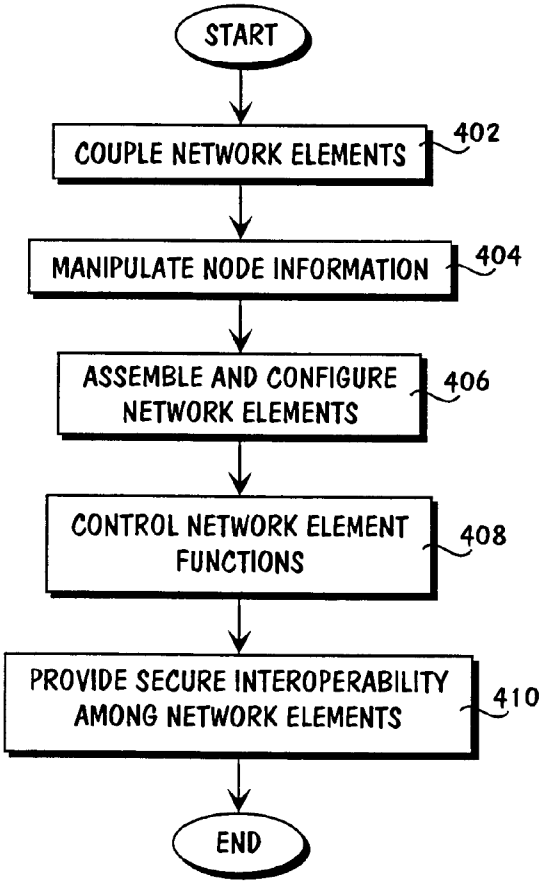

START
COUPLE NETWORK ELEMENTS
402
MANIPULATE NODE INFORMATION
404
ASSEMBLE AND CONFIGURE NETWORK ELEMENTS
406
CONTROL NETWORK ELEMENT FUNCTIONS
408
PROVIDE SECURE INTEROPERABILITY AMONG NETWORK ELEMENTS
410
END

FIG. 4

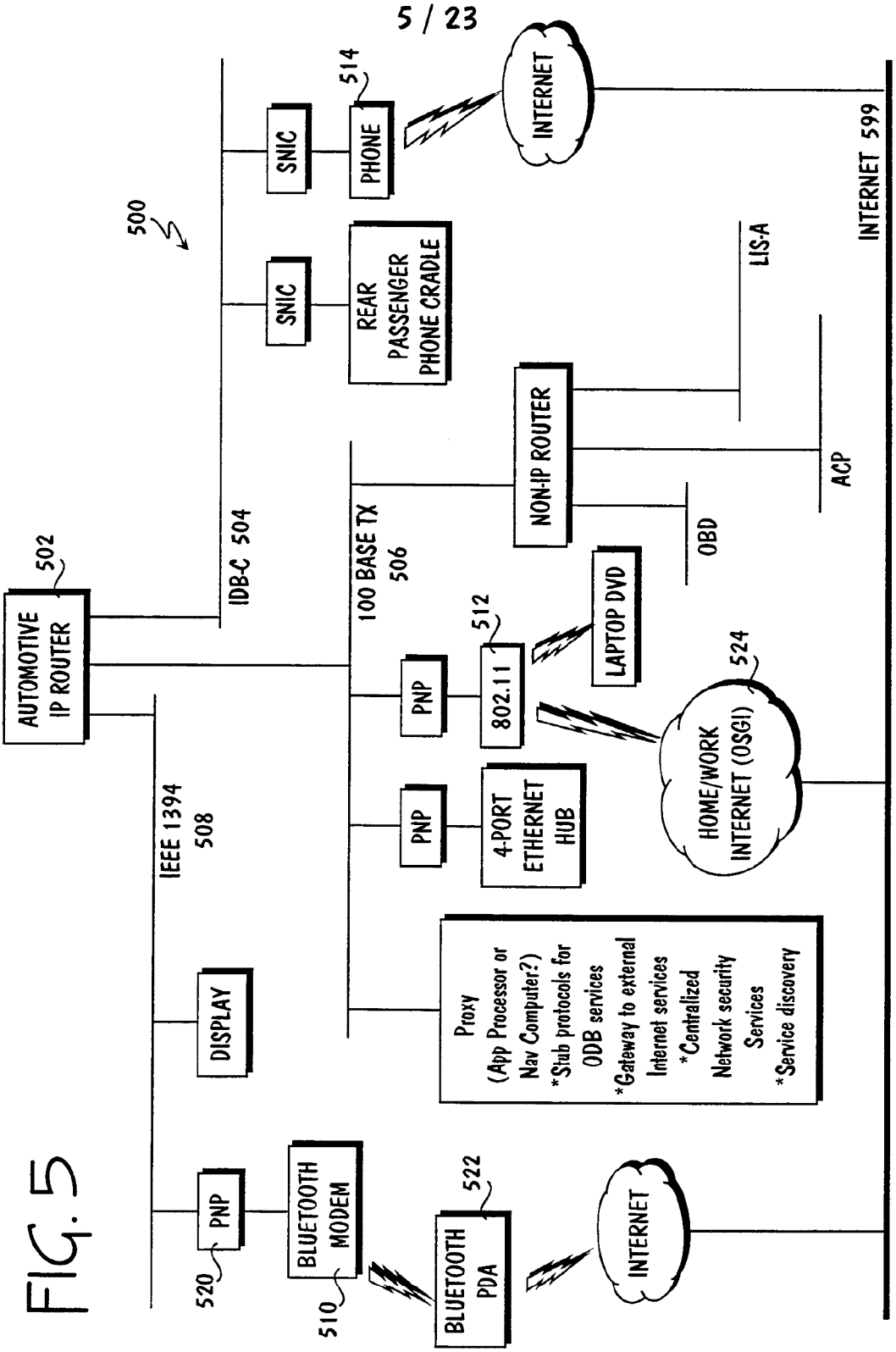

INTERNET
514
PHONE
SNIC
500
SNIC
REAR PASSENGER PHONE CRADLE
LIS-A
INTERNET 599
NON-IP ROUTER
ACP
OBD
IDB-C 504
100 BASE TX 506
502
AUTOMOTIVE IP ROUTER
LAPTOP DVD
512
PNP
802.11
524
HOME/WORK INTERNET (OSGI)
PNP
4-PORT ETHERNET HUB
IEEE 1394 508
Proxy (App Processor or Nav Computer?) *Stub protocols for ODB services *Gateway to external Internet services *Centralized Network security Services *Service discovery
DISPLAY
520
PNP
BLUETOOTH MODEM
510
BLUETOOTH PDA
522
INTERNET

FIG. 5

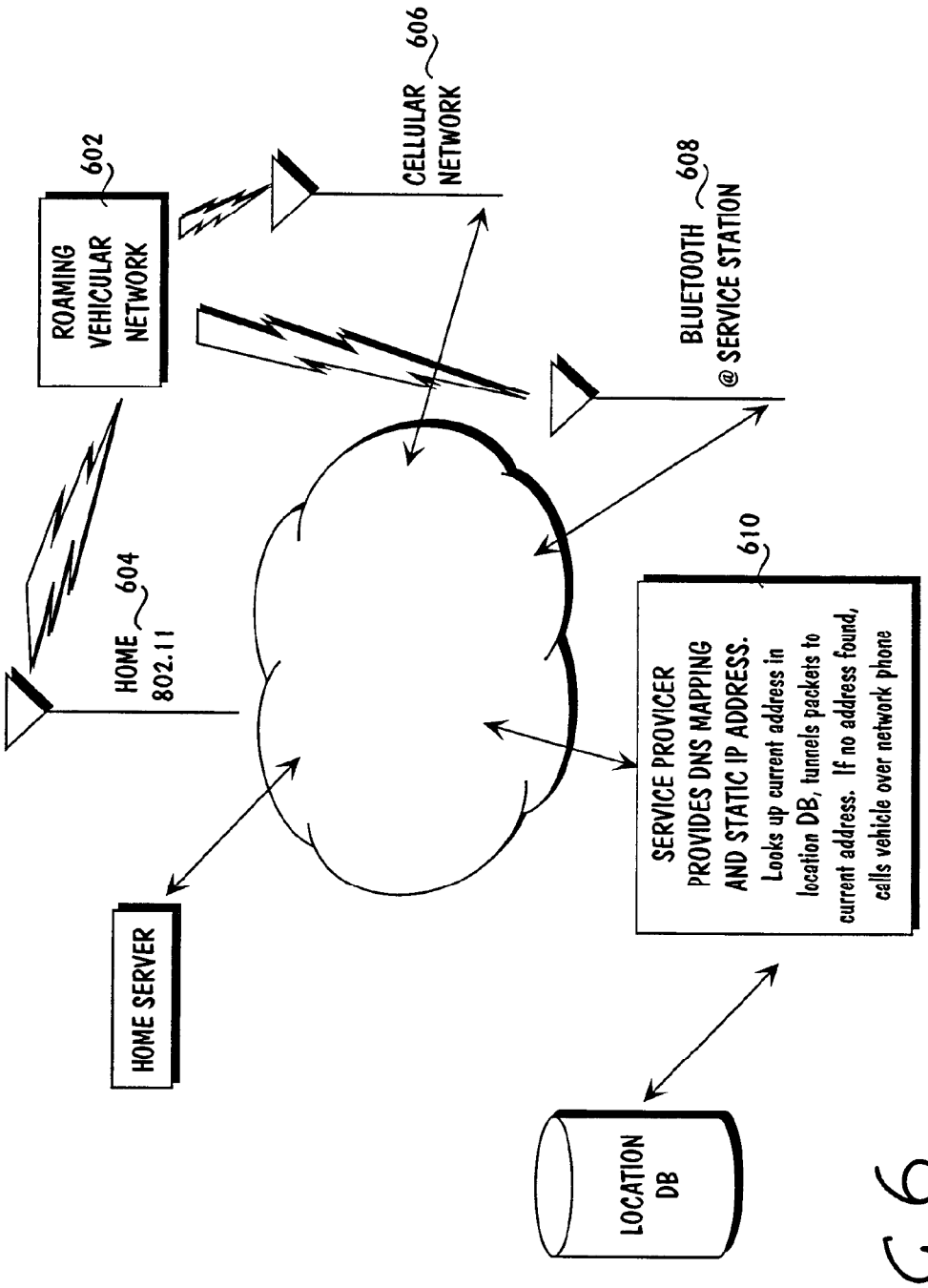

602
ROAMING VEHICULAR NETWORK
606
CELLULAR NETWORK
608
BLUETOOTH @ SERVICE STATION
604
HOME 802.11
610
SERVICE PROVICER PROVIDES DNS MAPPING AND STATIC IP ADDRESS.
Looks up current address in location DB, tunnels packets to current address. If no address found, calls vehicle over network phone
HOME SERVER
LOCATION DB

FIG. 6

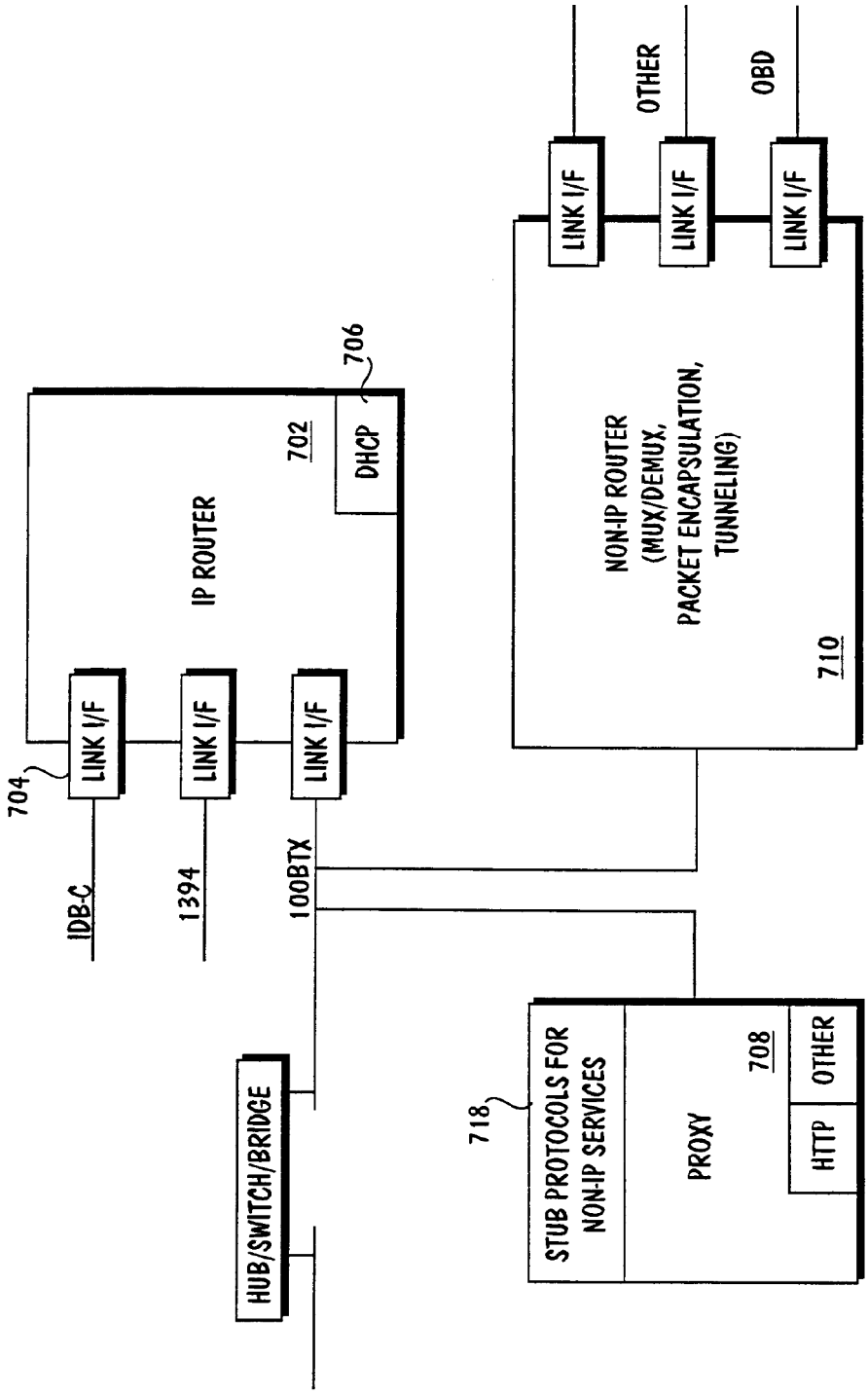

OTHER
OBD
LINK I/F
LINK I/F
LINK I/F
706
DHCP
702
IP ROUTER
NON-IP ROUTER
(MUX/DEMUX,
PACKET ENCAPSULATION,
TUNNELING)
710
LINK I/F
LINK I/F
LINK I/F
704
IDB-C
1394
100BTX
HUB/SWITCH/BRIDGE
718
STUB PROTOCOLS FOR
NON-IP SERVICES
PROXY
708
HTTP
OTHER

FIG. 7

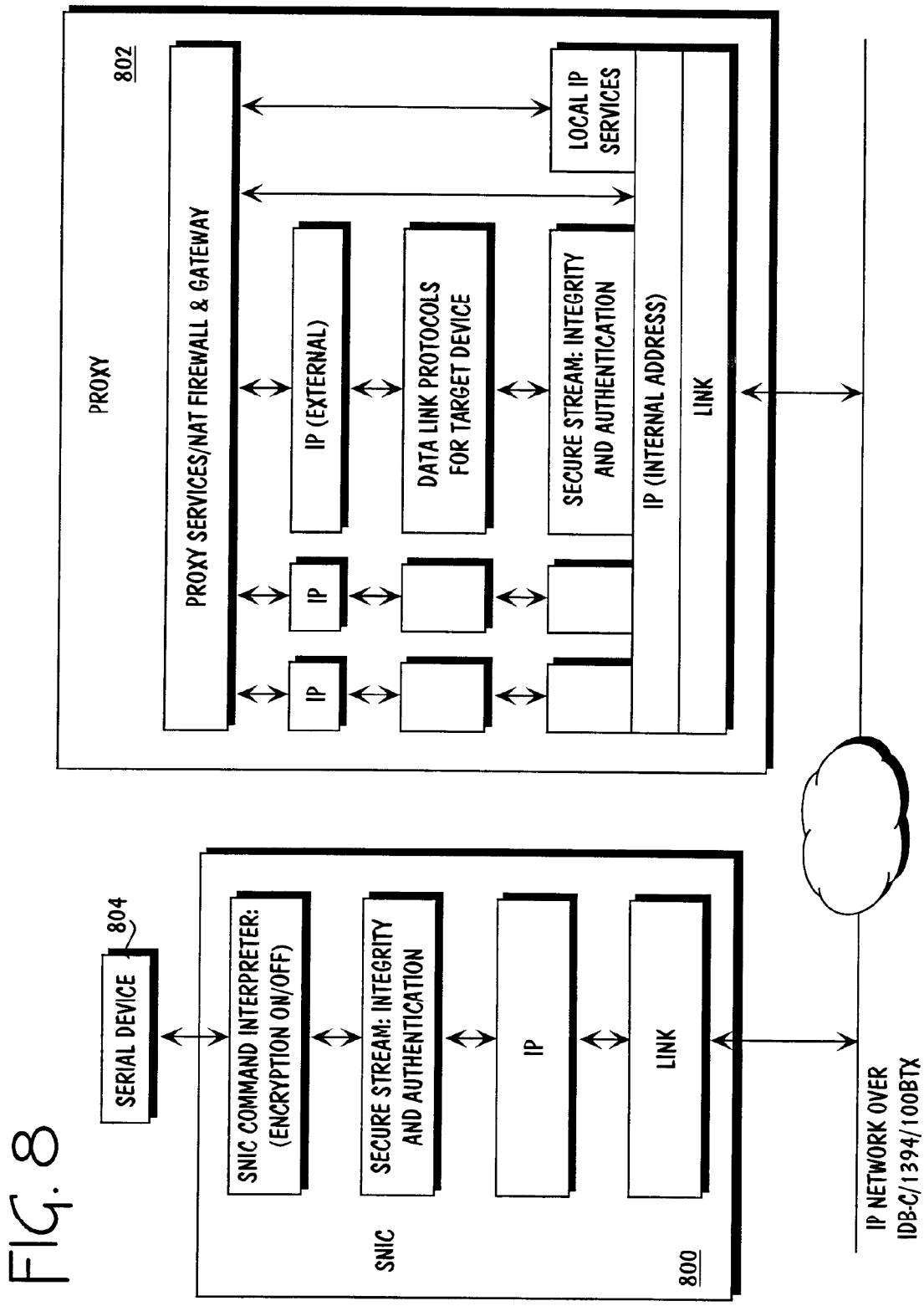
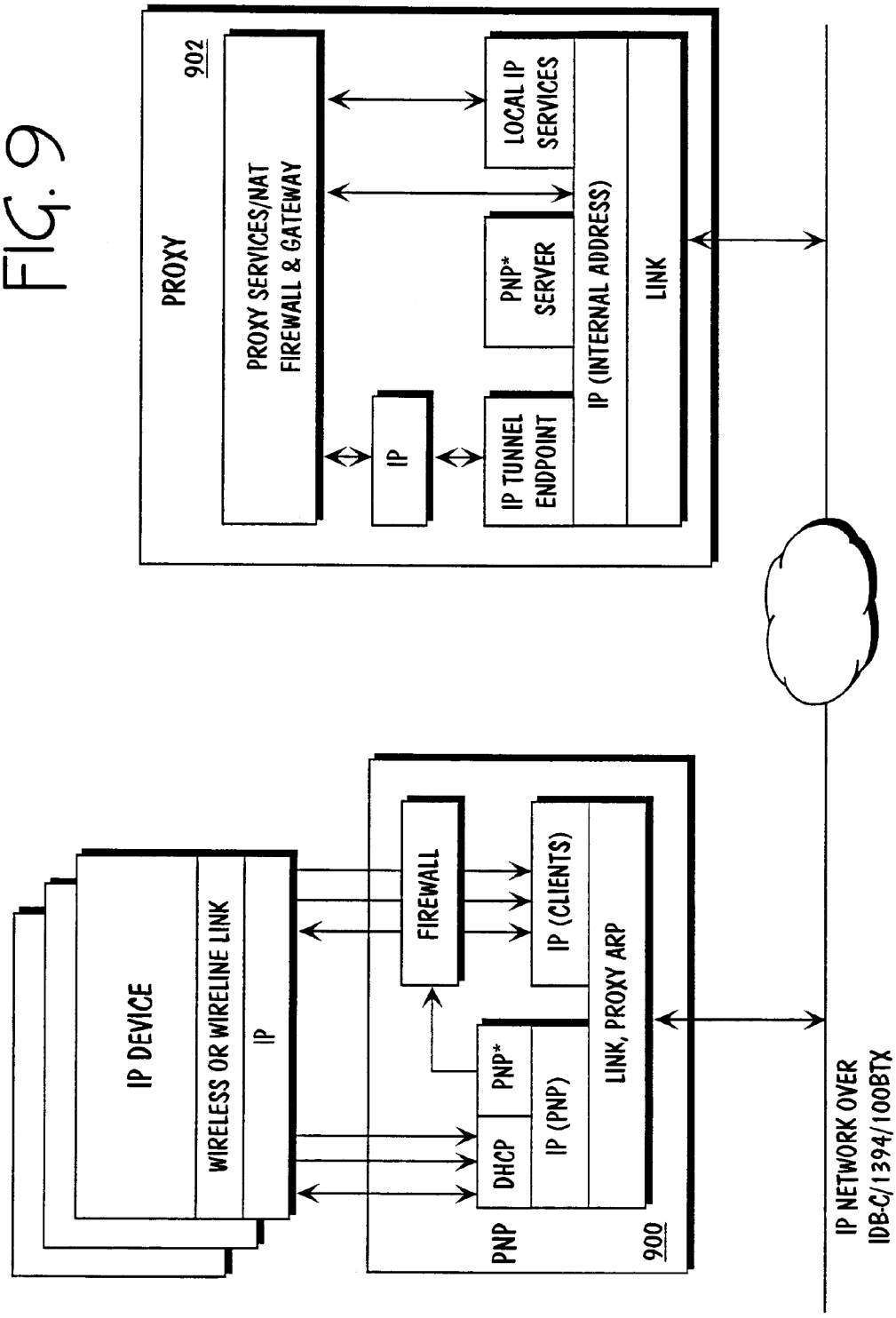

PROXY
802
PROXY SERVICES/NAT FIREWALL & GATEWAY
IP (EXTERNAL)
DATA LINK PROTOCOLS FOR TARGET DEVICE
SECURE STREAM: INTEGRITY AND AUTHENTICATION
LOCAL IP SERVICES
IP (INTERNAL ADDRESS)
LINK
IP
IP
SERIAL DEVICE
804
SNIC COMMAND INTERPRETER: (ENCRYPTION ON/OFF)
SECURE STREAM: INTEGRITY AND AUTHENTICATION
IP
LINK
SNIC
800
IP NETWORK OVER IDB-C/1394/100BTX

FIG. 8

FIG. 9


PROXY
902
PROXY SERVICES/NAT
FIREWALL & GATEWAY
IP
IP TUNNEL
ENDPOINT
PNP*
SERVER
LOCAL IP
SERVICES
IP (INTERNAL ADDRESS)
LINK
IP DEVICE
WIRELESS OR WIRELINE LINK
IP
FIREWALL
IP (CLIENTS)
LINK, PROXY ARP
PNP*
DHCP
IP (PNP)
PNP
900
IP NETWORK OVER
IDB-C/1394/100BTX

