking device **116** (shown within the dashed line). In some embodiments, the tracking device may be part of the vehicle **114** as purchased from the manufacturer (i.e., an original equipment manufacturer (OEM) device). In other embodiments, however, the tracking device may be part of a third-party after-market system.

[0026] Tracking device **116** may comprise a computer system **118**. Although not specifically shown, computer system **118** may comprise a processor, where the processor may communicate with subsystems of the vehicle, such as a computer system **128** of the vehicle **114**. An example onboard device **116** configured to couple to the onboard diagnostic two (OBD-II) port may also have the ability to read or determine data associated with the vehicle **114**.

[0027] Tracking device **116** may further comprise a wireless network interface **124** coupled to the computer system **118**. By way of the wireless network interface **112**, programs executed by the computer system **118** may communicate with other devices. In some embodiments, the wireless network interface **124** enables the computer system **118** to communicate with operations center **100** by way of a wireless transmission through the wireless network **110**. The wireless network interface **124** thus implements a wireless communication system and/or protocol.

[0028] The tracking device **116** further comprises a global position system (GPS) receiver **120** coupled to computer system **118**. The GPS receiver **120** receives signals from an array of GPS satellites orbiting the earth, and based on timing associated with arrival of those signals, a location of the tracking device **116** (and thus the vehicle **114**) can be determined. In some cases, the GPS receiver **120** has sufficient functionality to calculate location, and thus the data passed to computer system **118** may be a direct indication of location. In other cases, the functionality to determine location may be shared between the GPS receiver **120** and software executing on the processor **102**, by way of wireless network **110**. That is, the GPS receiver **120** may receive the plurality of GPS signals and pass the information to a program on the processor **102**, which program may then make the determination as to location of the tracking device **116**, and thus the vehicle **114**. In still other cases, software executing on computer system **118** combined with information received by the GPS receiver **120** may make a determination as to the location of the tracking devices **116**.

[0029] In one embodiment, the tracking device **116** tracks the vehicle with high precision, thus one may be able to identify the street and block at which the vehicle is passing at any given time (though the tracking device **116** may not necessarily have or contain street level databases). In other cases, the tracking device **116** may act only to determine the end-points of each trip. In another embodiment, location tracking may be accomplished by way of cellular signal triangulation. For example, the wireless network interface may be a cellular transceiver implementing implement a wireless communication system and/or protocol (i.e., radio frequency communication by way of electromagnetic waves propagating through air).

[0030] In some cases, the location determined by the tracking device **116** may only be a position on the face of the earth, for example, latitude and longitude. The mapping module **112**, located at the operations center **100** and receiving a stream of locations from the tracking device **116**, may correlate to streets and addresses. In other cases, the tracking device **116** may have sufficient memory and computing functionality to not only determine position in a latitude and longitude sense, but also to correlate the positions to cities, streets, block numbers and addresses. The tracking device **116** coupled to vehicle **114** may further comprise its own mapping module **122** coupled to computer system **118**. In accordance with at least some embodiments, the mapping module **122** may be a computer program or program package that operates or executes on the computer system **118** to perform a mapping function associated with the location of vehicle **114** and any geo-fences which may be activated on the tracking device **116**.

[0031] Consider the following example situation. A lien-holder offers loans to finance the inventory of a car dealership. The dealership borrows funds in order to stock an inventory of vehicles, and repays the debt as the vehicles are sold. In order to protect the lien-holder's investment on the inventory, a representative from the lien-holder may make a periodic (e.g., monthly) physical count of the vehicles to ensure the accounting of each vehicle. The physical visit and physical accounting of the inventory is both costly and time-consuming. Furthermore, a physical accounting of the vehicles is prone to human error. As a result, the lien-holder may request that each vehicle on the lot be outfitted with a uniquely linked tracking device. Each tracking device is linked with an identification number **130** associated with a specific vehicle (e.g., a vehicle identification number (VIN), a dealer-assigned tracking number, or a lien-holder assigned tracking number). In accordance with a plurality of established and activated geo-fences (one each for each tracking device), the tracking devices track the locations of respective vehicles, thus making an accounting of the vehicles automated, fast, and less prone to error, and subsequently reducing the number of times a physical accounting must be made.

