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Himmelstein

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(54) **SYSTEM AND METHOD FOR WIRELESS COMMUNICATION BETWEEN A VEHICLE AND A MOBILE UNIT**

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

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

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H04Q 7/002 (2006.01)

(52) **U.S. Cl.** **455/569.2**; 455/569.1; 455/550.1; 455/411

(58) **Field of Classification Search** 455/402.2, 455/456.1–457, 9, 550.1, 569.1, 569.2, 521, 455/345, 517, 524, 557, 566, 403, 410–411, 455/445; 340/7.61–7.62, 7.55, 534, 539.1, 340/425.15, 426.19, 426.2, 426.22; 701/211, 701/29, 213, 200, 207; 342/357.01, 352, 342/357.02, 357.06, 357.09, 357.12; 348/14.01–14.03
See application file for complete search history.

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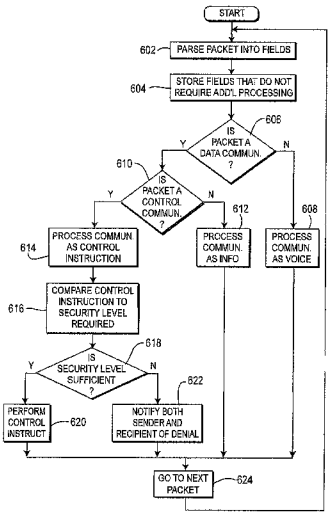
(57) **ABSTRACT**

Systems and methods for providing a communication between a cellular phone and a vehicle are described. In one embodiment, a user of a cellular phone inputs a communication via an audio-visual interface associated with the cellular phone. A microprocessor assembles at least one packet of the communication and transmits the at least one packet to an electromechanical system of a vehicle.

28 Claims, 7 Drawing Sheets



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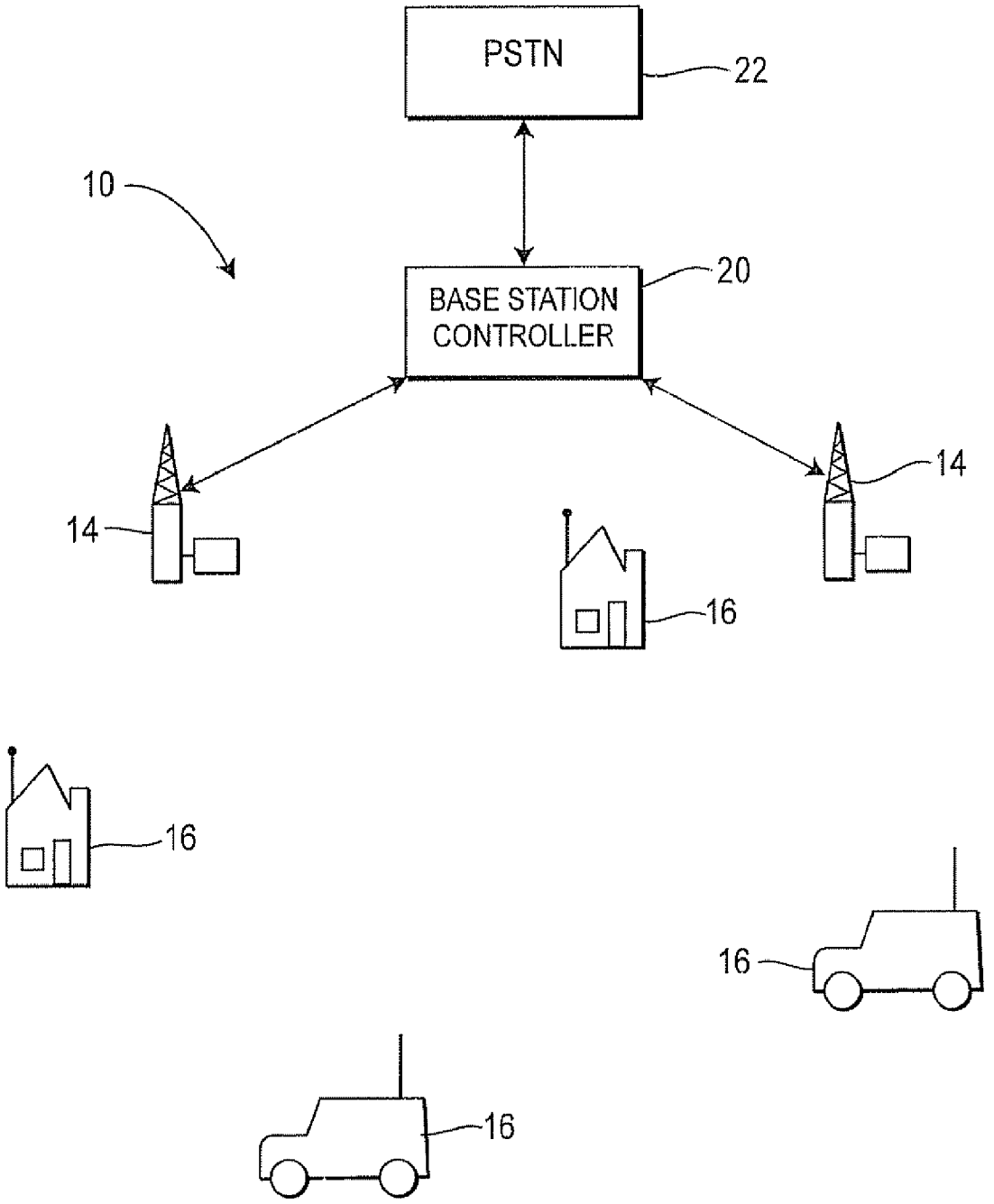