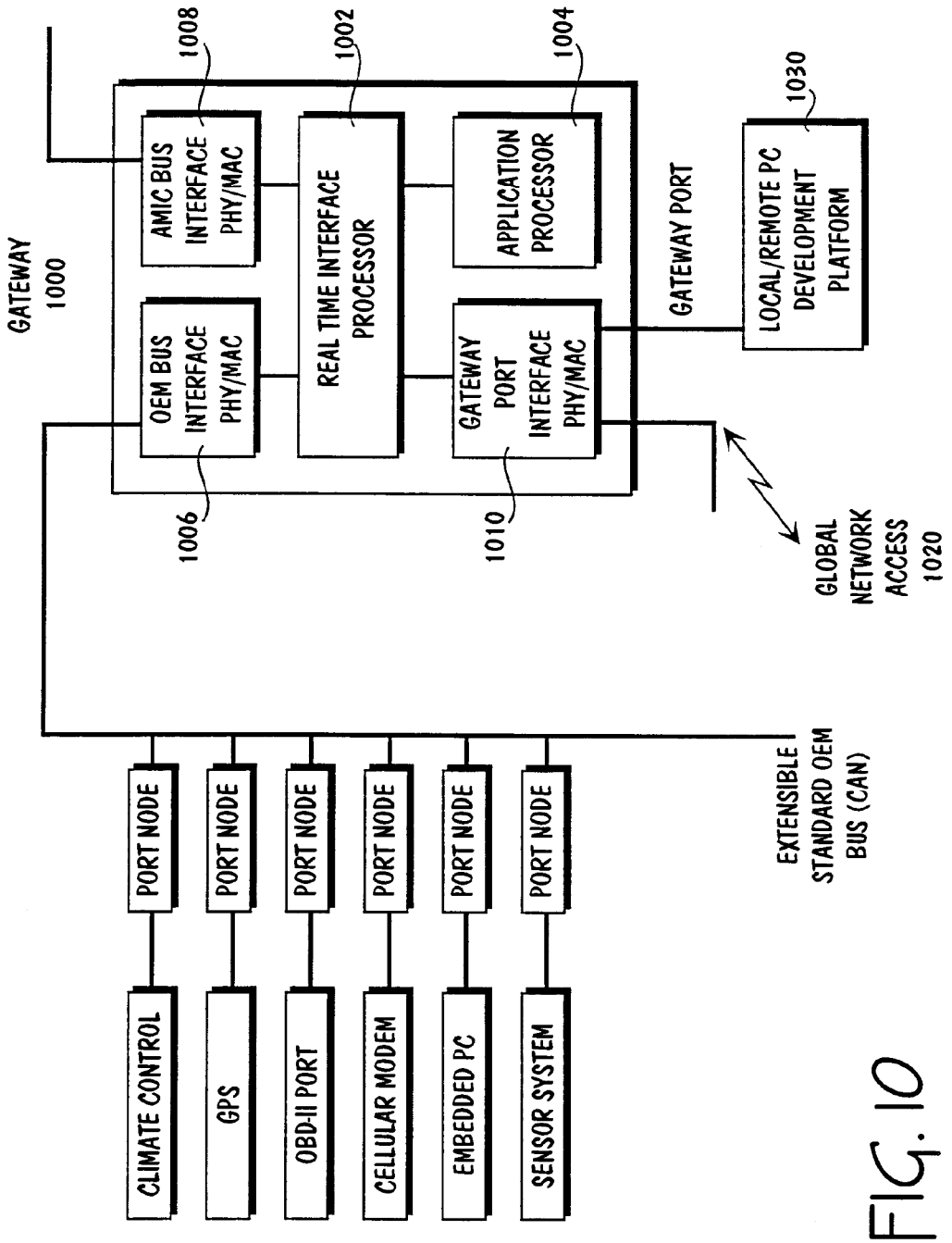

GATEWAY
1000
AMIC BUS INTERFACE PHY/MAC
1008
OEM BUS INTERFACE PHY/MAC
1006
REAL TIME INTERFACE PROCESSOR
1002
APPLICATION PROCESSOR
1004
GATEWAY PORT INTERFACE PHY/MAC
1010
GATEWAY PORT
LOCAL/REMOTE PC DEVELOPMENT PLATFORM
1030
GLOBAL NETWORK ACCESS
1020
EXTENSIBLE STANDARD OEM BUS (CAN)
PORT NODE
PORT NODE
PORT NODE
PORT NODE
PORT NODE
PORT NODE
CLIMATE CONTROL
GPS
OBD-II PORT
CELLULAR MODEM
EMBEDDED PC
SENSOR SYSTEM

FIG. 10

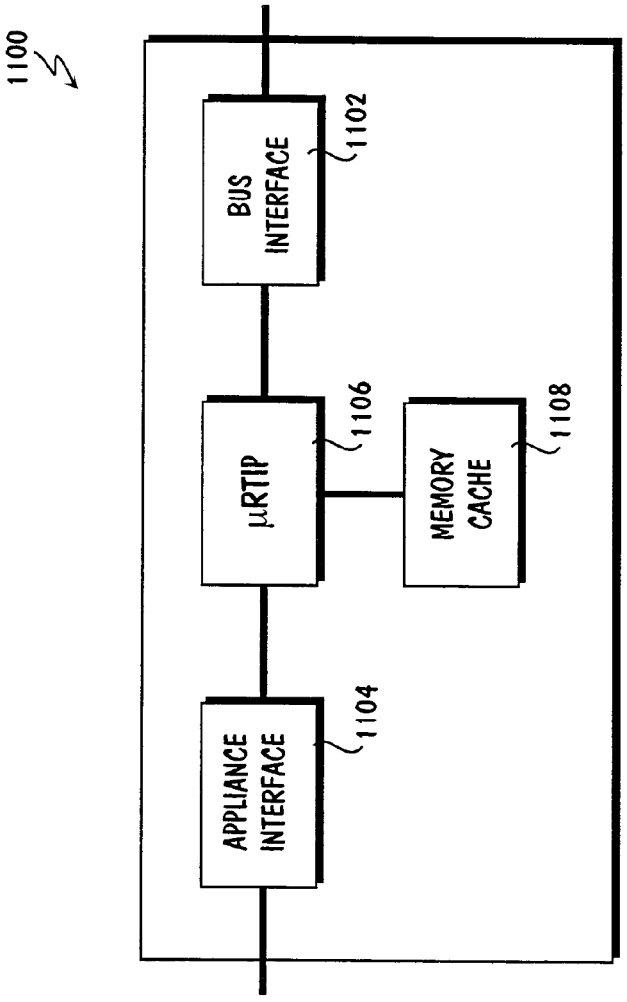

1100
BUS INTERFACE
1102
µRTIP
1106
MEMORY CACHE
1108
APPLIANCE INTERFACE
1104

FIG. 11

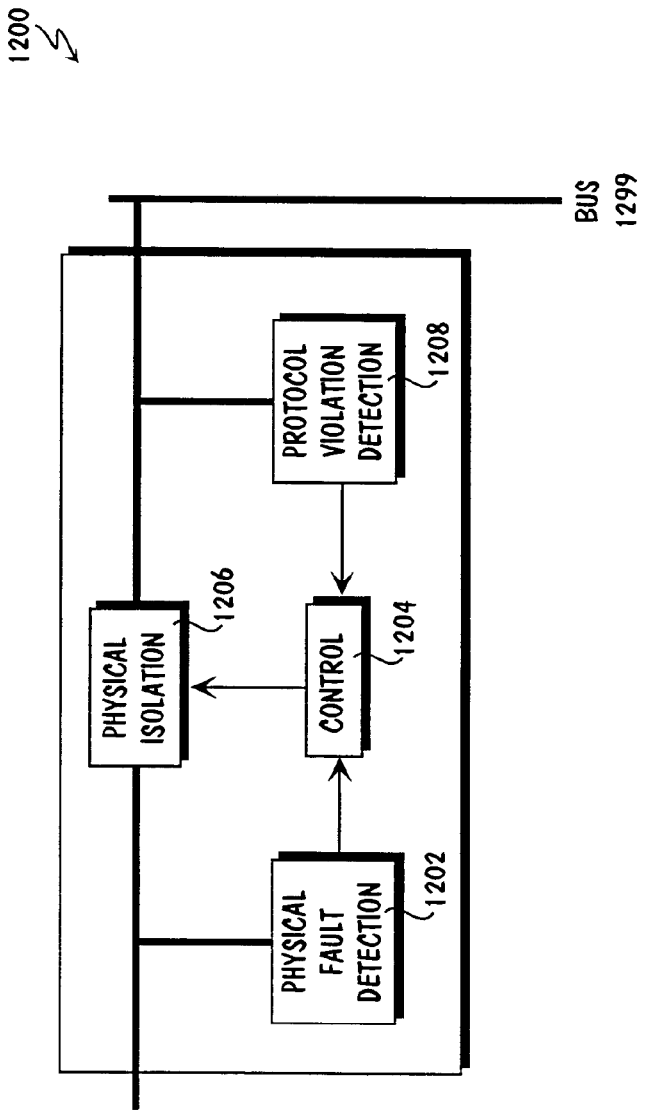

1200
BUS
1299
PROTOCOL VIOLATION DETECTION
1208
PHYSICAL ISOLATION
1206
CONTROL
1204
PHYSICAL FAULT DETECTION
1202

FIG. 12

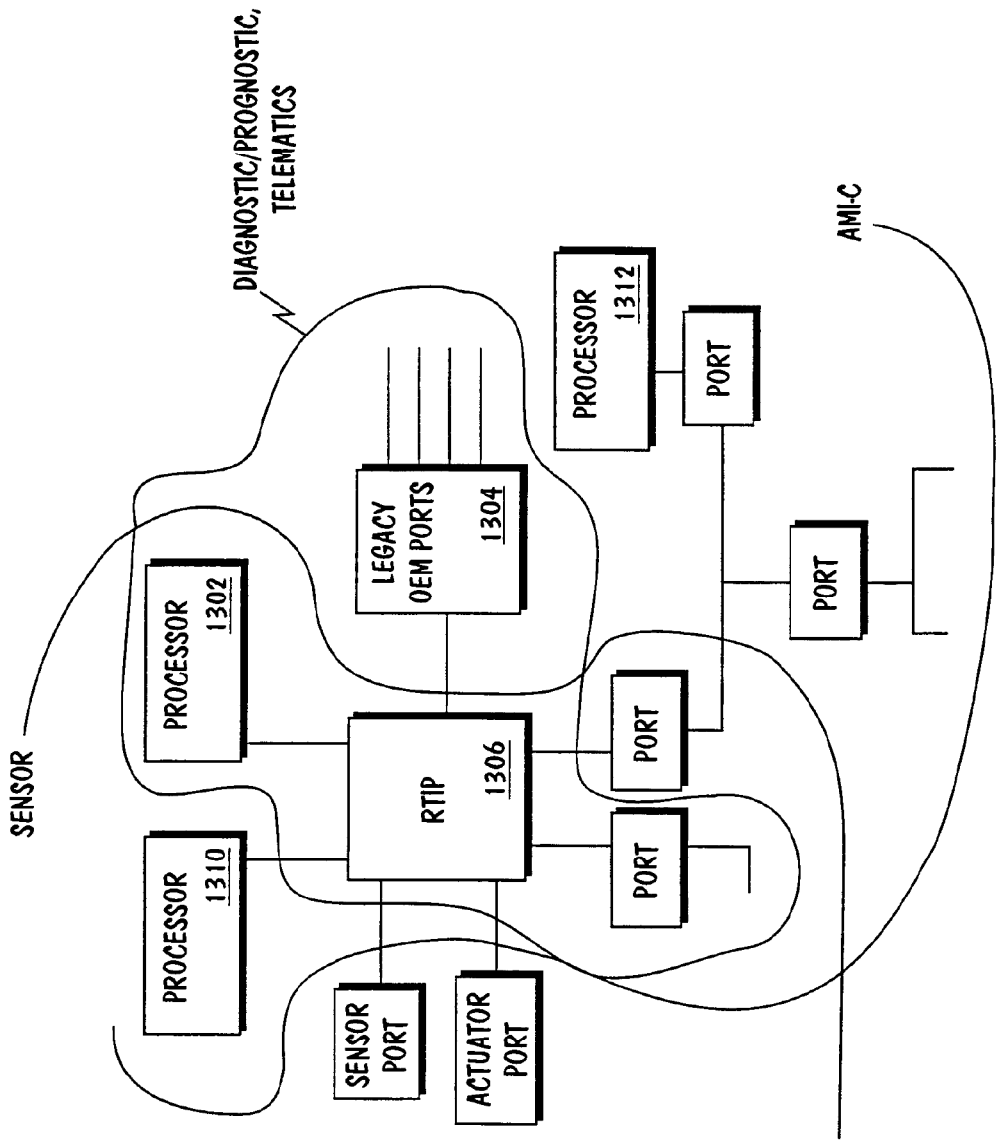

DIAGNOSTIC/PROGNOSTIC, TELEMATICS
AMI-C
SENSOR
PROCESSOR 1312
PORT
LEGACY OEM PORTS 1304
PROCESSOR 1302
PORT
RTIP 1306
PORT
PROCESSOR 1310
PORT
SENSOR PORT
ACTUATOR PORT

FIG. 13

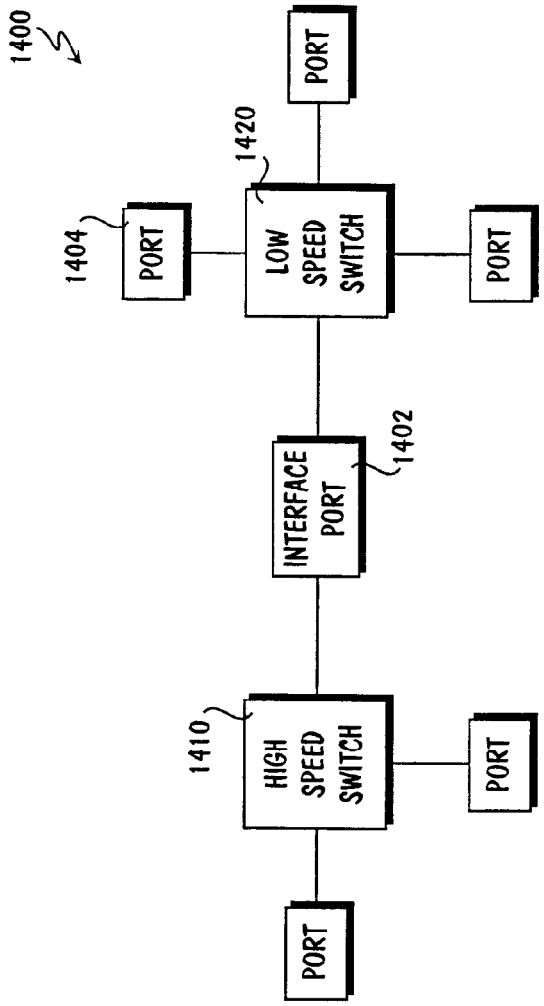

1400
PORT
1420
1404
PORT
LOW SPEED SWITCH
PORT
INTERFACE PORT
1402
1410
HIGH SPEED SWITCH
PORT
PORT

FIG. 14

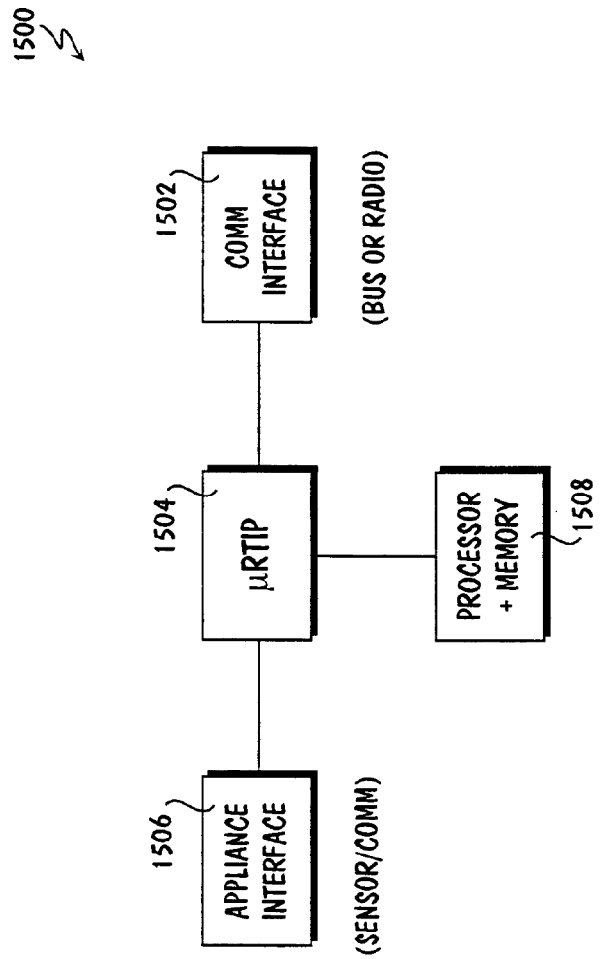

1500
1502
COMM INTERFACE
(BUS OR RADIO)
1504
µRTIP
PROCESSOR + MEMORY
1508
1506
APPLIANCE INTERFACE
($ENSOR/COMM)

FIG. 15

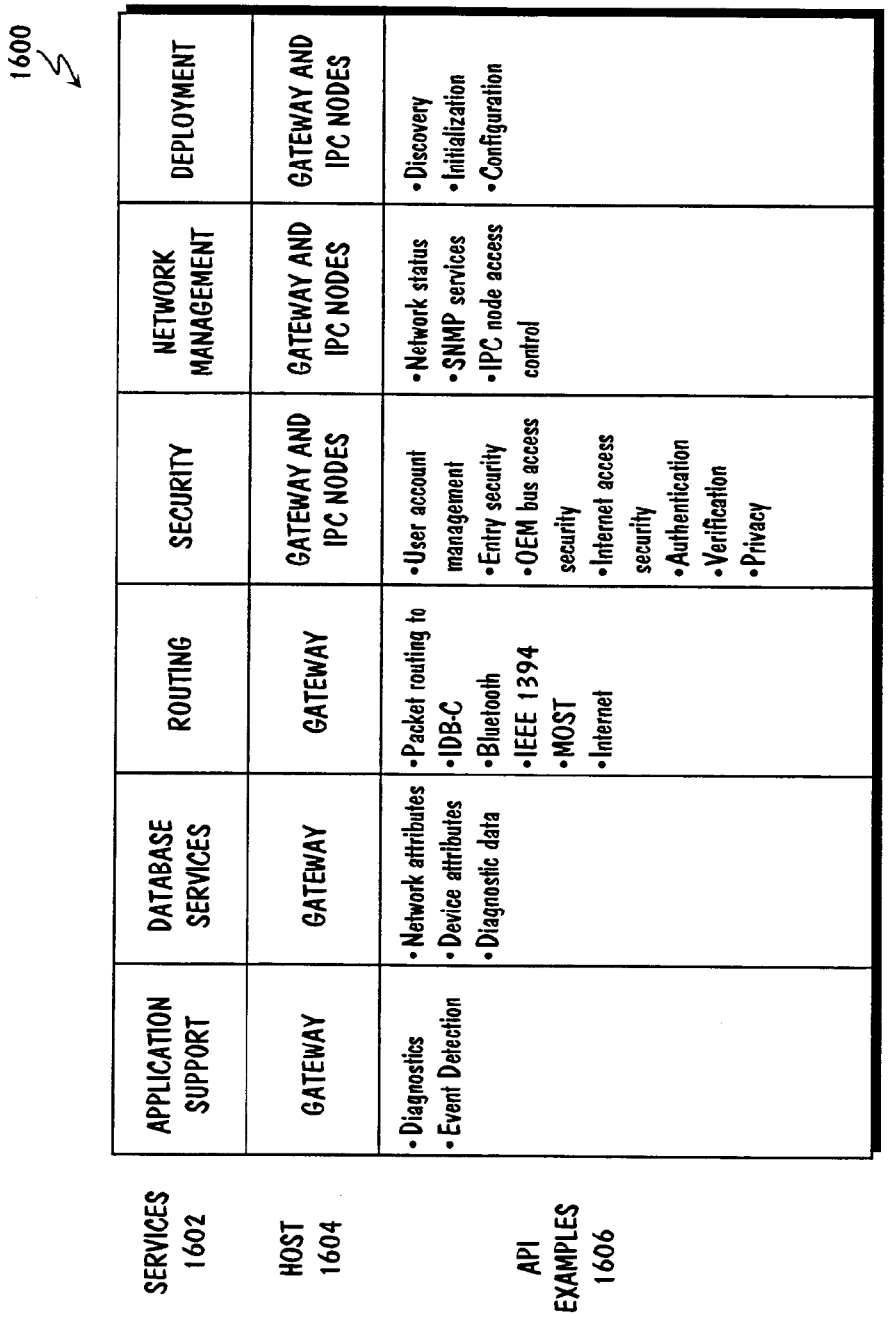

1600
SERVICES 1602
HOST 1604
API EXAMPLES 1606
APPLICATION SUPPORT
DATABASE SERVICES
ROUTING
SECURITY
NETWORK MANAGEMENT
DEPLOYMENT
GATEWAY
GATEWAY
GATEWAY
GATEWAY AND IPC NODES
GATEWAY AND IPC NODES
GATEWAY AND IPC NODES
• Diagnostics
• Event Detection
• Network attributes
• Device attributes
• Diagnostic data
• Packet routing to
• IDB-C
• Bluetooth
• IEEE 1394
• MOST
• Internet
• User account management
• Entry security
• OEM bus access security
• Internet access security
• Authentication
• Verification
• Privacy
• Network status
• SNMP services
• IPC node access control
• Discovery
• Initialization
• Configuration

FIG. 16

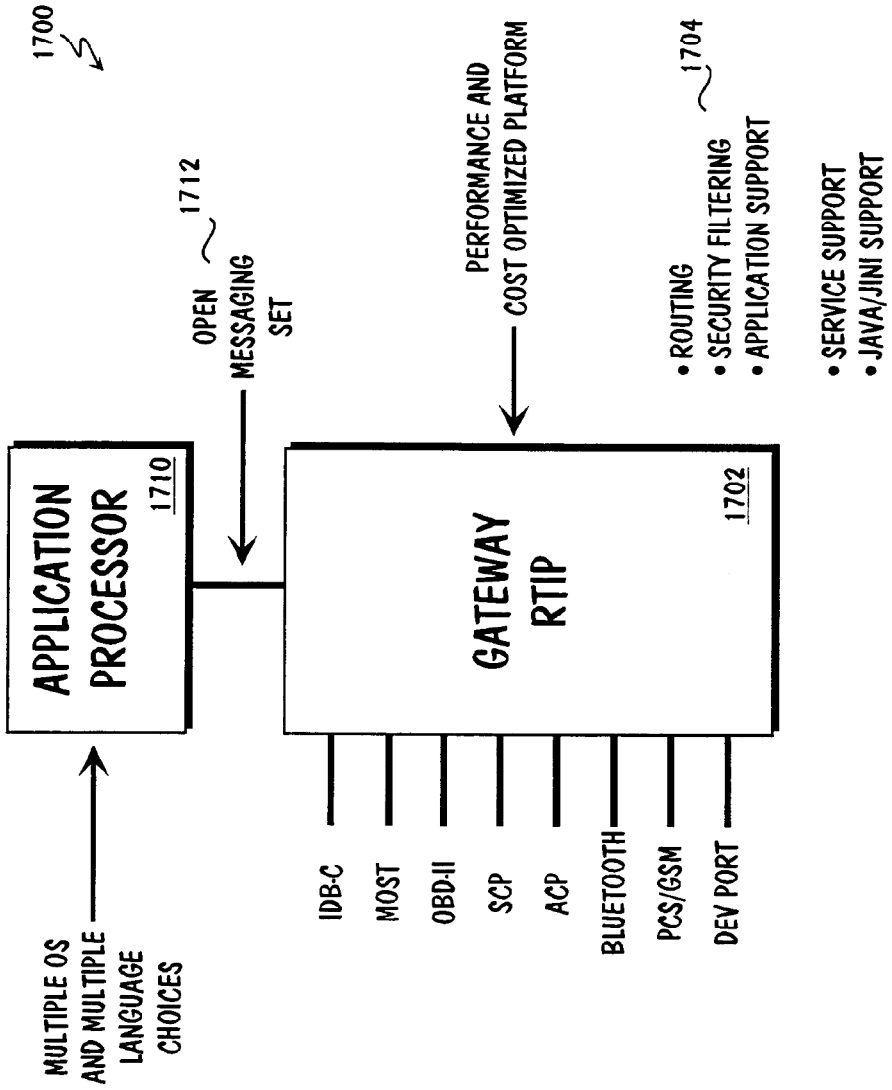

1700
1712
OPEN MESSAGING SET
PERFORMANCE AND COST OPTIMIZED PLATFORM
1704
• ROUTING
• SECURITY FILTERING
• APPLICATION SUPPORT
• SERVICE SUPPORT
• JAVA/JINI SUPPORT
APPLICATION PROCESSOR
1710
GATEWAY RTIP
1702
MULTIPLE OS AND MULTIPLE LANGUAGE CHOICES
IDB-C
MOST
OBD-II
SCP
ACP
BLUETOOTH
PCS/GSM
DEV PORT

