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(72) Inventors:  
• **Jørgensen, Brian**  
**9000, Aalborg (DK)**  
• **Frilev, Karsten**  
**9530, Støvring (DK)**

(71) Applicant: **Inntrasys ApS**  
**9530 Støvring (DK)**

(74) Representative: **Plougmann & Vingtoft A/S**  
**Sundkrogsgade 9**  
**P.O. Box 831**  
**2100 Copenhagen Ø (DK)**

(54) **On-board unit for electrical appliance of a vehicle**

(57) The invention relates to an On-Board Unit (OBU), possibly for after sales mounting, in most common types of vehicles. The OBU (6) has a female part and a male part of an ISO standard 10487 connector (13) or other type of electrical and/or electronic connection to a radio or a navigation system (11) of the vehicle. The existing wire harness (14) from the car will be plugged into this connector, and thus allowing the OBU to act as

a 'bridge' or 'shunt' between the existing vehicle wires and the radio or navigation system of the vehicle. The OBU act as remote and mobile element in the system setup. The main system scenarios for the OBU may be Intelligent Transport Systems (ITS), congestion control, Intelligent Speed Adaption (ISA), road-pricing, tracking and logistic systems, asset tracking, fleet management, theft monitoring, alarm functions, insurance.

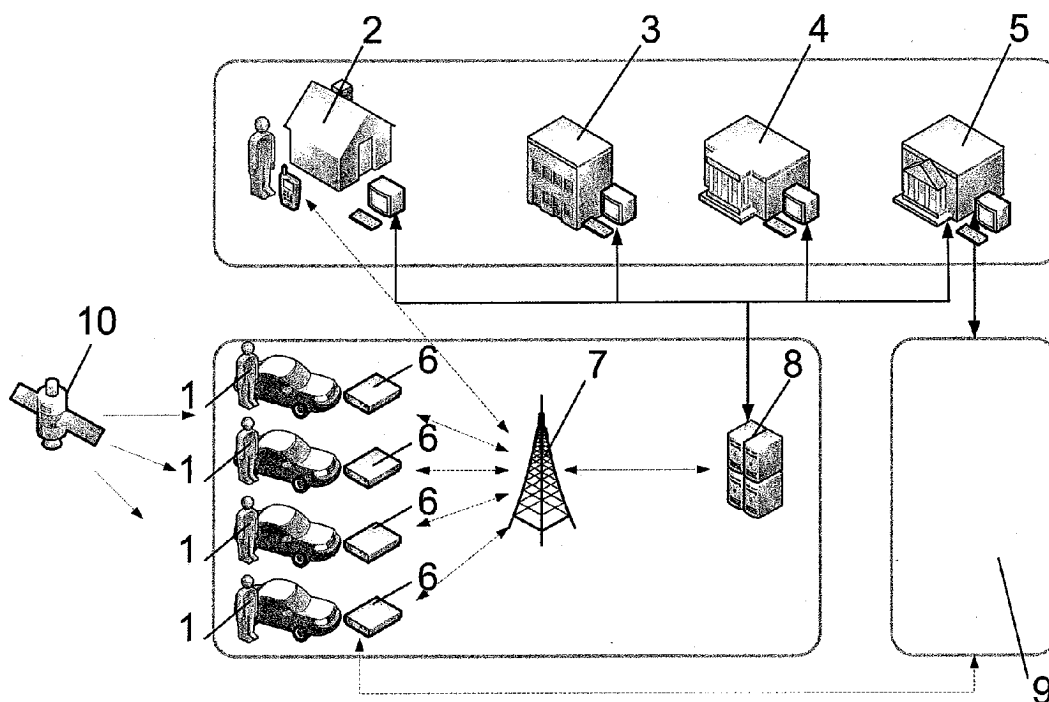


Fig. 1

## Description

[0001] The invention relates to an on-board unit serving as an On-Board Unit for communication along an electrical appliance of a vehicle. The electrical appliance may be a radio and/or a navigation system of the vehicle and the unit is a unit for communicating to a user along the radio and/or the navigation system.

## BACKGROUND OF THE INVENTION

[0002] Systems and method are known for providing information to occupants of a vehicle such as a driver of a vehicle either along the radio or along a navigation system of the vehicle. The information may be transmitted to the occupants of the vehicle along different known systems such as RDS etc. The information communicated is dependent on the hardware and software of the systems, i.e. the overall communication capabilities of the radio and/or the navigation system.

[0003] US 6,324,592 discloses a system for a robust and configurable computer architecture which combines standard Amplitude Modulation (AM)/Frequency Modulation (FM) radio and Compact Disk Read Only Memory (CDROM) features with mobile computational capabilities. The system provides a unique bus network which allows for an efficient and durable Input/Output (I/O) management system. The I/O management system has configurable data bus and discrete line connections to allow for modular addition, expansion, or replacement of navigation, crash detection, and communication line replacement units (LRUs). Additional I/O device connections allow several modes of input into the computational system. The apparatus is a single, self-contained enclosure which easily installs into most existing vehicles with minimum time and effort. Furthermore the present invention provides an accessible user interface for the computer system and possesses several theft protection features.

[0004] JP 06319335 discloses antennas for receiving the radio waves from a GPS satellite on the top parts of signal lights and incorporating GPS receivers into the signal lights. A control center equipment composed of a host computer is provided on a traffic control center providing drivers with road information (traffic information). Connection is established with a spot controller via a communication line of a telephone line, etc. A transmission information generation part makes a pair of the information on the contents of a set regulation and the positional information from the GPS receivers, generates transmission information and transmits the information to the control center equipment via a communication control part. The system is capable of promptly notifying about a traffic obstacle portion to a control center by calculating the location of traffic obstacle spot from the radio waves received by a reception means receiving the radio waves from the GPS satellite provided on the traffic obstacle section and transmitting the positional information to the traffic control center.

[0005] WO 2009/047176 discloses a terminal box for an electronic appliance, especially a car radio or a navigation system, said box comprising a housing and contacts which co-operate with corresponding contacts of the appliance. In order to improve the compatibility, the terminal box is placed in front of the appliance and contacting takes place by means of a plug connector.

## SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a device which makes it possible for the radio and/or the navigation system and/or another communication system of the vehicle to communicate information beyond that which the hardware and software of the communication system itself is capable of communicating.

[0007] It may also be an object to provide a device which may be installed without the need for specialized hardware and/or software skills. It may also be an object of the invention to provide a device, the communication along which is a secure communication between a transmitter and the occupants of the vehicle.

[0008] The firstly mentioned object of the invention is obtained by an On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the rear surface of the electronic appliance, and said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, said lead-out electrical contacts of the electrical signal supply leading towards the rear surface of the electrical appliance and leading electrical signals to the electrical appliance, along the On-Board Unit.

