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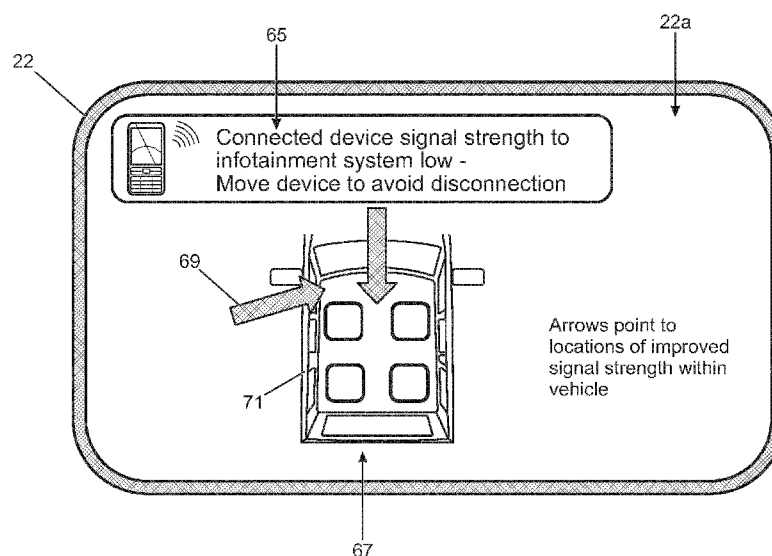


FIGURE 4

(57) **Abstract:** According to an aspect of the invention, there is provided a method of assisting use of a consumer electronic device on board a vehicle. The method comprises determining that a portable consumer electronic device is connected to a controller of the vehicle by virtue of a first connection. A first signal strength of said first connection is determined by the controller and/or a second signal strength of a second connection between the consumer electronic device and a second communications network is determined by the controller. In dependence upon the determined first signal strength and/or the determined second signal strength, the controller is configured to issue information about one or more locations on-board said vehicle at which one or more locations, the first signal strength and/or the second signal strength may be improved.



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METHOD OF ASSISTING USE OF A CONSUMER ELECTRONIC DEVICE ON BOARD A VEHICLE

TECHNICAL FIELD

5 The present disclosure relates to a method of assisting use of a consumer electronic device on-board a vehicle and particularly, but not exclusively, to the determination of one or more signal strength and to the generation of relevant information. Aspects of the invention relate to a method, to a controller, to an infotainment system and to a vehicle.

10 BACKGROUND

Many vehicles, including motor vehicles, planes and trains, accommodate passengers who bring on board their own portable consumer electronic device such as a phone, smartphone, tablet computer, laptop computer and video gaming device. Such portable consumer electronic devices are often connectable with infotainment systems on board the vehicles.

15 This allows, for example, head sets and display screens on-board the vehicle to be used in association with the portable consumer electronic device and/or allows the portable consumer electronic device to access data such as stored music, films and games held on the infotainment system of the vehicle, which can then be played using the audio visual capability of the portable consumer electronic device. Additionally such portable consumer
20 electronic devices are connectable to communications networks, such as mobile telephone networks, local area networks and Wi-Fi networks. This allows, for example, the portable consumer electronic device to access cloud and internet based services and mobile telephone networks.

25 It has been recognised by the present applicants that the structure, layout, and interior trim and other internal features of vehicles can interfere with the connectivity of portable consumer electronic devices. Low signal strength levels between the portable consumer electronic device and an infotainment system or communications network can compromise the connection between the portable consumer electronic device and an infotainment or
30 other communications network and result in: loss of data; poor or complete loss of infotainment transmissions (such as streaming of music, game, or video); and poor or complete loss of telephone conversation transmission or other infotainment transmission.

It is an aim of the present invention to provide an improvement in the field of infotainment
35 and similar systems on board vehicles that has particular application for motor vehicles. The invention may be utilised in applications for vehicles other than motor vehicles and may be

utilised in applications other than for vehicles. For example, it is foreseen that the invention may have application in buildings, for example houses and offices.

SUMMARY OF THE INVENTION

5 Aspects and embodiments of the invention provide a method, a controller, an infotainment system and a vehicle as claimed in the appended claims.

According to an aspect of the invention, there is provided a method of assisting use of a consumer electronic device on-board a vehicle. The method comprises determining a first
10 signal strength of a first connection between the consumer electronic device and a controller of the vehicle; and/or determining a second signal strength of a second connection between the consumer electronic device and a second communications network; and comparing said determined first signal strength and/or said determined second signal strength with at least one predetermined signal strength. In dependence upon said comparison, the controller may
15 be configured to issue information about one or more locations on-board said vehicle at which one or more locations the signal strength of the first connection may be improved over the first determined signal strength and/or at which one or more locations the signal strength of the second connection may be improved over the second determined signal strength.

20 The issued information may assist a user of the portable consumer electronic device. In this way a consumer whose electronic device is suffering from poor connectivity is warned about the poor connectivity and is alerted to locations where signal strength may be improved. Such locations may be stored in a memory storage device associated with the controller and may be, for example, locations where good signal strength is found because of the structure
25 and location of the vehicle or locations where a signal strength booster is within range. The user can then move their electronic device into a location where the first signal strength and/or the second signal strength may be improved. This may prevent the device becoming unusable and/or may mitigate against loss of data, compromised connectivity and/or poor broadcasting and/or transmission of services such as telephone conversation and
30 navigational information provided by the portable consumer electronic device.

Without limitation, the signal strength may be defined in terms of the magnitude or amplitude of the signal, but may include other indicators of signal quality such as signal bandwidth, signal data capacity, or signal data rate etc.

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Optionally, the predetermined signal strength comprises a threshold signal strength value and/or a signal strength at a predetermined location within the vehicle.

Optionally, the issuing of information about one or more locations on-board said vehicle is made in dependence on a type of the consumer electronic device. For example, if the device is a smartphone and other mobile telephone then the information issued will relate to a cellular signal boosting mat. Conversely if the device is a DVD player then the information issued may relate to a Wi-Fi signal antenna.

Optionally, the second signal strength is obtainable from the first signal between the consumer electronic device and the controller of the vehicle. In this way, the signal strength information can be gathered from RSSI indicator rather than having to measure the signal strength.