FIG. 17

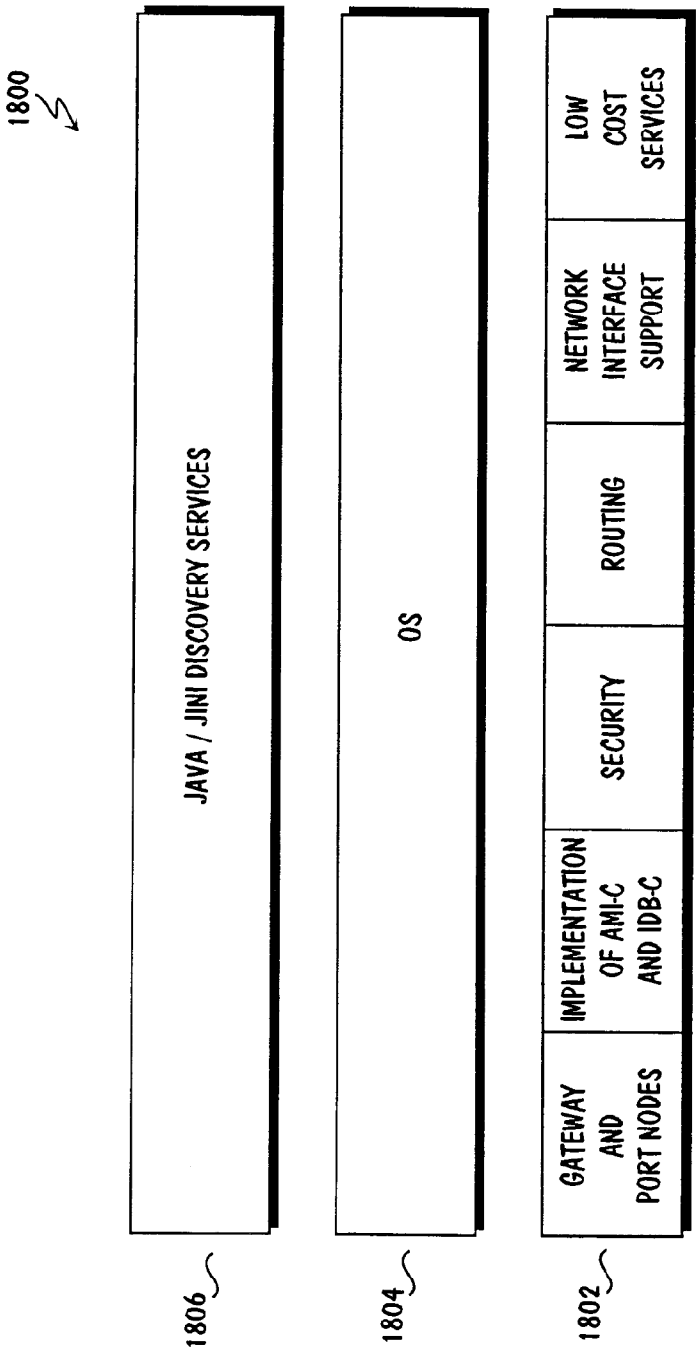

1800
JAVA / JINI DISCOVERY SERVICES
OS
GATEWAY AND PORT NODES
IMPLEMENTATION OF AMI-C AND IDB-C
SECURITY
ROUTING
NETWORK INTERFACE SUPPORT
LOW COST SERVICES
1806
1804
1802

FIG. 18

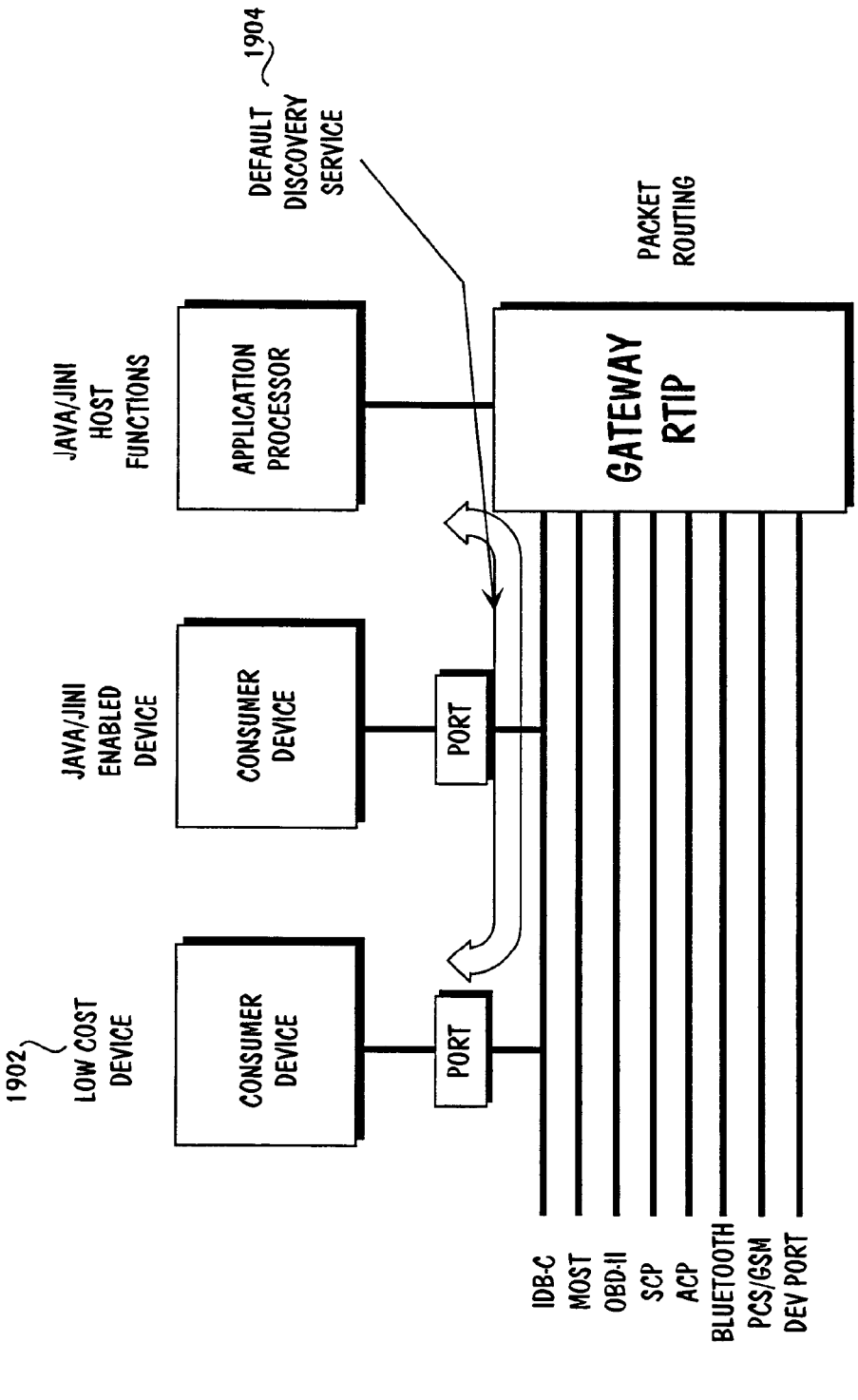

1904
DEFAULT DISCOVERY SERVICE
PACKET ROUTING
JAVA/JINI HOST FUNCTIONS
APPLICATION PROCESSOR
GATEWAY RTIP
JAVA/JINI ENABLED DEVICE
CONSUMER DEVICE
PORT
1902
LOW COST DEVICE
CONSUMER DEVICE
PORT
IDB-C
MOST
OBD-II
SCP
ACP
BLUETOOTH
PCS/GSM
DEV PORT

FIG. 19

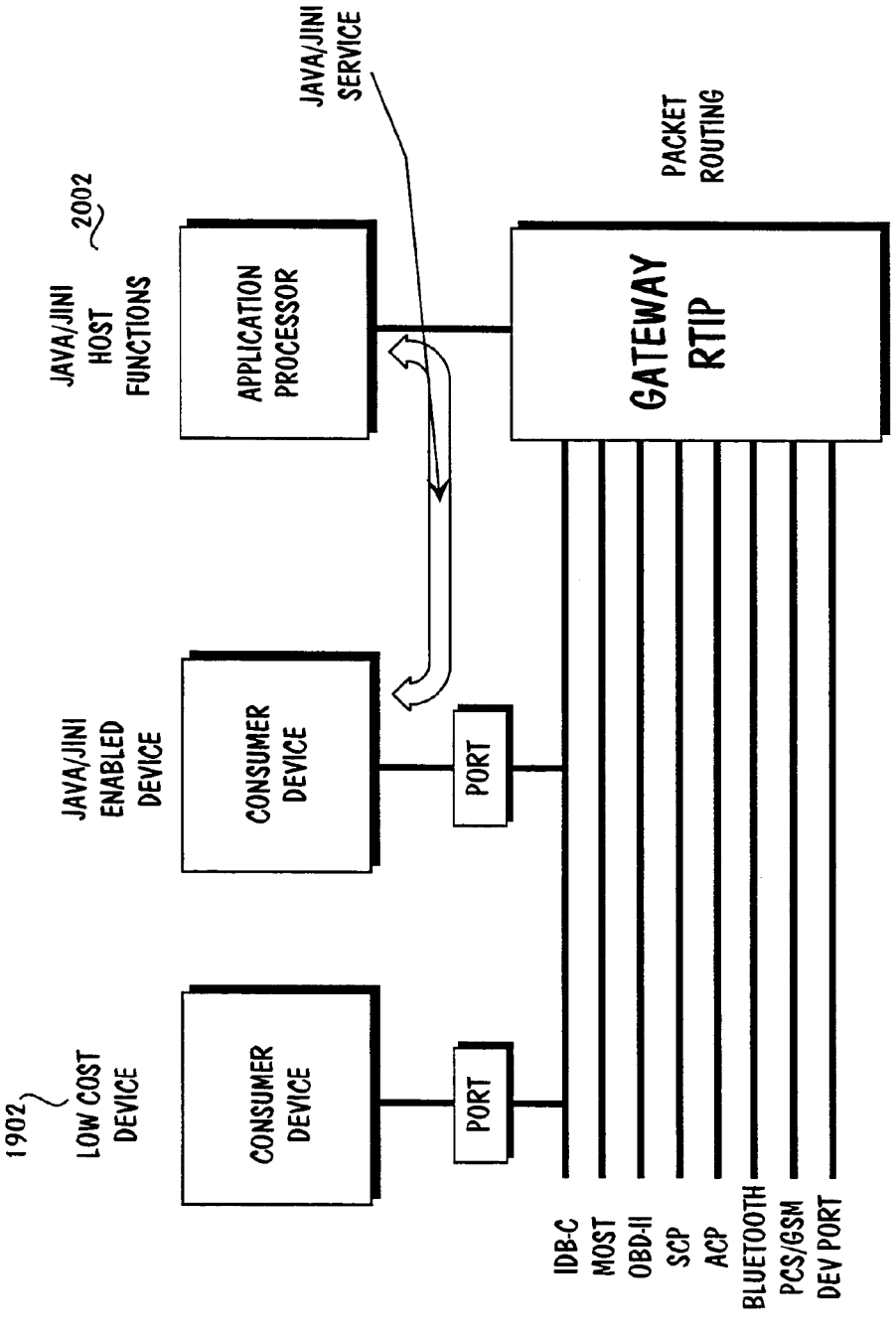

JAVA/JINI SERVICE
PACKET ROUTING
2002
JAVA/JINI HOST FUNCTIONS
APPLICATION PROCESSOR
GATEWAY RTIP
JAVA/JINI ENABLED DEVICE
CONSUMER DEVICE
PORT
1902
LOW COST DEVICE
CONSUMER DEVICE
PORT
IDB-C
MOST
OBD-II
SCP
ACP
BLUETOOTH
PCS/GSM
DEV PORT

FIG. 20

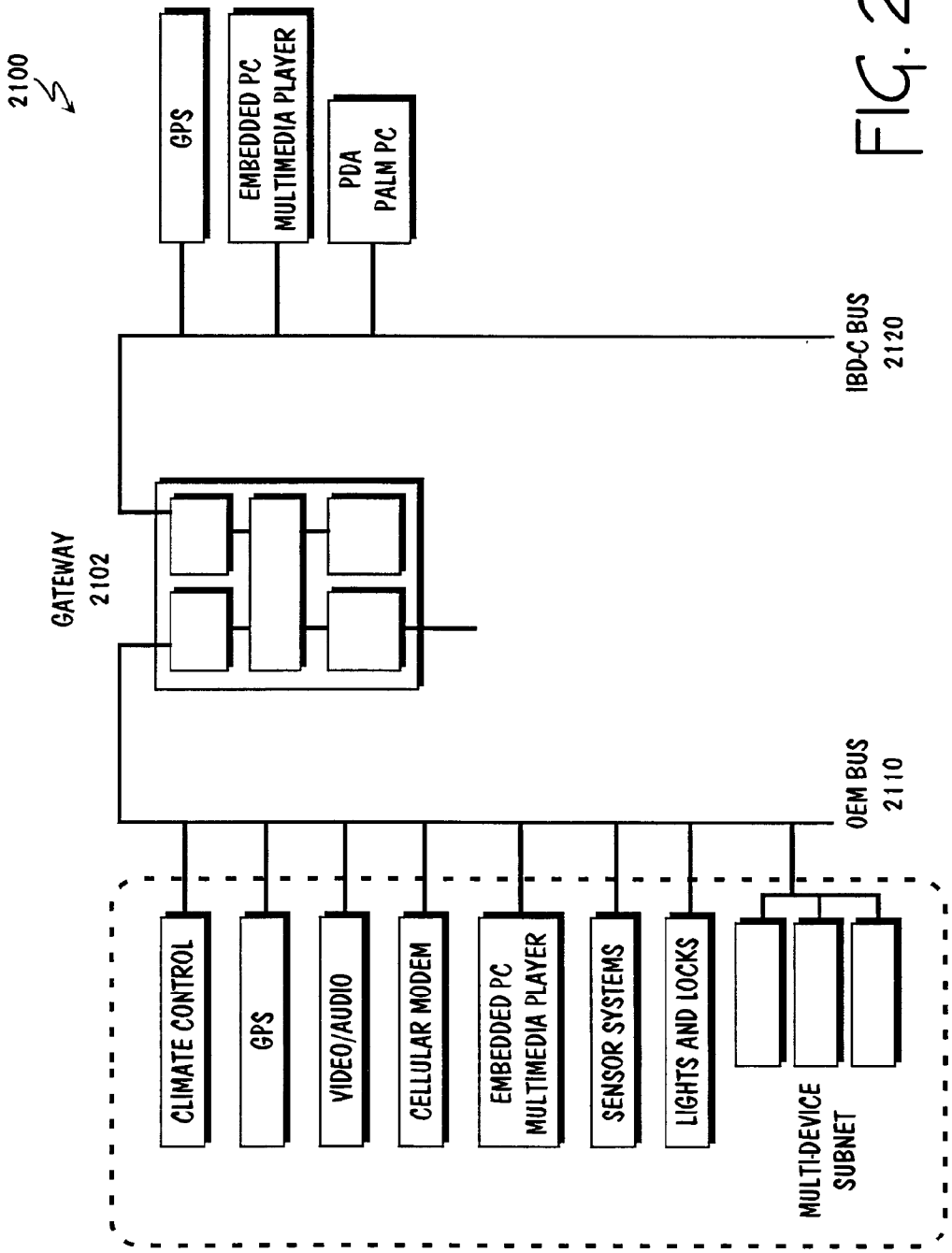

2100
GPS
EMBEDDED PC MULTIMEDIA PLAYER
PDA PALM PC
IBD-C BUS 2120
GATEWAY 2102
OEM BUS 2110
CLIMATE CONTROL
GPS
VIDEO/AUDIO
CELLULAR MODEM
EMBEDDED PC MULTIMEDIA PLAYER
SENSOR SYSTEMS
LIGHTS AND LOCKS
MULTI-DEVICE SUBNET

FIG. 21

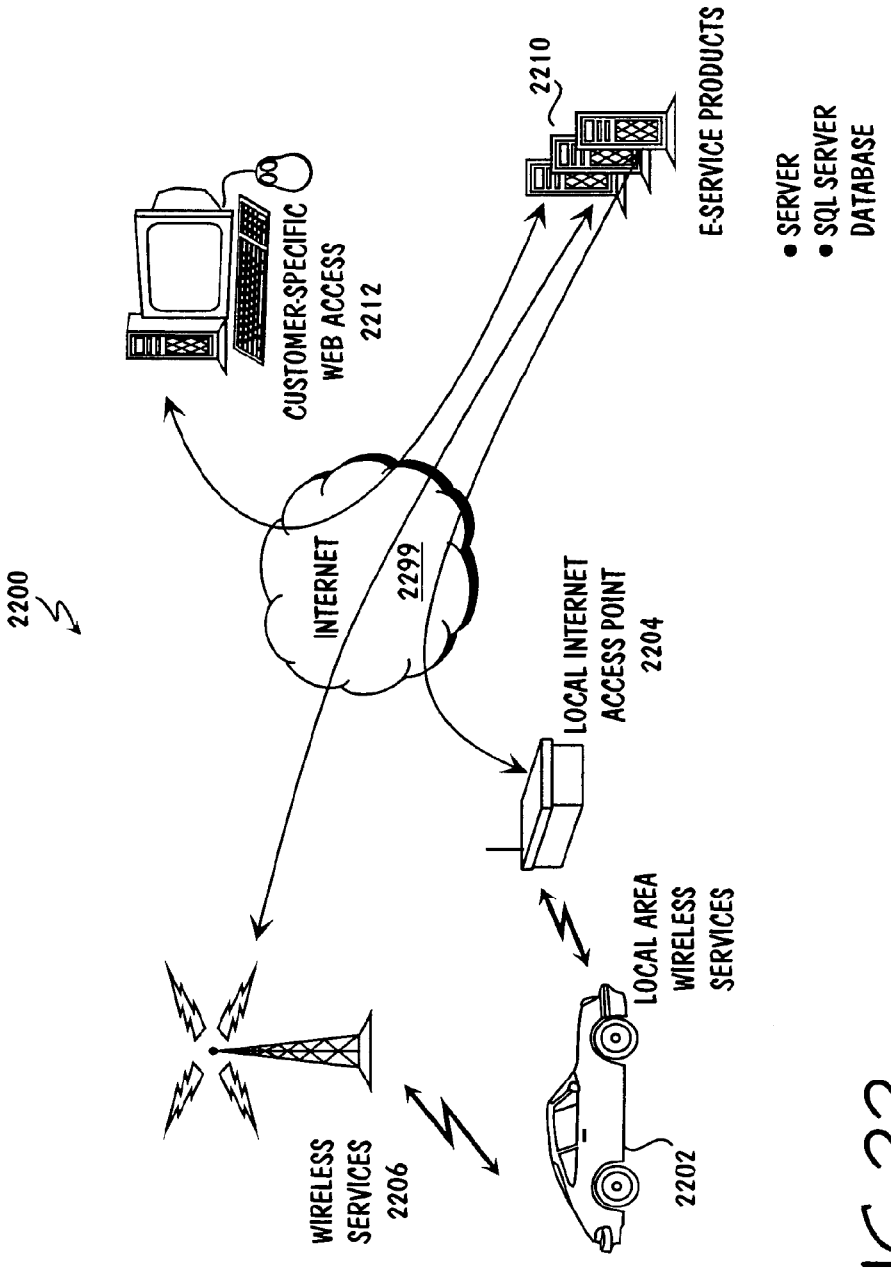

2200
INTERNET
2299
CUSTOMER-SPECIFIC
WEB ACCESS
2212
2210
E-SERVICE PRODUCTS
• SERVER
• SQL SERVER
DATABASE
LOCAL INTERNET
ACCESS POINT
2204
LOCAL AREA
WIRELESS
SERVICES
WIRELESS
SERVICES
2206
2202

FIG. 22

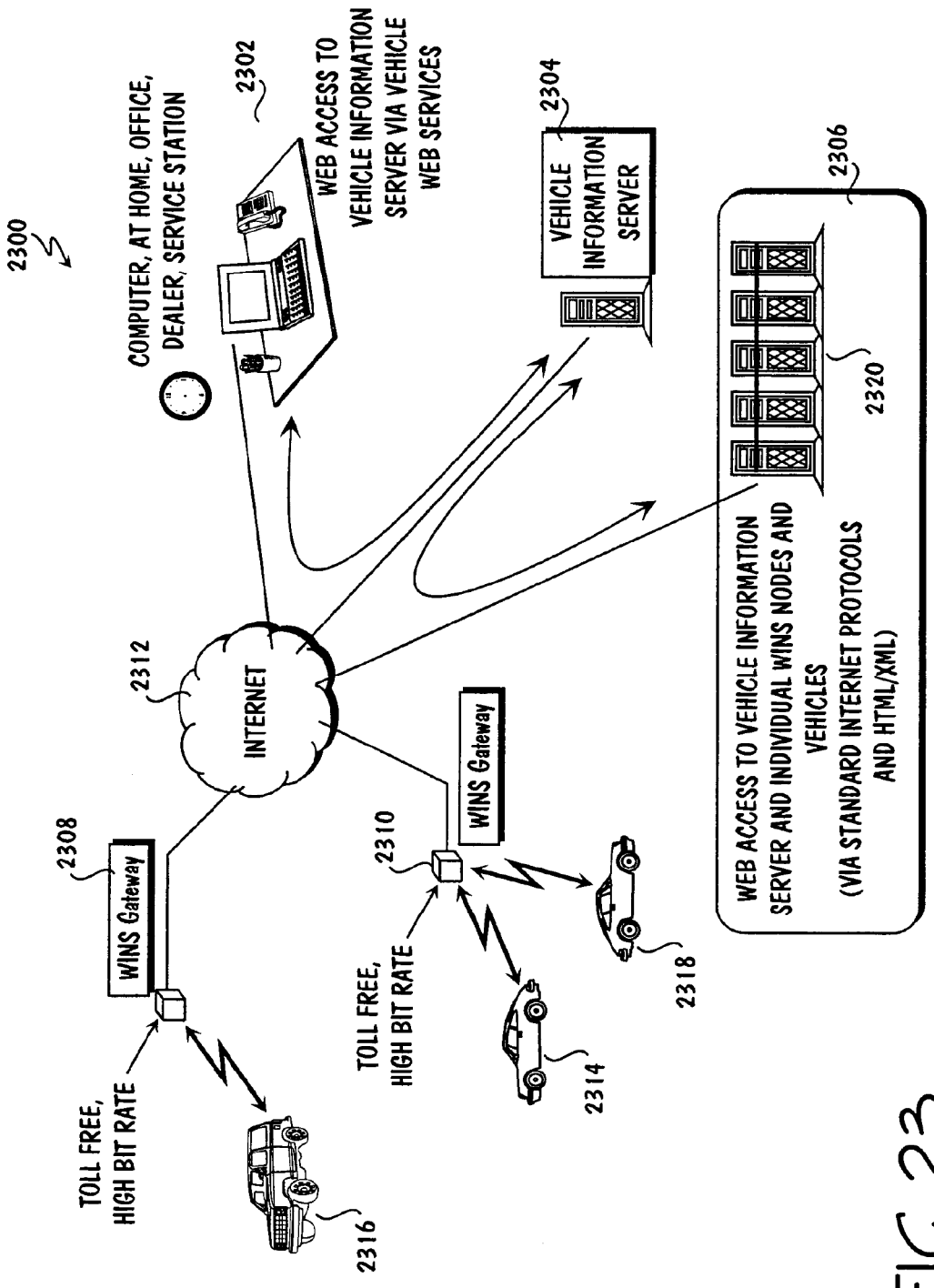

2300
COMPUTER, AT HOME, OFFICE, DEALER, SERVICE STATION
2302
WEB ACCESS TO VEHICLE INFORMATION SERVER VIA VEHICLE WEB SERVICES
VEHICLE INFORMATION SERVER
2304
2306
2320
WEB ACCESS TO VEHICLE INFORMATION SERVER AND INDIVIDUAL WINS NODES AND VEHICLES (VIA STANDARD INTERNET PROTOCOLS AND HTML/XML)
2312
INTERNET
WINS Gateway
2310
WINS Gateway
2308
TOLL FREE, HIGH BIT RATE
TOLL FREE, HIGH BIT RATE
2316
2314
2318

FIG. 23

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 August 2001 (02.08.2001)

PCT

(10) International Publication Number
WO 01/55690 A1

(51) International Patent Classification[7]: G01M 15/00

(21) International Application Number: PCT/US01/02546

(22) International Filing Date: 25 January 2001 (25.01.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/492,264 27 January 2000 (27.01.2000) US

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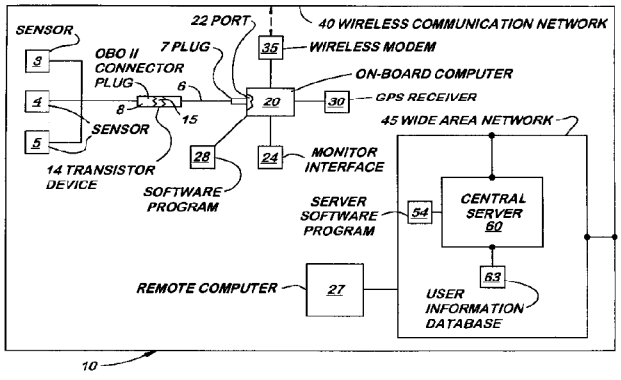
(81) Designated States *(national)*: AT, AU, BR, CA, CN, DE, DK, ES, FI, GB, JP, KP, MX, NO, NZ, PT, SE.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).