[0032] In order to track a vehicle, a geo-fence may be established for a variety of different situations. If the vehicle departs a geo-fenced area, an alert may be sent to the remote operations center, or directly to the lien-holder. If a vehicle is purchased, the tracking device is disassociated from the vehicle, which may be an indication for the lien-holder to request partial payment on the loan. Various techniques for associating a vehicle with a tracking device will be discussed first.

[0033] FIGS. **2**A-**2**E show a plurality of identification and association technologies in accordance with a variety of embodiments. In particular, a plurality of technologies may be employed to read an identification number uniquely linked to the vehicle, and further associating the identification number with the tracking device coupled to the vehicle. For simplification, the following discussion will assume the identification number is a standardized Vehicle Identification Number (VIN), although the identification number need not be a VIN and may be any type of unique identification code.

[0034] FIG. **2**A shows an example VIN identification method. In this example embodiment, vehicle **114** is tagged

with an optical machine-readable representation containing VIN information, such as a bar code **200** or Quick Response Code (QR Code). The bar code **200** or QR code may contain VIN information including the manufacturer of the vehicle, the year of manufacture, the country of origin, the type of vehicle, and a unique serial number for vehicle **114** specifically. The bar code **200** may be affixed to the vehicle by way of a sticker or a label, or other adhesive means, or may be physically imprinted on the vehicle directly, (e.g., printed on the VIN tag behind the front windshield).

[0035] The bar code may be read and decoded by using a portable computing device, such as a handheld scanner **202**. For example, the handheld scanner **202** may be a laser scanner, a charge-coupled device (CCD) reader, a camera-based reader, or a pen-type laser reader. In particular, a person (e.g., an employee of the dealership, a representative of the lien-holder, or another third-party) may use the handheld scanner to physically scan bar code **200**. In another example, the scanner **202** need not be physically handled by a person, but may be mounted and machine controlled.

[0036] In the example system, decoded VIN information is then wirelessly transmitted to the computer system **118** of tracking device **116** coupled to vehicle **114**. Alternatively, the handheld scanner **202** may transmit information to the tracking device **116** by way of a hardwired connection, such as by a universal serial bus (USB) cable. Once the tracking device **116** receives the vehicle specific VIN information, the tracking device **116** is associated with vehicle **114**.

[0037] In FIG. **2**B, example vehicle **114** is associated with tracking device **116** by way of a radio frequency identification (RFID) chip. In particular, the VIN associated with vehicle **114** may be embedded within an RFID chip **204** attached to the vehicle. In one embodiment, the information on the RFID chip may be decoded by a handheld two-way radio transceiver **208**. Transceiver **208** sends an electromagnetic query signal to the RFID chip, and then reads the signal received from the RFID chip in return. In the example system, the transceiver then wirelessly transmits the RFID chip response to the computer system **118** in order to associate the VIN information from vehicle **114** with tracking device **116**. Alternatively, the transceiver **208** may transmit information to the tracking device **116** by way of a hardwired connection, such as by a universal serial bus (USB) cable.

[0038] In another embodiment, the RFID chip **204** may be read as the vehicle passes by an RFID scanner, where the scanner may be embedded in a portion of a physical gate **206** into the dealership lot **300**. In particular, because the RFID chip **204** may be read at short ranges via electric or magnetic fields, or by way of emitted radio waves, the RFID chip **204** may be read from up to several meters away, and unlike scanning a bar code, the RFID chip **204** need not be within the line of sight of a handheld reader. Thus, where an individual may physically scan each bar code (or each RFID tag, in some embodiments), it may also be possible for the RFID chip **204** to be read and decoded as vehicle **114** is driven past the RFID scanner **208** and onto the dealership lot **300** for the first time.