Optionally, the method comprises determining that a portable consumer electronic device is currently on-board a vehicle. Optionally, the method comprises determining that a portable consumer electronic device is connected to a controller of the vehicle by virtue of a first connection being established therebetween.

Optionally, said issuing information comprises explicitly issuing information about the first signal strength and/or the second signal strength.

Optionally, said issuing information comprises implicitly issuing information about the first signal strength and/or the second signal strength by means of issuing information about the one or more locations on-board said vehicle.

Optionally, issuing information about one or more locations on-board said vehicle comprises providing visual information on a display screen on board said vehicle.

Optionally, said visual information comprises an image of at least part of the vehicle and a demarcation on that image of the one or more locations on-board said vehicle.

Optionally, issuing information about the one or more locations on-board said vehicle comprises providing visual information on, adjacent or otherwise proximate to at least one of said one or more locations on-board said vehicle.

Optionally, said visual information comprises an illumination on, adjacent or otherwise proximate to at least one of said one or more locations on-board said vehicle.

Optionally, issuing information about the one or more locations on-board said vehicle comprises providing visual information on a display screen on said consumer electronic device.

5 According to another aspect of the invention, there is provided a controller for a vehicle, the controller being connectable to a portable consumer electronic device by a first connection, the consumer electronic device being connectable by a second connection to an external network. The controller may be configured to determine a first signal strength of said first connection and/or determine a second signal strength of said second connection. The
10 controller may be configured to cause, in dependence upon said determined first signal strength and/or second signal strength, information to be issued about one or more locations on-board said vehicle at which one or more locations the first and/or second signal strength may be improved.

15 Optionally, the controller is configured to compare the first signal strength and/or the second signals strength with a predetermined signal strength, the predetermined signal strength comprising a threshold signal strength value and/or a signal strength at a predetermined location within the vehicle.

20 Optionally, the controller is configured to issue information about one or more locations on-board said vehicle in dependence on a type of the consumer electronic device. For example, if the device is a smartphone and other mobile telephone then the information issued will relate to a cellular signal boosting mat. Conversely if the device is a DVD player then the information issued may relate to a Wi-Fi signal antenna.

25 Optionally, the controller is configured to obtain second signal strength from the first signal between the controller and the consumer electronic device. In this way, the signal strength information can be gathered from RSSI indicator rather than having to measure the signal strength.

30 Optionally, the controller is additionally configured to cause information about the first signal strength and/or the second signal strength to be explicitly issued.

Optionally, the controller is configured to cause information about the first signal strength
35 and/or the second signal strength to be implicitly issued by virtue of issuing information about said one or more locations on-board said vehicle.

Optionally, the information issued about the one or more locations on-board said vehicle comprises visual information on a display screen on board said vehicle.

Optionally, said visual information comprises an image of at least part of the vehicle and a
5 demarcation on that image of the one or more locations on-board said vehicle.

Optionally, the information issued about the one or more locations on-board said vehicle comprises visual information on, adjacent or otherwise proximate to at least one of said one or more locations on board said vehicle.

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Optionally, said visual information comprises an illumination on, adjacent or otherwise proximate to at least one of said one or more locations on board said vehicle.

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According to yet another further aspect of the invention, there is provided a second controller for use on a consumer electronic device, the second controller being able to determine a first signal strength of a first connection between the consumer electronic device and a first controller on-board a vehicle; and/or the second controller being able to determine a second signal strength of a second connection between the consumer electronic device and a second communications network, the second controller being configured to cause, in
20 dependence upon said determined first and/or second signal strengths, information to be issued about one or more locations on-board said vehicle whereat the first signal strength and/or the second signal strength may be improved.

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According to a further still aspect of the invention, there is provided an infotainment system as described above wherein said controller comprises an electronic processor having an electrical input for receiving data relating to a strength of a first signal and/or a strength of a second signal, from said portable consumer electronic device; and an electronic memory device, electrically coupled to the electronic processor and having instructions stored therein; said controller causing, in dependence upon said strengths of the first and/or second
30 signals, information to be issued about locations on-board said vehicle, comprising the processor being configured to access the memory device and execute the instructions stored therein such that it is operable to issue said information based on the signal strengths.

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According to yet an even further aspect of the invention there is provided a vehicle comprising a controller according to any of the relevant preceding paragraphs.

According to yet a still further aspect of the invention there is provided a vehicle comprising a controller, the controller being connectable to a portable consumer electronic device by a first data connection having a first signal strength, the portable consumer electronic device having a second data connection with an external system, the second data connection
5 having a second signal strength, the controller being configured to cause, in dependence upon said first and/or second signal strengths, information to be issued about locations within said vehicle at which the strength of the first and/or second signal may be improved.

Within the scope of this application it is expressly intended that the various aspects,
10 embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed
15 claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

20 One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIGURE 1 is a plan view of a motor vehicle schematically illustrating a dashboard mounted display screen, one or more hot-spot locations, a portable consumer electronic device and a
25 controller of an infotainment system according to an embodiment of the invention;

FIGURE 2 is a perspective illustration of a cabin of the motor vehicle of Figure 1 illustrating visual information in the form of an illumination on, adjacent, or otherwise proximate to at least one of said one or more hot-spot locations on board the motor vehicle;

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FIGURE 3 is a flow diagram illustrating a method of assisting use of a consumer electronic device on board a vehicle according to an embodiment of the invention; and

FIGURE 4 is a schematic illustration of a display screen on board the motor vehicle
35 displaying explicit information about the signal strength of a consumer electronic device and showing, on an image of the vehicle, one or more locations whereat a first signal strength and/or a second signal strength may be improved.

DETAILED DESCRIPTION

Detailed descriptions of specific embodiments of the methods, controllers, infotainment systems and vehicles of the present invention are disclosed herein. It will be understood that the disclosed embodiments are merely examples of the way in which certain aspects of the invention can be implemented and do not represent an exhaustive list of all of the ways the invention may be embodied. Indeed, it will be understood that the methods, controllers, infotainment systems and vehicles described herein may be embodied in various and alternative forms. The Figures are not necessarily to scale and some features may be exaggerated or minimised to show details of particular components. Well-known components, materials or methods are not necessarily described in great detail in order to avoid obscuring the present disclosure. Any specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the invention.