FIG. 1

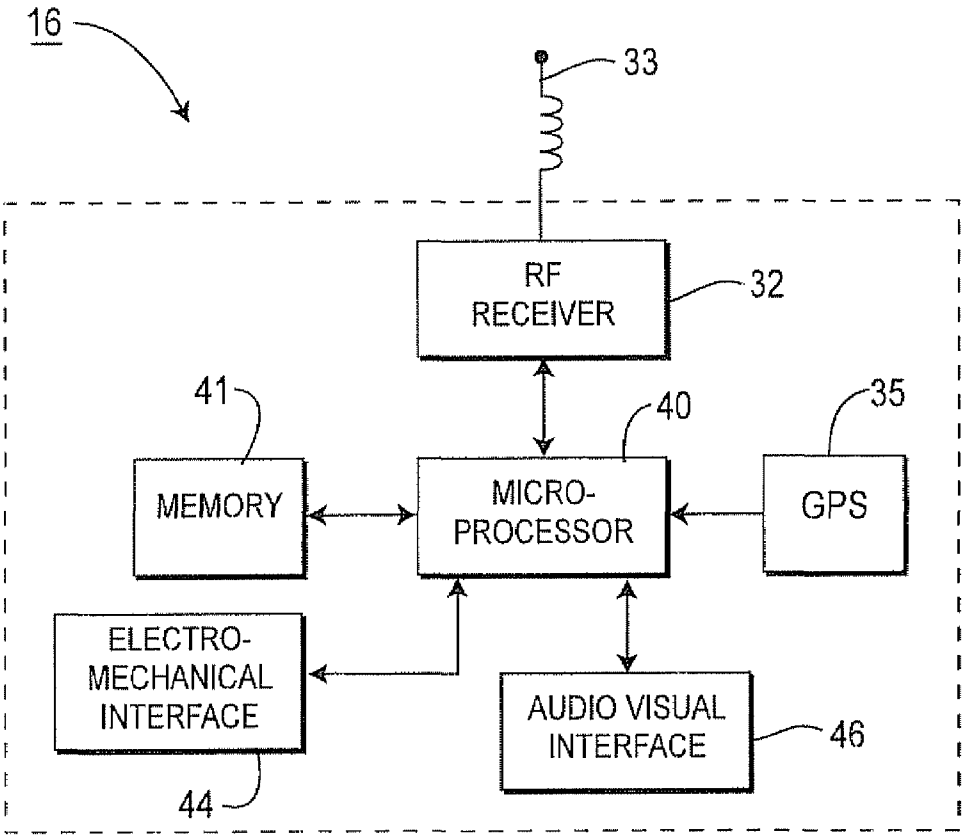


FIG. 2

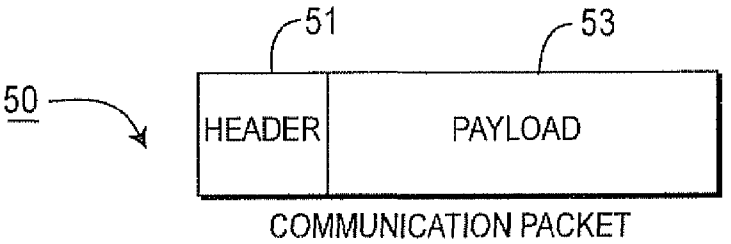


FIG. 3A

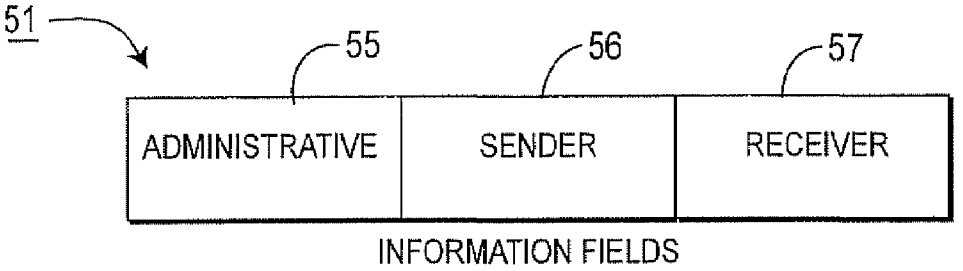
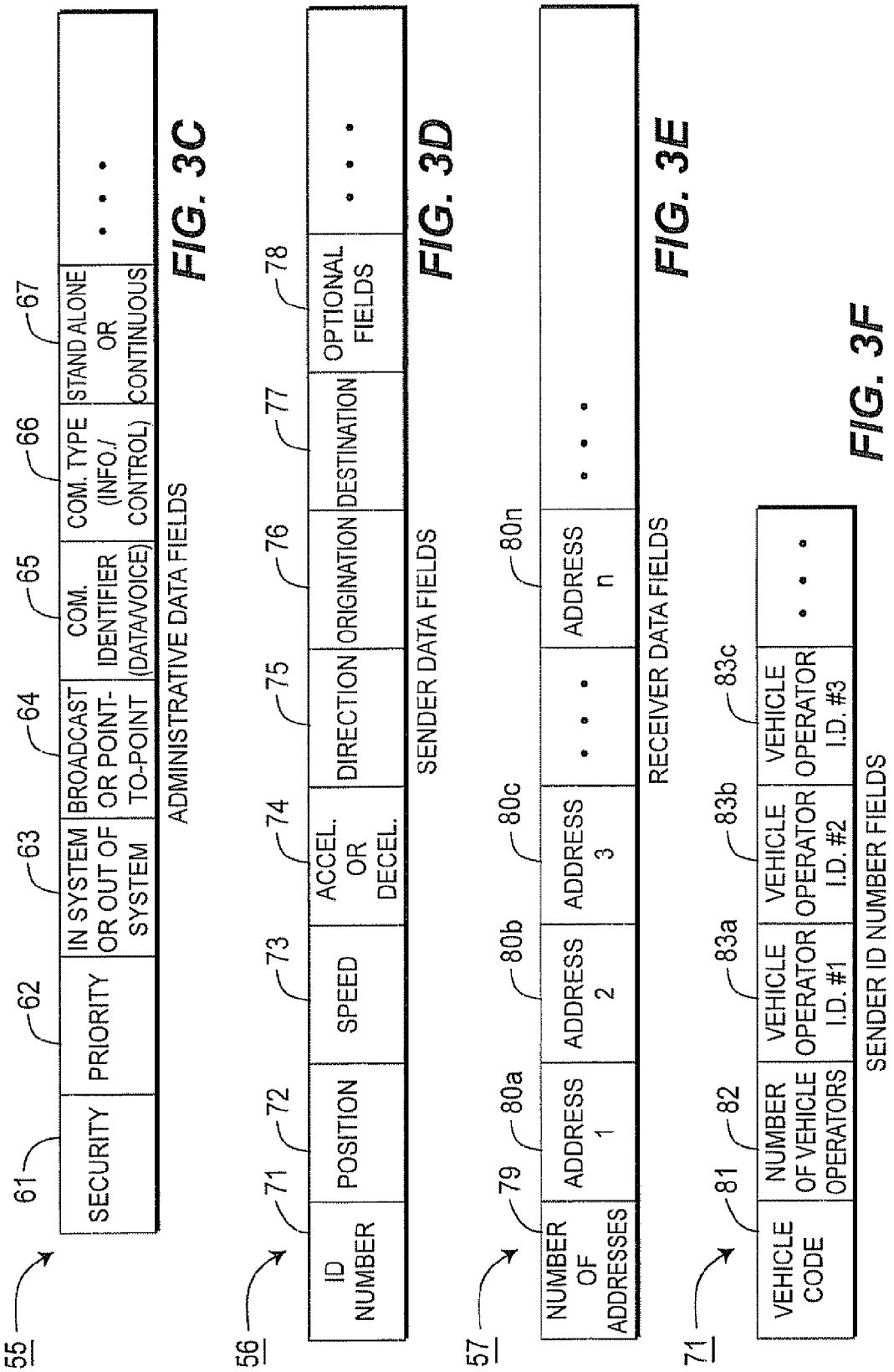


FIG. 3B


55
61
SECURITY
62
PRIORITY
63
IN SYSTEM OR OUT OF SYSTEM
64
BROADCAST OR POINT-TO-POINT
65
COM. IDENTIFIER (DATA/VOICE)
66
COM. TYPE (INFO./ CONTROL)
67
STAND ALONE OR CONTINUOUS
. . .
ADMINISTRATIVE DATA FIELDS
FIG. 3C
56
71
ID NUMBER
72
POSITION
73
SPEED
74
ACCEL. OR DECEL.
75
DIRECTION
76
ORIGINATION
77
DESTINATION
78
OPTIONAL FIELDS
. . .
SENDER DATA FIELDS
FIG. 3D
57
79
NUMBER OF ADDRESSES
80a
ADDRESS 1
80b
ADDRESS 2
80c
ADDRESS 3
. . .
80n
ADDRESS n
. . .
RECEIVER DATA FIELDS
FIG. 3E
71
81
VEHICLE CODE
82
NUMBER OF VEHICLE OPERATORS
83a
VEHICLE OPERATOR I.D. #1
83b
VEHICLE OPERATOR I.D. #2
83c
VEHICLE OPERATOR I.D. #3
. . .
SENDER ID NUMBER FIELDS
FIG. 3F

90

TIME (90a)	DATE (90b)	POSITION (90c)	SPEED (90d)	ACC./DECEL. (90e)	DIRECTION (90f)
08:50	09/01/2000	42'34,18'31	65	A	NNW

FIG. 4A

92

TIME (92a)	DATE (92b)	INCOMING/ OUTGOING (92c)	ADDRESSES (92d)	PRIORITY (92e)	BROADCAST/ POINT-TO-POINT (92f)	IN/OUT OF SYSTEM (92g)	SECURITY (92h)	DATA/ VOICE (92i)	INFO/ CONTROL (92j)	CONTENTS (92k)
08:52	09/01/2000	I	432967185	4	B	I	5	V	I	TRAFFIC MESSAGE
12:08	09/01/2000	I	458341788	1	P	I	1	D	C	REDUCE SPEED CONTROL INSTRUCTION

FIG. 4B

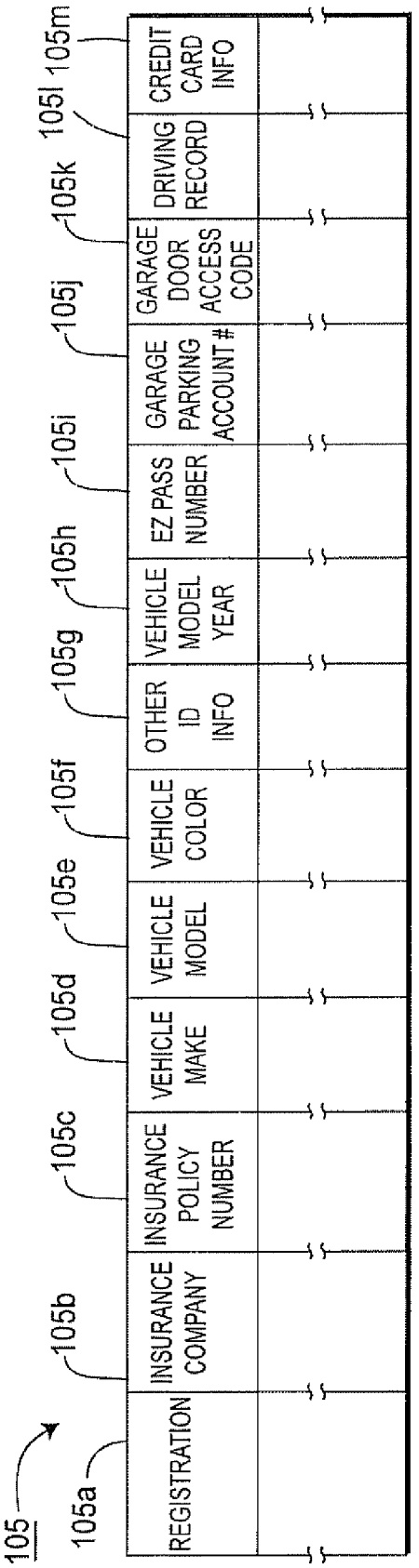

105
105a
REGISTRATION
105b
INSURANCE COMPANY
105c
INSURANCE POLICY NUMBER
105d
VEHICLE MAKE
105e
VEHICLE MODEL
105f
VEHICLE COLOR
105g
OTHER ID INFO
105h
VEHICLE MODEL YEAR
105i
EZ PASS NUMBER
105j
GARAGE PARKING ACCOUNT #
105k
GARAGE DOOR ACCESS CODE
105l
DRIVING RECORD
105m
CREDIT CARD INFO