[0009] Connecting the On-Board Unit with the communication lines of the vehicle by means of the already available lead-in and lead-out electrical sockets has the advantage that the box may be connected to the communication system of the vehicle in a manner already available. Preferably, connecting the On-Board Unit with the communication system of the vehicle is established along already available electrical power socket according to ISO standard 10487.

[0010] A further advantage is that no specialized technical skills are needed of how to connect different elements of hardware, i.e. the communication system of the vehicle and the On-Board Unit. An even further advantage is the possibility of the On-Board Unit receiving electrical power through the same lead-in and lead-outs electrical sockets of the communication system of the vehicle.

[0011] The secondly mentioned object of the invention is obtained by an On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the electronic appliance, and said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic ap-

pliance, said lead-out electrical contacts of the electrical signal supply leading towards the rear surface of the electrical appliance and leading electrical signals to the electrical appliance, along the On-Board Unit, and said first set of electrical contacts of the On-Board Unit leading towards the rear surface of the electrical appliance and also leading electrical signals to the electrical appliance.

**[0012]** Connecting the On-Board Unit with the communication system of the vehicle by means of the already available lead-in and lead-out signal transmitters and signal receivers has the advantage that the box may be connected to the communication system of the vehicle in a manner already available. A further advantage is that no specialized technical skills are needed of how to connect different elements of hardware, i.e. the communication system of the vehicle and the On-Board Unit. An even further advantage is the possibility of the On-Board Unit receiving electrical signals through the same lead-in and lead-out signal transmitters and signal receivers of the communication system of the vehicle.

**[0013]** The thirdly mentioned object of the invention is obtained by an On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the electronic appliance, and said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, where the On-Board Unit comprises an identification means for indicating when at least one of the following situations occur: the first set of electrical contacts are removed from the corresponding lead-in electrical contacts of the electronic appliance, or the second set of electrical contacts are removed from the corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, or a surface of the On-Board Unit is tampered with, or a physical relation is altered between the On-Board Unit and another element present in or on the vehicle.

**[0014]** Monitoring the On-Board Unit in order to detect any tampering is an advantage because tampering may be detected without the need for visual inspection of the On-Board Unit. A further advantage is that tampering may be detected immediately when tampering takes place. An even further advantage is that it may be possible to block further use of the On-Board Unit having been tampered.

**[0015]** The On-Board Unit of the present invention is an On Board Unit (OBU) configured as a small electronic device intended for after sales mounting in most common types of vehicles. The main purpose of the On-Board Unit is to act as the remote and mobile element in the overall system setup which the On-Board Unit is a part of. The system scenarios in which the On-Board Unit may be employed are:

Intelligent Transport Systems (ITS). The On-Board Unit according to the invention constitutes a mobile

element in the infrastructure of the ITS. The On-Board Unit is capable of radio communication and radio broadcasting information of a radio information and communication providing system including Intelligent Transport Systems. The On-Board Unit may include a frequency division multiplexer that converts individual radio or intermediate frequencies modulated for mobile telephones and broadcasts so that the modulated frequencies are included in a specific frequency band, and the On-Board Unit produces radio signals in the specific frequency band. The Intelligent Transport System transmits and/or receives the radio signals; the On-Board Unit is provided with an antenna for receiving and transmitting the radio signals. An object of the present invention may be obtained by providing a On-Board Unit made simple and compact by integrating a plurality of radio-frequency units and a plurality of antennas into a single or more radio-frequency unit and a single or more antennas.

**[0016]** Traffic congestion control. At an external traffic congestion monitoring station or between external traffic congestion monitoring stations, which the vehicle may pass, the On-Board Unit may communicate to the driver or other user of the vehicle about possible traffic congestion, thereby preventing, as far as possible, the vehicle from entering into traffic congestion between stations. The On-Board Unit may itself calculate, or may receive signals from an external source of calculation, a route from a station which the vehicle passes at a present time or at a present position to a next station so as to arrive at the next station on time. The On-Board Unit communicates to the driver or other user of the vehicle a possible route for preventing, as far as possible, traffic congestion zones, said calculations and communication to the driver being based on at least one of the following parameters: an operation diagram information of the vehicle and stored in a memory of the On-Board Unit, route information of a Personal Navigation Assistant of the vehicle, positional information of one or more traffic light signals, said positional information inputted to the navigation system of the vehicle, traffic congestion information of a road or zone along the route of the vehicle, or control information of the one or more traffic light signals.

**[0017]** Intelligent Speed Adaption (ISA). The system may comprise automated Intelligent Speed Adaptation for the vehicle. If the On-Board Unit is self-contained, as the vehicle approaches a new speed zone, the unit only signals to warn the driver to take appropriate action. If the On-Board Unit is connected to the engine management system, the automatic GPS based cruise control is activated, and the On-Board Unit uses Intelligent Speed Adaptation and geographically based speed zone location tables to interact with the engine management system to slow down or speed up the vehicle to stay within appropriate speed limits in each zone. In both cases, regardless of the drivers actions, whether speeding up

or slowing down, the unit may automatically record the date, time, location and current speed of the vehicle only in case of speeding violations within each speed zone.

**[0018]** Road-pricing. The system may comprise automated Road Pricing means. The On-Board Unit is provided with a transmitter for transmitting a signal through a communication channel to be used for calling a mobile station of a vehicle communication system to the On-Board Unit entering the area of a road pricing. On the other hand, the On-Board Unit is provided with a receiver for receiving a signal and a charging signal for generating a charging process to be used for charging usage of the road by the vehicle.

**[0019]** Tracking and logistic systems. The system may comprise data processing along mobile communication between a service center and the On-Board Unit mounted in the vehicle. A vehicle list for storing vehicle data, a cargo list for storing cargo data and a vehicle/cargo list for storing the relationship between vehicle and cargo may be stored in a database of the service center. A change of the relationship between vehicle and goods is recorded by updating the three lists in the database, during possible loading, transportation, and unloading, etc. Possibly, managerial staff of the transportation service provider and owner of the cargo being transported can real-time obtain the current position information and transportation state of vehicles and goods by using mobile communication from the On-Board Unit to transfer positional data, preferably by GPS, of each vehicle.

**[0020]** Asset tracking. The system may comprise the possibility of tracking the vehicle. The On-Board Unit is monitoring and reporting the status of the vehicle. Destination information is provided to the On-Board Unit, and a geographical boundary or physical state boundary of the vehicle is set. As the vehicle with the On-Board Unit moves from a starting location to a destination location, the current location of the vehicle with the On-Board Unit is determined, and a determination is made whether the current location is within the geographical boundary. If the current location of the On-Board Unit is within the geographical boundary, an arrival message is transmitted from the On-Board Unit. Preferred embodiments of the invention include the step of transmitting a departure message from the On-Board Unit, if the current location of the mobile asset moves from within the geographical boundary to outside the geographical boundary. The On-Board Unit possibly also includes a tether sensor and one or more door sensors. The tether sensor senses whether the On-Board Unit is electrically connected to or disconnected from the vehicle, and the one or more door sensors sense whether one or more doors on the vehicle are open or closed. Thus, the On-Board Unit includes a processor, a location determining device for determining the geographic location of the mobile asset, and a transceiver for transmitting and receiving status messages related to the status of the vehicle.