Referring to Figure 1 a motor vehicle 20 is shown which has an on-board infotainment system 100. The infotainment system 100 comprises a controller 90 (also referred to as a head unit), one or more speakers 21a, 21b located about the cabin 24 of the vehicle 20, and a display screen 22. In the present embodiment, the display screen 22 comprises a single display screen that is mounted within a dashboard of the vehicle 20. In other embodiments, the number and position and style of display screen is different to that shown and may optionally include a head-up display.

The speakers 21a, 21b of the infotainment system 100 are connected to the head unit 90 (controller 90) and broadcast audio into the cabin 24. Audio broadcast by the speakers 21a, 21b may include music from a variety of sources including, for example and without limitation, an on-board CD player, a portable consumer electronic device 50 and an on-board radio. Other audio signals that may be output by the amplifiers 21a, 21b include, for example and without limitation, telephone conversation from the portable consumer electronic device 50, information alerts and updates from on-board assistance systems (such as parking assist, seat belt wearing warnings, and the like), and other audible information such as satellite navigation information.

The controller 90 of the present embodiment is connectable to the portable consumer electronic device 50. The connection between the portable consumer electronic device 50 and the controller 90 may be established in a wireless manner utilising, for example, Wi-Fi or

Bluetooth® or other suitable wireless connectivity by virtue of a first data connection or first signal 41 having a first signal strength. Alternatively, the connection may be established by wire. The consumer electronic device 50 may take the form of: a smartphone, mobile telephone, portable computer, tablet, portable music storage device such as an MP3 player or ipod®, a video gaming device, and an entertainment device such as a DVD player, Blu-Ray® player or electronic reader (e-book). It will be recognised that the invention disclosed herein may be utilised in applications where the consumer electronic device 50 is a different device compared to those listed here and the list of possible formats that the consumer electronic device 50 may take is provided merely for illustrative purposes and to explain the vast application of the invention and is in no way intended and should in no way be taken as limiting.

As shown in Figure 1, the controller 90 connects to the consumer electronic device 50 via a first data connection 41. In this way, the consumer electronic device 50 can transmit data to the controller 90. The first data connection 41 (also referred to herein as “first signal”) has a first signal strength associated with it. The first signal strength is a data value that quantifies the magnitude of the signal between the device 50 and a receiver associated with the controller 90. The first signal may provide a data indicative of a signal strength transmitted from the consumer electronic device 50. For example, the data may be indicative of the signal strength of the second signal described below.

The consumer electronic device 50 additionally comprises capability to connect to a remote network 95 hosted externally of the vehicle 20. The remote network 95 may be, for example, a mobile communications network 95. The consumer electronic device 50 connects to the remote network 95 by virtue of a second signal 42 having a second signal strength associated therewith. It will be recognised that the second connection 42 to the remote network (also referred to as the external network) 95 may be a longer range wireless connection (i.e. not Bluetooth®) for example, but not limited to, Wi-Fi, and radio frequency (RF) mobile telecommunications signal (cellular signal). The second signal strength is a data value that quantifies the magnitude of the signal between the device 50 and a receiver associated with the remote network 95.

The strength of the first and/or second signal 41, 42 may be degraded, compromised or otherwise impeded by the environment surrounding the consumer electronic device 50. For example, but without limitation, the strength of the first and/or second signal 41, 42 may be degraded, compromised or otherwise impeded by the structure, layout, and / or interior trim or features of a vehicle within which the consumer electronic device is placed. In such a

case, attenuation of the first and/or second signal 41, 42 may be estimated or predetermined during design of the vehicle or may be determined empirically thereafter. In the illustrated scenario of Figure 1, the device 50 is stowed in a boot (trunk) 33 of the vehicle 20. The tailgate of the vehicle and other structural elements of the boot 33 shield the device 50 to some extent and attenuate the first and second signals 41, 42. The first signal 41 is of sufficient strength that the controller 90 can detect the presence of the device 50.

The motor vehicle 20 comprises one or more locations, “hot-spots” or signal boosting regions 18a, 18b, 18c located about the motor vehicle cabin 24. In the presently illustrated embodiment, three “hot-spot” locations 18a, 18b, 18c are illustrated. Each location 18a, 18b, 18c provides a place whereat the strengths of the first and/or second signals 41, 42 is predetermined or known and at which the first and/or second connections with the consumer electronic device 50 may be improved, enhanced or boosted. The first and second locations 18a, 18b may improve the strengths of the first and/or second signals 41, 42 simply because at these locations 18a, 18b there is less structural interference and/or structural shielding and the first and/or second signals 41, 42 are attenuated to a lesser degree compared to when the device 50 is positioned in the boot 33. Additionally or alternatively, the third location 18c comprises a signal boosting device (not shown), such as but not limited to a connection (wired or wireless) to a cellular antenna external to the vehicle, to a compensator®, to a cellular signal amplifier / booster, or to a cellular signal repeater.

The first location 18a is optionally close to the dashboard and windscreen of the vehicle and optionally juxtaposed in relation to a spatial region of the windscreen in which radio-frequency (RF) opaque coatings (such as infrared (IR) reflective coatings) are reduced or eliminated. (see Figure 2); the second location 18b is located in a centre console between the driver's and front passenger's seats; and a third location 18c in the form of a cellular signal connecting, boosting or repeating mat is provided proximate the driver's seat and optionally also in the centre console.

In dependence upon the type of consumer electronic device 50, data transmitted via the first communications signal 41 and the controller 90 may vary. However, it is expected that the consumer electronic device 50 will transmit data relating to its identity and/or type and/or second signal strength. The first signal strength may be determined by the controller 90. The controller 90 is configured to carry out a method of assisting use of a consumer electronic device 50 on board a vehicle 20. The method is illustrated in Figure 3 and comprises the following steps:

A1: Determine that one or more portable consumer electronic devices 50 are connected to the controller 90 of the infotainment system 100 of the vehicle 20 by virtue of a first signal 41 and determine a strength of that first signal 41.

5 A2: Determine that one or more portable consumer electronic devices 50 are connected to a remote system 95 externally of the vehicle 20 by virtue of a second signal 42 and determine a strength of that second signal 42.