**Published:**
— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: SYSTEM FOR TRANSMITTING AND DISPLAYING MULTIPLE, MOTOR VEHICLE INFORMATION




(57) Abstract: A system (10) for transmitting, collecting and displaying diagnostic and operational information from one or more motor vehicles to a central server (60) connected to a wide area network (45). The system (10) is designed to be used with an existing on-board diagnostic system found in most motor vehicles manufactured today. The system (10) includes a translator device (14) capable of translating the codes from an on-board diagnostic connector (8) into computer readable file such as ASCII files. The translator device (14) may be connected to an on-board computer (20) that includes a wireless modem (35) capable of connecting to a wireless communication network (40) and eventually to a wide area network (45). A central server (60) is connected to the wide area network (45) which receives and stores information from the on-board computer (20). Authorized users may connect to central server (60) via the wide area network (60) and request information therefrom regarding selected motor vehicles. All of the information may be presented in a single interface.

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# TITLE: SYSTEM FOR TRANSMITTING AND DISPLAYING MULTIPLE, MOTOR VEHICLE INFORMATION

## TECHNICAL FIELD

This invention relates to methods of presenting multiple, mobile wireless communications network service information, and more particularly, to systems for transmitting and displaying multiple motor vehicle information.

## BACKGROUND ART

On-board computers coupled to a wireless communications network service are now available that enable manufacturers of motor vehicles to obtain useful information regarding the motor vehicle. Typically, these on-board computers are electrically connected to sensors located in various systems in the motor vehicle that instantaneously report the status or condition of the system. Manufacturers of motor vehicles can connect to the on-board computer via the mobile, wireless communication network to obtain information from the motor vehicle anywhere within the region covered by the wireless communication network.

Recently, it has been reported that on-board computers can now be used by motor vehicle operators to download and upload information from a central server connected to a wide area network such as the World Wide Web via the mobile, wireless communications network. Using the on-board computer, an operator can now obtain e-mail messages or other important information from any other servers connected to the wide area network.

Many motor vehicle drivers own motor vehicles manufactured by different manufactures. Unfortunately, no standard computer program has been developed which can interact with all on-board computers used in every motor vehicle. This creates a large burden for the operator of multiple motor vehicles to understand and learn to operate every computer and program.

On-board diagnostic systems are used today in most cars and light trucks. To meet federal EPA emission standards implemented in the 1970's, motor vehicle manufacturers started using electronic devices to control engine functions such as fuel feed, ignition, and to diagnose engine problems.

Initially, motor vehicle manufacturers had their own systems which were not

compatible. In 1988, the Society of Automotive Engineers (SAE) set standards which included a standard connector plug and a set of diagnostic test signals that dealer's used when adjusting or repairing the motor vehicle. Although motor vehicle manufacturers may used a uniform set of test signals, the meaning of these test signals is proprietary. The standard connector plug and set of test signals, today, is known collectively as OBD-II which applies to all cars and light trucks built after January 1, 1996. It is anticipated that new on-board diagnostic connectors (i.e. OBD-III) will be developed in the future.

Translator devices, also known as diagnostic scanners, are available that connect to the OBD-II connector plug and translate the diagnostic test signals into ASCII files capable of being used by a personal computer. One translator device, known as AUTOTAP, is available from B&B Electronics Manufacturing Company, of Ottawa, IL. Using this device, independent mechanics are able to connect to the OBD-II connector plug and obtain factory diagnostic service code information. What is needed is a system for operators of motor vehicles to easily obtaining motor vehicle diagnostic and operating information and store this information in a location for later retrieval.

What is also needed is such a system that enables operators to obtain information remotely for a plurality of motor vehicles and then present this information in a concise manner on a single interface.

## DISCLOSURE OF THE INVENTION

It is an object of the present invention to provide a system for collecting and transmitting diagnostic and operation motor vehicle information to a central computer for real time or later retrieval.

It is another object of the present invention to provide such a system that collects and transmits motor vehicle information from a plurality of motor vehicles in remote locations and collects the information on a central server.

It is a further object of the present invention to provide such a system that enables the information to be presented in a single interface.

These objects and other objects are met by a system designed to be used with motor vehicles that use sensors and an on-board diagnostic system , such as OBD-II, that enables users to review real time and historical diagnostic and performance

information data for one motor vehicle or a plurality of motor vehicles. The system includes the use of a translating means that connects to the motor vehicle's on-board diagnostic system. In one embodiment, the translating means is a separate translator device designed specifically to connect to a commonly used OBD-II connector plug. The translator device includes a translator program capable of translating the proprietary diagnostic test signals into diagnostic service codes presented in a standard computer language, such as ASCII files, to be used by an electronic device, hereinafter called an on-board computer.

The on-board computer is connected to a wireless communication means that continuously or intermittently transmits the ASCII files to a central network server connected to a wide area network, such as the INTERNET. The central network server collects the ASCII text files in a user database file. Authorized users, such as the owner of the motor vehicle or representatives of the motor vehicle manufacturer may connect to the central network server and receive real time data or historical information from the user's database file.

An important aspect of the system is that information from multiple motor vehicles may be collected and transmitted to the central server for retrieval by authorized users. A second important aspect is that the system may be used with all motor vehicles that use EPA-mandated diagnostic codes, translating manufacturer's proprietary diagnostic service codes, and provides real time performance data. A third important aspect is that operators can obtain this information anywhere they have access to the wide area network and have it presented in a single interface.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic of the system showing the relationship between the different motor vehicle manufacturers, the central server, the wide area network, a plurality of different motor vehicles owned by one operator with a motor vehicle computer coupled to various motor vehicle systems, a translator device, an add-on computer with an display interface, and a remote computer with a display interface.

Fig. 2 is a front plan view of a monitor presenting information collected for a plurality of motor vehicles

## BEST MODE FOR CARRYING OUT THE INVENTION

Disclosed herein is a system 10 of transmitting and displaying real time and historical multiple motor vehicle information over a central server 60 connected to a wide area network 45. Authorized users may then connect to the central server 60 to connect the real time or historical information on selected motor vehicles. The system 10 is especially beneficial to operators of multiple motor vehicles, each having factory-installed sensors or computer module which enables the operators to conveniently connect to the wide area network 45 and receive the stored uploaded information for each motor vehicle. The information for all of the motor vehicles controlled by the operation may be conveniently present on one monitor interface as shown in Fig. 2.

The system 10 uses a translator device 14, also known as diagnostic scanners, capable of connected to an existing OBD-II connector plug 8 and translate the diagnostic test signals into ASCII files capable of being used by a personal computer. One translator device 14, known as AUTOTAP, is available from B&B Electronics Manufacturing Company, of Ottawa, IL. Each motor vehicle that uses the system 10 must have a translator device 14 that connects to the OBD-II plug connector 8. The translator device 14 includes an output cable 6 and plug 7 that connects to a RS 232 (COM) port 22 on the on-board computer 20. The translator device 14 includes a microprocessor and custom circuitry (not shown) that translate the signals from the motor vehicle's sensors 3-5 or computer module 7 to ASCII text file capable to being used by the on-board computer 20.

The on-board computer 20 may be a hand-held device, a lap-top computer, or a PDA. Each on-board computer 20 is coupled to a wireless communication means, such as a wireless modem 35, which transmits the diagnostic and performance information and other useful information over a wireless communication network 40 to the central server 60 connected to a wide area network 45. The central server 60 collects the uploaded information from an on-board computer 20 located in one motor vehicle or in a plurality of motor vehicles located in the region.

The on-board computer 20 may also be coupled to an optional physical location detection means capable of instantaneously determining the physical location, heading, and elevation of the on-board computer 20, and hence, the motor vehicle. In the preferred embodiment, the physical location detecting means is a

global positioning system (GPS) receiver 30. The GPS receiver 30 is able to immediately establish the monitoring electronic device's global position, (i.e. latitude, longitude, elevation), heading, and velocity.

The GPS is a location system based on a constellation of twenty-four satellites orbiting the Earth at altitudes of approximately 11,000 miles. The GPS satellites provide accurate positioning information twenty-four hours per day, anywhere in the world. The GPS uses a receiver that stores orbit information for all GPS satellites. During use, the receiver determines the time and the positions of the overhead satellites and then calculates the amount of time it takes a GPS radio signal to travel from the satellites to the receiver. By measuring the amount of time it takes for a radio signal to travel from the satellites, the exact location of the GPS receiver can be determined. GPS receivers 30 are available from Corvallis Microtechnology, Inc., in Corvallis, Oregon. It should be understood however, that other means for automatically determining the user's physical location could be used.

In the preferred embodiment, the system 10 uses GPS receivers 30 that are 3-D coordinate receivers that require a minimum of four visible satellites. It should be understood, however, that the system 10 could be used with 2-D coordinate receivers, which require a minimum of three satellites. The 3-D coordinate receivers are preferred, since they will continue to provide 2-D coordinate information when their views are obstructed by trees, mountains, buildings, etc.

A critical component of the system is the client-side software program 28 loaded on each on-board computer 20. The software program 28 collects the information from the translator device 14 and the GPS receiver 30 and transmits it via the wireless modem 35 to the wireless communication network 40. The client-side software program 28 must be able to communicate with the server software program 54 located in the central computer 60. When the user initially logs into the system 10, the client-side software program 28 also transmits the user identification information such as the user's name and password.

Another important function of the client-side software program 28 is also used to display a standard interface is then created which displays the translated information to the operator. The interface can then be used to review all of the data stored in the central server 60 thereby providing a complete review of all of the sensors 3-5 used in the motor vehicles under the operator's control. The client-side

software program 28 can also be loaded into remote computers to enable the operator to obtain information regarding the motor vehicles. .

As discussed above, the central server 60 is connected to the wide area network 45 and is able to communicate with a plurality of on-board computers 20 also connected to the wide area network 45. It should be understood that the central server 60 may be one server or a group of servers all connected to the wide area network 45. Loaded into the memory of the central computer 60 or in the memory of each server is the server-side software program 56 capable of uploading and processing data from the client side software program 28 used with each on-board computer 20 and remote computer 27 as shown in Fig. 2. During use, the central server 60 creates a user information database 63 containing all of the user ID information collected motor vehicle information.

In order to download information from the central server 60, the user must submit a request using the client-side software program 28. In order to use the system 10, the user's or on-board computer's network address must be known to the central server 60 so that information may be downloaded thereto. If the central server 60 is also the authorized user's network service provider to the wide area network 45 and a previously established account has been set up on the central server 60, the numerical or temporary address would be known to the central computer 60 when the user signs onto the central server 60. If the user does not have a previously established account on the central server 60, then the client side software program 28 must be used to collect and transfer the account information to the central server 60 each time the user logs onto the central computer 60.

During use, the user's personal information is entered into the client side software program 28. When initial contact is made with the central server 60, the personal information is automatically downloaded to the central server 60. The client side software program 28 may be a proprietary software program, or may be included as an add-on to an existing INTERNET browser software program. After the account information has been confirmed or set up on the central server 60, the users may begin to download and/or upload information from the central server 60.

In compliance with the statute, the invention, described herein, has been described in language more or less specific as to structural features. It should be understood, however, the invention is not limited to the specific features shown, since

the means and construction shown comprised only the preferred embodiments for putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the amended claims, appropriately interpreted in accordance with the doctrine of equivalents.

## INDUSTRIAL APPLICABILITY

This invention has application in the wireless communications industry. More specifically, this invention has application in the communications industry that deal with systems for transmitting and displaying multiple motor vehicle information.

## CLAIMS

We claim:

1. A system (10) for transmitting and displaying diagnostic and performance information for motor vehicles having an on-board diagnostic system, said diagnostic system (10) including a plurality of sensors (3 – 5) capable of transmitting codes indicating the status of component on said motor vehicle, said system (10) comprising:

b. a translating means capable of translating said codes from said sensors (3 – 5) to a computer readable file;

c. a wireless communication means coupled to said translating means capable of communicating with a wireless communication network (40) located around a region;

d. a wireless communication network (40) located around a region;

e. a computer wide area network (45); and,

f. a central computer (60) connected to said wide area network (45), said central computer (60) capable of receiving said translating information from said on-board computers (20) in a region and connected to said wide area network (45) by said wireless communication means (40).

2. The system (10) as recited in Claim 1, further including an on-board computer (20) connected between said translating means and said wireless communication means (40).

3. The system (10) as recited in Claim 1, wherein said translating means is a translator device (14) capable of connecting to said on-board diagnostic system (10) in said motor vehicle.

4. The system (10) as recited in Claim 3, wherein said translating means translates said codes into ASCII files.

5. The system (10) as recited in Claim 2, further including a physical location detecting means (30) coupled to each said on-board computer (20), said physical

location detecting means (30) capable of determining the physical location of said on-board computer (20);

6. The system (10), as recited in Claim 6, wherein said physical location detecting means (30) is a GPS receiver used in a GPS network.

7. The system (10), as recited in Claim 6, wherein said wireless communication means is a wireless modem (35) capable of communicating with said wireless communication network (40).

8. The system (10), as recited in Claim 2, further including a client-side software program (28) loaded into each said on-board computer (20) and a server side software program (56) loaded into said central server to enable said on-board computer to communicate with said central server (60).

9. A system (10) for transmitting and displaying diagnostic and performance information for motor vehicles having an on-board diagnostic system, said on-board diagnostic system including a plurality of sensors capable of transmitting codes indicating the status of components on said motor vehicle, said system (10) comprising:

a. a translating device located in each motor vehicle capable of being coupled to said sensors and capable of translating said codes from said sensors to a computer readable file;

b. an on-board computer (20) connected to said translating device;

c. a wireless communication means coupled to said translating means capable of communicating with a wireless communication network (40) located around a region;

d. a wireless communication network (40) located around a region;

e. a computer wide area network (45); and,

f. a central computer (60) connected to said wide area network (45), said central computer (60) capable of receiving said translating information from said on-board computers (20) in a region and connected to said wide area network (45) by said wireless communication means.

10. The system (10) as recited in Claim 9, wherein said translating means translates said codes into ASCII files.

11. The system (10) as recited in Claim 9, further including a physical location detecting means (30) coupled to each said on-board computer (20), said physical location detecting means (30) capable of determining the physical location of said on-board computer (20);

12. The system (10), as recited in Claim 11, wherein said physical location detecting means (30) is a GPS receiver used in a GPS network.

13. The system (10), as recited in Claim 9, wherein said wireless communication means is a wireless modem (35) capable of communicating with said wireless communication network (40).

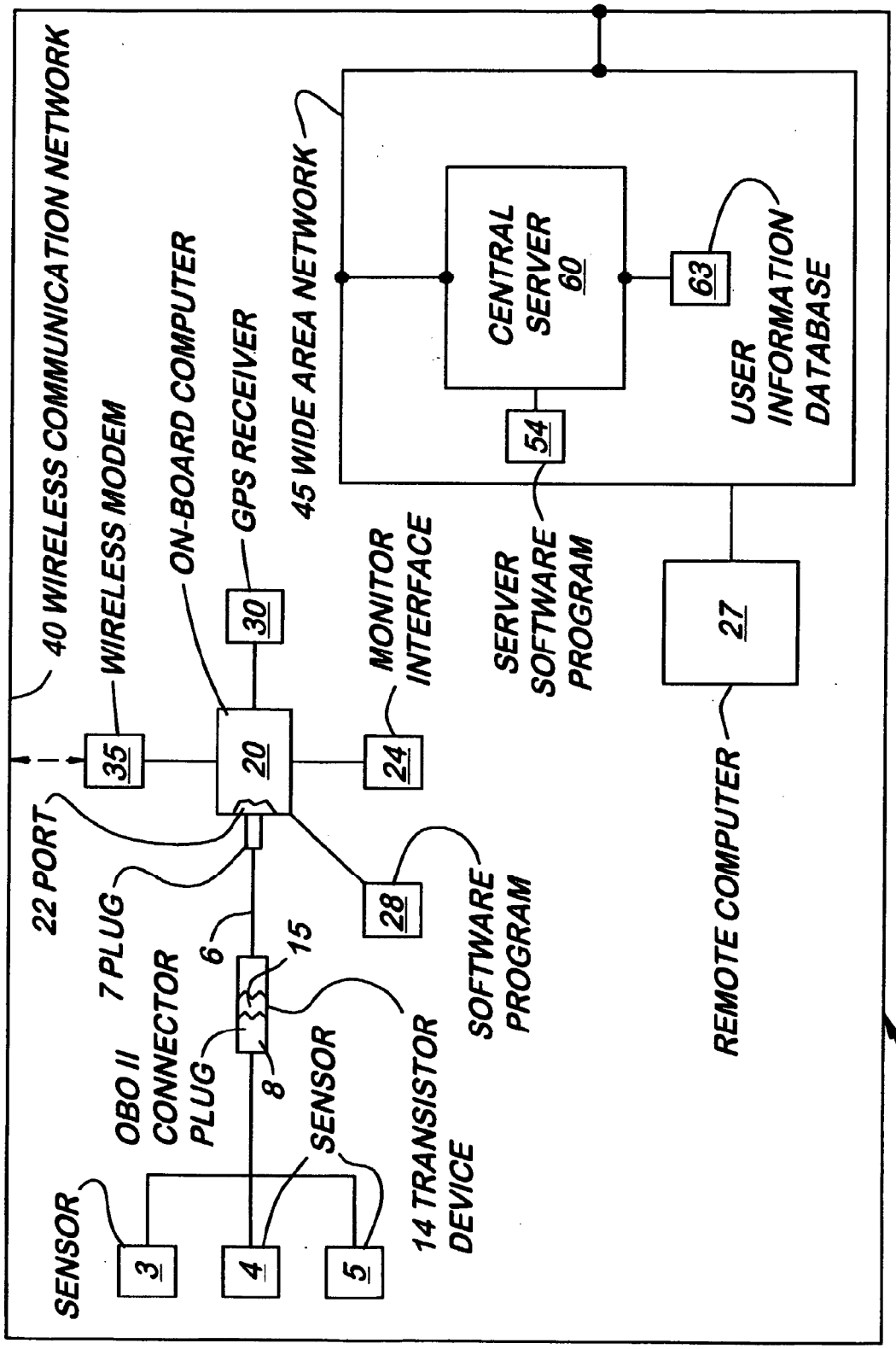
40 WIRELESS COMMUNICATION NETWORK
WIRELESS MODEM
ON-BOARD COMPUTER
GPS RECEIVER
45 WIDE AREA NETWORK
CENTRAL SERVER 60
63
USER INFORMATION DATABASE
54
MONITOR INTERFACE
SERVER SOFTWARE PROGRAM
30
35
20
24
27
22 PORT
7 PLUG
6
15
28
SOFTWARE PROGRAM
REMOTE COMPUTER
OBD II CONNECTOR PLUG
8
SENSOR
14 TRANSISTOR DEVICE
SENSOR
3
4
5
10

FIG. 1

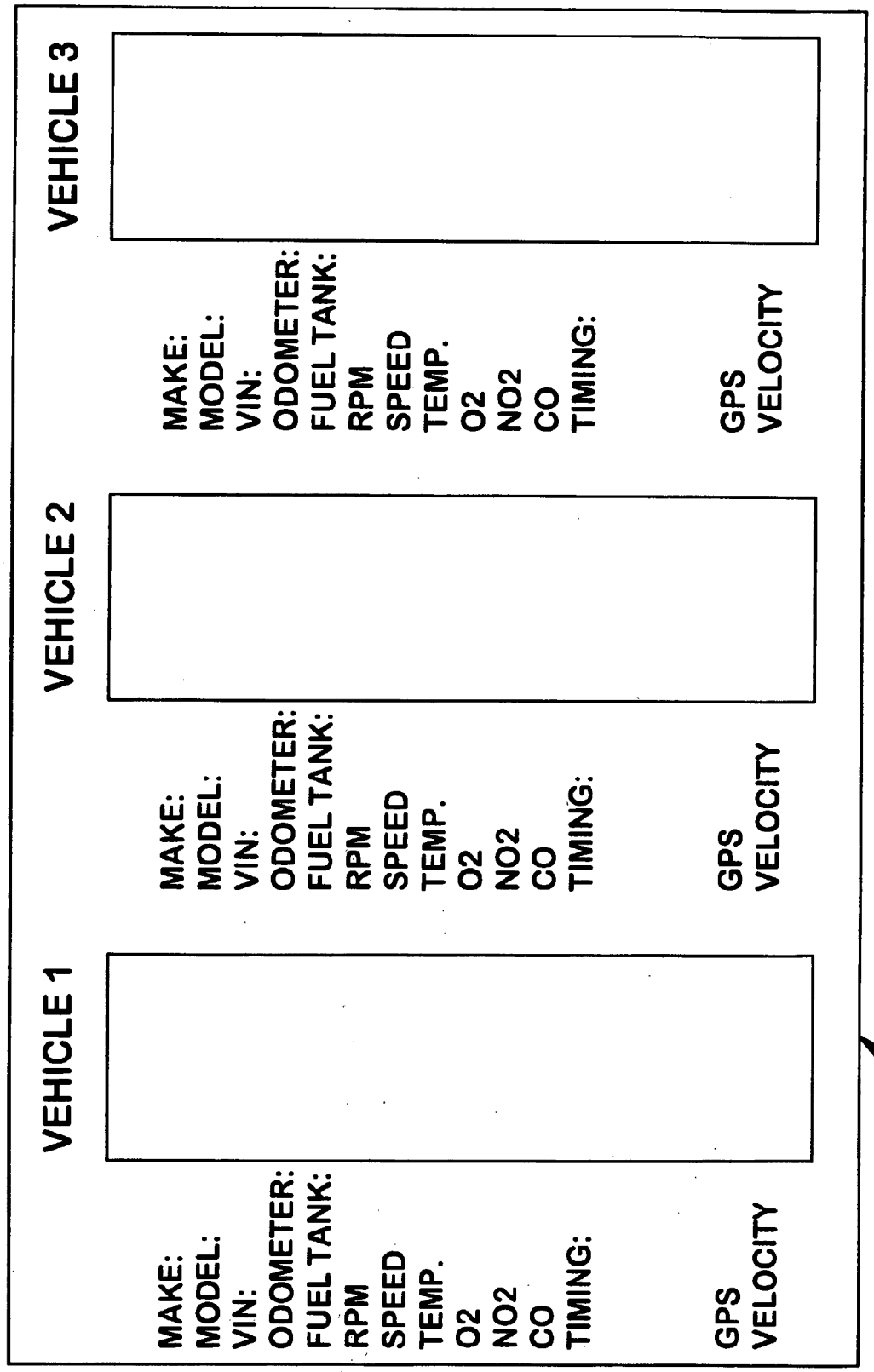
VEHICLE 1
VEHICLE 2
VEHICLE 3
MAKE:
MODEL:
VIN:
ODOMETER:
FUEL TANK:
RPM
SPEED
TEMP.
O2
NO2
CO
TIMING:
GPS
VELOCITY
24