[0039] Although discussion with regard to the handheld scanners in both the bar code technology and RFID technology has involved the scanner directly providing the tracking device computer system with the VIN information, it is also contemplated the handheld devices **202** and **208** may transmit the VIN information first to another remote computer system (e.g., the remote operations center **100**), where the remote computer system in turn transmits the information to the tracking device **116**.

[0040] FIG. **2**C shows yet another embodiment in which the tracking device may be associated with the vehicle. In particular, the tracking device **116** may receive VIN information from the computer system **128** of vehicle **114**. For example, the tracking device **116** is coupled to the OBD-II port **214** in order to read or determine data associated with the vehicle, including reading the VIN, as well as associating the tracking device **116** with vehicle **114**.

[0041] FIG. **2**D shows yet another embodiment in which the tracking device may be associated with the vehicle. In particular, the tracking device may be associated with a unique serial number as well. Both the serial number of the tracking device and the VIN for vehicle **114** may be manually entered into a computer program running on a computer system **210** at a remote location, such as at operations center **100**.

[0042] FIG. **2**E shows yet another embodiment in which the tracking device may be associated with the vehicle. In particular, the tracking device **116** may comprise an input device **218**, where the input device may be, for example, a touch-screen or a tactile keypad. In this example embodiment, the VIN information for vehicle **114** may be physically entered directly into the tracking device **116**.

[0043] Once the tracking device **116** has been associated with the vehicle **114** by way of the unique identifier (e.g., the VIN), the vehicle's location with respect to a geo-fence may be tracked. Various techniques for activating a geo-fence, as well as monitoring the location of a vehicle are now discussed.

[0044] FIG. **3** shows an overhead view of a geo-fence in accordance with at least some embodiments. In particular, FIG. **3** shows a dealership lot **300** containing multiple vehicles **302**, as well as example vehicle **114**. Each vehicle being financed by the lien-holder has been coupled to and associated with a tracking device. Responsive to the acknowledgement that at least one vehicle on the dealership lot **300** is associated with a tracking device, a geo-fence may be established to aid in tracking the location of the vehicle inventory. In the event a vehicle departs the geo-fenced area, an alert will be sent to a remote location informing any interested party (e.g., the dealership, the lien-holder) that the vehicle is no longer on the dealership lot **300**.

[0045] In some cases, mapping module **112** of the remote operations center **100** may play a role in establishing the geo-fence when a vehicle is within the coordinates of the dealership lot **300**. In particular, the mapping module may receive information from the tracking device **116** regarding the vehicle location, as well as other related information (e.g., the time of day, whether the vehicle is schedule for a test-drive, whether the vehicle is schedule for maintenance), and the operations center establishes the relevant geo-fence boundary.

[0046] In other cases, the tracking device **116** may establish the geo-fence. In particular, the GPS receiver, receiving timing signals from the satellites, passes the location information to computer system **118**. Computer system **118** processes the information received from the GPS receiver **120**, and establishes an appropriate geo-fence boundary. Regardless of how the geo-fence boundary is established, once the geo-fence boundary is established, movement of the vehicle with respect to the geo-fence is monitored.

[0047] Still referring to FIG. **3**, a geo-fence **306** is established along the perimeter of the dealership (shown offset for illustration purposes). While a vehicle is located within the boundary of geo-fence **306**, the vehicle is accounted for in the inventory. If a vehicle is crosses out of the area bounded by geo-fence **306**, an alert may be sent to the operations center **100** or the lien-holder **126** that the vehicle has departed the lot. In some cases, notification that the vehicle has left the lot is indicative of an unauthorized departure, thus prompting potential investigation.

[0048] In addition to monitoring when a vehicle leaves the geo-fenced area without authorization, it is also possible that vehicles recognized as being located within the geo-fence **306** correspond to an accurate and correct inventory accounting of vehicles in which the lien-holder has a financial interest. When the lien-holder wants an inventory, a query regarding the vehicles on the lots can be performed automatically and without human interaction (outside of requesting the data from the operations center).