A3: Dependent upon said first signal strength and/or said second signal strength, determine and issue information about better locations 18a, 18b, 18c on-board the vehicle 20 for the or each consumer electronic device 50. This warns the user of a
10 low signal strength and assists a user of the portable consumer electronic device 50 in finding a more suitable location 18a, 18b, 18c for their device 50, so that they can move their device 50 into a better location 18a, 18b, 18c to improve the strength of the first and/or second signal.

15 In step A2, when determining the strength of the second signal 42 it may be measured and/or a data indicative of second strength may be sent to the controller 90.

The step A3 of issuing information about better locations 18a, 18b, 18c on-board the vehicle 20 for the or each consumer electronic device 50 is optionally dependent upon a comparison
20 of the determined strength of said first signal 41 and/or the determined strength of said second signal 42 with at least one known or predetermined signal strength at one or more predetermined locations within the vehicle. Specifically, the determined strength of said first signal 41 and/or the determined strength of said second signal 42 is optionally compared
25 with the known or predetermined strength of signal(s) at the "hot-spots" or signal boosting regions 18a, 18b, 18c located about the motor vehicle cabin 24. In particular, although not exclusively, the predetermined locations optionally comprise the location of an internal connection (wired or wireless) to a cellular antenna external to the vehicle, of a compenser®, of a cellular signal amplifier / booster, or of a cradle for a consumer electronic device. The signal strength at such locations is relatively easy to pre-determine during design of the
30 vehicle or empirically thereafter.

In a first illustrative scenario, the driver of the vehicle 20 has a smartphone 50 which connects to the controller 90 via Bluetooth®. The controller 90 determines, at least partly from data provided to it from the smartphone 50 (e.g. from a Receive Signal Strength
35 Indicator - RSSI), that the first signal strength between the smartphone 50 and the controller 90 is sufficiently strong, but that the strength of a second cellular signal 42 between the smartphone 50 and a mobile telecommunications network is low. The strength of the second

cellular signal 42 is determined instantaneously or alternatively the signal strength is determined over a given period of time, for example averaged over a predetermined period. In one embodiment, the controller 90 is arranged to compare the strength of the second cellular signal 42 with a threshold signal strength value and determine that the strength of a second cellular signal 42 is low in dependence on the comparison. Specifically, the controller 90 determines that the strength of a second cellular signal 42 is low if the determined strength of the second cellular signal falls below the threshold signal strength value. The strength of the second signal 42 means that the smartphone 50 may not be effectively or optimally used for placing or receiving a telephone call. Based upon the determined strength of the second signal 42, the controller 90 determines that a warning should be issued to the driver and the driver should be advised to move the smartphone 50 to a better location 18a, 18b, 18c.

In the presently illustrated example, issuing information 67, 65 about the locations 18a, 18b, 18c of the "hot-spots" available on-board the vehicle 20 comprises providing visual information 67 on a window 22a of the display screen 22 mounted on the dashboard. Optionally, the visual information 67 comprises an image 71 of at least part of the vehicle 20 and a demarcation 69 on that image of the locations 18a, 18b, 18c. The image 71 of the vehicle 20 may be a plan view, a perspective view and/or any other suitable view and be an image of only part of the vehicle 20. The demarcation 69 may take many and various forms. As shown in Figure 4, the demarcation 69 optionally takes the form of a static arrow pointing at a "hot-spot" location 18a, 18b, 18c. In other arrangements, the demarcation 69 may be a flashing arrow, other indicia, other flashing indicia, a ring or other shape about the location and any other suitable means for indicating the position within the vehicle of one or more "hot-spot" locations 18a, 18b, 18c.

Optionally, when the controller 90 causes information 67, 65 to be issued about the "hot-spot" locations 18a, 18b, 18c in addition to or instead of visual information 67, 65 being shown by the display 22, visual information 30a, 30b, 30c may be provided on, adjacent or otherwise proximate to at least one of the one or more "hot-spot" locations 18a, 18b, 18c on board the vehicle 20. See Figure 3, wherein the visual information 67, 30a, 30b, 30c comprises an illumination 30a, 30b, 30c on, adjacent or otherwise proximate to at least one of (in this case each of) the "hot-spot" locations 18a, 18b, 18c within the vehicle 20.

The device 50 may comprise a second controller 60 which is optionally used to communicate with the controller 90 on-board the vehicle 20. The second controller 60, in the present arrangement, may be considered as a secondary controller provided only to facilitate a basic

level of communication with the controller 90 on-board the vehicle and to supply first and second signal strength data to the primary controller 90.

In the present embodiment, the method conducted by the controller 90 additionally, albeit optionally, includes explicitly issuing signal strength information 65. In the present embodiment, this is achieved by providing a symbol of a device shown with a signal strength symbol and optional accompanying text. As shown in Figure 4, the text may state “Connected device signal strength to infotainment system low – Move device to avoid disconnection”. The signal strength symbol may take many and various forms. Likewise the text 65 may be varied from that shown and may state the identity of the device, particularly where more than one device is connected. For example, in another embodiment, the text 65 states: “Signal Strength between Apple® iPhone 4S® and infotainment system is low, move device to indicated location to avoid disconnection”.

In the present arrangement, the method conducted by the controller 90 additionally, albeit optionally, includes implicitly issuing signal strength information by means of issuing information 67 about the “hot-spot” locations 18a, 18b, 18c on-board the vehicle 20. In other words, it may not be necessary to indicate or state by information displayed as a visual, graphical or textual image 65 on a display 22 that a connected device 50 is suffering from a low signal strength. Rather, the mere act of indicating where the “hot-spot” locations 18a, 18b, 18c are may be sufficient to relay to a user of the device 50 that the signal strength is considered to be low. Such implicit communication would be quickly learned by a user of the vehicle 20 who would only receive such implicit information when appropriate i.e., when it is considered that a connected device 50 needs moving.

It can be appreciated that various changes may be made within the scope of the present invention. For example, in other embodiments of the invention it is envisaged that information about the strength of the first signal 41, about the strength of the second signal 42 and/or about the “hot-spot” locations 18a, 18b, 18c may be provided by means of an audio signal. For example, a “voice-over” alert broadcast by an infotainment system may be issued to inform a user of a connected device that moving the device is recommended to improve signal strength and/or may inform a user of a “hot-spot” location.