**[0021]** Fleet management. The system may comprise the possibility of managing a fleet having a plurality of

vehicles. The On-Board Unit is installed in the plurality of vehicles. The On-Board Unit collects and stores at least time and location data of the vehicle, and a monitoring unit is provided for downloading the stored at least time and location data from the On-Board Unit, either when the vehicle passes the monitoring unit at certain traffic locations or by means of GPS. A control and management unit is connected to the monitoring unit so as to provide a travelling record, i.e. travelling route and/or travelling distance, of the vehicle.

**[0022]** Theft monitoring and alarm. The system may comprise theft monitoring, possibly combined with an alarm at the location of the vehicle. The On-Board Unit may comprise one or more of the following signal detection circuit: an Engine Management Unit (EMU) control circuit, a driving control circuit, or a control circuit of any doors, windows or other entrances to the vehicle. The state of the vehicle can be detected anytime and anywhere, and possibly the primary user or a secondary user such as a fleet management staff can directly control perhaps the fuel supply or the electrical power supply of the vehicle, by mobile phone and GSM signal to the On-Board Unit.

**[0023]** Insurance. The system may be provided with means for reporting positioning data and/or conditional data of a vehicle to a back-end server. A class of vehicle insurance schemes relies on data received from the On-Board Unit in the vehicle, generally known as "Pay-As-You-Drive" insurance schemes. Reporting of positioning data to the back-end server is obtained by establishing a local connection from the On-Board Unit to the back-end server and transmitting stored positioning data to the back-end server and further on to an insurance company or other company managing insurance of the vehicle. The On-Board Unit may, additionally or alternatively to the positioning data, function as a black box monitoring and possibly reporting conditional data of the vehicle, e.g. speed of the vehicle, functionality of braking system, ABS, EPS and other safety elements of the vehicle etc. Furthermore, the system may comprise an accident database and matching parameters derived from the vehicle positioning data with accident data. Alternatively, or additionally, to reporting positioning data and/or conditional data of a vehicle to a back-end server, the data may be loaded in the On-Board Unit for the On-Board unit to function as a so-called black-box of the vehicle, similar to known so-called black-boxed of aircrafts.

## BRIEF DESCRIPTION OF THE INVENTION

**[0024]** The invention will hereafter be described with reference to the drawings, where

Fig. 1 is a schematic view of a possible setup of a communication system architecture incorporating an OBU according to the invention.

Fig. 2 is a plane view of a back of a radio for a vehicle such as a passenger car, showing the plug-in of the

radio,

Fig. 3A and 3B are perspective view of possible embodiments of an On-Board Unit according to the invention, showing the plug-in connection of the unit, Fig. 4A is a perspective view of one possible assembly of the car radio, the On-Board Unit according to the invention and a car wire harness,

Fig. 4B is a perspective view of another possible assembly of the car radio, the On-Board Unit according to the invention and a car wire harness,

Fig. 5 is a schematic view of a possible setup of a user interaction system architecture incorporating a On-Board Unit according to the invention, and

Fig. 6 is a schematic view of a possible setup of a tampering detection system architecture incorporating a On-Board Unit according to the invention.

#### DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

**[0025]** Fig. 1 shows, schematically, a setup of a system architecture of a communication system. The communication system comprises various users 1,2,3,4,5 and various elements 6,7,8,9, the interaction between which users and elements will be described further in the following.

**[0026]** The users may be at least one primary user 1 such as a driver or another person related to one or more vehicles, either as users of a vehicle or as persons in some manner having a responsibility of a vehicle such as a garage park attendant, an employee of a car hire firm, a hotel clerk, a personal chauffeur etc.

**[0027]** Additionally or alternatively, the users may be at least one secondary user. The secondary user may be a private person 2 also related to one or more cars and which private person needs or wants to monitor and possibly log a driving pattern, a driven route by tracking, traffic information and other information related to an already performed use or a possible future use of one or more vehicles.

**[0028]** Additionally or alternatively, a secondary user may be an industrial or commercial plant 3 such as a fleet management company and which industrial or commercial plant 3 needs or wants to monitor and possibly log a driving pattern, a driven route by tracking, mileage information and other information related to an already performed use of one or more vehicles.

**[0029]** Additionally or alternatively, a secondary user may be a university or other intellectual institution 4 and which intellectual institution 4 needs or wants to monitor and possibly log a driving pattern, a driven route by tracking, mileage information and other information related to an already performed use or a possible future use of one or more vehicles.

**[0030]** Additionally or alternatively, a secondary user may be a traffic government or other governmental institution 5 and which governmental institution 5 needs or wants to monitor and possibly log a driving pattern, a driven route by tracking, mileage information and other

information related to an already performed use or a possible future use of one or more vehicles.

**[0031]** The elements are at least an On-Board Unit (OBU) 6 installed in a vehicle, preferably more OBUs 6 installed in a vehicle each. In the following, the abbreviation OBU will be used for designation the On-Board Unit 6 according to the invention as disclosed in the claims and in the Summary of the Invention.

**[0032]** The elements are also at least a communication network 6, a wireless network between the OBUs 6 of the vehicles and a communication point 7 such as a telecommunication mast, and a wireless network or wired network between the communication point 7 and at least one back-end communication server 8.

**[0033]** The driver or other person 1,2 related to the one or more vehicles, the one or more OBUs 6, the at least one communication point 7 and the at least one back-end communication server 8 constitute a core platform of the communication system.

**[0034]** In the communication system architecture shown, an Intelligent Traffic System (ITS) infrastructure 9 is a possible feature. Also, a GPS satellite 10 is shown as a possible of the communication system architecture, and to be used if positioning of the one or more vehicles is necessary to the primary user 1 or to one or more of the secondary users 2-5, e.g. if the system is used for asset tracking, mileage or the like.

**[0035]** The OBU 6 is capable of determining its position through the use of Global Navigation Satellite Systems (GNSS) technology and assisting sensors. The OBU 6 is capable of communicating with the primary user 1 of the vehicle in a traffic safe manner. The OBU 6 communicates with the back-end server 8 through a Wide Area Network (WAN) e.g. Global System for Mobile Communications (GSM) and/or General Packet Radio Service (GPRS). Communication to the fixed ITS infrastructure 9, such as active road-signs, tolling stations etc. is carried out through short range Radio Frequency (RF) systems.

**[0036]** Depending on the overall system setup, the OBU may either function as a stand-alone unit with minimum external interaction e.g. in asset tracking cases. In other system setups, the OBU will function as the mobile part of an overall communication platform. This will allow execution of specific and dedicated applications in the OBU itself, on board user interaction and dedicated real-time interaction with the server back-end.