FIG. 2

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/02546

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : G01M 15/00
US CL : 701/33

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 701/33, 36, 200, 213, 24, 35, 1; 340/438,425.5,459,286.02,286.01

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 5,884,202 A (Arjomand) 16 March 1999 (16.03.1999), see entire document. | 1-2 |
| --- | | ----- |
| Y | | 9 |
| Y, P | US 6,141,611 A (Mackey et al.) 31 Octuber 2000 (31.10.2000), see complete document | 6,7,13 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 3/15/01 | **11.04.01** |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703)305-3230 | Authorized officer<br>William A. Cuchlinski Diane Smith<br>Telephone No. (703) 308-1113 |

Form PCT/ISA/210 (second sheet) (July 1998)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 November 2001 (15.11.2001)

PCT

(10) International Publication Number
WO 01/86576 A1

(51) International Patent Classification[7]: G06F 19/00, G06G 7/70

(21) International Application Number: PCT/US01/14747

(22) International Filing Date: 8 May 2001 (08.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/202,419 8 May 2000 (08.05.2000) US

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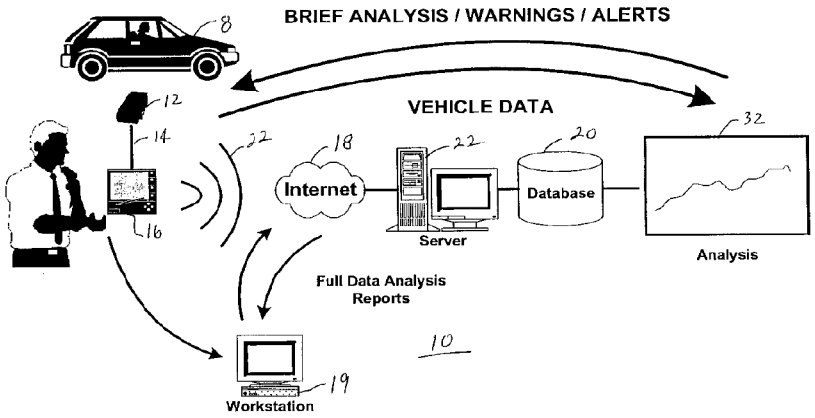
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: MONITORING OF VEHICLE HEALTH BASED ON HISTORICAL INFORMATION




(57) Abstract: A method and apparatus for detecting abnormal behaviour in a vehicle (8) with an engine having engine control module includes providing a database (20), and a vehicle analyser (12) having a communication device (16) and an interface (14) that links the communication device (16) to a vehicle (8). Engine parameters that are retrieved through the interface (14) during driving experience are uploaded to the database (20) using the communication device (16). The database (20) analyses the engine parameters from multiple driving experiences to establish historical data and determine normal operation of particular retrieved engine parameters based on the historical data. A vehicle (8) can be diagnosed by comparing its retrieved engine parameters with the database (20).

WO 01/86576 A1

# MONITORING OF VEHICLE HEALTH BASED ON HISTORICAL INFORMATION

## CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from U.S. provisional patent application Ser. No. 60/202,419 filed on May 8, 2000, the disclosure of which is hereby incorporated herein by reference in its entirety.

## BACKGROUND OF THE INVENTION

In the United States, automotive mechanics are not always viewed as being fully trusted and reliable. Practicality indicates that automotive mechanics typically are not fraudulent, but rather overwhelmed with the complexity of the modern computer-controlled vehicle. With hundreds of parameters dictating a vehicle's performance, it may be difficult to pinpoint the source of the problem regardless of the mechanic's skill level. There has also been decay in the number of households that perform basic maintenance to their own vehicles. The primary reason again relates to the increase in complexity of the modern vehicle.

The problem with the current approach for diagnosis and maintenance is that it is performed in a static manner. Typical diagnosis of a vehicle's performance is based on a single snap shop image of the vehicle's characteristics. Presently, adequate use of vehicle and driving mode specific historical information is not used to assist in this process.

Present diagnostic tools that interface to the vehicle computer will show various sensor data and information. However, aside from actual fault codes from the vehicle, these tools do not contain tolerances for each and every vehicle type and driving conditions for the vast available parameters. As a result, the mechanic must determine from hundreds of available parameters the potential cause of the problem. This requires extensive expertise and references to technical manuals on sensor input and output status for that vehicle type. Ultimately, vehicle maintenance and diagnosis can be complicated and costly, considering the current tools that are available.

Onboard Diagnostics, or OBD, was developed primarily for monitoring the vehicle's emissions control systems by the Engine Control Module (ECM), which will typically display a general warning to the operator when a fault is detected. It also provides a means by which a mechanic or vehicle inspector can access specific fault codes related to engine hardware that can affect emissions and engine performance. The OBD system is accessible via a standardized communications cable and a microprocessor-based device, often referred

to as a scan tool, that implements a standardized communications protocol. Data from onboard sensors can be accessed at a rate of up to 50 Hz.

Prior art includes U.S. Pat. Nos. 5,539,638 to Keeler et al. and 5,625,750 to Puskorius et al. that claim the use of artificial intelligence computer systems that can be trained to predict failure of the catalytic converter and to predict certain emissions levels. Both standard OBD sensors and additional sensors are used to generate inputs into these learning algorithms. Prior systems do not attempt to establish parameters during different driving and vehicle conditions. Instead, generic broad parameters are established covering multiple vehicles and driving conditions. Prior systems also use several parameters in conjunction to predict a certain condition, such as high hydrocarbon emissions.

## SUMMARY OF THE INVENTION

The federal government has mandated that all vehicles sold in the United States shall have a standardized interface to the vehicle's computer. The present invention provides a vehicle analyzer that can be embodied as a microprocessor-based hardware/software package designed to communicate with OBD (onboard diagnostics) computer systems contained in 1996 and later vehicles sold in the United States. The present invention provides a product that is useful for both the consumer and the professional.

A method of detecting abnormal engine behavior in a vehicle, according to an aspect of the invention, includes providing a database, a communication device and an interface to an engine control module and retrieving engine parameters through the interface during a driving experience and uploading the engine parameters to the database using the communication device. The method further includes analyzing the uploaded engine parameters from multiple driving experiences at the database to establish historical data and determining normal operation of particular retrieved engine parameters based on the historical data. The method further includes comparing engine parameters of a vehicle to be diagnosed with the normal operation of particular retrieved engine parameters to determine whether the vehicle to be diagnosed operates outside of the normal operation.

A method of detecting abnormal engine behavior in a vehicle, according to another aspect of the invention, includes providing a database and multiple vehicle analyzers, each of the vehicle analyzers including a communication device and an interface with an engine control module. The method further includes retrieving engine parameters for multiple vehicles that are generally the same type as each other using the multiple vehicle analyzers and uploading the retrieved engine parameters to the database. The method further includes analyzing the uploaded engine parameters from the multiple vehicles to establish historical

data and determining normal operation of particular retrieved engine parameters based on the historical data. The method further includes preparing engine parameters of a vehicle generally of the same type with the normal operation of particular retrieved engine parameters to determine whether the vehicle operates outside the normal operation.

In either of the above-identified methods, the analyzing may include retrieving engine parameters over multiple driving experiences, storing the data over multiple driving experiences into the database and establishing statistical control limits for the particular engine parameters. This may further include establishing statistical control limits for particular engine parameters during various driving conditions which may include idle, steady cruise at various speeds, and various rates of acceleration and deceleration. The particular engine parameters may include critical engine parameters. The historical data may be based on engine parameters retrieved previously from the vehicle to be diagnosed.

In either of the above-identified methods, the uploading may include communicating over either an Internet or an Intranet. The communication may be via wireless communication. The uploading may include communicating over a global network and may further include providing a wireless communication device that is adapted to connect with the database over the global network. The communication device may include browser software and the interface may include an onboard diagnostic interface.

A system for detecting abnormal vehicle engine behavior, according to an aspect of the invention, includes a vehicle analyzer having a communication device and an interface that links the wireless communication device to a vehicle. The system further includes a database system that is separate from the vehicle analyzer. The wireless communication device collects data from the vehicle through the interface scan tool while the vehicle is driven. The database system is programmed to receive data broadcast by the wireless communication device from the scan tool. The database includes normal operation of particular engine parameters based on historical data. The database system compares the collected data to the normal operation of particular engine parameters to determine normal conditions of the vehicle.

A system for detecting abnormal vehicle engine behavior, according to another aspect of the invention, includes a database and a plurality of vehicle analyzers, each including a communication device and an interface that links the communication device to a vehicle. The communication device is adapted to upload to the database engine parameters retrieved by the interface. The database is adapted to analyze the retrieved engine parameters uploaded from a plurality of vehicle analyzers to establish historical data among vehicles that are

generally of the same type and to determine normal operation of particular retrieved engine parameters based on historical data. The database is further adapted to compare engine parameters of a vehicle generally of the same type with the normal operation of particular retrieved engine parameters to determine whether that vehicle operates outside of the normal operation.

Either of the above-identified systems may further include determining the normal operation of particular engine parameters from data retrieved from multiple previous driving experiences. The communication device may include a wireless communication device, such as a cellular telephone or a personal digital assistant. The wireless communication device may include a radio frequency transmitter. The vehicle analyzer may include a data port for uploading data to a computer for subsequent uploading to the database at a later time. The communication device may be adapted to operate on a global network, such as an Internet or an Intranet, and may further include browser software. The database system may establish statistical control limits for particular engine parameters during various driving conditions which may include idle, steady cruise at various speeds, and various rates of acceleration and deceleration. The particular engine parameters may include critical engine parameters.

The present invention utilizes a technique to characterize normal limits for individual engine parameters and provides a means by which to detect when said parameters begin to operate outside normal levels for certain operating conditions. While the ECM contains limits on some engine parameters, these are typically gross limits that apply to all operating conditions, and vehicle age or mileage combined. The present invention provides a much narrower tolerance of what is considered normal operation of engine parameters to facilitate diagnosis of actual and imminent engine failure. This invention, therefore, provides a means of early detection of failure of specific components.

A vehicle analyzer, according to more detailed aspects of the invention, obtains information from the vehicle's computer to track critical engine parameters and reports any problems or potential problems to the user. The vehicle analyzers pass information from a large number of vehicles to a database that uses statistical modeling to "learn" typical performance of these critical engine parameters under various driving conditions, including idle, steady cruise, accelerations, and decelerations. Once a sufficient statistical database is established, the vehicle analyzer in conjunction with the database can diagnose a vehicle under driving conditions. The operating condition, including any abnormal behavior that could indicate or eventually lead to a failure of one or more engine components, can be determined with the use of either historical or reference information. The vehicle analyzer

will also translate any specific fault codes stored in the onboard computer system to useable information for the user in order to diagnose and repair the vehicle.

The vehicle analyzer and database, according to an aspect of the invention, is a system that implements a method of tracking and monitoring a vehicle's health based on historical statistical information, rather than only instantaneously accessing the vast diagnostic information available on vehicles. As a result, vehicle maintenance and diagnosis can be simplified such that the consumer has a tool that permits him or her to know when something has failed or is about to fail by comparing an individual vehicle's diagnostic information with the comparable data of the same vehicle fleet. It also assists the mechanic in repairing the vehicle back to the fault-free condition. The historical parameters also serve as a reference for the effectiveness of the repair on a broad range of parameters. The vehicle analyzer is able to gather significant data and establish tighter acceptable operating parameters based on the vehicle's history that allows early detection of problems.

In addition, the vehicle analyzer can be used to assess the health of a vehicle before it is purchased. In this case, the vehicle analyzer system is used in conjunction with the database that contains data on other vehicles of the same type. This can provide a more objective analysis by the consumer prior to the purchase of a modern vehicle.

The primary advantages of this system include its low cost and early detection of problems resulting from tight tolerances. It also provides simplification of diagnosis. The invention may be used for repair verification and objective purchase analysis.

These and other objects, advantages and features of this invention will become apparent upon review of the following specification in conjunction with the drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a system for detecting abnormal engine behavior, according to the invention; and

Fig. 2 is a flowchart of a method of detecting abnormal engine behavior, according to the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now specifically to the drawings, and the illustrative embodiments depicted therein, a system 10 for detecting abnormal engine behavior of a vehicle 8 based on historical information is provided including a vehicle analyzer, such as an OBD scan tool hardware device 12 having a connector, or data port, 14 to link to a wireless Internet ready communication device, such as a cellular telephone 16, a personal digital assistant (PDA), or the like. Wireless Internet ready phone 16 includes an Internet browser to connect, via a

wireless data link 22, to a global network, such as the Internet or an Intranet 18. A master database 20 and application software are run on a computer 22 connected with Internet or Intranet 18.

In operation, system 10 is linked to vehicle 8 to collect data. Vehicle analyzer 12 interfaces with the Engine Control Module (ECM) on a vehicle via standardized communications protocol, connector and hardware that is adapted to link to the data port of wireless Internet ready phones 16. Application software allows for communication between the wireless Internet ready phone 16 and the vehicle onboard computer.

A method 34 of detecting abnormal engine behavior of vehicle 8 begins at 26 by initiating data link 22 when performing a diagnosis or to generate or maintain the personal vehicle data on a predetermined frequency. The operator will be instructed to perform regular data acquisitions at a certain time interval, so parameters can be monitored with statistical tools. While the user drives the vehicle in a normal fashion (28), the vehicle analyzer will collect, process, and transmit data (30) on critical engine components to the master database. The engine parameters that will be tracked may include, but are not limited to, exhaust gas oxygen (both upstream and downstream of the catalytic converter), mass airflow, engine coolant temperature, engine rpm, and operating controls, such as degree of spark advance and degree of exhaust gas recirculation. This data will be sampled during various driving conditions and processed in such a way as to establish a database for certain operating conditions. These conditions include idle, cruise at various speeds, and various rates of acceleration and deceleration.

System 10 analyzes the data at 32. The vehicle analyzer will use Statistical Process Control (SPC) tools and trend-modeling analysis to analyze data-based vehicle history. When the master database of information at this condition is sufficiently large, upper and lower control limits are established based on statistical analysis of the master database. This establishes normal operation of particular retrieved engine parameters. This may include the mean and standard deviation of the database.

The application software at the master database compares the retrieved engine parameter (34) and determines if there are any trends in this data or if data is outside statistical limits. This would suggest a change in the operation of the engine, which may be an early detection of some component failure. If a problem is detected (36), the master database notifies (40) the operator and suggests how to further diagnose the problem, such as by sending a message, voice or data, to the wireless Internet ready phone. This message can also be sent by E-mail, facsimile, or mail. The same process can be performed on other

critical engine parameters and other operating conditions. If no problem is detected (38), the retrieved data can be used to further update the database of engine parameters.

System 10 may also analyze vehicle data based on data from vehicles of the same type and condition as the vehicle being analyzed. The vehicle analyzer may further have the ability to connect to a global network, such as the Internet or Intranet, to exchange data and information for the purpose of vehicle maintenance, diagnosis or purchase. In particular, the vehicle analyzer has the capability to connect to the Internet or an Intranet to upload vehicle data to the Internet/Intranet server system. Upon connection to the server system, the vehicle analyzer transmits all local vehicle data and information. At this time, the vehicle analyzer can request data on vehicles of the same type. Each connection increases the master database information. Data port 14 may also be connected with a computer 19 for uploading data retrieved by vehicle analyzer 12 at a later time. Computer 19 may also receive notifications (36) from database 20.

The master database may use variance analysis algorithms to perform analyses based on data from other vehicles of the same type. Data on the same vehicle type acquired from the database system may be used to compare to the consumer collected vehicle data. This will allow for a consumer to compare the sensor outputs from a properly operating vehicle to a vehicle being purchased. It also may be used to determine the source of the problem when performing vehicle diagnosis. Detailed comparisons and analyses are performed at the master database. The results can be sent and made available to the consumer in many different ways, such as wireless messaging, facsimile, E-Mail, web site, etc.

Example

An example of the invention used to evaluate the vehicle's oxygen ($0_2$) sensor follows. Data collected on that vehicle, whether continuous or discrete, is modeled in the same manner as the $O_2$ sensor described below to achieve the most effective early detection and diagnosis. Data is gathered from the vehicle using vehicle analyzer 12 based on an Internet ready wireless device, such as an Internet ready cellular phone 16. Data is sent to the main database 20. The application software at the main database analyzes $O_2$ data. Driving conditions, such as the vehicle is warm/cold or accelerating/decelerating/cruising/ idling, are determined for sets of data collected by looking at vehicle speed, engine coolant temperature, engine rpm, calculated vehicle load and much more. Data within a driving event may have different conditions from start to end, since a cold car will warm up over time. Vehicle condition can be affected by factors such as age, faulty condition, etc. For a given vehicle and given driving conditions, the vehicle analyzer evaluates $O_2$ parameters such as:

i. Time between transitions
ii. Min sensor voltage
iii. Lean to rich switch time
iv. Rich to lean switch time
v. Lean to rich threshold
vi. Rich to lean threshold
vii. High sensor voltage and low sensor voltage

Acceptable and actual decay rate of a sensor are modeled to achieve the tightest tolerances established utilizing SPC modeling tools. Since data of the same type, based on same vehicle and driving condition, is available in the master database, the resultant data-set will have a normal distribution allowing hypotheses testing for significant difference by utilizing analysis of variance design and analysis.

Changes and modifications in the specifically described embodiments can be carried out without departing from the principles of the invention which is intended to be limited only by the scope of the appended claims, as interpreted according to the principles of patent law including the doctrine of equivalents.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of detecting abnormal behavior in a vehicle having an engine with an engine control module, said method comprising:

providing a database, a communication device, and an interface to an engine control module;

retrieving engine parameters through said interface during a driving experience and uploading the retrieved engine parameter to said database using said communication device;

analyzing the uploaded engine parameters from multiple driving experiences at said database to establish historical data and determining normal operation of particular retrieved engine parameters based on the historical data; and

comparing engine parameters of a vehicle to be diagnosed with said normal operation of particular retrieved engine parameters to determine whether the vehicle to be diagnosed operates outside of the normal operation.

2. The method of detecting abnormal engine behavior of claim 1 wherein said analyzing includes retrieving engine parameters over multiple driving experiences, storing the data over multiple driving experiences into a database, and establishing statistical control limits for the particular engine parameters.

3. The method of detecting abnormal behavior of claim 2 including establishing statistical control limits for particular engine parameters during various driving conditions.

4. The method of detecting abnormal behavior of claim 3 wherein the various driving conditions include idle, steady cruise at various speeds, and various rates of acceleration and deceleration.

5. The method of detecting abnormal behavior in claim 1 wherein said particular engine parameters comprise critical engine parameters.

6. The method of detecting abnormal behavior in claim 1 wherein said historical data is based on engine parameters retrieved prior to said comparing from the vehicle to be diagnosed.

7. The method of detecting abnormal behavior in claim 1 wherein said uploading includes communicating over one of an Internet and an Intranet.

8. The method of detecting abnormal behavior in claim 1 wherein said uploading includes communicating via wireless communication.

9. The method of detecting abnormal behavior in claim 8 wherein said uploading includes communicating over a global network.

10. The method of detecting abnormal behavior in claim 9 wherein said uploading includes providing a wireless communication device that is adapted to connect with said database over said global network.

11. The method of detecting abnormal behavior in claim 10 wherein said communication device includes browser software.

12. The method of detecting abnormal behavior in claim 1 wherein said interface includes an onboard diagnostic interface.

13. A method of detecting abnormal behavior in a vehicle having an engine with an engine control module, said method comprising:

providing a database and multiple vehicle analyzers, each of said vehicle analyzers including a communication device and an interface with an engine control module;

retrieving engine parameters from multiple vehicles that are generally the same type as each other using said multiple vehicle analyzers and uploading the retrieved engine parameters to said database;

analyzing the uploaded engine parameters from the multiple vehicles to establish historical data and determining normal operation of particular retrieved engine parameters based on the historical data; and

comparing engine parameters of a vehicle generally of said same type with said normal operation of particular retrieved engine parameters to determine whether that vehicle operates outside of the normal operation.

14. The method of detecting abnormal behavior of claim 13 including retrieving engine parameters from multiple driving experiences from said multiple vehicles.

15. The method of detecting abnormal behavior of claim 14 wherein said vehicle analyzer includes an interface to an engine control module and a wireless communication module.

16. The method of detecting abnormal behavior of claim 15 wherein said uploading includes communicating over a global network.

17. The method of detecting abnormal behavior in claim 16 wherein said uploading includes providing a wireless communication device that is adapted to connect with said database over said global network.

18. The method of detecting abnormal behavior in claim 17 wherein said communication device includes browser software.

19. The method of detecting abnormal behavior in claim 13 wherein said analyzing includes retrieving engine parameters over multiple driving experiences, storing the data over multiple driving experiences into a database, and establishing statistical control limits for the particular engine parameters.

20. The method of detecting abnormal behavior of claim 19 including establishing statistical control limits for particular engine parameters during various driving conditions.

21. The method of detecting abnormal behavior of claim 20 wherein the various driving conditions include idle, steady cruise at various speeds, and various rates of acceleration and deceleration.

22. The method of detecting abnormal behavior in claim 13 wherein said particular engine parameters comprise critical engine parameters.

23. A system for detecting abnormal vehicle engine behavior of a vehicle having an engine with an engine control module, comprising:

a vehicle analyzer comprising a communication device and an interface scan tool that links said communication device to a vehicle engine control module;

a database system separate from said vehicle analyzer, said database system being programmed to receive data uploaded by said communication device, said database determines normal operation of particular engine parameters based on historical data;

wherein said vehicle analyzer retrieves data from the vehicle while the vehicle is driven to retrieve engine parameters and uploads the retrieved engine parameters to said database;

said database system compares the collected data to said normal operation of particular engine parameters to determine abnormal conditions of the vehicle.

24. The system for detecting abnormal vehicle engine behavior of claim 23 wherein said database determines normal operation of particular engine parameters from data retrieved from the vehicle being diagnosed over multiple previous driving experiences.

25. The system for detecting abnormal vehicle engine behavior of claim 23 wherein said communication device comprises a wireless communication device.

26. The system for detecting abnormal vehicle engine behavior of claim 25 wherein said wireless communication device comprises one of a cellular telephone and a personal digital assistant.

27. The system for detecting abnormal vehicle engine behavior of claim 25 wherein said wireless communication device comprises a radio frequency transmitter.

28. The system for detecting abnormal vehicle engine behavior of claim 23 wherein said vehicle analyzer includes a data port for uploading data to a computer for subsequent uploading to said database.

29. The system for detecting abnormal vehicle engine behavior of claim 23 wherein said communication device is adapted to operate on a global network.

30. The system for detecting abnormal vehicle engine behavior of claim 29 wherein said communication device includes browser software.

31. The system for detecting abnormal vehicle engine behavior of claim 23 wherein said database system establishes statistical control limits for particular engine parameters during various driving conditions.

32. The system for detecting abnormal behavior of claim 31 wherein the various driving conditions include idle, steady cruise at various speeds, and various rates of acceleration and deceleration.

33. The system for detecting abnormal behavior in claim 23 wherein said particular engine parameters comprise critical engine parameters.