[0049] In one embodiment, geo-fence **306** is established by the remote operations center **100** for all of the vehicles on the lot in total. In other words, geo-fence **306** is established regardless of how many vehicles are present on the dealership lot **300**, and regardless of whether any of the vehicle has its own situational geo-fence established (e.g., a test-drive geo-fence). In another embodiment, each tracking device coupled to a vehicle individually establishes a default geo-fence **306** corresponding to the dealership perimeter for the specific vehicle to which the tracking device is coupled. In other words, in some example cases, there are multiple geo-fences having the same size, shape and location; one for each vehicle on the dealership lot **300**.

[0050] Referring again to FIG. **3**, geo-fence **306** is established around vehicles **302**, including example vehicle **114**. During the time period that example vehicle **114** is located within the boundary created by geo-fence **306**, vehicle **114** is accounted for on the lot **300**. In some cases, the geo-fence **306** defining the boundary of the dealership may be activated 24 hours a day, such that at any point the location of each vehicle may be known. In other cases, the geo-fence **306** may be activated only part of the day, such as the hours during which the dealership is closed. In cases where the geo-fence **306** is individually established for individual vehicles, each vehicle may have its own specific geo-fence activation rules.

[0051] In the event vehicle **114** departs the area bounded by geo-fence **306** (i.e., the dealership lot geo-fence), the tracking device will send a message indicating a geo-fence violation. In one embodiment, the message may be sent from the tracking device to the operations center **100**. In another embodiment, the message may be sent from the tracking device directly to the lien-holder **126**. In yet another embodiment, the tracking device may send a message to the operations center, and then the operations center will send a message to the lien-holder.

[0052] In some instances, a geo-fence violation is indicative of an unauthorized departure, and may trigger an investigation by the dealership or by the lien-holder. For example, if a vehicle is stolen, when it is removed from the dealership the operations center and/or lien holder will receive a message that a vehicle has departed the lot without the knowledge of either or both parties. However, in some instances, the vehicle will have a legitimate reason for departing the area bounded by the dealership geo-fence **306**, such as for a test drive, for maintenance, or to transfer the vehicle from one dealership location to another dealership location.

[0053] If the vehicle leaves the dealership lot **300** with previous knowledge and authorization, a new geo-fence may be established to monitor the vehicle outside of the dealership. Circumstantial geo-fences may be established for a vehicle in a variety of ways and for a variety of reasons, as discussed with reference to FIG. **4**.

[0054] FIG. **4** shows two geo-fences in accordance with at least some embodiments. In particular, FIG. **4** shows dealership lot **300** bounded by default geo-fence **306**, as well as a new circumstantial geo-fence **400** for vehicle **114**. In this example, vehicle **114** departed, with previous knowledge, the dealership lot geo-fence **306**, but is still under the control of the dealership (i.e., the vehicle has not been sold or otherwise disassociated with the tracking device). As a result of the departure, circumstantial geo-fence **400** has been established as having a specific size, shape, and location in relation to the dealership.

[0055] In one embodiment, the geo-fence **400** may have a predefined size, shape, and location. For example, if geo-fence **400** is a test-drive geo-fence, geo-fence **400** may extend outwardly from the dealership, and having a radius of five miles. In another example, it may be possible to define the geo-fence as being defined by street coordinates. In particular, it may be possible to define the area bounded by the geo-fence by the following example street coordinates: the area south of E 15th Street; east of N Lamar Boulevard; north of Caesar Chavez Street; and west of Red River Street.