**[0037]** Data communicated from the OBU to the primary users 1 and/or to the secondary users 2-5 may be one or more of the following data: instant position of vehicle, route driven by vehicle over a period of time, accumulated mileage covered by vehicle, mileage covered by vehicle between two positions, etc.

**[0038]** Data communicated to the OBU and to the primary users 1 from one or more of the secondary users 2-5 may be one or more of the following data: traffic situation ahead of vehicle along a route to be driven by the vehicle, instant speed of vehicle, route driven by vehicle over a period of time, accumulated mileage covered by

vehicle, mileage covered by vehicle between two positions, etc.

**[0039]** In the communication system architecture shown, four different primary users 1 and different secondary users 2-5 are shown. In alternative communication system architectures, the number of primary users 1 may be fewer or more and/or the number and variety of secondary users 2-5 may be fewer or more.

**[0040]** On the one hand, if the monitoring and communication performed by the OBUs of the vehicles is intended for road pricing or other commercial activities, or is intended for traffic information from authorities or other informational activities, the number of primary users will be far more than four and possibly the university or other academic institution as a secondary user will be omitted.

**[0041]** On the other hand, if the monitoring and communication performed by the OBUs of the vehicles is intended for technical test purposes or test activities, or is intended for demographic test purposes or other such informational activities, the number of primary users may be limited and possibly the commercial companies and/or traffic authorities as secondary users will be omitted.

**[0042]** Fig. 2 shows the rear of a car radio 11 to be installed in a docking bay of vehicle. The rear of the car radio 11 is not visible when the car radio 11 is installed in the docking bay. The rear of the car radio 11 is provided with various plug-in sockets, one socket being a plug-in socket 12 for electrical power and for various communication signals to and from the car radio. Said plug-in socket 12 is shaped according to ISO standard 10487.

**[0043]** Fig. 3A and 3B show different embodiments of an OBU 6. The OBU 6 comprises various hardware elements and software programmes intended for making the OBU 6 capable of communication between the vehicle and exterior elements 6-10 as shown in Fig. 1. The OBU 6 is provided with a plug-in socket 13 at least partly being shaped according to ISO standard 10487. A reverse side (not shown) of the OBU 6 is provided with a plug-in socket also shaped at least partly according to ISO standard 10487. Fig. 3A shows the plug-in sockets 13 being integrate with the hardware elements and software programmes intended for making the OBU 6 capable of communication between the vehicle and exterior elements. Fig. 3B shows the plug-in sockets being separate from, but connected to, the hardware elements and software programmes intended for making the OBU 6 capable of communication between the vehicle and exterior elements. Connection between the plug-in sockets 13 and the hardware elements of the OBU 6 may be a wired connection, a wireless connection or a combination thereof.

**[0044]** Fig. 4A is an exploded view showing one assembly of a car radio 11 with an OBU 6 and a plug-in socket 14 for a power and communication cable of a vehicle. The OBU 6 constitutes an intermediate element between the car radio 11 and plug-in socket 14 of the power and communication signal cable. Thus, no special wiring is needed for installing the OBU 6 in connection

with a car radio 11.

**[0045]** Only installation needed is firstly unplugging the power and communication cable 14 from the rear of the car radio 11, secondly inserting the OBU 6 in the rear plug-in socket 12 of the car radio or in a plug-in socket 14 of the power and communication cable, and thirdly inserting the OBU 6 in the plug-in socket 14 of the power and communication cable or in the plug-in socket 12 of the car radio 11, respectively.

**[0046]** In the embodiment shown, the OBU 6 is provided with a plug-in socket 13 at least partly being shaped according to ISO standard 10487 and a reverse side (not shown) of the OBU 6 is provided with a plug-in socket also shaped at least partly according to ISO standard 10487. In an alternative embodiment, the plug-in socket 13 of the OBU 6 and/or the reverse side plug-in socket (not shown) of the OBU 6 may be separate elements connected to the OBU by cables provided between one or both sockets and the OBU. Thereby, the OBU 6 need not be positioned directly at the rear side plug-in socket 12 of the car radio 11.

**[0047]** Fig. 4B is an exploded view showing another assembly of a car radio 11 with an OBU 6 and a plug-in socket 14 for a power and communication cable of a vehicle.

**[0048]** The OBU is divided into a first sub-unit comprising at least a data receiver and the contacts, and a second sub-unit comprising at least a data processor and a data transmitter, said second sub-unit being separate from the first sub-unit. A wired or wireless communication line, or perhaps a combined wired and wireless communication line, is established between the first sub-unit and the second sub-unit. It may also be possible to combine a wired electrical power line with a wireless or wired communication line between the first sub-unit and the second sub-unit. Possible, a wired electrical power line may also function as a wired communication line between the first sub-unit and the second sub-unit thus, the second sub-unit may be powered along a wired electrical power line between the first sub-unit and the second sub-unit, but the second sub-unit may also be powered along another electrical power line of the vehicle.

**[0049]** The first sub-unit constitutes an intermediate element between the car radio 11 and plug-in socket 14 of the power and communication signal cable. Thus, no special wiring is needed for installing the first sub-unit in connection with a car radio 11.

**[0050]** Only installation needed of the first sub-unit is firstly unplugging the power and communication cable 14 from the rear of the car radio 11, secondly inserting the first sub-unit in the rear plug-in socket 12 of the car radio or in a plug-in socket 14 of the power and communication cable, and thirdly inserting the first sub-unit in the plug-in socket 14 of the power and communication cable or in the plug-in socket 12 of the car radio 11, respectively.

**[0051]** Installation of the second sub-unit may be accomplished anywhere in the vehicle. It may be at anon-

ther location than the location of the contacts, but still at the rear side of the electrical appliance, as shown in fig. 4B. it may be at another location behind the dashboard of the vehicle, or it may be at an even more remote location in relation to the electrical appliance.

**[0052]** Signals sent between the first sub-unit and the second sub-unit may be sent along a wired communication line or along a wireless communication line, depending on the signals sent, i.e., possibly wired communication line if signals are sensitive to other electrical signals, or depending on the remote location of the second sub-unit, i.e. preferably wireless communication line if the second sub-unit is located far from the first sub-unit.

**[0053]** In the embodiment shown, the first sub-unit is provided with a plug-in socket 13 at least partly being shaped according to ISO standard 10487 and a reverse side (not shown) of the first sub-unit is provided with a plug-in socket also shaped at least partly according to ISO standard 10487. In an alternative embodiment, the plug-in socket 13 of the first sub-unit and/or the reverse side plug-in socket (not shown) of the first sub-unit may be separate elements connected to the first sub-unit by cables provided between one or both sockets and the first sub-unit. Thereby, the first sub-unit need not be positioned directly at the rear side plug-in socket 12 of the car radio 11.