34. A system for detecting abnormal vehicle engine behavior of a vehicle having an engine with an engine control module, comprising:

a database and a plurality of vehicle analyzers, each including a communication device and an interface that links that communication device to a vehicle, wherein said communication device is adapted to upload to said database engine parameters retrieved by said interface; and

said database is adapted to analyze the retrieved engine parameters uploaded from said plurality of vehicle analyzers to establish historical data among vehicles that are generally of the same type and to determine normal operation of particular retrieved engine parameters based on historical data;

wherein said database is further adapted to compare engine parameters of a vehicle generally of said same type with said normal operation of particular retrieved engine parameters to determine whether that vehicle operates outside of the normal operation.

35. The system for detecting abnormal vehicle engine behavior of claim 34 wherein said communication device comprises a wireless communication device.

36. The system for detecting abnormal vehicle engine behavior of claim 35 wherein said wireless communication device comprises one of a cellular telephone and a personal digital assistant.

37. The system for detecting abnormal vehicle engine behavior of claim 35 wherein said wireless communication device comprises a radio frequency transmitter.

38. The system for detecting abnormal vehicle engine behavior of claim 34 wherein said vehicle analyzer includes a data port for uploading data to a computer for subsequent uploading to said database.

39. The system for detecting abnormal vehicle engine behavior of claim 34 wherein said communication device is adapted to operate on a global network.

40. The system for detecting abnormal vehicle engine behavior of claim 39 wherein said communication device includes browser software.

41. The system for detecting abnormal vehicle engine behavior of claim 34 wherein said database system establishes statistical control limits for particular engine parameters during various driving conditions.

42. The system for detecting abnormal behavior of claim 41 wherein the various driving conditions include idle, steady cruise at various speeds, and various rates of acceleration and deceleration.

43. The system for detecting abnormal behavior in claim 34 wherein said particular engine parameters comprise critical engine parameters.

1/2

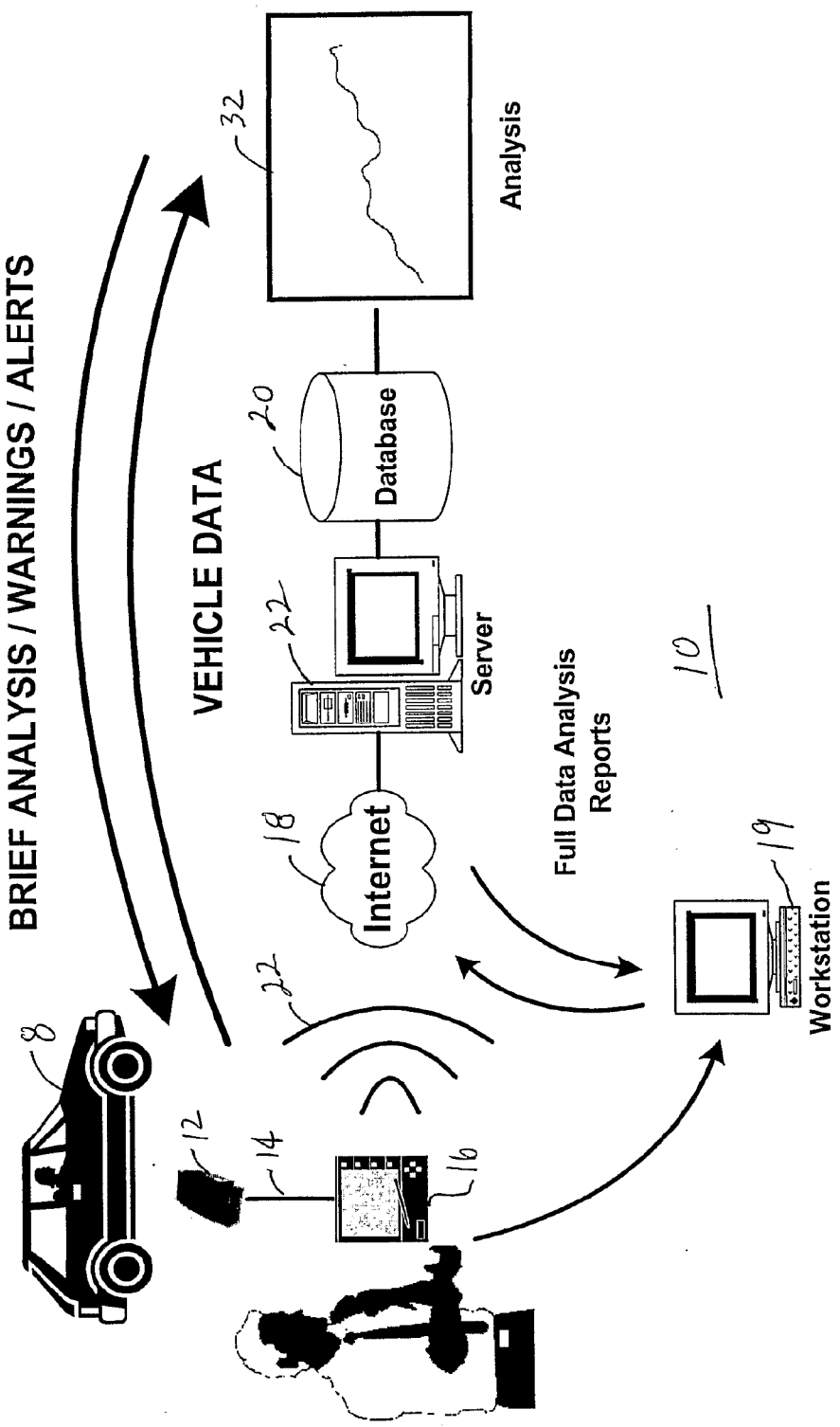

BRIEF ANALYSIS / WARNINGS / ALERTS
VEHICLE DATA
Analysis
32
Database
20
Server
22
Internet
18
Full Data Analysis
Reports
10
Workstation
19
8
12
14
16
22

Fig 1

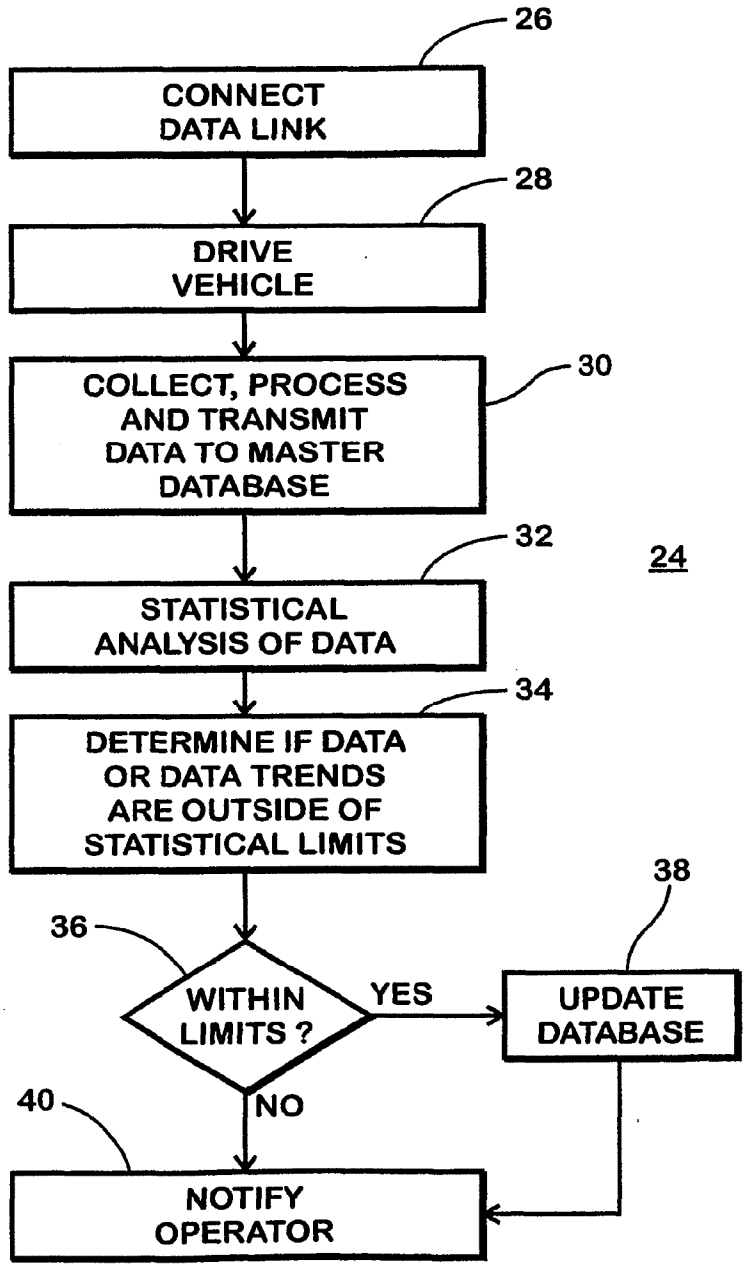

26
CONNECT DATA LINK
28
DRIVE VEHICLE
30
COLLECT, PROCESS AND TRANSMIT DATA TO MASTER DATABASE
32
24
STATISTICAL ANALYSIS OF DATA
34
DETERMINE IF DATA OR DATA TRENDS ARE OUTSIDE OF STATISTICAL LIMITS
36
WITHIN LIMITS ?
YES
38
UPDATE DATABASE
NO
40
NOTIFY OPERATOR

Fig. 2

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/14747

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC(7) : G06F 19/00; G06G 7/70
US CL : 701/114, 29, 33
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 701/114, 29, 33, 101, 102, 115; 340/439, 825.69; 455/456

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 4,602,127 A (NEELY et al.) 22 July 1986 (22.07.1986), abstract, Figures 1, 2. | 22-43 |
| Y | US 5,884,202 A (ARJOMAND) 16 March 1999 (16.03.1999), Figures 1, 6, 8-11. | 22-43 |
| A | US 5,916,287 A (ARJOMAND et al.) 29 June 1999 (29.06.1999), entire document. | 1-43 |
| X, P | US 6,055,468 A (KAMAN et al.) 25 April 2000 (25.04.2000), Figures 1, 2, entire document. | 22-43 |
| A, P | US 6,094,609 A (ARJOMAND) 25 July 2000 (25.07.2000), entire document. | 1-43 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 13 July 2001 (13.07.2001) | 22 AUG 2001 |
| Name and mailing address of the ISA/US<br>Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231<br>Facsimile No. (703)305-3230 | Authorized officer<br>HIEU T. VO<br>Telephone No. 703-308-1951 |

Form PCT/ISA/210 (second sheet) (July 1998)

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US01/14747

**Continuation of B. FIELDS SEARCHED Item 3:** EAST (ver 1.02.0008)search terms: vehicle analyzer, communication links, wireless, database, abnormal conditions.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 March 2006 (16.03.2006)

PCT

(10) International Publication Number
WO 2006/028484 A1

(51) International Patent Classification[7]: G06F 17/60

(21) International Application Number:
PCT/US2005/000914

(22) International Filing Date: 13 January 2005 (13.01.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/936,293 8 September 2004 (08.09.2004) US

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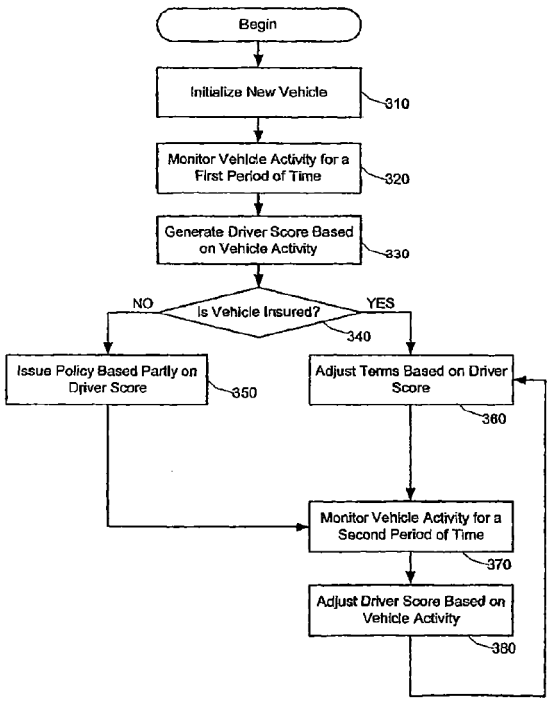
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*

*[Continued on next page]*

(54) Title: CALCULATION OF DRIVER SCORE BASED ON VEHICLE OPERATION




(57) Abstract: The monitored use of a vehicle provides accurate and reliable data that can be used to determine the insurable risk of a vehicle operator. What is disclosed is a system and method for monitoring vehicle operation and using the collected data to calculate a driver score. The driver score can then be applied to ascertain the risk of insuring a particular driver, as well as being used as a tool for defining or adjusting the terms of an insurance policy for an insured driver. The collection of data such as the times the vehicle is operated, the locations the vehicle is operated and the speeds or other characteristics of how the vehicle is operated can all be used to calculate the driver score. By installing a vehicle monitor within a vehicle and extracting this or similar data, more accurate and profitable insurance policies can be developed.

WO 2006/028484 A1

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# CALCULATION OF DRIVER SCORE BASED ON VEHICLE OPERATION

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not applicable.

## STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

## REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

[0003] Not applicable.

## BACKGROUND OF THE INVENTION

[0004] The present invention is directed towards data acquisition and processing of information related to various driver characteristics and, more particularly to collecting driver characteristic data and generating and driver score based on the collected driver characteristic data. The driver score can then be applied in the calculation of insurance premiums or risk analysis.

[0005] The insurance industry can be likened to an evening at a Las Vegas Black Jack table. The casino has picked the game and established the rules in such a manner that statistically over a period of time, the casino will win. Sure, some individual tourist will walk away with hundreds or thousands of dollars; however, compared to the number of visitors that leave tens, hundreds, thousands, and even tens or hundreds of thousands of dollars behind, these infrequent winners are negligible. This is quite evident upon staying at one of the casinos and viewing the elaborate

decorations, the granite tiling in the bathrooms, the reduced pricing for food and of course, the open bar for active gamblers.

[0006] How does this relate to the insurance industry? Similar to the odds setters in Las Vegas, insurance companies have their own odds setters. The odds setters in the insurance industry include highly compensated and highly educated and trained actuarial scientists. The actuarial scientists acquire and analyze large amounts of varied data that is even remotely related to the calculation of insurance risks, and apply the results of this analysis in the calculation of insurance premiums. The task faced by the actuarial scientists is to derive insurance premiums for a large domain of individuals that in the long run, will result in the amount of premiums collected by the insurance company to be significantly larger than the amount of required insurance payouts.

[0007] Traditionally, the insurance industry generates individual policies that are more likely than not to be profitable to the insurance company. The various aspects of the policies include premiums, deductibles, exclusions, liability limitations, etc. The policies are developed based on various characteristics of the individual seeking the policy, the characteristics of the general populous, and the characteristics of categories of the general populous that may be applicable.

[0008] In the automotive insurance industry, the data related to the various characteristics of the individual are gathered through the use of standard forms, personal interviews, obtaining the applicant's public motor vehicle driving record maintained by governmental agencies or a combination of any of these methods. This data results in a classification of the applicant to a broad actuarial class for which insurance rates are assigned based upon the empirical experience of the insurer. Many factors are relevant to such classification in a particular actuarial class. These factors can include age, sex, marital status, vehicle type, vehicle color, location of residence, driving record including accidents, past insurance claims, at fault accidents, types of losses covered, liability levels desired, inclusion of uninsured motorists, inclusion of comprehensive coverage, inclusion of collision coverage, deductibles, etc. Some of these classifications can be further sub-divided into additional sub-classes, such as age ranges, and vehicle types (i.e., trucks, sports cars, sedans).

[0009] Similar to the goal of the Las Vegas Black Jack table attracting patrons, the insurance companies need to provide competitive pricing of their insurance policies. However, the insurance companies walk a fine line between offering competitive pricing while maintaining viable operating profits. Thus, insurance companies continually seek ways in which to provide competitive pricing without compromising their profit margins. Presently, some insurance companies address this need

by providing discounts and surcharges for some types of use of the vehicle, equipment on the vehicle, and type of driver. For instance, the insurance company my add surcharges if the vehicle is being used for business. Likewise, the insurance company may provide discounts for vehicles that include airbags, antilock brakes, and theft deterrent devices, or if the driver has a good driving record or is a good student.

[0010] However, the insurance industry is faced with significant problems based on their current methodologies. For instance, the information obtained by the insurance company is time constrained. As and example, an insured party may live in a large city when obtaining the policy and subsequently move to the suburbs. Or the insured party may change jobs and consequently have a drastic change in the number of miles traveled during an insurance policy period. Unless the insured party notifies the insurance company regarding the address change, the expected mileage change or other such parameters, the insured party may end up paying a higher premium than would otherwise be available. Thus, the insurance company is vulnerable to churn based on lower premiums that may be offered by a competitor. In addition, the information collected by the insurance company may not be verifiable, and even existing public records may include limited or erroneous information. Thus, there is a need in the art for a more reliable and non-time sensitive mechanism for collection of information regarding the insured party.

[0011] Techniques have been suggested for addressing this problem in the art, such as the use of vehicle operating data recording systems. Such systems reside within a vehicle, measure various operating parameters, and report the information to a central recording system. In addition, the use of wireless or radio transmission of the data to the central recording system has also been suggested. However, there are no methods of applying this information in the insurance industry in an effort to improve the competitive nature of the insurance policy offerings. Thus, there is a need in the art for a method to identify pertinent vehicle operation information to be collected and to apply the collected information in a manner to generate a score that identifies the risks or insurability of a driver.

## BRIEF SUMMARY OF THE INVENTION

[0012] The present invention addresses these needs in the art, as well as other needs that are not herein identified, by providing a system and method for monitoring the use of a vehicle and calculating a driver score based on the monitored use. The driver score can then be applied in a

variety of manners to achieve a variety of results, including but not limited to, determining or adjusting the terms of an insurance policy, such as changing the premium, the deductibles, the exclusions, the duration or the like. More specifically, a vehicle monitor is installed or coupled to a vehicle to be monitored. The vehicle monitor collects data from various sensors to identify vehicle operation data. Based at least in part on the vehicle operation data, a driver score is calculated and then the driver score is applied in setting or modifying the terms of the insurance policy either on a retroactive basis or on a forward looking basis.

[0013] In one embodiment of the invention, the vehicle monitor may be used to determine a driver score that serves as input for calculating the terms of a new insurance policy. In another embodiment, the vehicle monitor may be used to determine a driver score that serves as input for modifying the terms of an existing insurance policy. In another embodiment, the driver score can be used to determine whether a party qualifies for insurance.

[0014] The vehicle monitor may operate to collect a variety of information or operating parameters including the times during which the vehicle is operated, the geographic areas or sub-areas within which the vehicle is operated and the speeds at which the vehicle is operated. Other parameters could also be monitored by the vehicle monitor and all or only subsets of this information may be used in the determination of the driver score.

[0015] The determination of the driver score can be accomplished by the vehicle monitor, by a central system or by a combination of both. In addition to the driver score, other extrinsic data such as claim propensities, vehicle types, driver records and demographics may also be used in determining or adjusting the terms of the insurance policy. In addition, this extrinsic data may also be applied in the calculation of the driver score.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Fig. 1 is a block diagram of an environment suitable for various embodiments of the present invention.

Fig. 2 is a mapping diagram of a geographic region that is divided into sub-areas that illustrates the second parameter – where the vehicle is used.

Fig. 3 is a flow diagram illustrating the steps involved in an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The present invention is directed towards acquiring performance and usage data through various sensors and monitors within and without a vehicle, utilizing the performance and usage data to generate a driver score, and then utilizing the driver score in the calculations of insurance premiums or rating factors. In general, the present invention includes at least four distinct aspects. These aspects include: (1) the methods and devices utilized in the acquisition of performance and usage data; (2) the types of performance and usage data collected and the treatment of the ranges of the data values; (3) the method to calculate the drivers score based at least in part on the performance and usage data; and (4) the application of the driver score in the calculation of insurance premiums, rating factors, risk analysis, etc.

[0017] Fig. 1 is a block diagram of an environment suitable for various embodiments of the present invention. Three vehicles 111-113 are shown, for illustrative purposes, operating within the environment. Each of the vehicles is equipped with a data collection and recording system 140 but the details are only shown with respect to one of the vehicles 111. The data collection and recording system is shown as including two data collection interfaces: a GPS interface 120 and a vehicle bus interface 130. It should be understood that the present invention is not limited to these two interfaces nor are these two interfaces required for the present invention. Other interfaces are also anticipated such as weather information interfaces, clock interface, or other similar interfaces. The vehicle bus interface 130 can acquire information such as the speed of the vehicle, state of the windshield wipers, state of the lights (on, off, fog lights, brights, etc.), amount of pressure applied to the brakes, motion through the use of an accelerometer, time of day, temperature, vehicle maintenance, operation of equipment within the vehicle such as radios, cellular telephones, DVD players or the like, the volume at which audio equipment is operated, and the identity of the driver based on the entry of an identification number, seat settings, weight or the like, status of seat belts, number of passengers, etc. The GPS interface 120 can acquire information such as the location of the vehicle, time of day, direction of motion, speed of the vehicle, etc. A recording system 140 collects information from the data collection interfaces and either stores the information locally, transmits the information through transmitter 150, or applies processing to the information prior to either storing or transmitting the information. For instance, in an exemplary embodiment of the present invention, the system may only operate to collect time of day, location and speed information. In such an embodiment, the data recording system 140 operates to filter the data available from the data

collection interfaces and only provide the necessary information to the central system. In an alternative embodiment, the data recording system 140 may operate to transmit all available information and a central system 170 operates to filter out the unnecessary information.

**[0018]** The data from the various vehicles 111-113 is received by a receiver 160 and then provided to a central system 170. The central system can perform processing on the received data, either alone or in conjunction with back end processing 180. The back end processing 180 may include input from actuarial scientist or other data collection and processing systems.

**[0019]** The data collected for the various vehicles may be transferred to the central system using a variety of different technologies and those skilled in the art will understand the benefits and limitations of each such technology. For instance, the invention may be embodied within an environment that uses wireless technology to periodically transmit collected data to the central system 170. The wireless technology may include pager technology or cellular technology conforming to any of a variety of past, existing or future technologies including FLEX, REFLEX, POCSAG, AMPS, NAMPS, TDMA, CDMA, GSM, GPRS or the like. Alternatively, the system may store the data and only transmit it when requested. In yet another embodiment, the data recording system 140 may store the data for later retrieval. Such later retrieval could be accomplished through a local wireless system, such as blue tooth, INFRARED, FM, AM, or I.E.E.E. 802.11 technology, or through a physical wired technology or even through the use of a memory card, storage media or print out.

**[0020]** Once the data is received by the central system 170, the data is used to generate a driver score. The driver score is based at least in part on the data collected by the vehicles and provided to the central system 170. However, additional data that is received independent from the data collection systems in the individual vehicles could also be used in calculating the driver score. This information may include the traditional information that has been collected by insurance companies for years as is listed in the background section, or may include other information such as satellite tracking of the vehicle, cellular signal tracking of the vehicle, weather information, mapping information, hazardous road condition information, or the like.

**[0021]** The driver score is basically a value that encompasses a variety of parameters. The driver score reflects a qualitative view of the driving characteristics for a particular vehicle or a combination of a vehicle and driver. Depending on the parameters that are used to calculate the driver score, the driver score can reflect various characteristics. In the preferred embodiment, the

driver score operates to establish a risk level associated with insuring a particular driver. Other uses of the driver score may include, but are not limited to, verifying the accuracy of information provided to an insurance company, verifying compliance of a teenaged driver within guidelines established by his or her parents, verify compliance of teenaged drivers with local/regional laws such as curfew and number of passengers, etc.

[0022] Advantageously, an insurance company can offer a product embodying aspects of this invention to its customers and offer a discount based on the inclusion of the product. The customer can further agree to be bound by restrictions to gain other discounts. For instance, an insured party can agree to maintain within the speed limit to obtain a premium discount in exchange for allowing the insurance company the ability to actively monitor compliance. The present invention can also be utilized as a theft deterrent, similar to a LO-JACK type system in that the location of the vehicle can be monitored.