[0056] In another embodiment, the circumstantial geo-fence **400** may be established in real-time. For example, while some geo-fences may be predefined to define a perimeter around the dealership, or may be predefined to define an area to accommodate a test-drive or maintenance trip, it may be possible to establish a circumstantial geo-fence in real-time specific to the circumstances at hand. For example, the dealership may be located in a city setting, but sells off-road type vehicles. A potential purchaser may want to test drive the vehicle in a location that is more similar to off-road conditions than urban city streets can provide. Thus, the operations center or the tracking device may receive real-time commands to establish a geo-fence outside the regular five-mile radius test drive geo-fence. In another example, in another example, a 16-year old looking to purchase his first vehicle may be given a smaller geo-fence area in which to test-drive the vehicle. In yet another example, the geo-fence may be altered to consider a specific path over which the vehicle may be test-driven, or a specific path to reach another dealership or to receive maintenance. Thus, the geo-fence need not be circular, oval, or square in shape, and may be any shape or size contemplated.

[0057] Although additional geo-fences may be established for specific circumstance in addition to established dealership lot **300** geo-fence **306**, it is also possible that specific circumstances regarding vehicles leaving the lot with authorization are handled with only geo-fence **306** and a timer.

[0058] For example, in another embodiment, geo-fence **306** is established and activated around dealership lot **300**. For an authorized purpose, not including the sale of the vehicle, vehicle **114** departs dealership lot **300**. Instead of a new geo-fence being established for vehicle **114**, the tracking device and/or operations center delays sending a message of a geo-fence violation for some predetermined time, such as 30 minutes for a test drive or an example five hours for a

maintenance trip. If vehicle **114** does not return to the area bounded by geo-fence **306** within the predetermined time period, then the tracking device and/or operations center will send a message of an unauthorized departure.

[0059] In yet another embodiment, the geo-fences established may be established on a time basis. For example, the geo-fence **306** may be activated during the hours the dealership is closed (e.g., 5:00 p.m. to 8:00 a.m.) to monitor the location of the vehicles when there are no employees nearby to monitor the location of the vehicles. Alternatively, specifically sized geo-fences may be set to activate and de-active on varying time bases. Thus, not all of the geo-fences established need necessarily be activated on the same time schedule, and may vary based on a variety of pre-determined rules.

[0060] Overall, when a geo-fence is established around a vehicle, the lien-holder or dealership is interested in the location of the vehicle. As discussed previously when a vehicle enters and/or exits an area bounded by a geo-fence, a message is sent regarding the movement and/or location of the vehicle.

[0061] In one embodiment, a message is sent at the time the vehicle crosses the geo-fence. The message may be sent directly from the tracking device to the operations center; directly from the tracking device to the lien-holder (or other third party); from the tracking device to the operations center, and then subsequently from the operations center to the tracking device; or from the tracking device to another indicated third-party.

[0062] In another embodiment, the tracking device may be instructed to send a message regarding the vehicle crossing the geo-fence after a specific period of time has elapsed. For example, the dealership has elected to not establish specific geo-fences for test drives, but rather has elected to provide a 30 minute window for test-drives. Thus, while the tracking device may recognize the vehicle has crossed over the geo-fence and is exiting the lot, the tracking device is also aware that this movement is a test-drive, and waits to send a message unless the vehicle is not recognized as returning to the lot within a 30 minutes time period.

[0063] In yet another embodiment, the tracking device may send a message regarding the movement and location of the vehicle only when queried by the operations center. For example, at the time a lien-holder is interested in the location of the financed vehicles, the lien-holder may ask the dealership to conduct a count by way of messages sent from the respective tracking devices.

[0064] The messages sent from the tracking device may provide varying degrees of information. In one embodiment, the tracking device may simply send a message indicating the vehicle has entered or exited the area bounded by the geo-fence. In another embodiment, the tracking device may send a message indicative of movement in relation to the geo-fence, tracking the location of the vehicle, and send indications of location of the vehicle. In yet another embodiment, the tracking device may send a message indicating the geo-fence has been breached and sends an indication of last-known location when the ignition of the vehicle has been deactivated.

[0065] At some point after the tracking device has been coupled to the vehicle, and the vehicles movements monitored with respect to the geo-fence(s) established, tracking device may be disassociated with the vehicle.