FIG. 4C

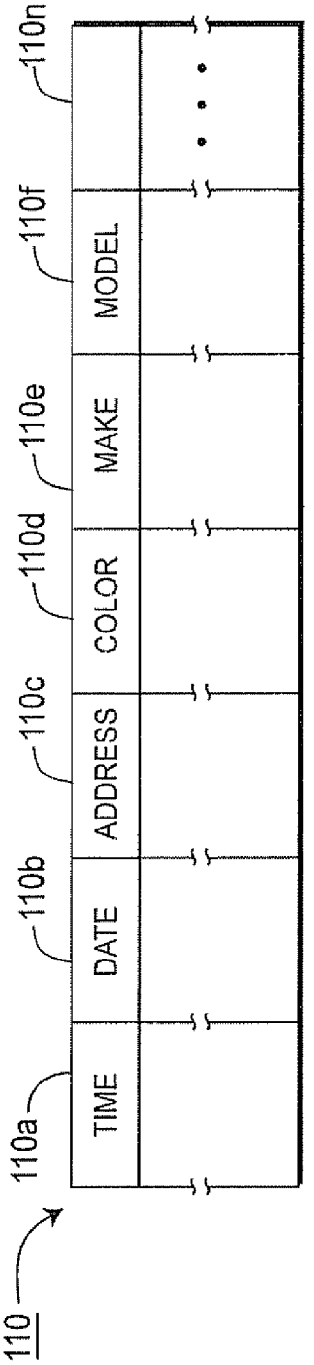

110
110a
TIME
110b
DATE
110c
ADDRESS
110d
COLOR
110e
MAKE
110f
MODEL
110n

FIG. 4D

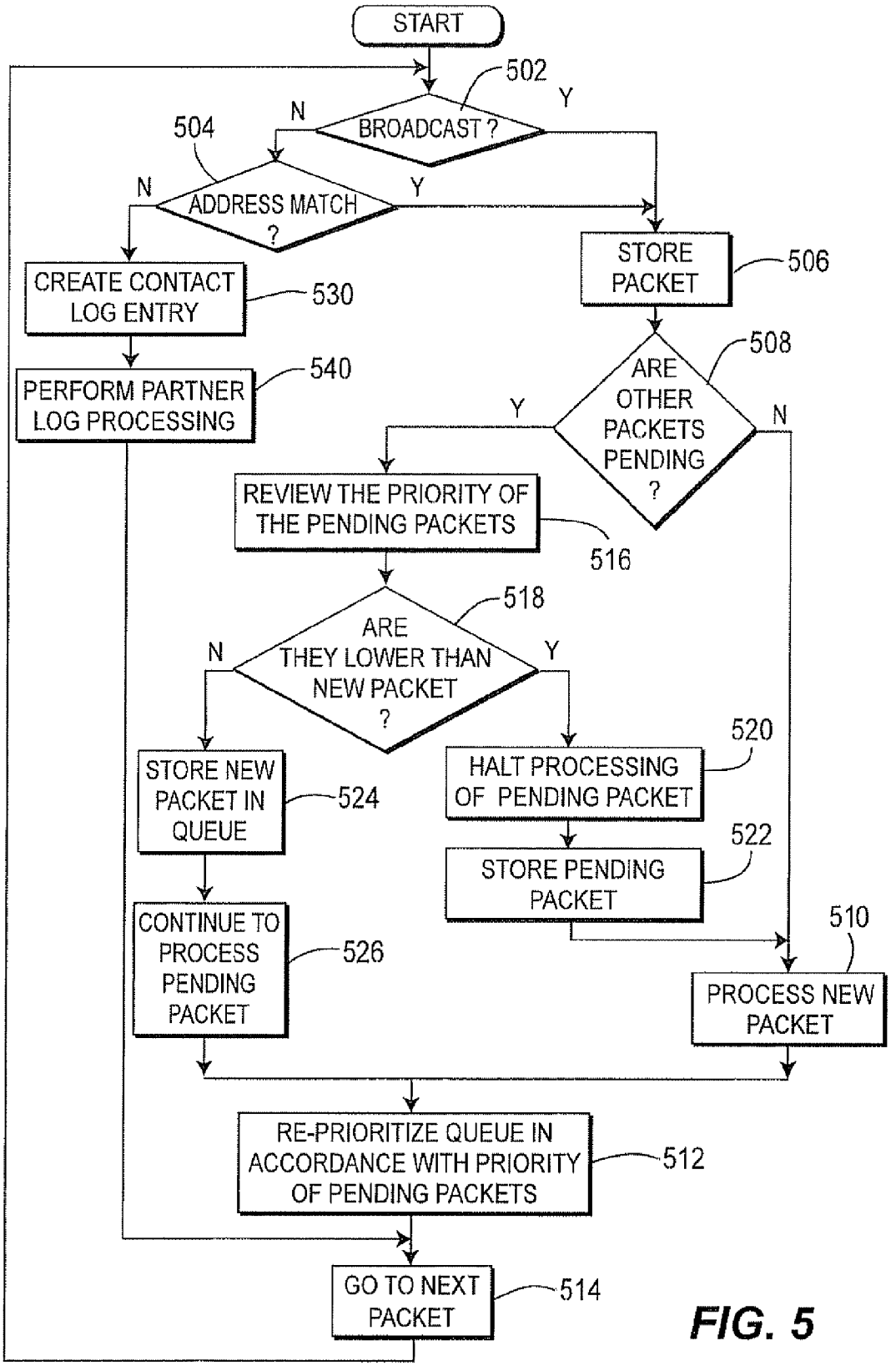

START
502
BROADCAST ?
N
Y
504
ADDRESS MATCH ?
N
Y
CREATE CONTACT LOG ENTRY
530
STORE PACKET
506
PERFORM PARTNER LOG PROCESSING
540
508
ARE OTHER PACKETS PENDING ?
Y
N
REVIEW THE PRIORITY OF THE PENDING PACKETS
516
518
ARE THEY LOWER THAN NEW PACKET ?
N
Y
520
STORE NEW PACKET IN QUEUE
524
HALT PROCESSING OF PENDING PACKET
522
STORE PENDING PACKET
CONTINUE TO PROCESS PENDING PACKET
526
510
PROCESS NEW PACKET
RE-PRIORITIZE QUEUE IN ACCORDANCE WITH PRIORITY OF PENDING PACKETS
512
GO TO NEXT PACKET
514

