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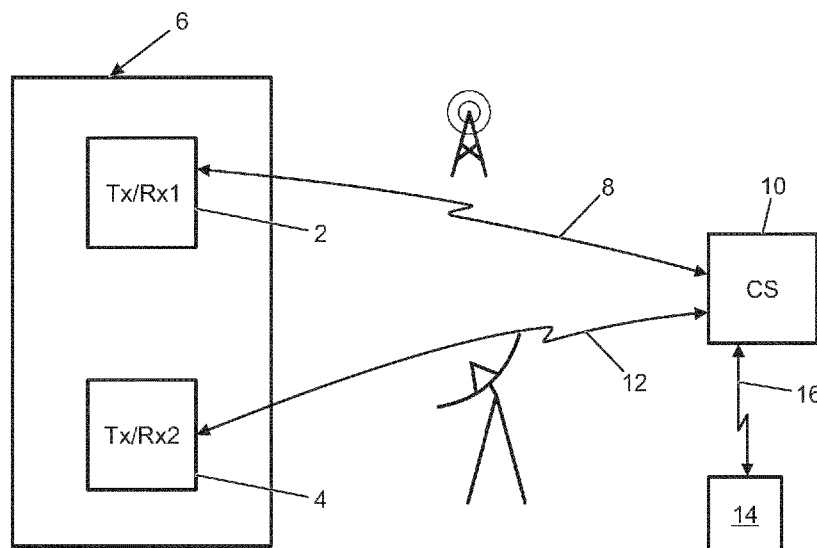


FIG 1

(57) Abstract: A vehicle communication system for wireless communication from a vehicle (6; 30), the apparatus comprising; a first transceiver (2) configured to establish a first communication channel (8) via a first wireless communications system and transmit a first signal to a communications server (10); and a second transceiver (4) configured to establish a second communication channel (12) via a second wireless communications system and transmit a second signal to the communications server (10), the second communication channel comprising a satellite telecommunications channel, wherein the first and second transceivers (2, 4) are configured to transmit respective first and second signals simultaneously.



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APPARATUS, SYSTEM, AND METHOD FOR WIRELESS COMMUNICATION FROM A VEHICLE

TECHNICAL FIELD

The present disclosure relates to an apparatus, system and method for wireless communication from a vehicle. Aspects of the invention relate to an apparatus, a system, a method, a vehicle and a computer program product.

BACKGROUND

It is increasingly desirable to be able to communicate data of differing types from a vehicle. The communication may be for different purposes, for example, the transmission of voice data to allow a vehicle occupant to conduct a voice call with someone remote from the vehicle, or the transmission of data, such as media data, to and from an entertainment or information device formed either as an integral part of the vehicle systems or a separate mobile device connected to the vehicle systems. Additionally, it may also be desirable to be able to communicate data concerning the status of the vehicle's operating systems to a remote location, for example a service centre.

To maintain vehicle mobility, the preferred communication channel is a wireless communication channel, which may for example be a cellular telephone system or a satellite communications system. Whilst an individual vehicle may be equipped and configured to use a number of different communication channels, for example may be equipped with both cellular and satellite communication systems, each communication channel is typically operated separately. Consequently, there will be instances where communication over one of the available communication channels is either unavailable or of a very poor quality due to known issues, such as a lack of cellular communication network in the vehicle's particular location, or the unavailability of satellite communications due to the vehicle being out of line of sight of a communications satellite. In such circumstances the particular data communication requiring the unavailable or degraded communication channel cannot occur or can only be accomplished at an undesirably low quality. Whilst this may be merely inconvenient for certain data communication types, for example such as streaming media data from a remote data provider, in some circumstances the lack of communication channel at an acceptable quality can be more critical, for example if the vehicle has been involved in

an accident then it is arguably important for an automated emergency call / signal to be able to be transmitted to the emergency services.

It is therefore an aim of certain embodiments of the invention to overcome or at least partially mitigate the problems associated with the prior art.

SUMMARY OF THE INVENTION

Aspects and embodiments of the invention provide an apparatus, a system, a method, a vehicle and a computer program product as claimed in the appended claims.

According to an aspect of the present invention, there is provided apparatus for wireless communication from a vehicle, the apparatus comprising a first transceiver configured to establish a first communication channel via a first wireless communication system and transmit a first signal to a communication server, and a second transceiver configured to establish a second communication channel via a second wireless communication system and transmit a second signal to the communication server, wherein the first and second transceivers are configured to transmit respective first and second signals simultaneously.