[0066] Now consider a situation where the vehicle **114**, coupled to the tracking device **116**, is sold. No longer needing to track the location of the vehicle, the tracking device is disassociated from the vehicle. While the tracking device itself may remain coupled to the vehicle for other functions, the association between the vehicle's VIN and the geo-fence location tracking is no longer linked. The disassociation may be accomplished by removing the sold vehicle's VIN from the dealership's inventory database. In another example, the VIN number may remain associated with the tracking device, but a program linking the tracking device with geo-fence monitoring is turned off. In yet another example, the tracking device may be physical disconnected from the vehicle, thus effectively disassociating the tracking device with the vehicle.

[0067] In another embodiment, the tracking device may be disassociated due to tampering. For example, the tracking device may be removed from the vehicle, thus severing power to the tracking device, and effectively disabling the tracking device's ability to monitor the location of the vehicle and send messages. In yet another example, the tracking device from one vehicle may be removed and subsequently coupled to another vehicle. In this example, tracking device **116** is still programmed to report the movement and location of vehicle **114**, but since it has been removed and coupled to another vehicle, in actuality the tracking device **116** is monitoring the location of another vehicle.

[0068] When disassociation of a tracking device with a vehicle is detected, a message is sent to the operations center, to the lien-holder, or the lien-holder via message first to the operations center. In one embodiment, the message sent in response to a disassociation may inform the lien-holder that a vehicle has been sold, and thus the vehicle should be removed from the inventory. In another embodiment, the message sent in response to a disassociation informs the lien-holder and/or the dealership that there has been tampering with one of the tracking devices, and may thus trigger an investigation as to the location of the previously associated vehicle.

[0069] In addition to monitoring the location of a vehicle with respect to one or more geo-fences, the tracking device coupled to the vehicle may have the capability to perform other actions. In one embodiment, the tracking device may receive operating power from the vehicle battery, and may be able to detect a loss of charge in the battery. In the event a loss of charge is detected by the tracking device, the tracking device may send a message to the dealership or to the operations center that a low battery is detected in the vehicle.

[0070] In another embodiment, the tracking device may have the capability to send a signal to the vehicle computer to lock or unlock the vehicle. For example, the vehicle computer may receive instructions from the tracking device to automatically engage the locks on the vehicle at 8:00 p.m. and to automatically disengage the locks at 8:00 a.m. In another example, the tracking device may send a message to the operations center that a vehicle is not locked after business hours, and a command may be issued in real-time to lock the vehicle (or to unlock the vehicle if the vehicle is locked during business hours). In another embodiment, before the tracking device sends a signal to the vehicle computer to lock the vehicle, the tracking device may first determine the location of the vehicle. More specifically, the tracking device may instruct the vehicle computer to lock the vehicle only if the vehicle is located within the dealership lot geo-fence **306**. This location check may thus prevent a situation where a customer is inadvertently locked out of the vehicle on test-drive occurring after business hours.

[0071] FIG. **5** shows a computer system **500**, which is illustrative of a computer system upon which the various embodiments may be practiced. The computer system **500** may be illustrative of, for example, computer system **118** coupled to the onboard device **116**. In yet another embodiment, computer system **500** may be illustrative of processor **102**. In particular, computer system **500** comprises a processor **502**, and the processor couples to a main memory **504** by way of a bridge device **506**. Moreover, the processor **502** may couple to a long term storage device **508** (e.g., a hard drive, solid state disk, memory stick, optical disc) by way of the bridge device **506**. Programs executable by the processor **502** may be stored on the storage device **508**, and accessed when needed by the processor **502**. The program stored on the storage device **508** may comprise programs to implement the various embodiments of the present specification, such as sending an indication of the last known location of vehicle **114** in the event of device tampering. In some cases, the programs are copied from the storage device **508** to the main memory **504**, and the programs are executed from the main memory **504**. Thus, the main memory **504**, and storage device **508** shall be considered computer-readable storage mediums.