**[0054]** Fig. 5 shows a possible system architecture for user interaction between a car radio 11, alternatively or additionally a Personal Navigation Assistant (PNA) 15, of a vehicle and a user of the vehicle. Thus, user interaction will use the already existing communication elements, e.g. the car radio and/or the Personal Navigation Assistant (PNA) 15, of the vehicle. Using the already existing communication elements of the vehicle is possible via FM transmission provided by a built-in FM modulator of the OBU 6. Radio Data System (RDS) standard allow feeding text data to the radio display and via RDS and/or Traffic Message Channel (TMC) to the Personal Navigation Assistant. Also Traffic Announcement (TA) and plain audio signals (voice and tones) to a loudspeaker 17 are means of user communication that may be used.

**[0055]** Information, either generated locally in the OBU 6 or received from the back-end server 8 of the overall communication system, will be communicated to the user/driver of the vehicle by the use of low-power FM transmission.

**[0056]** Audio messages that need to be communicated to the driver of the vehicle can be handled in two ways: The audio signal is transmitted at the FM band at a predetermined frequency. OBU and car radio needs to be tuned to the same frequency. The OBU will force the car radio to receive signals at a given (predetermined) frequency regardless of the current radio settings by invoking the Traffic Announcement function (TA). The audio message will then be transmitted, and the OBU will 'release' the radio back to normal operation.

**[0057]** Text messages that need to be communicated to the driver of the vehicle can be handled in two ways:

The message is encoded as a RDS text message and transmitted to the car radio. This can be done with or without utilization of the TA function as described above. The message is encoded as an RDS and/or TMC message and transmitted to the Personal Navigation Assistant (PNA). The PNA will display the OBU generated message in the same way as the PNA would display TMC messages received from the traffic authorities.

**[0058]** Fig. 6 shows a possible system architecture for tampering detection and monitoring of the OBU 6. A risk is present of unauthorized tampering with the OBU 6. Especially scenarios where significant amounts of money are involved, like road-pricing, are anticipated to contain a high risk of tampering attempts.

**[0059]** In the embodiment shown, the OBU 6 contain a number of countermeasures in order to detect and attempts of tampering. It will never be possible to avoid tampering attempts, but by the number of countermeasures described, it is possible to detect and report such attempts.

**[0060]** The OBU 6 monitor a Global Position System (GPS) antenna 21 in order to determine if the antenna 21 has either been removed or a signal path has been blocked. An obstructed GPS antenna 21 will prevent the OBU 6 in determining its accurate position, and thus in reality make it useless in most scenarios of use.

**[0061]** As for the GPS antenna 21, the OBU 6 will permanently monitor the GSM/GPRS antenna 22. If the GSM/GPRS antenna 22 is removed or a signal path is blocked, the OBU 6 will cease to be able to communicate with the back-end server 8 of the communication system. The OBU 6 itself may continue to operate, but without the ability to interact with the back-end server 8 of the communication system, the system is crippled. If the GSM/GPRS antenna 22 is blocked or removed, it is easily detected from both the mobile OBU 6 and from the fixed back-end server 8 of the communication system, and appropriate actions can be taken.

**[0062]** An electrical interface 23 to the vehicle needs to be monitored as a basic mean of detecting and monitoring if the OBU 6 is being removed from the vehicle. Power supply, ignition-detection etc. have to be monitored, and any abnormalities have is detected and monitored by the OBU 6 as a possible tampering attempt.

**[0063]** The physical presence of the OBU 6 in the vehicle is also monitored and secured by the use of RFID technology. A RFID tag 24 is fixed physically to the vehicle. The RFID tag 24 is fixed to the vehicle in such a way that the RFID tag 24 cannot be removed without breaking the RFID tag 24. This could be done by integrating the RFID tag 24 in a 'sticker' or vignette that is placed in plain sight somewhere on the windshield. Another option is to fix the RFID tag 24 to the vehicle body by use of glue or the like.

**[0064]** The OBU 6 will continuously monitor the presence of the passive RFID tag 24. If the OBU 6 is removed from the vehicle it will be detected, and so is the case if the RFID tag 24 is removed or broken in a tampering

attempt. The unique RFID tag 24 is paired (during installation) with the OBU 6 through the means of an RFID transceiver of the OBU 6. This ensures a direct link between the vehicle and the primary user 1 of the OBU 6.

## Claims

1. On-Board Unit for an electronic appliance of a vehicle,

- said electronic appliance having a front surface facing towards an interior of the vehicle, and a rear surface facing away from the interior of the vehicle, said On-Board Unit comprising a housing and comprising electrical contacts,
- said On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the rear surface of the electronic appliance, and
- said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance,
- said lead-out electrical contacts of the electrical signal supply leading towards the rear surface of the electrical appliance and leading electrical signals to the electrical appliance, along the On-Board Unit.

2. On-Board Unit according to claims 1, where the second set of contacts is capable of and intended for also co-operating with corresponding lead-out contacts of an electrical power supply to the electronic appliance.

3. On-Board Unit according to claim 1 or claim 2, where the first set of contacts and the second set of contacts correspond of the On-Board Unit corresponds to ISO10487 of the International Organization for Standardization.

4. On-Board Unit according to any of claim 1-3, where signals between the On Board Unit and the electrical appliance is communicated along lead-in contacts of the rear surface of of a vehicle radio.

5. On-Board Unit according to any of claim 1-4, where signals between the On Board Unit and the electrical appliance is passed along a wireless communication line between a signal transmitter of the electrical contacts of the On-Board Unit and a signal receiver of a data processing element of the On-Board Unit.

6. On-Board Unit according to any of claim 1-4, where signals between the On Board Unit and the electrical

appliance is passed along a wired communication line between a signal transmitter of the electrical contacts of the On-Board Unit and a signal receiver of a data processing element of the On-Board Unit.

7. An On-Board unit according to claim 4 or 5, where the electrical contacts are dimensioned so as to be plugged into corresponding contacts of the electrical appliance, and where the data processing element is dimensioned so as to be placed in a location of the vehicle remote from the electrical appliance.

8. On-Board Unit according to any of claim 1-7, where signals between the On-Board Unit and the electrical appliance is communicated along a Radio Data System (RDS) and/or Traffic Message Channel (TMC) communication system.

9. On-Board Unit according to any of claim 1-8, where the On-Board Unit is capable of and intended for providing at least one of the following signals to the electrical appliance: general information of traffic ahead, personalized information of traffic ahead, information of mileage covered, information on tolling/parking stations ahead, information of tolling/parking station payment transactions via the OBU, for the electrical appliance to communicate the at least one signal to at least a driver of the vehicle.

10. On-Board Unit for an electronic appliance of a vehicle,

- said electronic appliance having front surface facing towards an interior of the vehicle and a rear surface facing away the interior of the vehicle, said On-Board Unit comprising a housing and comprising electrical contacts,
- said On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the electronic appliance, and
- said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance,
- said lead-out electrical contacts of the electrical signal supply leading towards the rear surface of the electrical appliance and leading electrical signals to the electrical appliance, along the On-Board Unit, and
- said first set of electrical contacts of the On-Board Unit leading towards the rear surface of the electrical appliance and also leading electrical signals to the electrical appliance.