FIG. 5

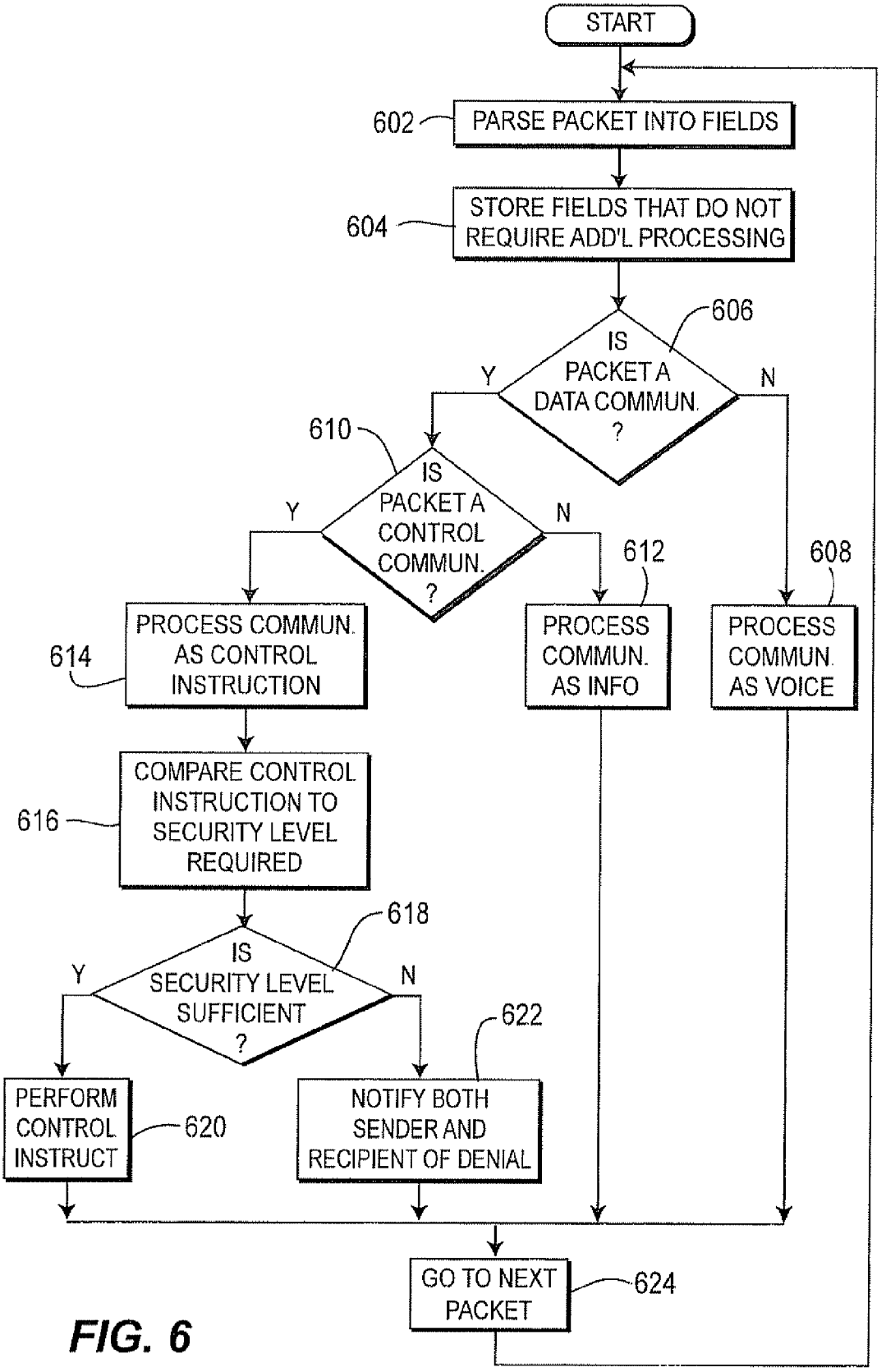

START
602
PARSE PACKET INTO FIELDS
604
STORE FIELDS THAT DO NOT REQUIRE ADD'L PROCESSING
606
IS PACKET A DATA COMMUN. ?
Y
N
610
IS PACKET A CONTROL COMMUN. ?
Y
N
612
608
PROCESS COMMUN. AS CONTROL INSTRUCTION
614
PROCESS COMMUN. AS INFO
PROCESS COMMUN. AS VOICE
COMPARE CONTROL INSTRUCTION TO SECURITY LEVEL REQUIRED
616
618
IS SECURITY LEVEL SUFFICIENT ?
Y
N
622
PERFORM CONTROL INSTRUCT
620
NOTIFY BOTH SENDER AND RECIPIENT OF DENIAL
GO TO NEXT PACKET
624

FIG. 6

SYSTEM AND METHOD FOR WIRELESS COMMUNICATION BETWEEN A VEHICLE AND A MOBILE UNIT

This application claims priority from U.S. application Ser. No. 12/018,588 filed Jan. 23, 2008 which is a continuation of U.S. application Ser. No. 11/524,858 filed Sep. 20, 2006, issued as U.S. Pat. No. 7,450,955 on Nov. 11, 2008, which is a continuation of U.S. application Ser. No. 10/705,674 filed Nov. 10, 2003, issued as U.S. Pat. No. 7,123,926 on Oct. 17, 2006, which was a continuation of U.S. application Ser. No. 09/659,074 filed Sep. 11, 2000, issued as U.S. Pat. No. 6,647,270 on Nov. 11, 2003, which in turn claims priority from U.S. Provisional Application No. 60/153,424 filed Sep. 10, 1999, all of which are incorporated by reference as if fully set forth herein.

BACKGROUND

The present invention generally relates to communication systems. More particularly, the invention relates to a mobile communication system which allows mobile vehicles to communicate with neighboring vehicles and roadside communication networks.

Various communication systems have been used by automobile drivers to communicate with other vehicles while the vehicle is in motion. While many advances have been made in vehicle to vehicle communication, numerous disadvantages still remain in using conventional communication systems.

Conventional mobile communication systems include cellular telephones and CB or two-way radio. When using a cell phone as a means of mobile communication, there is no practical way of discovering whether a neighboring vehicle operator possesses a cell phone. Additionally, there is no process for determining the phone number of the targeted cell phone. Accordingly, the cell phone as a communication medium is severely limited.

CB radio is a widely broadcast public medium where mobile users may talk to other mobile or stationary users in their vicinity. However, since there is no ability to prevent others from listening, there is no privacy between mobile communicators.

Automobile accidents are one of the greatest causes of serious injury and fatalities in society. Accordingly, the development of improved control and warning systems to minimize personal and financial losses resulting from automobile accidents is of utmost importance. The limitations of present forms of communication are even more severe when considering the extent to which a communication link can improve both the driving experience and the safety statistics of modern vehicles.

SUMMARY

According to a first aspect of the present application, a method is disclosed for providing a communication between a cellular phone and a vehicle. The method comprises: inputting, from a user of a cellular phone, a communication via an audio-visual interface associated with the cellular phone; assembling, by a microprocessor, at least one packet of the communication; transmitting the at least one packet to an electromechanical system of a vehicle.

According to a second aspect of the present application, a method is disclosed for providing a communication between a vehicle and a cellular phone. The method comprises: receiving a communication from a cellular phone by a vehicle, the communication including at least one packet; disassembling the at least one packet by a microprocessor associated with the vehicle; exerting, by the microprocessor, electromechanical control over the vehicle based on the communication.

According to a third aspect of the present application, a method is disclosed for providing a communication between a cellular phone and a garage door. The method comprises: inputting, from a user of a cellular phone, a communication via an audio-visual interface associated with the cellular phone; assembling, by a microprocessor, at least one packet of the communication; and transmitting the at least one packet to a garage door.

BRIEF DESCRIPTION OF THE DRAWING(S)

FIG. **1** shows an example vehicle communication system.

FIG. **2** is a block diagram showing a mobile unit in accordance with the example embodiment.

FIG. **3**A is a diagram illustrating the contents of a communication packet transmitted by the mobile unit shown in FIG. **2**.

FIG. **3**B illustrates the header of the communication packet.

FIG. **3**C illustrates the information fields of the header's transmission administration.

FIG. **3**D illustrates the information fields of the header's sender portion.

FIG. **3**E illustrates the information fields of the header's receiver portion.

FIG. **3**F illustrates the sub fields contained in the identification number field.

FIG. **4**A illustrates the memory of the example mobile unit shown in FIG. **2**.

FIG. **4**B is a diagram of a vehicle communication log. FIG. **4**C is a diagram of a vehicle user log. FIG. **4**D is a diagram of a vehicle contact log.

FIG. **5** is a flow diagram of the procedure utilized by the microprocessor upon receipt of a communication packet.

FIG. **6** is a flow diagram of the procedure for processing communication packets.

DETAILED DESCRIPTION

The present invention provides a communication link among vehicles which eliminates these pitfalls. The system comprises a broadband RF transceiver with antenna, a position determining means (such as a GPS receiver) an audio-visual interface, an electromechanical interface, and a microprocessor with associated memory. These components are incorporated into a mobile unit located within each vehicle.

The GPS receiver receives signals from GPS satellites and calculates the position of the vehicle. The microprocessor carries out overall control of the system. The memory includes identification information that is unique to each vehicle. In response to input from the GPS receiver, information received by the transceiver and instructions input by the vehicle operator via the audio-visual interface, the microprocessor determines the necessary subsequent actions.

The transmission from a vehicle may include information describing the status of the vehicle for use by the receiving vehicle. For example, the transmission may provide information regarding the speed, direction, and position of the transmitting vehicle. This information is received and processed by the receiving vehicle to provide a visual or audible display of the position, direction, and speed of the transmitting vehicle.

According to one aspect of the present invention, there is provided a communication system for transmitting informa-

tion between a mobile unit within a vehicle traveling on a road and a fixed communication network installed on a roadside. The fixed communication network includes a base station having a transceiver for communicating with the vehicle by transmitting and receiving a plurality of communication packets. This communication can include payment instructions, security instructions, and/or access codes which can be transmitted with or without intervention by the vehicle operator.

An example embodiment will be described with reference to the drawing figures where identical numerals represent similar elements throughout.

A vehicle communication system embodying the present invention is shown in FIG. **1**. The vehicle communication system **10** generally includes one or more base stations **14**, each of which is in wireless communication with a plurality of remote units **16**. Although the remote units **16** may be fixed or mobile, they will be referred to hereinafter for simplicity as mobile units **16**. Each mobile unit **16** can communicate with another mobile unit **16**, the closest base station **14**, or the base station **14** which provides the strongest communication signal. The base station **14** communicates with a base station controller **20**, which coordinates communications among base stations **14** and mobile units **16**. The communication system **10** may be connected to a public switched telephone network ("PSTN") **22**, wherein the base station controller **20** also coordinates communications between the base stations **14** and the PSTN **22**. In the example embodiment, each base station **14**, communicates with the base station controller **20** over a wireless link, although a land line may also be provided. A land line is particularly applicable when a base station **14** is in close proximity to the base station controller **20**. The fixed remote units **16** may also communicate with a base station **14** over a land line.