[0072] The method of tracking an associated vehicle will now be discussed in more detail. FIG. **6** shows a flow diagram depicting an overall method of associating a vehicle with a tracking device, and subsequently tracking the vehicle. The method starts (block **600**), and continues with coupling a tracking device to a vehicle, the vehicle having an identification number (block **602**); associating the identification number with the tracking device (block **604**); creating a geo-fence boundary containing a location of the vehicle (block **606**); sending a first message from the tracking device indicating that the vehicle has traveled outside the geo-fence boundary (block **608**). Thereafter, the method ends (block **610**).

[0073] From the description provided herein, those skilled in the art are readily able to combine software created as described with appropriate general-purpose or special-purpose computer hardware to create a computer system and/or computer sub-components in accordance with the various embodiments, to create a computer system and/or computer sub-components for carrying out the methods of the various embodiments and/or to create a non-transitory computer-readable medium (i.e., not a carrier wave) that stores a software program to implement the method aspects of the various embodiments.

[0074] References to "one embodiment," "an embodiment," "some embodiments," "various embodiments," or the like indicate that a particular element or characteristic is included in at least one embodiment of the invention. Although the phrases may appear in various places, the phrases do not necessarily refer to the same embodiment.

[0075] The above discussion is meant to be illustrative of the principles and various embodiments of the present invention. Numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. For example, the various embodiments have been described in terms of vehicle inventory tracking for lien-holders. This context, however, shall not be read as a limitation as to the scope of one or more of the embodiments described—the same techniques may be used for other embodiments. It is intended that the following claims be interpreted to embrace all such variations and modifications.

We claim:

1. A method comprising:
- coupling a tracking device to a vehicle being part of a dealer inventory, the vehicle having an identification number;
- associating the identification number with the tracking device;
- creating a geo-fence boundary containing a location of the vehicle; and
- sending a first message to a lien-holder indicating the vehicle has crossed the geo-fence boundary.

2. The method of claim **1** wherein creating the geo-fence boundary further comprises creating by at least one method selected from the group consisting of: creating responsive to the association of the identification number; and creating the geo-fence responsive to a command from a lien-holder on the vehicle.

3. The method of claim **1** wherein sending the first message further comprises sending the first message indicating the vehicle has crossed the geo-fence boundary and not returned within a predetermined period of time.

4. The method of claim **3** wherein the predetermined period of time is a time window for a test drive of the vehicle.

5. The method of claim **1** further comprising, after creating the geo-fence boundary but prior to sending the first message:
- receiving a message indicating the vehicle is to be taken for a test drive; and
- expanding the geo-fence boundary responsive to the message.

6. The method of claim **1** wherein sending further comprises:
- sending the first message from the tracking device to an operations center remotely located from the tracking device; and then
- sending a second message from the operation center to the lien-holder.

7. A method comprising:
- coupling a tracking device to a vehicle, the vehicle having an identification number;
- associating the identification number with the tracking device;
- creating a geo-fence boundary containing a location of the vehicle; and
- sending a first message from the tracking device indicating that the vehicle has traveled outside the geo-fence boundary.

8. The method of claim **7** wherein creating the geo-fence boundary further comprises creating by at least one method selected from the group consisting of: creating responsive to the association of the identification number; and creating the geo-fence responsive to a command from a lien-holder on the vehicle.

9. The method of claim **7** wherein associating the identification number with the tracking device further comprises:
- coupling the tracking device to a computer system of the vehicle; and
- reading the identification number by the tracking device from the computer system of the vehicle.

10. The method of claim **7** wherein associating the identification number with the tracking device further comprises providing the identification number to the tracking device by way of a portable computing device communicatively coupled to the tracking device.

11. The method of claim **7** wherein sending the first message further comprises sending the message to an operations center.

12. The method of claim **11** further comprising sending a second message from the operations center to a lien-holder of the vehicle that the vehicle has traveled outside the geo-fence boundary.

13. The method of claim **7** wherein sending the first message further comprises sending the first message from the tracking device to the lien-holder.

14. The method of claim **7** wherein associating the identification number with the tracking device further comprises associating a manufacturer assigned vehicle identification number with the tracking device.

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