11. On-Board Unit according to claim 10, where the On-Board Unit is capable of and intended for providing

at least one of the following signals to the electrical appliance for the electrical appliance to communicate the at least one signal to the interior of the vehicle: information of position of vehicle, information of speed of vehicle, information of acceleration of the vehicle, information of state of the vehicle such as engine ignited, vehicle driving, vehicle stopped, vehicle parked, information of mileage covered by the vehicle,

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**12.** On-Board Unit for an electronic appliance of a vehicle,

- said electronic appliance having front surface facing towards an interior of the vehicle and a rear surface facing away the interior of the vehicle, said On-Board Unit comprising a housing and comprising electrical contacts, 15
- said On-Board Unit having a first set of electrical contacts capable of and intended for co-operating with corresponding lead-in electrical contacts of the electronic appliance, and 20
- said On-Board Unit having a second set of electrical contacts capable of and intended for co-operating with corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, 25
- where the On-Board Unit comprises an identification means for indicating when at least one of the following situations occur: 30

the first set of electrical contacts are removed from the corresponding lead-in electrical contacts of the electronic appliance or the second set of electrical contacts are removed from the corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, or a surface of the On-Board Unit is tampered with, or a signal between the On-Board Unit and external communication means is interrupted, or a physical relation is altered between the On-Board Unit and another element present in or on the vehicle.

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**13.** On-Board Unit according to claim 12, where the detection means is at least one of the following means: No Global Positioning System (GPS) signal while accelerometer showing car acceleration and ignition on, 50

GPS signal giving fixed position while accelerometer showing car acceleration and ignition on, car battery supply removed while accelerometer is indicating movement of On-Board Unit, no ignition while accelerometer data or microphone data indicate engine running. 55