The base station controller **20** performs several functions. Primarily, the base station controller **20** provides all of the operations, administrative, and maintenance ("OA&M") signaling associated with establishing and maintaining all of the wireless communications between the mobile units **16**, the base stations **14**, and the base station controller **20**. The base station controller **20** can provide the routing of all communications between mobile units **16**, and between the mobile units **16** and the PSTN **22**. The base station controller **20** also provides an interface between the mobile units **16** and the PSTN **22**. This interface includes multiplexing and demultiplexing of the communication signals that enter and leave the system **10** via the base station controller **20**. Although the vehicle communication system **10** is shown employing antennas to transmit radio frequency ("RF") signals, one skilled in the art should recognize that communications may be accomplished via microwave or satellite uplinks. Additionally, the functions of the base station controller **20** may be combined with a base station **14** to form a "master base station."

An example embodiment of the mobile unit **16** is shown in FIG. **2**. Each mobile unit includes an RF transceiver **32** with an antenna **33** capable of transmitting and receiving a plurality of RF signals, a global positioning system ("GPS") receiver **35**, a microprocessor **40** with associated memory **41**, an interface to the vehicle's electromechanical systems **44**, and an audiovisual interface **46**.

The RF transceiver **32** transmits and receives RF signals at a plurality of RF frequencies to one or more vehicles which include a mobile unit **16**. Received signals are downloaded to baseband and forwarded to the microprocessor **40** for further processing. Transmitted signals are forwarded from the microprocessor **40** to the RF transceiver **32** for upconversion and transmission over one of the plurality of RF frequencies. The vehicle communication system **10** also provides for the option of transmitting a communication over currently licensed radio station channels, for example 105.9 FM. This can permit mobile unit operator to broadcast to non-mobile unit operators. It also can provide a "scanning channel", such that non-mobile unit operators can listen to broadcast communications.

The GPS receiver **35** is configured to receive signals from GPS satellites and compute the position of the mobile unit **16**. There are many commercially available GPS receivers **35** that can perform such a function. GPS readings which are provided to the microprocessor **40** permit the microprocessor **40** to accurately calculate the speed, direction, and acceleration or deceleration rate of the vehicle.

The microprocessor **40** provides central control of the mobile unit **16**. As will be explained in greater detail hereinafter, the microprocessor **40** also performs packet handling, including packet assembling for outgoing communication packets **50** and packet disassembling for incoming communication packets **50** received from the RF transceiver **32**. Communication packets **50** received by the microprocessor **40** are stored in memory **41**. The memory **41** is also used to store identification information that is unique to each vehicle and/or vehicle operator. For example, license and registration for each vehicle can be read if positioned with a bar code or magnetic strip in a specific location of the vehicle. Optionally, the system may have a card reader where the operator must place their card prior to the vehicle starting. This card can be a license with a magnetic strip or a smartcard that identifies the driver and the vehicle. This unique information regarding the vehicle may also include the position of the vehicle, speed of the vehicle and rate of acceleration or deceleration as calculated by data obtained from the GPS receiver **35**.

The audio-visual interface ("AVI") **46** may comprise a microphone, speakers, and graphic display along with alphanumeric and directional keypads. However, those of skill in the art should realize that the AVI **46** may encompass other input devices which are known, such as a voice activated input unit, an infrared ("IR") remote control, a full keyboard or any other type of electronic or manual data input means. Additionally, the output portion of the AVI **46** may include any type of output means such as a stereo system or a heads-up display.

The electromechanical interface **44** provides an electrical coupling to the electromechanical systems of the vehicle over which the mobile unit **16** has control. These systems may include the radio, lights, horn, windows, locks, steering, braking, and any other electromechanical systems of the vehicle.

Communications between mobile units **16** using the vehicle communication system **10** are accomplished through a stream of transmitted communication packets **50**. As shown in FIG. **3**A, each communication packet **50** includes a header **51** and a payload **53**. The header **51** includes a plurality of predefined information fields which provide information regarding the particular communication, the sender which originated the communication, and the receiver to which the communication is destined. It should be recognized that a voice or data communication may be segmented or "packetized" and transmitted using a plurality of packets **50**. The present invention is not restricted to transmitting a communication having a predefined length. Accordingly, the payload **53** may include only a portion of the communication that is sent between mobile units **16**, and a single communication may be sent using a plurality of packets **50**. Communications may include data transmissions, such as uploads from the mobile unit **16**, downloads to the mobile unit **16**, or voice communications.

Referring to FIG. 3B, the header **51** includes a plurality of information fields which can be generally categorized by three different functional groups: 1) transmission administrative information **55**; 2) sender information **56**; and 3) receiver information **57**. These fields will be explained in greater detail hereinafter.

Referring to FIG. 3C, the information fields associated with the transmission administration **55** are shown. These fields provide information that defines the particular communication being transmitted. Although the number of fields vary, and the type of fields described may change depending on the particular communication and the requirements of the system **10**, in one embodiment of the present application, the fields associated with transmission administration **55** include, the following fields: security **61**; priority **62**; in system/out of system **63**; broadcast/point-to-point **64**; communication identifier (data/voice) **65**; communication type (information/control) **66**; and communication length (standalone or continuous) **67**.

Since the vehicle communication system **10** in accordance with the present invention permits control of a vehicle and overall control of the communication system **10** by law enforcement authorities via a "security instruction", the system **10** has a plurality of security levels to ensure that unauthorized individuals will not use the system **10** for subversive purposes. Optionally, driver may override law enforcement. The system **10** may ask for permission for law enforcement to control vehicle. The security field **61** is defined as follows:

0—Access to all functions of the vehicle communication system **10**, including the physical control of the vehicle and all of the information stored within the memory **41**.

1—Access only to the physical control of the vehicle.

2—Access only to the information stored within the memory **41**.

3—Access for transmitting and receiving communications.

4—Access only to receiving communications.

The security field **61** may also include a security code, which permits authentication of the entity sending the security instruction. As aforementioned, it should be understood by those skilled in the art that additional fields may be added or defined as desired to increase the functionality of the system **10** or the security layers. Additionally, it should be recognized that although the system **10** is capable of a broad range of functionality, there are legal implications to implementing all of the functionality. For example, a court order would most likely be necessary before permitting law enforcement officials access to information in, or control of, the mobile unit **16**.

The priority field **62** is an indicator of the urgency of the transmitted communication. The priority field **62** can be a numeric priority from one to ten; with urgent communications having the highest priority of one (e.g., communications from law enforcement officials) and non-urgent communications having the lowest priority of ten (e.g., advertisements).

The in system/out of system field **63** indicates whether the communication is destined for, or originated from, another mobile unit **16** or an entity located outside of the vehicle communication system **10**. Communications with entities outside the vehicle communication system **10** can be routed between the mobile unit **16** and the outside entity over the PSTN **22**.

The broadcast/point-to-point field **64** identifies whether the message is intended for broadcast to all mobile units **16** or whether it is intended to be routed to a particular mobile unit **16**. As will be explained in detail hereinafter, the receiver field **57** will specify the particular address, or multiple addresses, of the mobile units **16** to which the communication will be transmitted.

The communication identifier field **65** identifies whether the communication is a voice or data transmission since each transmission may be encoded and processed differently by the receiving microprocessor **40**.

The communication type field **66** identifies whether the communication comprises information for output to the user via the AVI **46**, or whether the information is a control instruction that will permit electromechanical control of the vehicle.

The communication length field **67** indicates whether the entire communication is included within the current packet **50**, or whether the packet **50** is part of a multi-packet communication.

Referring to FIG. 3D, the fields associated with the sender portion **56** of the header **51** include identification number **71**, position **72**, speed **73**, acceleration or deceleration **74**, direction **75**, origination **76**, and destination **77**, and may include additional optional fields **78** as specified by the vehicle operator.

The identification number **71** provides a unique identification for the sending mobile unit **16**. The identification number may be the vehicle license number with two additional letters representing the state where the license plate was issued, such as PA for Pennsylvania. Depending upon system administration, the identification number **71** may further relate to one or more individual operators of the vehicle. As shown in FIG. 3F, the identification number field **71** may include a plurality of subfields including vehicle code **81**, number of authorized vehicle operators **82**, and a vehicle operator identification number $\mathbf{83}_{a,\,b\,\ldots\,n}$ for each operator. This feature is particularly useful if the vehicle is part of a commercial fleet of vehicles with multiple drivers. Upon turning on the vehicle, the vehicle operator inputs their identification number **71**. This number **71** is compared to the list of authorized operators previously stored in memory **41**. If the input operator identification number **71** matches favorably with one of the authorized operators previously stored in memory **41**, operation of the vehicle is permitted; if not, operation is denied. Optionally, license plate, registration, insurance information and driver's license information can be additional fields stored with the identification number **71**.