In some embodiments, the controller is configured to consider the type of connected device and whether particular “hot-spot” locations 18a, 18b, 18c are appropriate. For example, the second location 18b in the illustrated arrangement of Figure 1 may take the form of a cellular signal boosting mat that is compatible only with certain devices. The controller may be

provided with data relating to devices, the second signals 42 of which can be boosted at that second location 18b. For example, smartphones and other mobile telephones may have a cellular second signal that can be boosted by the mat 18b, but placing a DVD player on the mat to boost a Wi-Fi signal between the DVD player and the internet may not be effective.

5 The controller upon recognising that the identified connected device is capable of having its second signal strength boosted at the second location 18b may therefore include the second “hot-spot” location 18b when it provides information 67 about the available “hot-spot” locations 18a, 18b, 18c. However, in some embodiments, the controller is arranged to only inform about suitable “hot-spot” locations 18a, 18b, 18c. In a scenario where the strength of
10 the first and/or second signal of the connected device cannot be improved by cellular signal boosting then the controller, having determined this, would only provide information about the suitable “hot-spot” locations 18a, 18c and would not provide information (whether audio or visual) about the location of the unsuitable cellular boosting mat location 18b.

15 In some embodiments the controller and methods of the present disclosure are arranged to accommodate more than one connected device. In such embodiments, an identifier for each device will be transmitted to the controller, for example via the first Bluetooth® connection such that the controller can identify each device and determine the first and/or second signal strengths of each device.

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In other embodiments the portable consumer electronic device 50 may be connectable to the controller by a wired connection, for example using an on-board dock. In such an embodiment, it is unlikely that the signal strength of the first connection would be impeded, and as such a warning may only be presented to the user by the controller 90 of the
25 infotainment system 100 to which the device is hard wired, regarding a low signal strength of a “second” wireless signal. The second wireless signal may be between the device and an external network, such as but not limited to a mobile communications network.

The portable consumer electronic device may take many and various forms and may be a
30 device used by the driver, a passenger located in the front of the cabin 24 and/or a passenger located in the rear of the cabin. The controller 90 in some embodiments is capable of connecting to more than one such device simultaneously, albeit only one such device is shown in the Figures. In embodiments having more than one device connected, each device may have a first wireless connection to the infotainment system, having a first
35 signal strength; and a second wireless connection to an external network, having a second signal strength.

In some embodiments it is envisaged that the “controller” may comprise one or more controllers. In some embodiments comprising two or more controllers, a first controller is (permanently) on-board the vehicle and the second controller is located within or on or otherwise directly associated with the consumer electronic device itself (such that it is only temporarily on-board the vehicle or removable therefrom). For example, the second controller may form part of an application (“app”) that may be installed, for example by being downloaded, onto the consumer electronic device. In such embodiments, the first and second controllers between them are configured to carry out the method of assisting use of a consumer electronic device 50 on board a vehicle 20.

It is envisaged that the first and second controllers may “share” the tasks of the method between them in a variety of ways. For example, in some embodiments the method of assisting use of a portable and rechargeable consumer electronic device on-board a vehicle is achieved by the second controller determining a second signal strength of a second signal between the consumer electronic device and an external communications network; and in dependence upon said determined second signal strength, the second controller signalling, instructing or otherwise causing the first controller to issue information about the location of one or more “hot-spots” or signal boosting regions.

In other embodiments, the method of assisting use of a portable and rechargeable consumer electronic device on-board a vehicle is achieved by the second controller determining a first signal strength of a first signal between the consumer electronic device and a first controller of the vehicle and/or determining a second signal strength of a second signal between the consumer electronic device and a second communications network; and in dependence upon said first signal strength and/or in dependence upon said second signal strength, the second controller issuing information about the one or more locations whereat the first and/or second signal strength may be improved. Such information may be issued on a screen of the consumer electronic device itself. In some such embodiments, the second controller may communicate with the first controller to determine the information about the one or more locations at which the first and/or second signal strength may be improved. Additionally or alternatively, the information about the one or more locations at which the first and/or second signal strengths may be improved may be stored in a memory on or associated with the second controller. For example, the information about the one or more locations for a particular vehicle may be supplied as part of the installed “app”.

In embodiments using a second controller of the consumer electronic device to determine the first and/or second signal strength and in dependence thereupon cause information to be

issued about the one or more locations, such information may be issued on or by the device and/or on or by the vehicle. Additionally, the second controller may determine that the consumer electronic device is (currently) on-board the vehicle (such that use of the “app” is appropriate). This may be done by the second controller on the consumer electronic device
5 being in communication with a first controller on-board the vehicle. Alternatively, the second controller may determine that the consumer electronic device is on-board the vehicle by some other means, for example by means of visual identification of its location, and/or by means of being activated by a user of the device.

10 As used herein the terms “connected”, “connectable” and “in communication with” refer to all manner of suitable ways in which a consumer electronic device can co-operate, converse, correspond, or otherwise interact with a controller, which co-operation may be achieved by means of a wireless connection. Wireless communication may be facilitated by any suitable means, including, but not exclusively, for example, Bluetooth® and Wi-Fi.

15 The terms “first” and “second” as used herein are used to distinguish described elements from one another and in part no limitation as to the number of elements. As used herein the terms “second controller”, “second signal strength” and “second signal” do not impart a limitation that the methods and controllers described herein comprise at least two controllers,
20 signal strengths or signals.

CLAIMS

1. A method of assisting use of a consumer electronic device on board a vehicle, the method comprising:

determining a first signal strength of a first connection between the consumer electronic device and a controller of the vehicle; and/or

determining a second signal strength of a second connection between the consumer electronic device and a second communications network;

comparing said determined first signal strength and/or said determined second signal strength with at least one predetermined signal strength; and

in dependence upon said comparison, issuing information about one or more locations on-board said vehicle whereat the signal strength of the first connection may be improved over the first determined signal strength and/or whereat the signal strength of the second connection may be improved over the second determined signal strength.

2. A method according to claim 1, wherein the predetermined signal strength comprises a threshold signal strength value and/or a signal strength at a predetermined location within the vehicle.