[0023] In the preferred embodiment, the driver score reflects an insurance risk and is used to either increase or decrease an insurance premium or otherwise modify the terms of an insurance policy.

**Driver Score Example**

[0024] The present invention can be illustrated through the use of an exemplary embodiment that bases the driver score on the following information: when the vehicle is in use, where the vehicle is used, and how the vehicle is used.

[0025] Table 1 illustrates a simple heuristic that can be applied to determine a weighted score reflecting the first parameter - when the vehicle is in use.

| Time of Day | Normal Traffic | Peak Traffic | Risk Traffic | Weighted Score |
|---|---|---|---|---|
| Risk Factor | 0.60 | 1.40 | 2.50 | |
| Driver A | 20% | 75% | 5% | 1.295 |
| Driver B | 80% | 20% | 0% | 0.760 |
| Driver C | 20% | 20% | 60% | 1.900 |
| | | | (capped at 50%) | 1.650 |

**Table 1**

[0026] Various sensors or collection interfaces could be used to determine the time of day that a vehicle is operated such as through the GPS system, the vehicle bus, or through notifying the central system through a wireless interface. Regardless of the technique used, the time of day operational characteristics of a vehicle can be determined over a period of time and continually updated over time. The actual times that the vehicle is operated can be recorded by the recording system 140 and reported to the central system 170 or categories of times can be reported. Table 1 shows one

technique to breakdown the operation of a vehicle within three time-categories, normal traffic, peak traffic and risk traffic. For instance peak traffic could include the times between 7:00-9:00 AM and 4:00-7:00 PM, risk traffic could include late night driving, such as between 11:00 PM to 4:00 AM and normal traffic would include the remainder. It will be appreciated that these categories are for illustrative purposes only and the present invention is equally applicable to other sets of categories. For instance, one or more of the following categories could be added to or substitute any of the already listed categories: weekend, particular day of the week, morning rush, evening rush, holiday travel, lunch time rush, garaged, parked, Sunday morning, Friday/Saturday evening, etc.

[0027] The second block in the left most column of Table 1 defines a risk factor for each of the listed time categories. The values listed in this table define a risk factor that is associated with driving during the identified time periods. This information can be derived using various techniques such as empirical data or information that is obtained from actuarial tables published by insurance companies. The risk factors can be based on a national average or could be regionally based as well.

[0028] Table 1 lists driving characteristics for three vehicles or drivers (Driver A, B and C). The driving characteristics provide a percentage of driving time that the vehicle is operated, or the driver operates a vehicle during the listed time categories.

[0029] Based on the risk factor and the driving characteristics, a weighted score, as shown in Table 2, is calculated by multiplying the percentage of time that a vehicle is operated in a particular category by the risk factor associated with that category and then summing the products for each of the categories. For the provided example, Driver A's weighted score is determined as follows:

| Time-Category | Claim Propensity | | % of Time | Products |
|---|---|---|---|---|
| Normal Traffic | 0.6 | * | 20% | 0.12 |
| Peak Traffic | 1.4 | * | 75% | 1.05 |
| Low Traffic | 2.5 | * | 5% | 0.125 |
| | | | Weighted Score | **1.295** |

**Table 2**

[0030] Driver B has more of a tendency to drive during normal traffic (80%) and thus, has a much lower weighted score of 0.76. Driver C has a tendency to drive late at night in the risk traffic category and thus has a weighted score of 1.9. Thus, Driver C has the highest weighted score. If it is desired not to penalize a driver that happens to be assigned to night shift work, one technique to

alleviate an adverse affect based on Driver C's weighted score would be to apply a cap. For instance, if the late night percentage is capped at 50%, then the weighted score for Driver C drops to 1.65. This illustrates how the driver score can be flexible and fair by basing the data on more than just the actually measured data. For instance, if the driver score is being utilized by an insurance company to determine premium rates, the insurance company may decide not to penalize a night shift worker simply because his job forces him to travel within a higher risk time period.

[0031] It should be understood that this example is provided for illustrative purposes only and that the present invention may use other techniques to calculate such a weighted score. For instance, rather than percentages of time, the actual number of hours averaged over a period of time, such as a day, week, month or quarter could be utilized. In addition, the application of risk factors to the various time categories can be adjusted based on a variety of factors, some of which may include, but are not necessarily required, are type of vehicle, driver's record, population of the area, etc.

[0032] Fig. 2 is a mapping diagram of a geographic region that is divided into sub-areas that illustrates the second parameter – where the vehicle is used.

[0033] The region includes 5 sub-areas A-E. The sub-areas can be defined based on any of a variety of techniques including zip codes, area codes, counties, states, cellular cells, longitude and latitude, traffic density, population, road density, or any of a variety of other techniques of combinations of techniques. Regardless of the technique used to sub-divide a region, risk factor data for the region can be obtained and applied in the determination of a weighted score for this parameter. Table 3 illustrates a simple heuristic that can be applied to determine a weighted score reflecting the second parameter - where the vehicle is used.

| Area | Rural Streets | Suburb Streets | Metro Streets | Rural H'way | Metro H'way | Weighted Score |
|---|---|---|---|---|---|---|
| Risk Factor | 0.55 | 1.75 | 2.20 | 1.55 | 1.35 | |
| Driver A | 15% | 20% | 30% | 15% | 20% | 1.5950 |
| Driver B | 70% | 15% | 10% | 5% | 0% | 0.9450 |
| Driver C | 15% | 0% | 15% | 70% | 0% | 1.4975 |

**Table 3**

[0034] The risk factor data for each region identifies a driving risk associated with that region. Thus, in the example provided, a high risk factor indicates that the area has a higher probability of

resulting in an incident, such as a traffic accident, when a vehicle is operated in the area. Similar to the time of day calculations in Table 1, the risk factor values are multiplied by the percentage of time that the vehicle/driver is within that region or sub-area and then the products are summed to obtain the weighted score.

[0035] Again, the use of percentages is just an example and other criteria could also be applied such as accumulative hours over a period of time, average number of hours over a period of time, number of miles driven in the particular area, or the like.

[0036] In an alternative embodiment, the tables used to calculate a weighted score based on time of day and area can be combined into a multi-dimensional table. Thus, each of the sub-areas in the region could include a time of day table that includes different risk factors based on sub-area and time of day. For instance, the area surrounding a subway station may have a high risk factor during peak traffic but a very low risk factor during normal traffic. Thus, those skilled in the art will appreciate that various techniques can be applied to calculate the weighted scores and the examples provided in this description are simply to illustrate calculation of a value that rates driver characteristics. However, certain aspects of the selection of parameters and assignment of risk factors and techniques to calculate the score that are disclosed herein are also considered novel.

[0037] Table 4 illustrates a simple heuristic that can be applied to determine a weighted score reflecting the third parameter - how the vehicle is used. This example shows one alternative for calculating the driver score, or elements of the driver score by using an offset rather than a weighted score.

| Speed | Highway | Streets | Limited Access | Penalty Offset |
|---|---|---|---|---|
| **Speed limit ± 5mph** | **+0.015** | **+0.025** | **+0.02** | |
| **Speed limit ± 15 mph** | **+0.05** | **+0.10** | **+0.08** | |
| Driver A | 10/4 | 4/2 | 4/1 | 0.81 |
| Driver B | 2/1 | 8/0 | 4/2 | 0.52 |
| Driver C | 5/0 | 5/0 | 4/0 | 0.28 |

**Table 4**

[0038] The illustrated heuristic identifies offsets to be added to the weighted scores calculated in accordance with the first two parameters. The offset is based on ranges of miles per hour centered on the speed limit and the types of roadways being traveled. For instance, a set of offsets are

provided for the highways, streets, and limited access roadways for speeds that are 5 mph above or below the posted speed limit and speeds that are 15 mph above or below the posted speed limit. This particular configuration is once again provided as an example only and the present invention is not limited to this particular configuration. For example, one set of offsets could also be used when the vehicle is a particular threshold below the speed limit and another set of offsets could be used when the vehicle is above the posted speed limit. In addition, the structure defined in Table 4 is set up as a penalty system. An award system could also be established to subtract offsets from the score based on conforming to the speed limit.

**[0039]** The values entered for Driver A, Driver B and Driver C illustrate an alternative method to the percentages used in the previous examples. In this example, the propensity of the driver on a scale of 0 to 10 is listed for the various conditions. This number could also represent a frequency over a period of time – for instance over a given period of time, Driver A will be over the speed limit by more than 5 mph 10 times and over the speed limit by more than 15 mph 4 times. For each occurrence, the offset is added for the particular driver. Thus, for Driver A, the total offset penalty of 0.81 is calculated as follows:

$$10 * 0.015 + 4 * 0.05 + 4 * 0.025 + 2 * 0.1 + 4 * 0.02 + 1 * 0.08 = 0.81$$

**[0040]** As previously mentioned, the examples that have been provided are for illustrative purposes only and other factors and weighting systems could also be incorporated into the present invention and the present invention is not limited to any particular arrangement. The main focus of the present invention is to provide a means for calculating a driver score that is based on various operational parameters. In the example provided, these parameters have included when the vehicle is in use, where the vehicle is used and how the vehicle is used.

**[0041]** Once the various parameters have been determined and the weighted scores and penalties calculated, then the driver score can be determined. For the illustrated example, the driver score is simply the sum of the "when" and "where" parameters plus the penalty or offset determined by the "how" parameters. Table 5 illustrates the calculation of the driver score for Driver A, Driver B and Driver C. Alternatively, the driver score could be calculated in different manners, such as multiplying the weighted score for the "when" with the weighted score for the "where" and than adding in the offsets. It will be appreciated that the particular technique employed, although novel in and of itself, in no way limits other aspects of the present invention.

| | Driver A | Driver B | Driver C |
|---|---|---|---|
| Time of day (When) | 1.295 | 0.760 | 1.150 |
| Area (Where) | 1.5950 | 0.9450 | 1.4975 |
| Speed (How) | 0.81 | 0.52 | 0.28 |
| **Driver Score** | 3.7 | 2.225 | 2.9275 |

**Table 5**

[0042] Thus, in the illustrated example, Driver A has a driver score of 3.7, Driver B has a driver score of 2.225 and Driver C has a driver scored of 2.9275. Based on the particular parameters and structure of the provided examples, in this situation Driver A is a higher risk driver than Driver B or Driver C. The driver score can then be used in a variety of manners. For instance, the driver score could be used as one of several parameters entered into the calculation of an automobile insurance premium or, as an offset or adjustment to an automobile insurance premium. The driver score could also be used for providing discounts or rate adjustments for life and/or health insurance. Other uses for the driver score may include, but are not limited to State tax credits, purchase price discounts or rebates for automobiles, discounts for extended warranties, discounts for vehicle registration, access to High Occupancy Vehicle (HOV) lanes or the like.

[0043] Table 6 illustrates one method of applying the driver score. In this example, the driver score is used to select a rating factor. The rating factor is a multiplier to the insurance premium derived using other available rating mechanisms.

| Driver Score | Rating Factor |
|---|---|
| 0.0 to 0.9 | 0.85 |
| 1.0 to 1.75 | 0.90 |
| 1.76 to 2.49 | 0.95 |
| 2.50 to 3.19 | 1.00 |
| 3.20 to 3.59 | 1.05 |
| 3.60 to 3.99 | 1.10 |
| 4.0 to 4.29 | 1.15 |
| 4.30 + | 1.30 |

**Table 6**

[0044] In accordance with Table 6 and the calculated driver scores, Driver A would have a rating factor of 1.10, Driver B would have a rating factor of 0.95 and Driver C would have a rating factor of 1.00. Thus, in this example, based on the rating factors, Driver A's premium would be increased by 10% based on his driver score, Driver B's premium would be reduced by 5% and Driver C's premium would not be adjusted.

[0045] Thus, the present invention has been described by way of example as a system that includes a vehicle based component and a central component. The vehicle based component collects usage data through one or more interfaces and then provides the usage data to the central system either by means of wireless transmission or other methods. The central system then calculates a driver score based at least in part on the usage data received, as well as claim propensity information. Finally, the driver score can be applied in adjusting the premium of an insurance policy or other terms and conditions of the policy.

[0046] Fig. 3 is a flow diagram illustrating the steps involved in an embodiment of the present invention. The process begins at step 310 where a new vehicle is selected for driver score based insurance. At step 310 the new vehicle is initialized. This process can include a variety of tasks, such as but not limited to nor requiring, installation of the monitoring and recording system into the vehicle, provisioning the system including provisioning of any wireless communication systems, entry of user data into the central system and verification of operation. These tasks can include gathering initial information about the driver, the vehicle, the topographical area in which the vehicle is operated, the identification of what drivers will be utilizing the vehicle, matching the identification of the monitoring and recording system with the drivers, etc.

[0047] Once the system is initialized, the monitoring and recording system begins to monitor the vehicle activity for a first period of time 320. The data collected can be provided to the central system either on-line in real-time, periodically over a wireless interface, or through physically docking the vehicle with the central system either locally or remotely. The first period of time can vary depending on the particular embodiment but generally is sufficiently long to obtain data that is an accurate portrayal of the vehicle activity. Logically an entire year would seem like a valid period when calculating a driver score for insurance premium purposes but realistically, this would not be practical. Thus, a shorter period of time that encompasses enough variants in the individuals schedule should suffice. For instance, a two to four week period of time may be sufficient if during

that period of time, no extreme conditions occur, such as the driver going on vacation, the driver taking an extended road trip or the vehicle being in the shop.

[0048] Once the first period of time has been satisfied, the system can operate to generate the driver score 330. As previously described, the driver score may include a variety of parameters with various weights applied to the parameters. Several examples have been previously provided, each of which may contain novel aspects of the invention, yet do not operate to limit the generality of the invention to utilize various other parameters, combinations of parameters and the application of various weighting factors.

[0049] Once the driver score is determined, if the vehicle or user is currently uninsured 340, the processing continues at step 350 where the driver score is applied in the selection and definition of an insurance policy. On the other hand, if the vehicle or user is already insured, processing continues at step 360 where the terms of the insurance policy can be adjusted. In steps 350 and 360, the typical application of the driver score is in the adjustment of the insurance premium, however, other adjustments or term settings could also be made, such as but not limited to, changing deductibles, changing exclusions, changing the duration of the policy, etc.

[0050] After the completion of steps 350 or 360, processing continues at step 370 where the vehicle activity continues to be monitored. At step 370, the monitoring process continues for a second duration of time. The second duration of time can be as insignificant as seconds or fractions of seconds or, could be substantial such as days, weeks, etc. Preferably, the second period of time is less in duration than the first period of time but this is not a requirement.

[0051] Upon completion of the second period of time, the driver score is then adjusted at step 380. The adjusted driver score is then reapplied in step 360 for adjusting the terms of the insurance policy. Thus, the driver score and the terms of the insurance policy can be continually updated as the system collects further information about the vehicle activity.

[0052] In an alternate embodiment, an insurance policy can simply be issued to an insured party at premiums and terms calculated in the normal fashion. Subsequent premiums and terms can then be adjusted over time by employing the monitoring and driver score calculation aspects of the present invention.

[0053] The present invention has been described using detailed descriptions of embodiments thereof that are provided by way of example and are not intended to limit the scope of the invention. The present invention can be implemented as a process that runs within a variety of system

environments or as an entire system including various components. The described embodiments comprise different features, not all of which are required in all embodiments of the invention. Some embodiments of the present invention utilize only some of the features, aspects or possible combinations of the features or aspects. Variations of embodiments of the present invention that are described and embodiments of the present invention comprising different combinations of features noted in the described embodiments will occur to persons of the art.

CLAIMS

What is claimed is:

1. A method of quantifying vehicle activity, the method comprising the steps of:

monitoring particular parameters of the activity of a vehicle for a first period of time; and

calculating a driver score based at least in part on the particular parameters of the vehicle activity during the first period of time.

2. The method of claim 1, further comprising the step of applying the driver score to adjust the terms of an insurance policy for the vehicle.

3. The method of claim 2, wherein the terms of the insurance policy that are adjusted include the deductibles.

4. The method of claim 2, wherein the terms of the insurance policy that are adjusted include the premiums.

5. The method of claim 1, wherein the step of calculating a driver score further comprises the steps of:

identifying time of day classes in which the vehicle can be utilized;

determining the amount of driving time that the vehicle is used in each of the time of day classes;

calculating a time of day weighted value based at least in part on the amount of driving time that the vehicle is used in each of the time of day classes; and

applying the time of day weighted value in the calculation of the driver score.

6. The method of claim 5, wherein the step of calculating a time of day weighted value further comprises calculating a time of day weighted value based at least in part on risk tendencies for the time of day classes.

7. The method of claim 5, wherein the step of calculating a driver score further comprises the steps of:

identifying geographical sub-areas in which the vehicle can be utilized;

determining the amount of driving time that the vehicle is used in each of the geographical sub-areas;

calculating an area weighted value based on the amount of driving time that the vehicle is used in each of the geographical sub-areas; and

applying the area weighted value in the calculation of the driver score.

8. The method of claim 7, wherein the step of calculating an area weighted value further comprises calculating an area weighted value based at least in part on risk tendencies for the geographical sub areas.

9. The method of claim 7, wherein the step of calculating a driver score further comprises the steps of:

identifying speed classes in which the vehicle can be utilized;

determining the frequency at which the vehicle is used in each of the speed classes;

calculating a speed weighted value based at least in part on the frequency at which the vehicle is used in each of the speed classes; and

applying the speed weighted value in the calculation of the driver score.

10. The method of claim 1, wherein the step of calculating a driver score further comprises the steps of:

identifying geographical sub-areas in which the vehicle can be utilized;

determining the amount of driving time that the vehicle is used in each of the geographical sub-areas;

calculating an area weighted value based on the amount of driving time that the vehicle is used in each of the geographical sub-areas; and

applying the area weighted value in the calculation of the driver score.

11. The method of claim 1, wherein the step of calculating a driver score further comprises the steps of:

identifying speed classes in which the vehicle can be utilized;

determining the frequency at which the vehicle is used in each of the speed classes;

calculating a speed weighted value based at least in part on the frequency at which the vehicle is used in each of the speed classes; and

applying the offset value in the calculation of the driver score.

12. The method of claim 1, further comprising the steps of:

monitoring the activity of the vehicle for a second period of time; and

adjusting the driver score based at least in part on the vehicle activity during the second period of time.

13. A method of generating a rating factor that can be used as the basis for adjusting the terms of an insurance policy, the method comprising the steps of:

installing a vehicle monitor within a vehicle;

monitoring the activity of the vehicle for a first period of time;

calculating a driver score based at least in part on the vehicle activity during the first period of time;

applying the driver score to determine the terms of an insurance policy for the insured vehicle;

monitoring the activity of the vehicle for a subsequent period of time; and

adjusting the driver score based at least in part on the vehicle activity during the subsequent period of time.

14. The method of claim 13, wherein vehicle monitor includes a wireless interface and the step of calculating a driver score further comprises the steps of:

wirelessly transmitting data obtained from the monitoring step to a central system; and

the central system calculating the driver score based at least in part on the transmitted data.

15. The method of claim 14, wherein the step of calculating a driver score further comprises the steps of:

identifying time of day classes in which the vehicle can be utilized;

determining the amount of driving time that the vehicle is used in each of the time of day classes;

calculating a time of day weighted value based on the amount of driving time that the vehicle is used in each of the time of day classes and claim propensities for the time of day classes;

applying the time of day weighted value in the calculation of the driver score;

identifying geographical sub-areas in which the vehicle can be utilized;

determining the amount of driving time that the vehicle is used in each of the geographical sub-areas;

calculating an area weighted value based on the amount of driving time that the vehicle is used in each of the geographical sub-areas and claim propensities for the geographical sub-areas;

applying the area weighted value in the calculation of the driver score;

identifying speed classes in which the vehicle can be utilized;

determining the frequency at which the vehicle is used in each of the speed classes;

calculating an offset value based on the frequency at which the vehicle is used in each of the speed classes; and

applying the offset value in the calculation of the driver score.

16. The method of claim 13, wherein the step of monitoring the vehicle during the first period of time further comprises the steps of:

identifying times during the first period of time at which the vehicle was operated;

identifying geographical sub-areas in which the vehicle was operated during the first time period; and

identifying the speeds at which the vehicle was operated during the first period of time.

17. The method of claim 16, wherein the step of calculating a driver score further comprises the steps of:

applying the identified times, geographical sub-areas and speeds in the calculation of the driver score.

18. A system for calculating a driver score and applying the driver score in the determination of the terms of an insurance policy, the system comprising:

a recording system that is installable within a vehicle;

a GPS interface that is couple to the recording system;

a vehicle bus interface that is couple to the recording system;

a transmitter coupled to the recording system for transmitting vehicle operation data obtained by the recording system through the GPS interface and the vehicle bus interface;

a receiver that is communicatively coupled to the transmitter for receiving the vehicle operation data; and

a central system that is coupled to the receiver and operable to:

calculate a driver score based at least in part on the vehicle operation data; and

apply the driver score determine the terms of the insurance policy.

19. The system of claim 18, wherein the transmitter and the receiver are communicatively coupled over a wireless interface.

20. The system of claim 18, wherein the wireless interface is a cellular interface.

21. The system of claim 18, wherein the wireless interface is a pager interface.

22. The system of claim 18, wherein the vehicle operation data comprises:

times at which the vehicle is operated;

locations in which the vehicle is operated; and

speeds at which the vehicle is operated;

23. The system of claim 22, further comprising a back end processor that is coupled to the central system and is operable to provide the central system with claim propensity data related to time, locations and vehicle speeds.