Use of a vehicle operator identification number **71**, such as a driver's license, also permits different operators to use the vehicle while retaining their distinct identity and storing information particular to that vehicle operator, similar to a screen name for Internet use such as the America Online ("AOL") system.

Referring back to FIG. 3D, the next four fields associated with the sender portion **56** of the header **51** include position **72**, speed **73**, acceleration or deceleration **74**, and direction **75**, which are automatically created from the information obtained from the sender's GPS receiver **35**.

The origination field **76** includes the location of the vehicle when the vehicle was turned on. The destination field **77** includes the destination of the vehicle. This, of course, requires that the destination be input into the mobile unit **16**, such as when a destination is input into a navigation system. It should be understood that the mobile unit operator may override certain fields to ensure that this information is not obtained by other mobile unit operators. For example, the origination **76** and destination fields **77**, which may include personal information that the mobile unit operator does not desire other mobile unit operators to have access to, may include null data such that the sender's destination and origination will be listed as "not available" to the receiver. The

vehicle operator configures their mobile unit **16** as desired to specify which fields should be transmitted with null data.

Referring to FIG. **3**E, the fields associated with the receiver portion **56** of the header **51** are shown in greater detail. As discussed with reference to FIG. **3**C, the broadcast or point-to-point field **64** indicates whether the communication is destined for one, multiple, or all operators. If the communication is to be broadcast to all mobile unit operators, the number of addressees field **79** is designated as zero indicating that all operators will receive the communication. For point-to-point or point-to-multipoint communications, (whereby a plurality of operators may be included within a conversation or communication), the number of addressees field **79** includes the number of operators which will be receiving the communication. For example, if a point-to-point communication is desired, the number of addressees field **79** will include the number one (1) and address field number one **80***a* will be the only field which includes an address. If a point-to-multipoint communication is desired between, for example four additional mobile unit operators, the number of addresses field **79** will include the number four (4) and address fields one through four **80***a-d* will include the addresses of the four receivers to be sent the communication.

Once all of the aforementioned fields have been populated with the information, the microprocessor **40** builds each communication packet **50** and forwards the packet **50** to the transceiver **32** for transmission. The packets **50** are preferably transmitted to the base station **14**, and then forwarded to the base station controller **20**. The base station controller **20** routes all of the communication packets **50** to the specified addresses, either to one or more mobile unit operators, one or more outside entities, or both. This routing function is the same as an Internet router, whereby the destination address or addresses are read by the router and the communication packet **50** is forwarded to those addresses. If the communication packet **50** is to be forwarded to multiple addresses or broadcast to all addresses, the base station controller **20** provides such a routing function.

The base station controller **20** may also confirm to sender whether or not a signal has been received by the recipient. In an alternative embodiment, each communication may require a confirmation packet be sent from the recipient to the sender to provide the confirmation. Using such an embodiment, the sending mobile unit operator will know whether or not the communication packet **50** has reached its destination.

Although the present invention has been explained with reference to a plurality of base stations **14** and a base station controller **20**, the system **10** can also use technology similar to Bluetooth wireless technology. Using technology such as Bluetooth allows mobile units and base stations to communicate through other mobile units and base units (i.e., repeaters). This permits a wireless interconnect between mobile devices, and between mobile devices and their peripherals. The mobile devices can form a secure piconet and communicate among the connected devices. Accordingly, using this technology, mobile units **16** can talk directly to other mobile units **16** without the intervention of the base stations **14** and the base station controller **20**.

It is intended that the present invention be used with any type of wireless communication standard including Bluetooth or other wireless or data transmission standard. The particular standard used in transmitting the data is not critical since there are many types of wireless technologies and standards that can be used to transfer information between mobile units **16**. It should be recognized that any of the communications could be encrypted by currently known technologies so that only certain authorized mobile units can communicate with each other. For example, if two users were communicating with one another and either requested a private conversation, the system can immediately encrypt their communication.

As should be understood by those of skill in the art, if the address of the receiver is outside of the system **10** and must be routed via the PSTN **22**, the base station controller **20** formats the communication packet **50** in a format that may be handled by the PST N **22**. Although the present invention has been explained using a general packet **50** "structure" as illustrated by FIGS. **3**A-**3**F, this structure is intended to serve as an example of the information to be transmitted by the system **10** in each communication. It is not the intention herein to specify a new communication standard, since the present invention may be utilized with any current or future wireless communication standard. For example, the packets **50** transmitted over the vehicle communication system **10** may use the Internet Protocol (JP) format, such that they may be transmitted seamlessly to any communication system which uses the IP format. The discussion of the particular format and/or conversion to another format for forwarding over the PSTN **22** is outside the scope of the present invention.

As shown in FIGS. **4**A and **4**B, the memory **41** is used to store information which populates the aforementioned fields. As will be described in greater detail hereinafter with reference to FIG. **4**C, the memory **41** is also used to store other detailed information which may be helpful to the mobile unit operator, other mobile unit operators, the base station controller **20**, or law enforcement agencies. The information stored in memory **41** may originate from a received communication, or may be input into the mobile unit via the AVI **46**. For example, information that is specific to a particular operator, such as those fields illustrated in FIG. **4**C, may be input by the mobile unit operator via the AVI **46**.

Referring to FIG. **4**A, one of the uses of the memory **41** is to automatically store a current vehicle activity log **90** and previously entered logs. The vehicle activity log **90** includes a plurality of fields including the time **90***a*, date **90***b*, position **90***c*, speed **90***d*, acceleration/deceleration **90***e*, and direction **90***f* of the vehicle. This log **90** is updated on a periodic basis as determined by the mobile unit operator. For example, private individuals may desire the log **90** to be updated every 15 minutes whereas commercial businesses may require the log **90** to be updated every 15 seconds or even less. It should be realized that the vehicle activity log **90**, if updated on the order of fractions of a second, would be extremely useful during accident reconstruction.

Referring to FIG. **4**B, a vehicle communication log **92** is shown. The communication log **92** includes the following fields: the time of the communication **92***a*; the date of the communication **92***b*; an indication of whether the communication was incoming or outgoing **92***e*; the addresses) of the communicating entity **92***d*; the priority of the communication **92***e*; an indication of whether the communication is broadcast or point-to-point **92***f*; an indication of whether the communicating entity is within the system or outside the system **92***g*; the security level of the communicating entity **92***h*; an indication of whether the communication is data or voice **92***i*; an indication of whether the communication is information or control **92***j*; and the actual contents of the communication **92***k*. The vehicle communication log **92** continually tracks each ongoing communication and stores the contents of the communication in the contents field **92***k* and all of the related information in the remaining fields **92***a-j*.

Referring to FIG. **4**C, a operator may input via the AVI **46** a plurality of fields related to the specific user and/or vehicle in a user log **105**. One example of a user log **105** is shown in

FIG. **4**C which includes the following fields: registration number **105***a*; insurance company **105***b*; insurance policy number **105***c*; vehicle make **105***d*; vehicle model **105***e*; vehicle color **105***f*; other identifying information **105***g*; vehicle model year **105***h*; EZpass number **105***l*; garage parking account number **105***j*; garage door access code **105***k*, driving record **105***l*; and credit card information **105***m*. There is no limit to the number of fields which may be stored in the user log **105**, and all fields can be defined by the mobile unit operator. Since many of these fields include sensitive information, the mobile unit operator may decide not to send any information from the user log **105** and the microprocessor **40**, when constructing the data packets, will place null data in those fields.

The procedure utilized by the microprocessor **40** upon receipt of a communication packet **50** is shown in FIG. **5**. The microprocessor **40** first determines whether the incoming packet **50** is addressed to the specific mobile unit **16**. Accordingly, at step **502**, the microprocessor determines whether the incoming packet is a broadcast, and at step **504**, the microprocessor determines whether the specific address matches the mobile unit address. If either of these determinations is affirmative, the new packet is stored (step **506**). The microprocessor then determines if there are other communication packets pending for processing (step **508**). If no other packets are pending, the new packet is processed (step **510**). If applicable, any packets in the queue are reprioritized in accordance with the priority of each packet (step **512**) which, in the case where no other packets are pending, would not be necessary. The microprocessor then goes on to reviewing the next packet step (**514**).

If it has been determined in step **508** that other packets are pending, the priority of all of the pending packets are reviewed (step **516**) and a determination is made (step **518**) whether the pending packets have a lower priority than the new packet. If the new packet has a higher priority then the pending packets, the microprocessor halts processing of the pending packet currently being processed (step **520**), restores the pending packet into memory (step **522**), and proceeds with processing the new packet (step **510**).