3. A method according to claim 1 or claim 2, wherein the issuing of information about one or more locations on-board said vehicle is made in dependence on a type of the consumer electronic device.

4. A method according to any preceding claim, wherein the second signal strength is obtainable from the first signal between the consumer electronic device and the controller of the vehicle.

5. A method according to any preceding claim, comprising determining that a portable consumer electronic device is currently on-board a vehicle.

6. A method according to claim 5 comprising determining that a portable consumer electronic device is connected to a controller of the vehicle by virtue of a first connection being established therebetween.

7. A method according to any preceding claim, wherein issuing information comprises explicitly issuing information about the first signal strength and/or the second signal strength.

8. A method according to any preceding claim, wherein issuing information comprises implicitly issuing information about the first signal strength and/or the second signal strength by means of issuing information about the one or more locations on-board said vehicle.
9. A method according to any preceding claim, wherein issuing information about one or more locations on-board said vehicle comprises providing visual information on a display screen on-board said vehicle.
10. A method according to claim 9 wherein said visual information comprises an image of at least part of the vehicle and a demarcation on that image of the one or more locations on-board said vehicle.
11. A method according to any preceding claim wherein issuing information about the one or more locations on-board said vehicle comprises providing visual information on, adjacent or otherwise proximate to at least one of said one or more locations on board said vehicle.
12. A method according to claim 11 wherein said visual information comprises an illumination on, adjacent or otherwise proximate to at least one of said one or more locations on-board said vehicle.
13. A method according to any preceding claim wherein issuing information about the one or more locations on-board said vehicle comprises providing visual information on a display screen on said consumer electronic device.
14. A controller for a vehicle, the controller being connectable to a portable consumer electronic device by a first connection, the consumer electronic device being connectable by a second connection to an external network, the controller being configured to determine a first signal strength of said first connection and/or determine a second signal strength of said second connection, the controller being configured to cause, in dependence upon said determined first signal strength and/or in dependence upon said second signal strength, information to be issued about one or more locations on-board said vehicle at which one or more locations the first and/or second signal strength may be improved.
15. A controller according to claim 14, the controller is configured to compare the first signal strength and/or the second signals strength with a predetermined signal strength, the

predetermined signal strength comprising a threshold signal strength value and/or a signal strength at a predetermined location within the vehicle.

16. A controller according to claim 14 or claim 15, wherein the controller is configured to issue information about one or more locations on-board said vehicle in dependence on a type of the consumer electronic device.

17. A controller according to any one of claims 14 to 16, wherein the controller is configured to obtain second signal strength from the first signal between the controller and the portable consumer electronic device.

18. A controller according to any one of claims 14 to 17 wherein the controller is additionally configured to cause information about the first signal strength and/or the second signal strength to be explicitly issued.

19. A controller according to any one of claims 14 to 18 wherein the controller is configured to cause information about the first signal strength and/or the second signal strength to be implicitly issued by virtue of issuing information about said one or more locations on-board said vehicle.

20. A controller according to any one of claims 14 to 19 wherein the information issued about the one or more locations on-board said vehicle comprises visual information on a display screen on board said vehicle.

21. A controller according to claim 20 wherein said visual information comprises an image of at least part of the vehicle and a demarcation on that image of the one or more locations on-board said vehicle.

22. A controller according to any one of claims 14 to 21 wherein the information issued about the one or more locations on-board said vehicle comprises visual information on, adjacent or otherwise proximate to at least one of said one or more locations on board said vehicle.

23. A controller according to claim 22 wherein said visual information comprises an illumination on, adjacent or otherwise proximate to at least one of said one or more locations on board said vehicle.

24. A second controller for use on a consumer electronic device, the second controller being able to determine a first signal strength of a first connection between the consumer electronic device and a first controller on-board a vehicle; and/or the second controller being able to determine a second signal strength of a second connection between the consumer electronic device and a second communications network, the second controller being configured to cause, in dependence upon said determined first and/or second signal strengths, information to be issued about one or more locations on-board said vehicle whereat the first signal strength and/or the second signal strength may be improved.

25. An infotainment system for a vehicle comprising a controller according to any one of claims 14 to 24.

26. A vehicle comprising a controller according to any one of claims 14 to 24.

27. A vehicle comprising an infotainment system comprising a controller according to any one of claims 14 to 24.

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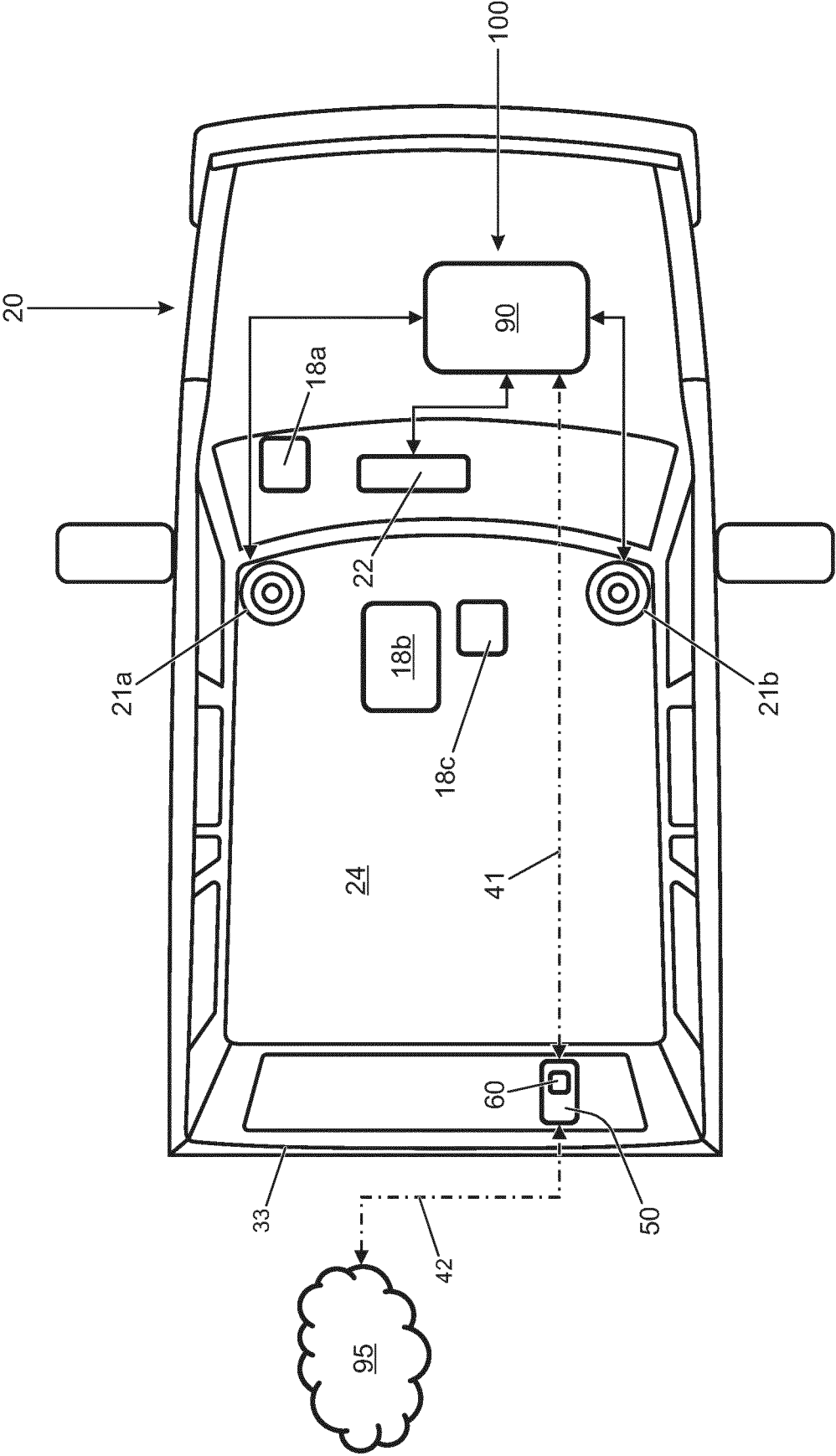