According to an aspect of the present invention, there is provided a vehicle communication system for wireless communication from a vehicle, the apparatus comprising a first transceiver configured to establish a first communication channel via a first wireless communication system and transmit a first signal to a communication server, and a second transceiver configured to establish a second communication channel via a second wireless communication system and transmit a second signal to the communication server, the second communication channel comprising a satellite telecommunications channel, wherein the first and second transceivers are configured to transmit respective first and second signals simultaneously.

An advantage of the vehicle communication system having at least a first and second transceiver for utilising separate wireless communication systems is that data transmission can occur over both communication channels simultaneously so as to improve the likelihood of at least one of the channels achieving successful communication. Equally, this arrangement permits different data types, e.g. voice data and vehicle status data to be

separately transmitted at the same time.

The first communication channel may comprise a cellular telecommunications channel. Other wireless communications channels may additionally or alternatively be provided.

The first and second signals may comprise the same information content.

The first and/or second signal may comprise a voice signal. The first and/or second signal may comprise a data signal relating to a status of the vehicle. At least one of the first and second transceivers may be arranged to receive a third signal from the communications server. This permits at least one of the communication channels to be used for bidirectional communication.

The vehicle communication system may further comprise a communication server having a first receiver configured to receive the first signal and a second receiver configured to receive the second signal, and having a processor configured to compare the first and second signals. The communication server is thus enabled to take further actions based on analysis of both the received first and second signals.

When the first and second signals comprise the same information content, the processor may be configured to determine, for a given portion of the received signals, which of the first and second signals has the greater of one or more signal quality metrics. The processor may be configured to provide an output indicative of the determination.

The one or more signal quality metrics may comprise any one or more of bandwidth, throughput, number of dropped data packets, latency, and jitter. In some embodiments the signal quality metric used may be determined in dependence on the type of data contained within the first and/or second signal.

When used herein and throughout the specification, the term “greater” when referring to the signal quality metric is intended to be interpreted as a value of the signal quality metric which is indicative of a better signal quality. For example, in some embodiments, the signal quality metric may be quantified by a numerical value, or assigned an ordinal value or ranking.

In embodiments wherein the one or more signal quality metrics comprise bandwidth or throughput, the or each metric may comprise a numerical value indicative of signal quality, with the largest number being indicative of the better signal quality. Here, the signal comprising the “greater” signal quality metric will be the signal with the largest bandwidth or throughput. Additionally or alternatively, the or each metric may comprise an ordinal value or ranking which may be determined with reference to a threshold or acceptable bandwidth/throughput. For example, if the bandwidth/throughput is larger than the threshold value, the signal quality metric may be assigned a value “good” or the like. Similarly, if the bandwidth/throughput is less than the threshold value, the signal quality metric may be assigned a value “bad”, or the like. In such instances, the signal having a “good” signal quality metric may be determined to be the signal having the greater signal quality metric.

In embodiments wherein the one or more signal quality metrics comprise a number of dropped data packets, the or each metric may comprise a numerical value indicative of signal quality, with the smallest number being indicative of the better signal quality. Here, the signal comprising the “greater” signal quality metric will be the signal with the smallest number of dropped data packets. Additionally or alternatively, the or each metric may comprise an ordinal value or ranking which may be determined with reference to a threshold or acceptable number of dropped data packets. For example, if the number of dropped packets is below the threshold value, the signal quality metric may be assigned a value “good”, or the like. Similarly, if the number of dropped packets is above the threshold value, the signal quality metric may be assigned a value “bad”, or the like. In such instances, the signal having a “good” signal quality metric may be determined to be the signal having the greater signal quality metric.

In embodiments wherein the one or more signal quality metrics comprise a latency or jitter, the or each metric may comprise a numeral value indicative of the signal quality, with the smallest number being indicative of the better signal quality. Here, the signal comprising the “greater” signal quality metric will be the signal with the smallest latency or jitter. Additionally or alternatively, the or each metric may comprise an ordinal value or ranking which may be determined with reference to a threshold or acceptable latency/jitter. For example, if the latency/jitter is below the threshold value, the signal quality metric may be assigned a value “good” or the like. Similarly, if the latency/jitter is above the threshold value, the signal quality metric may be assigned a value “bad”, or the like. In such instances, the signal having a “good” signal quality metric may be determined to be the

signal having the greater signal quality metric.