If, however, the pending packets do not have a lower priority than the new packet, the microprocessor stores the new packet in a queue with all other pending packets (step **524**) and continues to process the pending packet (step **526**). In this manner, the microprocessor **40** is able to process higher priority packets first, and delay processing of lower priority packets to a more appropriate time when the microprocessor has the proper resources.

Optionally, even if the microprocessor determines in steps **502** and **504** that the communication is not addressed to the particular mobile unit **16**, either as point-to-point communication or as part of a broadcast communication, the microprocessor may still undertake minimal processing of such packets. This is performed in step **530** whereby a contact log is created.

As shown in FIG. **4**D, the contact log **110** may include a minimum number of fields such as the time **110***x*, date **110***b*, address **110***c*, color **110***d*, make **110***e*, and model **110***f* of the vehicle related to the incoming communication packet **50**. The number and type of fields is determined by the mobile unit operator. The payload of the packet may not be stored. The contact log **110** is used by the microprocessor **40** to search for "matches" with other mobile unit operators. Upon request by the mobile unit operator, the microprocessor **40** searches the contact log **110** for any addresses (i.e., sending addresses) that have multiple entries in the log **110**. Once the microprocessor **40** searches the contact log **110** and outputs the addresses which show up on the contact log **110** greater than a certain frequency threshold as set by the mobile unit operator, the operator can determine whether those addresses should be placed in a "commuter" log; which is a list of mobile unit operators as identified by their addresses.

This information is provided to the mobile unit operator via the AVI **46**. This permits the operator to identify, either graphically as located on a real-time map or via a list, other mobile unit operators which may be in the vicinity during a certain portion of the day. For example, during a commute to work if other mobile unit operators are typically within the vicinity of the present mobile unit operator during a certain time of day, a "partner log" may be created by each mobile unit operator to permit mobile unit operators to identify, contact, and establish a rapport with other mobile unit operators.

Since the communication packet headers **51** include detailed information about other mobile units **16**, the system **10** can provide flexibility in contacting other mobile unit operators in the vicinity. For example, if a mobile unit operator observes a vehicle that they would like to establish a private conversation with, the operator may command the mobile unit **16** to "talk" to the blue car. If more than one mobile unit **16** is in a blue car in the vicinity, the microprocessor **40** can filter the commuter log to vehicles having the color blue. If more than one blue car was in the vicinity, the microprocessor **40** presents the make and model of each blue car and requests further instructions.

Since all of the detailed information is available in the packet header **51**, the system **10** can provide the speed, direction, and location of the other vehicle in relation to the present vehicle. This information is also important in order to evaluate whether another mobile unit **16** will be available for a conversation having a duration of a minimum length. For example, if a mobile unit operator notes that one of the operators on his partner log is currently traveling in the vicinity, and the mobile unit operator would like to establish communications with the other mobile unit operator, the system **10** can calculate the duration of a potential conversation based upon the speed and direction of both vehicles and their ultimate destinations, if available. The system **10** can combine that information and advise both mobile unit operators by an audible alarm or a voice message that there is a certain amount of time left in the conversation. The microprocessor **40** can also filter out any mobile units **16** that will not be in the range long enough to establish a reasonable conversation.

At step **540**, the microprocessor **40** reviews all incoming communication packets **50** to determine if a particular communication packet **50** originates from an address that is on the operator's partner log. As the communication packets **50** are reviewed at step **540**, the mobile unit operator is notified and can decide whether or not they want to establish a communication with the particular mobile unit operator having the address that has compared favorably with the partner log. It should be noted that mobile unit operators can block out transmissions being received from particular individuals or cancel conversations at anytime. Further, mobile unit operators can require information such as drivers license, license plate, and registration to be provided before they allow any other transmissions to be received.

Referring to FIG. **6**, the procedure for processing communication packets **50** by the microprocessor **40** is shown. The microprocessor first parses the packets into separate fields (step **602**) and stores all of the fields that do not require additional processing (step **604**). The microprocessor then determines whether a packet includes a data communication by viewing the communication identifier field (step **606**). If the microprocessor determines that the packet is not carrying

a data communication, then it is a voice communication and the microprocessor processes the communication as such (step **608**).

If the packet includes a data communication, the microprocessor must make a determination whether the data communication is a control communication (step **610**). If it is not a control communication, the data communication is an information communication and it is processed as such (step **612**). Examples of packets which include information communications include audio, visual, and text files that are downloaded over the Internet, facsimile transmissions, and transmissions from peripheral devices such as laptop computers, handheld devices, and the like.

If it has been determined that the packet includes a control communication, the communication is processed as such (step **614**). The microprocessor compares the control instruction to the security level required (step **616**). This includes reviewing the security field, including the optional security access code. If the security access code is proper (i.e., authorized), the security level is reviewed and the microprocessor makes a determination of whether the security level is sufficient (step **618**). If so, the microprocessor performs the control instruction (step **620**). If not, the microprocessor generates a transmission to the sender of the control instruction that they are not authorized to control the particular mobile unit (step **622**). The microprocessor **40** also notifies the particular mobile unit operator that a control attempt was made and was unsuccessful. This will alert the mobile unit operator that someone may be utilizing the system for subversive purposes. Optionally, the system may require the mobile unit operator to authorize their vehicle to accept a control instruction, prior to undertaking any control instructions. Once the processing of the packet is performed, the microprocessor goes to the next packet (step **624**).

With respect to the step of performing a control instruction (step **620**), this may include instructions for the microprocessor to exert electromechanical control over certain aspects of the vehicle's operation, or may simply include a request for the microprocessor to upload data to the recipient. For example, if the control instruction is a request for the microprocessor to upload information, the microprocessor may upload one or a plurality of the fields shown in FIG. **4**C.

In a first example relating to a request for information, if the vehicle is entering a toll booth which utilizes the EZpass system, the control instruction from the transmitting toll booth may request that the EZpass number be transmitted. The microprocessor **40** will transmit the number in the EZpass number field shown in FIG. **4**C in response thereto.

In a second example relating to a request for information, a request for information may occur in a parking garage, gas station, or any other establishment which requires payment from the vehicle operator, such as a drive-in fast-food restaurant. In this example, the vehicle operator will drive up to an ordering kiosk and order the desired food. After the food has been ordered, the driver pulls up to the window whereby the proper food order is presented to the driver. Meanwhile, the restaurant's communication system sends a communication requesting the credit card information for billing purposes. The information shown in the credit card so information field **105***u*, of FIG. **4**C can then be presented to the communication system of the restaurant for payment. Optionally, the mobile unit operator may require that they must first approve of any information being released. Moreover, the communication log for both the fast-food restaurant and the vehicle may store the communication noting the charge amount. For the vehicle it can be a "virtual receipt".

With respect to an instruction which exerts electromechanical control over the vehicle, as shown in FIG. **2**, the electromechanical interface **44** will interface with those systems of the vehicle over which the mobile unit **16** has control. These systems may include the radio, lights, horn, steering, braking, and any other electromechanical systems of the vehicle. For example, if a mobile unit operator is listening to their favorite radio station and a point-to-point or broadcast communication is received by the mobile unit **16**, the microprocessor **40** through the electromechanical interface **44** will stop the radio, or turn down the volume of the radio, so that a conversation can commence.

It should be understood that due to the amount of information set forth in the header **51** of each communication packet **50**, the system **10** provides flexibility in processing and filtering communications. For example, the microprocessor **40** can be programmed to accept only communications from certain makes and models of vehicles. As such, the system **10** set up as part of a Mercedes can be programmed by the manufacturer to be able to talk to only other Mercedes operators.

The present invention has the ability to increase safety to drivers and can be a valuable resource for emergency services personnel and a law enforcement personnel. For example, emergency vehicles can automatically send signals to warn motorists that an emergency vehicle is approaching. This may supplement the emergency light and siren which are standard on emergency vehicles. Since the packets **50** are prioritized, a communication sent from an emergency vehicle in transit may have the highest priority and can override all other signals having a lower priority. At the scene of an accident, the signal output from an emergency vehicle may, at a slightly lower priority, transmit instructions for avoiding the accident scene and may provide detour instructions.

With respect to motor vehicle code enforcement, law enforcement agencies can automatically review the status of a driver, vehicle registration, and insurance and may provide warnings for expired or soon to be expired license, registrations, or insurance policies.

If an unauthorized operator has gained access to the vehicle and has not input the proper operator identification number, the microprocessor **40** can transmit an emergency instruction to alert law enforcement agencies that the vehicle has been stolen. The signal sent from the vehicle can automatically include the vehicle's position, speed, acceleration or deceleration rate, and direction. Law enforcement officials may send an instruction in response to limit the vehicle speed to no greater than 30 miles per hour until the unauthorized operator of the vehicle is apprehended. It should be noted that various fixed units may be strategically placed along highways, major intersections, toll booths, and bridges to monitor traffic and to relay messages back to law enforcement agencies.