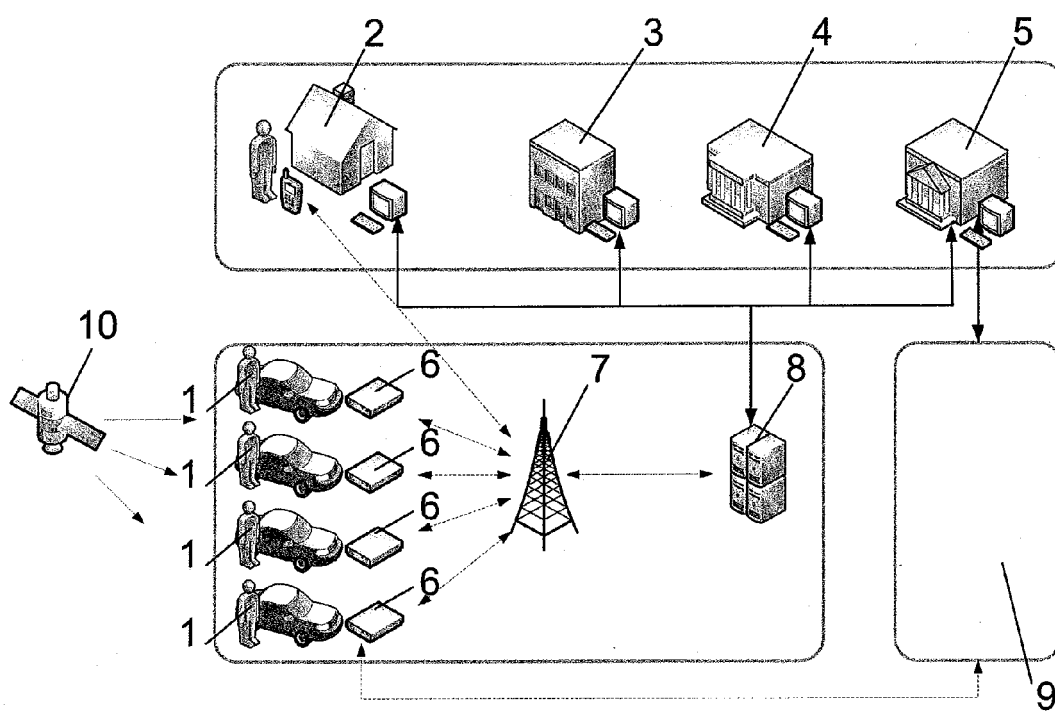


Fig. 1

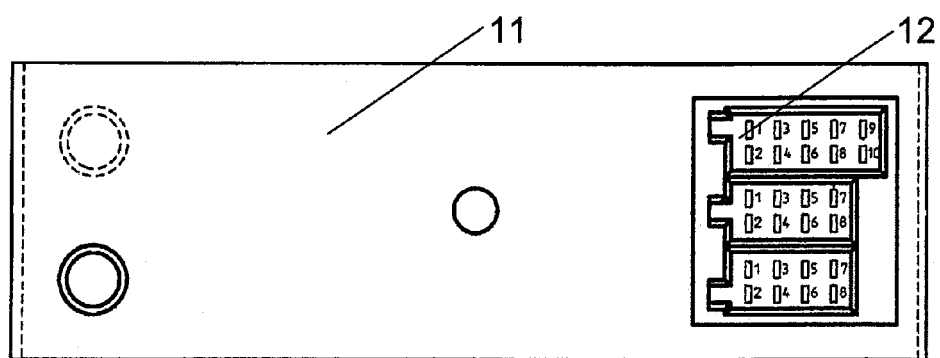


Fig. 2

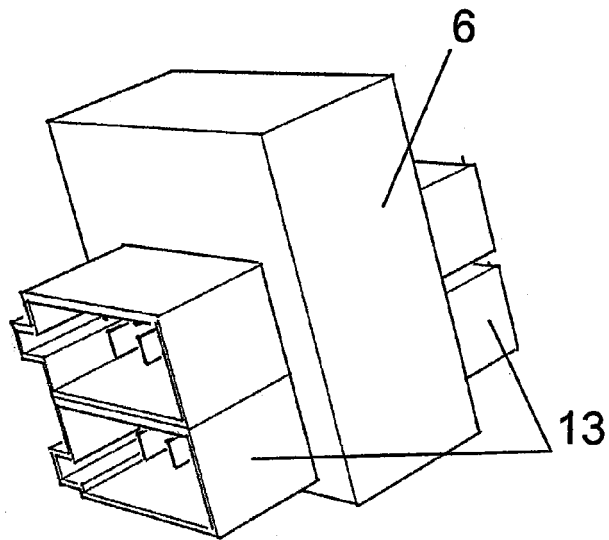


Fig. 3A

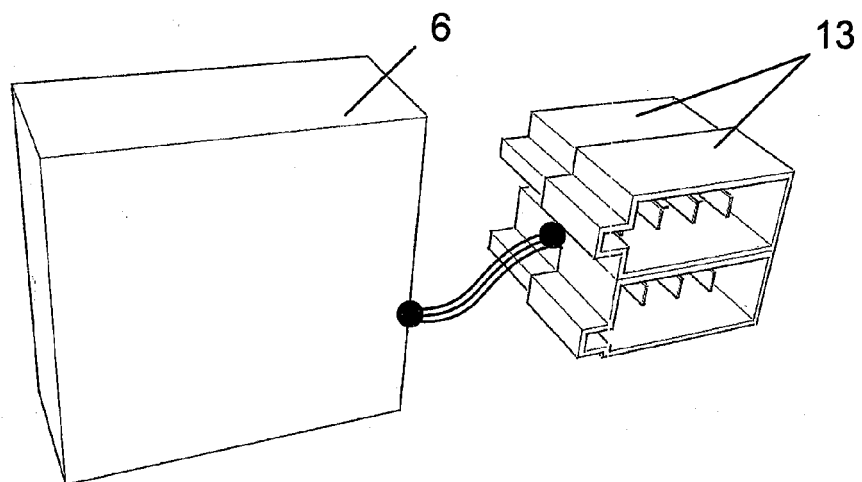


Fig. 3B

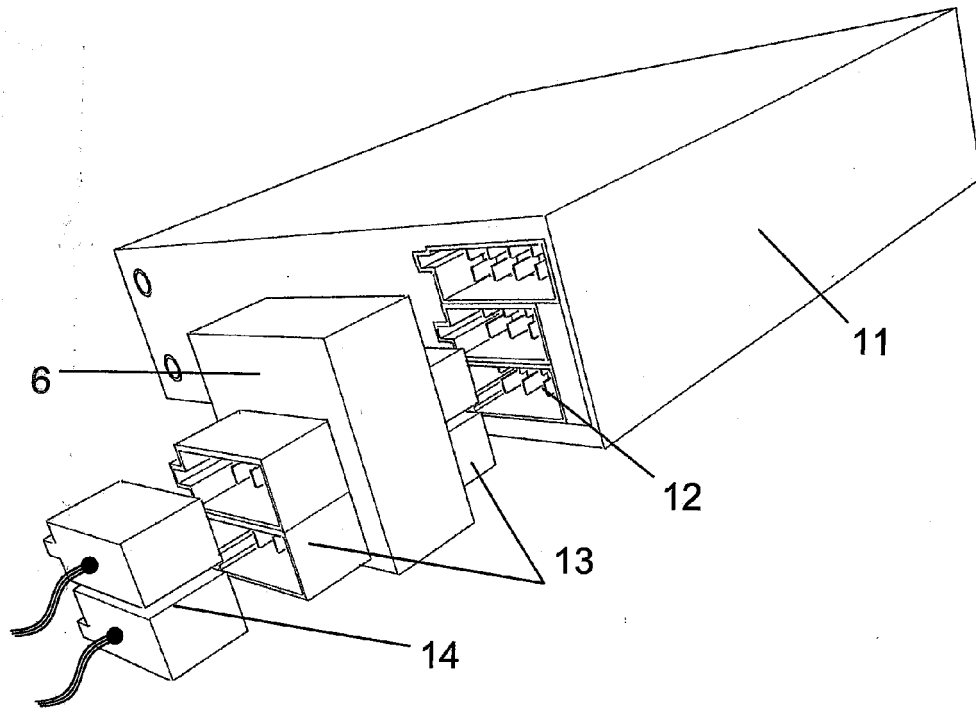


Fig. 4A

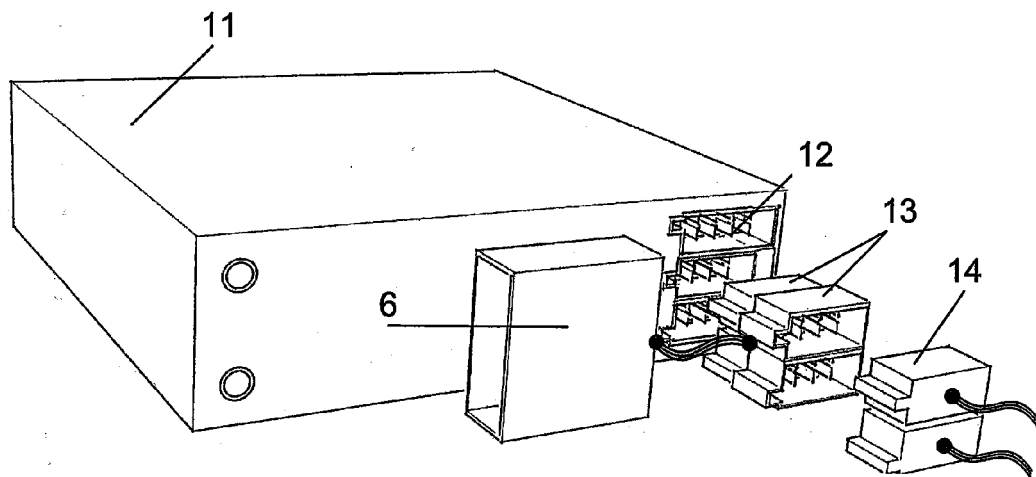


Fig. 4B

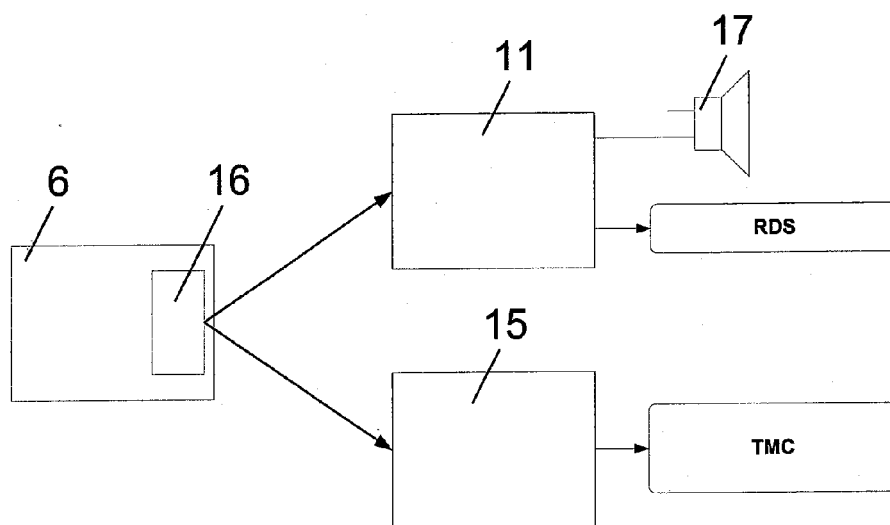


Fig. 5

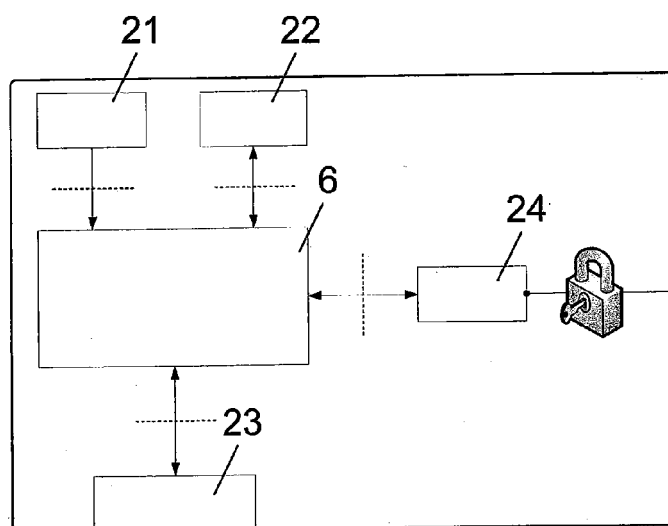


Fig. 6



## EUROPEAN SEARCH REPORT

Application Number  
EP 10 15 3707

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                 |                                                 |                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Citation of document with indication, where appropriate, of relevant passages                                                                                   | Relevant to claim                               | CLASSIFICATION OF THE APPLICATION (IPC)      |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | WO 01/39566 A1 (BOSCH GMBH ROBERT [DE]; KEINDORFF JENS MATTHIAS [DE])<br>31 May 2001 (2001-05-31)<br>* page 3, line 11 - page 5, line 14;<br>figures *<br>----- | 1-4,6,10                                        | INV.<br>B60R11/02<br>G07B15/00<br>G08G1/0968 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                 |                                                 | TECHNICAL FIELDS SEARCHED (IPC)              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                 |                                                 | B60R<br>G07B<br>G08G                         |
| <p>5 <del>The present search report has been drawn up for all claims</del></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                 |                                                 |                                              |
| Place of search<br>Berlin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 | Date of completion of the search<br>28 May 2010 | Examiner<br>David, Pascal                    |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>.....<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                 |                                                 |                                              |

EPO FORM 1503 03.02 (P04C01)



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**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-4, 6, 10

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4, 6, 10

The additional features of dependant claim 3 are not known from the prior art and can therefore be seen to make a contribution over the prior art (Special Technical Features (STF); Rule 44 EPC): the first set of contacts and the second set of contacts correspond of the On-Board Unit corresponds to ISO10487 of the International Organization for Standardization.

The problem corresponding to these special technical features can be seen as how to chose the contacts of the On-Board Unit.

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2. claims: 5, 7, 8

Signals between the On Board Unit and the electrical appliance is passed along a wireless communication line between a signal transmitter of the electrical contacts of the On-Board Unit and a signal receiver of a data processing element of the On-Board Unit.

The data processing element is dimensioned so as to be placed in a location of the vehicle remote from the electrical appliance.

Signals between the On-Board Unit and the electrical appliance is communicated along a Radio Data System (RDS) communication system and/or Traffic Message Channel (TMC) communication system.

The problem corresponding to these special technical features can be seen as how to improve use of portable electronic devices in the vehicle.

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3. claims: 9, 11(all partially)

The On-Board Unit is capable of and intended for providing general or personalized information of traffic ahead or information of position of the vehicle to the electrical appliance, for the electrical appliance to communicate said information to at least a driver of the vehicle.

The problem corresponding to these special technical features can be seen as how to improve navigation.

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4. claims: 9, 11(all partially)



**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number

EP 10 15 3707

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

The On-Board Unit is capable of and intended for providing general information of mileage covered, for the electrical appliance to communicate said information to at least a driver of the vehicle.

The On-Board Unit is capable of and intended for providing information of mileage covered by the vehicle to the electrical appliance for the electrical appliance to communicate the information of mileage covered to the interior of the vehicle.