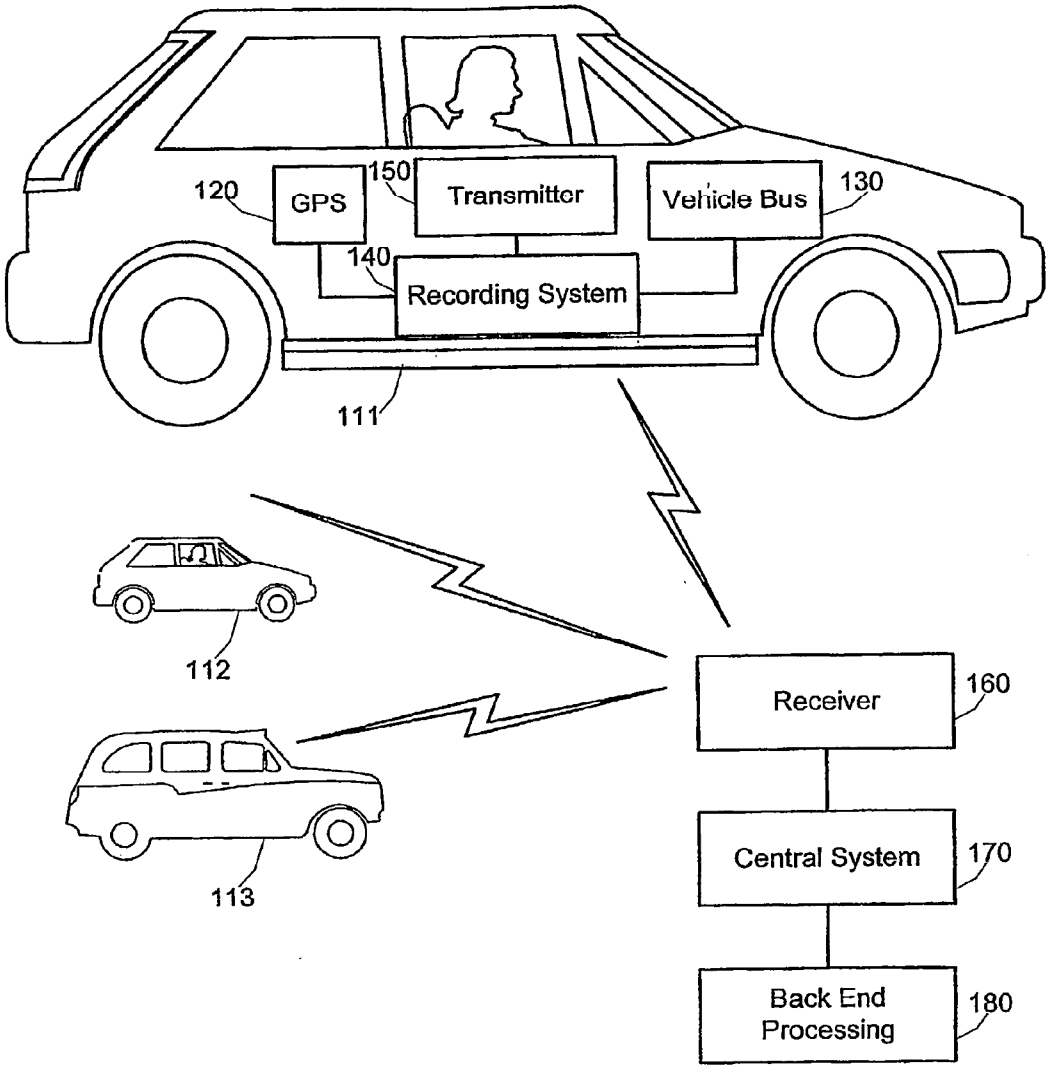

120
GPS
150
Transmitter
Vehicle Bus
130
140
Recording System
111
112
113
Receiver
160
Central System
170
Back End
Processing
180

Fig. 1

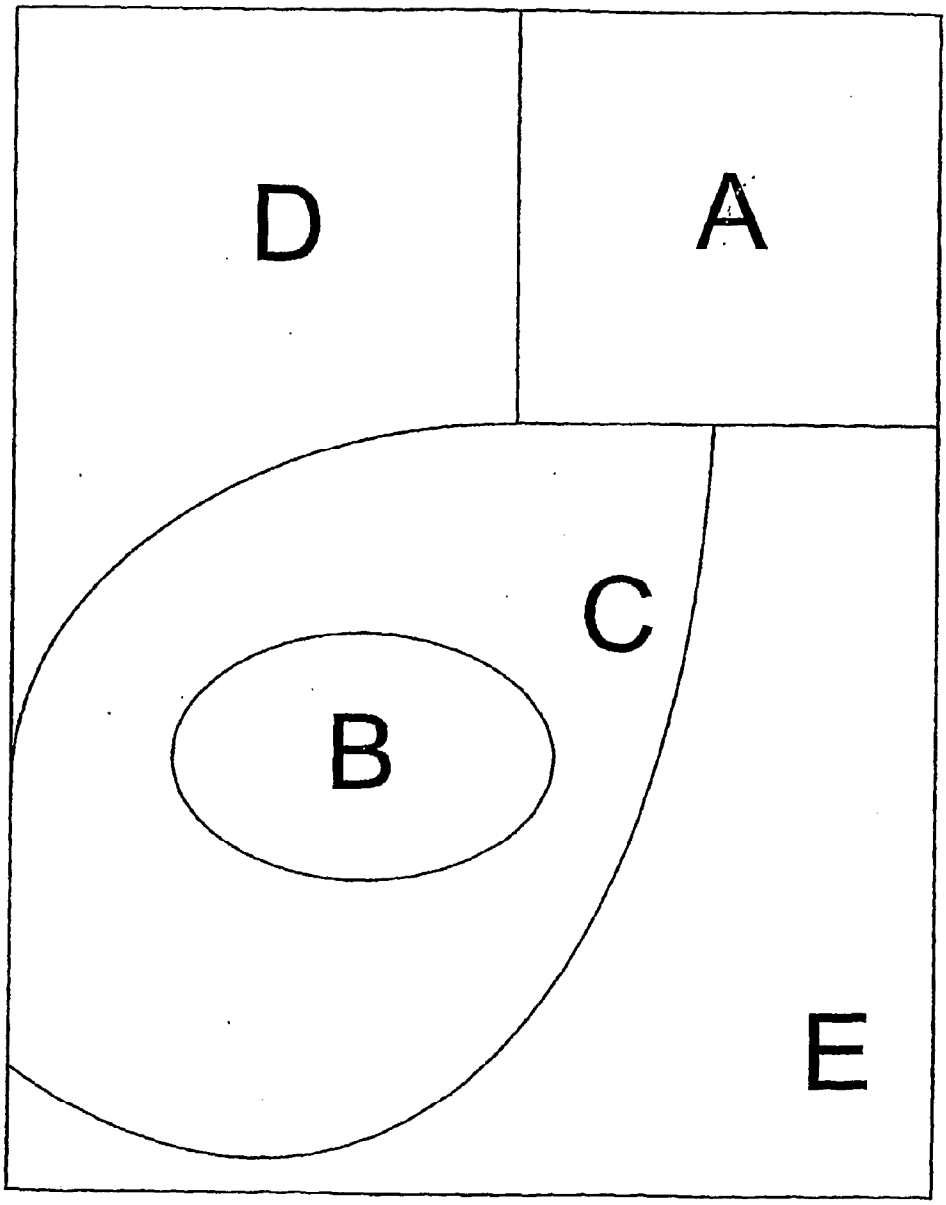



Fig. 2

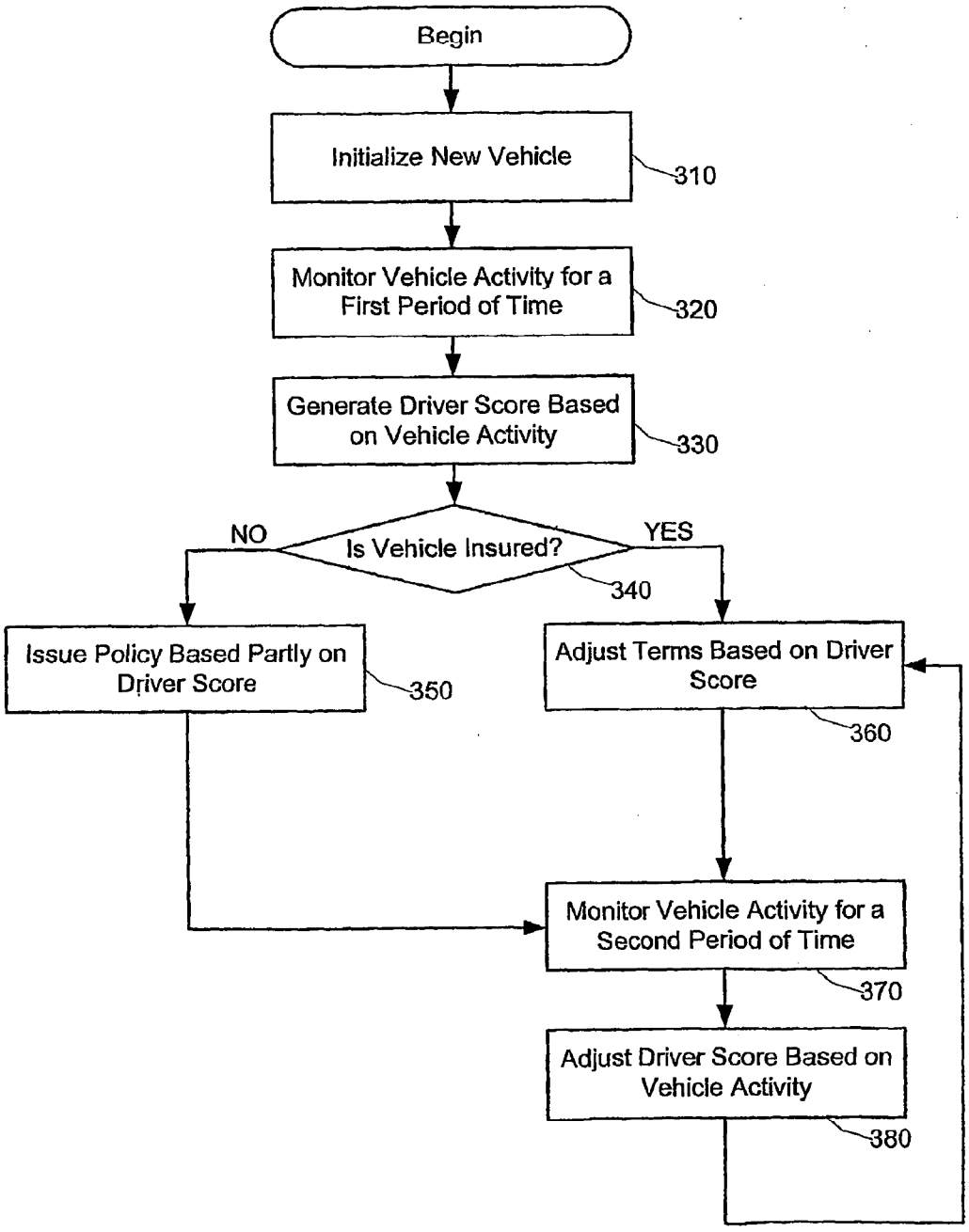



Fig. 3



SUBSTITUTE SHEET (RULE 26)

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/00914

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : G06F17/60
US CL : 705/4
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 705/4

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 5,797,134 A (McMillan) 18 August 1998 (18.08.1998), column 6, lines 45-56. | 1-23 |
| A | US 6,182,048 B1 (Osborn et al) 30 January 2001 (30.01.2001), column 1, line 53-column 2, line 13. | 1-23 |
| X | US 6,711,495 B1 (Ukai et al) 23 March 2004 (23.03.2004), column 6, lines 15-31 and column 16, lines 48-62. | 1-23 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
20 October 2005 (20.10.2005)

Date of mailing of the international search report
23 NOV 2005

Name and mailing address of the ISA/US
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Authorized officer
for Joseph Thomas

Telephone No. (571) 272-6776

Form PCT/ISA/210 (second sheet) (July 1998)

**Continuation of B. FIELDS SEARCHED Item 3:**
EAST/WEST Files: USPAT, USPGPUB, EPO, JPO, Derwent and IBM_TDB. Search Terms: insurance, vehicle, sensor, premium, parameters, vehicle activity, GPS and monitoring.

| Electronic Acknowledgement Receipt | |
|---|---|
| **EFS ID:** | 9275379 |
| **Application Number:** | 90011252 |
| **International Application Number:** | |
| **Confirmation Number:** | 4116 |
| **Title of Invention:** | MOTOR VEHICLE MONITORING SYSTEM FOR DETERMINING A COST OF INSURANCE |
| **First Named Inventor/Applicant Name:** | 6,064,970 |
| **Correspondence Address:** | James A. Collins<br>-<br>P.O. BOX 10395<br>-<br>Chicago IL 60610<br>US -<br>- |
| **Filer:** | James A. Collins/Nkosi Harvey |
| **Filer Authorized By:** | James A. Collins |
| **Attorney Docket Number:** | LMIC-019 |
| **Receipt Date:** | 21-JAN-2011 |
| **Filing Date:** | 22-SEP-2010 |
| **Time Stamp:** | 15:31:58 |
| **Application Type:** | Reexam (Patent Owner) |

## Payment information:

| | |
|---|---|
| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
|---|---|---|---|---|---|
| 1 | Foreign Reference | EP_0629978A1.pdf | 627640<br>6e53eb31d7ea37a90f8c86b46a593abfc55914e4 | no | 11 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 2 | Foreign Reference | EP_0700009A2_Abstract.pdf | 250640<br>56bcefb49254a5a4ba3863b31425c761ce40e290 | no | 5 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 3 | Foreign Reference | EP_0935208A2.pdf | 1574848<br>14fc66787cd73b500a391ae74bf6198b4d690891 | no | 49 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 4 | Foreign Reference | EP_1164551A2.pdf | 253674<br>4fc9d47c5b83c10e288ccbf3f80fd0403bcb0081 | no | 6 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 5 | Foreign Reference | EP_1207499A2.pdf | 914356<br>12f7e7dc1ae5b2d2b1013edbba6828b03888dc68 | no | 12 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 6 | Foreign Reference | FR_2533049A1_Abstract.pdf | 1416556<br>e67ed3219bc485d6e3ceca79dceac67e792215ec | no | 31 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 7 | Foreign Reference | GB_2143978A.pdf | 472607<br>b4abab5f556dddcb9cebcb53f65c436f599cc85e | no | 9 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 8 | Foreign Reference | GB_2225461A.pdf | 1114472<br>7c653b268ad3e7c9dc716591eb19af5e522d5472 | no | 38 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 9 | Foreign Reference | JP_3-4660_Abstract.pdf | 368810<br>ff8078d787415c0a530856b243141d4411384e54 | no | 7 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 10 | Foreign Reference | JP_4-182868_Abstract.pdf | 1067017<br>f67419bce475b1bccaeaafd7330b9f9ef191cf03 | no | 14 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 11 | Foreign Reference | JP_05104985_A1.PDF | 1459102<br>fcca0798991f60aee5dfef45f4747aae319fa3c3 | no | 31 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 12 | Foreign Reference | JP_6-4733_Abstract.pdf | 402993<br>9046b991ad9359e4b32ca37807102258ffda6781 | no | 9 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 13 | Foreign Reference | JP_6-259632_Abstract.pdf | 219120<br>69b443d0686cb33e62224bc20d13c7621f86fa57 | no | 7 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 14 | Foreign Reference | JP_7-159192_Abstract.pdf | 402314<br>4de44da59f3477489ed4a0629d05223fcf5706d2 | no | 8 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 15 | Foreign Reference | JP_2000_335450_A1.PDF | 2423316<br>3d6d13216799db80f17fbe82901bd11580d57246 | no | 33 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 16 | Foreign Reference | NL_C_1016618.PDF | 1685686<br>ba8af969eabac13527a5af22fbefd435116c6c5d | no | 39 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 17 | Foreign Reference | WO_84-03359_Abstract.pdf | 2539175<br>55199451d9cadd4bf66db542d3652c4dc7f821f9 | no | 56 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 18 | Foreign Reference | WO_88-09023_Abstract.pdf | 1344331<br>a5bef4008805fb12f5807977f0078e9963276eb4 | no | 27 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 19 | Foreign Reference | WO_90-02388A1.pdf | 457358<br>2ae10728f94e0a7b16f4a597d568090281a<br>d5fd5 | no | 12 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 20 | Foreign Reference | WO_93-10510_Abstract.pdf | 784273<br>20ec4ea6338fb6454ffac78879351bd81755<br>379e | no | 19 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 21 | Foreign Reference | WO_93-21583A1.pdf | 848887<br>bd2d1cda65acb9f32584de129d5d87d798<br>b7cbb9 | no | 20 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 22 | Foreign Reference | WO-94-04975.pdf | 1727139<br>8b3ac27aa45b99af6258719483a4d20a860f<br>2c9b | no | 47 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 23 | Foreign Reference | WO_94-18645_Abstract.pdf | 471134<br>04dfb20cfba9ec14f56cbf2958e74d93d355<br>462c | no | 14 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 24 | Foreign Reference | WO_97-13208A1.pdf | 2180707<br>e741fa03bf5dde680024bdf14f7c1eae9ed0<br>c601 | no | 46 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 25 | Foreign Reference | WO_97-27561A1.pdf | 1218690<br>cfe1b9ed9f43241c6248e0eeec050b3c309e<br>f587 | no | 36 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 26 | Foreign Reference | WO-98-47109.pdf | 1348791<br>b06a2d5d0a7f9bf695be578e235517d1a00<br>ff5fd | no | 29 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 27 | Foreign Reference | WO-00-17721.pdf | 3422491<br>e1f9dc17a1c9c588b901158ac33190eb8f81<br>1640 | no | 85 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 28 | Foreign Reference | WO_00-52616A2.pdf | 641461<br>106ed16fc20b89399e4441bd20f3bd346491ea4f | no | 17 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 29 | Foreign Reference | WO_00-79727A2.pdf | 2541448<br>1db7109701db293e0c9fc7504ff0c31f3894bdb2b | no | 79 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 30 | Foreign Reference | WO-01-18491A1.pdf | 1052988<br>ac4aabedb6a42e39236f008894b9168978cb0d0b | no | 25 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 31 | Foreign Reference | WO_01-26338A2.pdf | 3591033<br>46c174fe3a71479ce69a5871122ccb95d1899447 | no | 84 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 32 | Foreign Reference | WO_01-55690A1.pdf | 592480<br>d3664eedc149606f29d656873f82a9c61a95104c | no | 14 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 33 | Foreign Reference | WO_01-86576A1.pdf | 955146<br>5df1cc772581c580a73c3e042d1bda3407a7563d | no | 19 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 34 | Foreign Reference | WO_2006-028484A1.pdf | 1094985<br>4bdc571aeb3d810e908ef6db3e05cbd45f9d1bc9 | no | 27 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 35 | NPL Documents | A158--Automatic_Vehicle_Location_for_Public_Safety.PDF | 2306792<br>7107f375ecb9dacc923f7ed8257557290859 2b03 | no | 8 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 36 | NPL Documents | A159--AutoWatch_product_description.PDF | 202164<br>bdad4e85b84a5925aee227d8ec75f6af0c1d4233 | no | 2 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 37 | NPL Documents | A160--Autowatch_Its_There_When_Youre_Not_Requirements.pdf | 76632<br>1a125e6f2c6da0a3f62bf5c844b84f85e3a75de2 | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 38 | NPL Documents | A161--Dorweiler---Notes_on_Exposure_and_Premium_Bases.pdf | 5616671<br>f6be0ad58f73c5ade3bfb59eebb23e398a82504f | no | 29 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 39 | NPL Documents | A162--Ease_Simulation_Inc_website.PDF | 689360<br>2d0360aa738a1d40ce35b24d3c08d0d82469fe5c | no | 19 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 40 | NPL Documents | A163--Eldridge--If_Your_Teen_Puts_Pedal.PDF | 250752<br>d85bee2daa2f500b33881824d06d60f73b00bda5 | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 41 | NPL Documents | A164--Electric_Insurance_Joines_Intuits.pdf | 117034<br>34db808b41154a87d43ebbc0d6e3f0cf391fda2e | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 42 | NPL Documents | A165--Festa--For_Insurance_Sales_Turn_To_Web.pdf | 98643<br>5355a2ea187bee253638aa4b35e8886f4c288a63 | no | 3 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 43 | NPL Documents | A166--Garfinkel--The_Road_Watches_You--rev.PDF | 99572<br>3b6339b93ace18fdec1f4dc82dab25096e695072 | no | 1 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 44 | NPL Documents | A167--January_UK_An_Interest_in_Black_Magic_Motor_Technology.pdf | 71058<br>01938a9d7a28c32755862e2e45be3443699ac33b | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 45 | NPL Documents | A168--Murray--PCs_Next_Stop_Your_Dashboard.pdf | 160682<br>221a1aaf6212b5375d81ee2f4382f2dcf8972f14 | no | 3 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 46 | NPL Documents | A169--News_Release_AutoWatch.PDF | 91147<br>1410efba4b6ce9d220a8685bf878b1a5940b6b3d | no | 3 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 47 | NPL Documents | A170---NHTSA_Event_Data_Recorder_Program.PDF | 189042<br>980f5a7b5f0092198f970be2be147b2249bf459 | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 48 | NPL Documents | A171--Pasher--Auto_Web_Site_Takes_Off.pdf | 76570<br>1c7bc3c024cb82a874a898de77a0012b946f7a18 | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 49 | NPL Documents | A172--PSC-200_Intelligent_Data_Controller_Product_Description_Trimble.pdf | 158318<br>9a96a1a0c11d10355afd073e46699afdc383a1a4 | no | 2 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 50 | NPL Documents | A173--Surface_Vehicle_SAE_J1978_Revised_Apr_2002.pdf | 821409<br>8df4be3882f0af45079579f62231b7cf42619e7e | no | 16 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 51 | NPL Documents | A174--ppw--Surface_Vehicle_SAE_J2201_Issued_Jun_1993.pdf | 8345584<br>efc85b6440f29853ceafd6e5d79387595895746a | no | 45 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 52 | NPL Documents | A175--ppw--Surface_Vehicle_SAE_J2201_Supersede_Jul_1999.pdf | 8160890<br>a1a3cbd68b4da22b0d00f6686176bf4335304d59 | no | 44 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 53 | NPL Documents | A176--Surface_Vehicle_SAE_J1979_Revised_Apr_2002_Part_One.pdf | 3499179<br>f35d45ba290574444ed809233cf8b47ed5760796 | no | 80 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 54 | NPL Documents | A176--Surface_Vehicle_SAE_J1979_Revised_Apr_2002_Part_Two.pdf | 2721630<br>605b590e3a2acfaad0fbc323a9e189c10c7d0323 | no | 79 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 55 | NPL Documents | A177--Users_Manual_for_AutoWatch.pdf | 5897801<br>420c5d066a9d55786f20d93a1c846c55fc04c3b5 | no | 71 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 56 | NPL Documents | A178--Vetronix_Press_Release--Vetronix_Corp_to_Provide_AutoConnect.pdf | 55369<br>943c80006dc35a31d8c3f82e0eb24c7dd3997a06 | no | 1 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 57 | NPL Documents | A179--Complaint_with_Exhibits_filed_Jun-18-2010--rev.pdf | 14180121<br>599e5459536a8377d1cf0a31fd00a101d7fc4ab9 | no | 201 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 58 | NPL Documents | A180--Defs_Mot_to_Dismiss_for_Failure_to_State_a_Claim_filed_Sep-08-2010--rev.pdf | 5357894<br>ad43d1cbc1997c327d29a9db587759cf5f0f3fde | no | 99 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 59 | NPL Documents | A181--Progressives_Memo_in_Opp_to_Defs_Mot_to_Dismiss_filed_Oct-12-2010.pdf | 1308302<br>477a77e84b10367f3831827703081405eabf5d0d | no | 59 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| | | **Total Files Size (in bytes):** | 102018284 | | |

**This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.**

**New Applications Under 35 U.S.C. 111**

**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

**National Stage of an International Application under 35 U.S.C. 371**

**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**

**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | | |
|---|---|---|
| Inventors: Robert J. McMillan, et al. | § | Control Number: 90/011,252 |
| U.S. Patent No. 6,064,970 | § | Art Unit: 3992 |
| Formerly Application No. 09/135,034 | § | Examiner: Karin M. Reichle |
| Issue Date: May 16, 2000 | § | |
| Filing Date: August 17, 1998 | § | Attorney Docket No.: LMIC-019 |
| Former Group Art unit: 2761 | § | Customer No.: 28120 |
| Former Examiner: Edward R. Cosimano | § | Requester: Liberty Mutual Insurance Co. |

For: MOTOR VEHICLE MONITORING SYSTEM FOR DETERMINING A COST OF INSURANCE

MAIL STOP *EX PARTE* REEXAM
Central Reexamination Unit
Office of Patent Legal Administration
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**NOTIFICATION OF CONCURRENT PROCEEDINGS PURSUANT TO MPEP §§ 2282, 2286**

Dear Sir:

Pursuant to the provisions of MPEP §§ 2282 and 2286, Third Party Requester Liberty Mutual Insurance Company ("the Requester") hereby apprises the Office of litigation activity involving United States Patent No. 6,064,970 ("the '970 patent") and the instant *ex parte* reexamination of the '970 patent. As stated in the September 22, 2010 Request for Reexamination, the '970 patent is also at issue in *Progressive Casualty Insurance Company v. Safeco Insurance Company of Illinois, et al.*, Case No. 1:10-cv-01370-PAG, in the U.S. District Court for the Northern District of Ohio, Eastern Division (the "Progressive Litigation"). On November 12, 2010, the Court in that matter ordered that the Progressive Litigation would be

stayed pending reexamination. A copy of the Court's November 12, 2010 Memorandum of Opinion and Order is attached.

Requester believes that no additional fees are due in connection with this Notice. However, should it be determined that a fee is due, the Commissioner is hereby authorized to charge any fee due, or to credit any overpayment to Deposit Account No. 18-1945, Order No. LMIC-019.

As identified in the attached Certificate of Service and in accordance with 37 C.F.R. §§ 1.33(c) and 1.510(b)(5), a copy of this submission, in its entirety, is being served to the address of the attorney or agent of record reflected in the publicly-available records of the United States Patent and Trademark Office as designated in the Office's Patent Application Information Retrieval system.

Respectfully submitted,

**ROPES & GRAY LLP**

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Dated: January 6, 2011