Another law enforcement use can be to limit speeding of vehicles by notifying law enforcement agencies when a vehicle has exceeded a certain speed limit, e.g., 20% over the speed limit. A law enforcement official, in response, may send an instruction for the vehicle to slow down or risk a traffic citation. This can eliminate the need for "speed traps" and high speed police chases.

For public safety applications, specifically located fixed units can warn drivers as the vehicle approaches a traffic light at an intersection that the vehicle must slow down or stop because it will not "make" the green light. The traffic light can make this determination based upon the speed and direction of the mobile unit and the cycle of the traffic light.

Other selectively placed fixed units can warn drivers that an intersection or roadway is dangerous for various reasons,

such as an accident, a sharp bend, or heavy traffic. The signals output by these locations can be periodically updated as weather and traffic conditions change. In the same manner, vehicles may be warned that a particular vehicle is driving in an erratic manner or that law enforcement officials are currently involved in a pursuit of the vehicle. The warnings to drivers are output through the AVI **46** and may include an audible warning, or may include a status light such as red, yellow, and green being located on the graphical operator interface of the AVI **46**. In extreme circumstances, selectively placed fixed units may automatically overtake control of a vehicle, for example, during extremely icy conditions to slow the vehicle prior to the danger zone.

It should be noted that although the mobile units **16** were described hereinbefore as being located in a vehicle or in a fixed location, they can be incorporated as part of a cellular phone or other portable communication device.

The present invention is particularly adaptable for interfacing with the Internet and providing a wealth of information for all mobile unit operators. In one Internet-related embodiment, the website permits storage of information and system administration through the Internet. A system administrator operating at the website or the base station controller **20** monitors and tracks all mobile units **16**. Through the system administrator, the fixed locations are provided with weather and traffic updates or advertisements which are specifically geared to the immediate vicinity of the fixed unit. In this manner, advertisers advertise both on the website and advertise their companies and products as vehicles approach or pass certain properties, stores, or business locations. This also permits stores to provide information to vehicles arriving or leaving the place of business, such as directions for parking or thanking them for their patronage.

The system administrator also provides centralized housekeeping functions in order to track all different types of information that are typically a nuisance to vehicle operators, such as the date their registration and insurance policy expire. The system administrator also tracks general vehicle maintenance information and traffic violation records. The tracking of vehicle maintenance can be particularly useful when a recall notification is issued from a manufacturer or even when regularly scheduled maintenance is required.

In a second Internet-related embodiment, the system **10** is used to aid law enforcement officials and insurance companies to determine when a traffic accident has occurred and to collect all of the detailed information regarding the traffic accident. This function is centralized in a website such as vehicleaccident.com. When an accident occurs, a signal is automatically sent to all vehicles involved (or in the vicinity) to transmit all pertinent information to vehicleaccident.com. This can include time, speed, direction, acceleration and deceleration, duration of trip, and other pertinent information such as the vehicle maintenance records, traffic citation records, insurance, and registration information. The system **10** permits all of this information to be stored in a centralized location at vehicleaccident.com for later review by law enforcement officials. The system **10** also stores law enforcement officials reports regarding the accident.

The insurance industry should benefit by having mobile unit operators agree in advance to accept a fact finding by an officer utilizing all of the information from the mobile units **16**. This avoids costly litigation and subrogation. A mobile unit operator accepting these terms may be permitted special insurance discounts for agreeing to such.

In another embodiment, the system can provide mobile units that does not include a GPS unit. It can be similar to portable phone(s) operating on the same frequency(s). If a user tunes their radio to a particular station, they can receive a transmission through their car stereo system. The mobile unit, in this instance, can have the microphone inside of it so a user can speak "hands free". This embodiment allows the mobile unit to beep (or voice activate) if another user comes within range, advising both mobile units that they have someone they can talk to. The mobile unit detects another mobile unit by actually receiving the signal of the other mobile unit. Accordingly, positioning of either mobile unit is not required.

Although the invention has been described in part by making detailed reference to example embodiments, such detail is intended to be instructive rather than restrictive. It will be appreciated by those skilled in the art that many variations may be made in the structure and mode of operation without departing from the scope of the invention as disclosed in the teachings herein.

What is claimed is:

1. A method of wireless communication between a mobile unit and a vehicle comprising a transceiver, the method comprising:

receiving a signal by the mobile unit comprising a microprocessor, the signal transmitted from the vehicle comprising the transceiver, the signal comprising a security field and a unique identifier;

advising that the mobile unit is within range of the vehicle;

determining by the microprocessor if the signal is authorized, the determining comprising parsing the signal to determine the security field and the unique identifier;

inputting a voice-activated input and/or a manual input from a user of the mobile unit via an audio-visual interface associated with the mobile unit, the voice-activated input and/or the manual input is associated with a control instruction;

assembling, by the microprocessor, at least one packet of a communication comprising the control instruction;

transmitting the at least one packet to the vehicle comprising the transceiver;

displaying that the control instruction was input by the user; and storing the communication in a communication log.

2. The method of claim **1** wherein displaying comprises displaying on a heads-up display.

3. The method of claim **1** wherein the control instruction controls a horn of the vehicle.

4. The method of claim **1** wherein the control instruction controls a lock of the vehicle.

5. The method of claim **1** wherein the control instruction controls a light of the vehicle.

6. The method of claim **1** wherein the control instruction controls a radio of the vehicle.

7. The method of claim **1** further comprising storing identifying information in a memory associated with the microprocessor.

8. The method of claim **7** further comprising authorizing the user based on the identifying information.

9. The method of claim **7** wherein the identifying information is unique to the vehicle.

10. The method of claim **7** wherein the identifying information is unique to the user.

11. The method of claim **1** wherein the audio-visual interface comprises a graphic display.

12. The method of claim **1** wherein the audio-visual interface comprises a microphone.

13. The method of claim **1** wherein the transmitting uses Bluetooth wireless technology.

14. The method of claim **1** wherein the transmitting comprises encrypting the communication.

15. The method of claim **1** wherein the mobile unit is a cellular phone.

16. A method of wireless communication between a mobile unit and a vehicle comprising a transceiver, the method comprising:

receiving a signal by the vehicle comprising the transceiver, the signal transmitted from the mobile unit, the signal comprising a security field and a unique identifier;

determining if the signal is authorized, the determining comprises a microprocessor parsing the signal to determine the security field and the unique identifier;

inputting an authorization by a user via an audio-visual interface;

accepting by the microprocessor, based on the authorization, a control instruction from the mobile unit;

processing, by the microprocessor of the vehicle, the control instruction from the mobile unit, the control instruction exerting electromechanical control over the vehicle;

transmitting, by the vehicle comprising the transceiver, a communication to the mobile unit that the control instruction was received;

displaying to the user that the control instruction exerts electromechanical control over the vehicle; and

storing the communication in a communication log.

17. The method of claim **16** wherein the control instruction controls a horn of the vehicle.

18. The method of claim **16** wherein the control instruction controls a lock of the vehicle.

19. The method of claim **16** wherein the control instruction controls a light of the vehicle.

20. The method of claim **16** further comprising storing identifying information in a memory associated with the microprocessor.

21. The method of claim **20** further comprising authorizing the user based on the identifying information.

22. The method of claim **20** wherein the identifying information is unique to the mobile unit.

23. The method of claim **20** wherein the identifying information is unique to the user.

24. The method of claim **16** wherein the receiving the signal uses Bluetooth wireless technology.

25. The method of claim **16** wherein the signal is encrypted.

26. The method of claim **16** wherein the audio-visual interface comprises a graphic display.

27. The method of claim **16** wherein the mobile unit is a cellular phone.

28. A method of wireless communication between a mobile unit and a vehicle comprising a transceiver, the method comprising:

receiving a signal by the mobile unit comprising a microprocessor, the signal transmitted from the vehicle comprising the transceiver, the signal comprising a security field and a unique identifier;

advising that the mobile unit is within range of the vehicle;

determining by the microprocessor if the signal is authorized, the determining comprising parsing the signal to determine the security field and the unique identifier;

inputting a voice-activated input and/or a manual input from a user of the mobile unit via an audio-visual interface associated with the mobile unit, the voice-activated input and/or the manual input is associated with a control instruction;

assembling, by the microprocessor, at least one packet of a communication comprising the control instruction;

transmitting the at least one packet to the vehicle comprising the transceiver;

displaying that the control instruction was input by the user; and

storing, by the user via the audio-visual interface, information related to the vehicle.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,596,391 B2
APPLICATION NO. : 12/389252
DATED : September 29, 2009
INVENTOR(S) : Richard B. Himmelstein

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

IN THE SPECIFICATION

At column 1, line 5, after "This application", delete "claims priority from" and insert therefor --is a continuation of--.

Signed and Sealed this
Fourth Day of June, 2013

Teresa Stanek Rea
Acting Director of the United States Patent and Trademark Office