The problem corresponding to these special technical features can be seen as how to inform the driver of the distance driven.

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5. claim: 9(partially)

The On-Board Unit is capable of and intended for providing information on tolling stations ahead to the electrical appliance, for the electrical appliance to communicate the information on tolling stations ahead to at least a driver of the vehicle.

The On-Board Unit is capable of and intended for providing information of tolling station payment transactions via the OBU, to the electrical appliance, for the electrical appliance to communicate the information of tolling station payment transactions via the OBU to at least a driver of the vehicle.

The problem corresponding to these special technical features can be seen as how to manage tolling.

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6. claim: 9(partially)

The On-Board Unit is capable of and intended for providing information on parking stations ahead to the electrical appliance, for the electrical appliance to communicate the information on parking stations ahead to at least a driver of the vehicle.

The On-Board Unit is capable of and intended for providing information of parking station payment transactions via the OBU to the electrical appliance, for the electrical appliance to communicate the information of parking station payment transactions via the OBU to at least a driver of the vehicle.

The problem corresponding to these special technical features can be seen as how to manage parking.

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7. claim: 11(partially)



**LACK OF UNITY OF INVENTION**  
**SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

The On-Board Unit is capable of and intended for providing information of speed of vehicle to the electrical appliance for the electrical appliance to communicate the information of speed of vehicle to the interior of the vehicle.

The On-Board Unit is capable of and intended for providing information of acceleration of vehicle to the electrical appliance for the electrical appliance to communicate the information of acceleration of vehicle to the interior of the vehicle.

The problem corresponding to these special technical features can be seen as how to inform the driver about the dynamic of the vehicle.

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8. claim: 11(partially)

The On-Board Unit is capable of and intended for providing information of state of engine ignition to the electrical appliance for the electrical appliance to communicate the information of state state of engine ignition to the interior of the vehicle.

The On-Board Unit is capable of and intended for providing information of state of vehicle driving to the electrical appliance for the electrical appliance to communicate the information of state of vehicle driving to the interior of the vehicle.

The On-Board Unit is capable of and intended for providing information of state of vehicle stopped to the electrical appliance for the electrical appliance to communicate the information of state of vehicle stopped to the interior of the vehicle.

The On-Board Unit is capable of and intended for providing information of state of vehicle parked to the electrical appliance for the electrical appliance to communicate the information of state of vehicle parked to the interior of the vehicle.

The problem corresponding to these special technical features can be seen as how to improve the security.

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9. claims: 12, 13



**LACK OF UNITY OF INVENTION  
SHEET B**

Application Number  
EP 10 15 3707

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

The On-Board Unit comprises an identification means for indicating when at least one of the following situations occur:  
the first set of electrical contacts are removed from the corresponding lead-in electrical contacts of the electronic appliance or the second set of electrical contacts are removed from the corresponding lead-out electrical contacts of an electrical signal supply to the electronic appliance, or a surface of the On-Board Unit is tampered with, or a signal between the On-Board Unit and external communication means is interrupted, or a physical relation is altered between the On-Board Unit and another element present in or on the vehicle.  
The problem corresponding to these special technical features can be seen as how to detect tampering of the On-Board Unit.

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 3707

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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28-05-2010

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

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