FIGURE 1

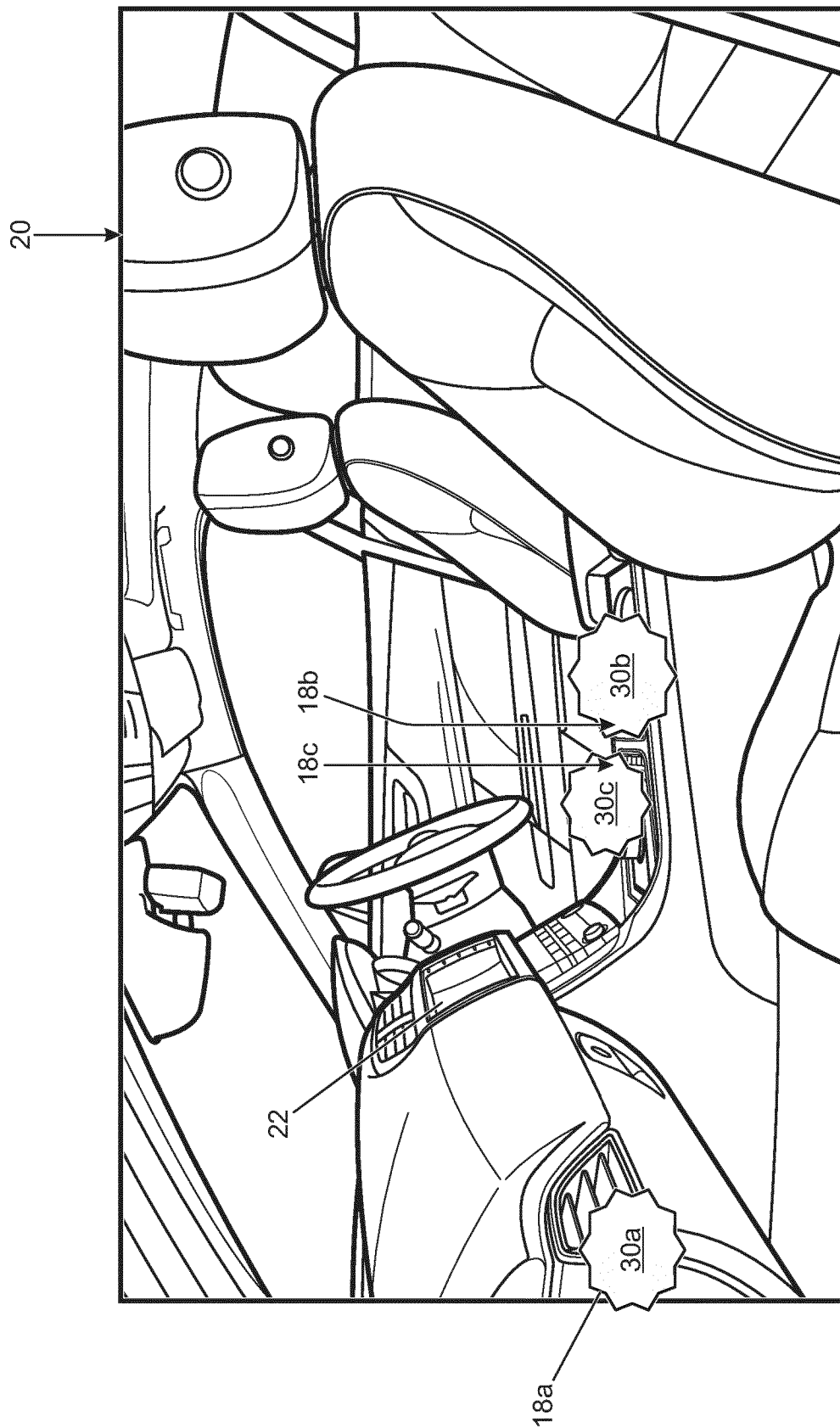


FIGURE 2

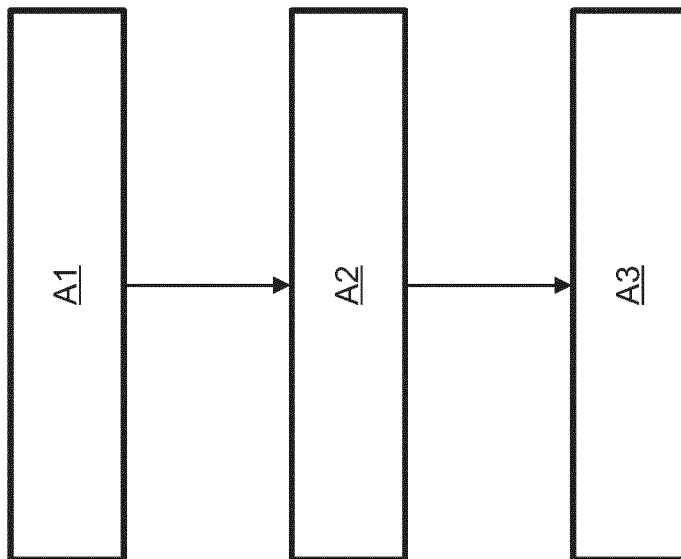


FIGURE 3

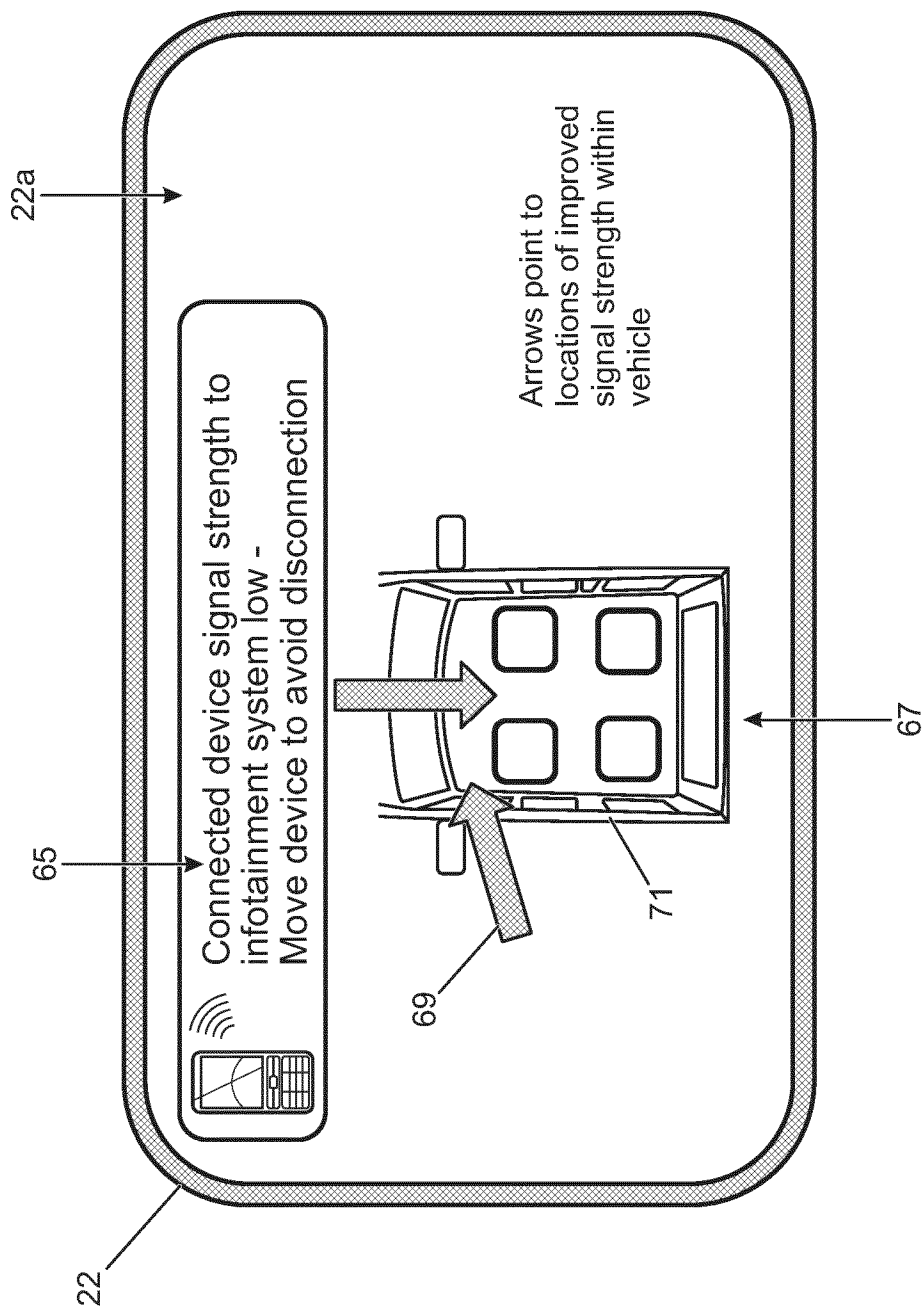


FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/066456

A. CLASSIFICATION OF SUBJECT MATTER INV. H04W64/00 H04W24/08 H04W4/04 H04W4/02 ADD.		
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) H04W		
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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/076587 A1 (LG ELECTRONICS INC [KR]) 19 May 2016 (2016-05-19) paragraph [0003] - paragraph [0015] paragraph [0149] - paragraph [0167] paragraph [0183] - paragraph [0195] figures 2, 6-10	1-6, 8-10, 12, 14-21, 23-27
X	WO 2016/054921 A1 (HUAWEI TECH CO LTD [CN]) 14 April 2016 (2016-04-14) ----- page 1, line 19 - page 6, line 24 page 8, paragraph 18 - page 11, paragraph 24 figures 1,2 -/--	1,2,8,9, 11, 13-15, 19,20, 22,24-27
☒ 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 but 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 "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
15 August 2017		21/08/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Durand-Schaefer, R

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/066456

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	& US 2017/215093 A1 (ZHANG HUIMIN [CN] ET AL) 27 July 2017 (2017-07-27) paragraph [0004] - paragraph [0033] paragraph [0047] - paragraph [0059] figures 1-5 ----- WO 2014/163836 A1 (QUALCOMM INC [US]) 9 October 2014 (2014-10-09) paragraph [0006] - paragraph [0013] paragraph [0027] - paragraph [0037] paragraph [0044] - paragraph [0065] figures 1-12 -----	1,7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/066456

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