The processor may be configured to transmit one of the first and second signals to a specified recipient in dependence on the output indicative of the signal quality metrics determination. The processor may be configured to transmit the signal having the greater of the one or more signal quality metrics. In this manner, the communication server is capable of determining the "better" signal received from the vehicle to be forwarded to a specified recipient.

When the first and second signals comprise the same information content, the processor may be configured to utilise one of the first or second signals to perform an error correction of the other respective signal. This permits both received signals to be used to perform error correction on at least one of the received signals to a greater degree than would be possible if only one of the signals was received, thus permitting a greater degree of error correction to be achieved.

The processor may be configured to correct a latency error between the received first and second signals. It is possible that the signals transmitted via the different first and second communication channels will experience differing degrees of latency and the correction of that latency difference at the communication server is likely to be beneficial in further analysis and/or processing of the signals.

Optionally, the processor comprises a microprocessor. In some embodiments the processor is configured as a signal processor.

According to a further aspect of the present invention there is provided a vehicle comprising the apparatus or system of an aspect of the invention. The vehicle may comprise a phased array satellite antenna. Phased array satellite antennas have a substantially flat profile and are thus particularly suitable for being installed on an exterior surface of a vehicle. Furthermore, the beam steering capabilities of a phased array antenna avoid the need to physically move the antenna in order to direct the signal transmission to a receiving satellite.

According to a further aspect of the present invention there is provided a method of a wireless communication from a vehicle, the method comprising establishing a first

communication channel via a first wireless communication system, transmitting a first signal from the vehicle to a communication server, establishing a second communication channel via a second wireless communication system, and transmitting a second signal from the vehicle to the communication server, the second communication channel comprising a satellite telecommunications channel, wherein the first and second signal are transmitted simultaneously.

The method may comprise receiving by at least one of the first and second transceivers a third signal from the communications server.

The first communication channel may comprise a cellular telecommunications channel.

The first and second signals may have the same information content. The first and/or second signal may comprise a voice signal or a data signal relating to status of a vehicle.

The method may also comprise receiving the first and second signals at the communication server and comparing the first and second signals.

The method may comprise determining, for a given portion of the received signals, which of the first and second signals is the greater of one or more signal quality metrics and providing an output indicative of that determination.

In dependence on the output indicative of the signal quality determination, the one of the first and second signals having the greater of the one or more signal quality metrics may be transmitted to a specified recipient.

The first and second signals may be utilised to perform error correction of the other respective signal. In some embodiments the method may comprise determining an error has occurred in the first or second signal and correcting the signal in dependence on said determination. For example, the method may comprise using data from the first or second signal to supplement the other respective signal so as to account for any data loss in said other respective signal.

Latency errors between the first and second signals may be corrected. For example, data

from the first or second signal may be used to supplement the other respective signal to account for any data loss caused by latency in said other respective signal.

According to another aspect of the present invention there is provided a computer program product comprising computer-readable instructions which, when executed on a processor of a vehicle, causes the processor to carry out the method of the preceding aspect of the invention. The computer program product optionally comprises a non-transitory computer-readable storage medium having said computer-readable instructions stored thereon.

Within the scope of this application it is expressly intended that the various aspects, 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 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

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 schematically illustrates a vehicle communication system for wireless communication from a vehicle in accordance with embodiments of the present invention;

Figure 2 schematically illustrates a communication server comprising part of a vehicle communication system according to embodiments of the present invention; and

Figure 3 schematically illustrates a vehicle comprising the vehicle communication system for wireless communication as shown in Figure 1.

DETAILED DESCRIPTION

Figure 1 schematically illustrates a vehicle communication system for wireless communication from a vehicle. First and second transceivers 2, 4 are located within a vehicle 6. The first transceiver 2 is configured to establish a first communication channel 8 between the vehicle 6 and a remotely located communication server 10, the communication channel 8 being established via cellular telecommunications network. The second transceiver 4 is configured to establish a second communication channel 12 between the vehicle 6 and the communication server 10 utilising a satellite telecommunications system. The communication server 10 is configured to receive and transmit further communication signals from and to at least one further recipient 14 via a further communication channel 16, which may be any known communication system, for example cellular network, satellite telecommunications network, cable telecommunications etc.

Figure 2 schematically illustrates the communication server 10 illustrated in Figure 1. The communication server has a first receiver 20 that is configured to receive signals from the cellular telecommunications network on which the first communication channel 8 resides. The communication server also includes a second receiver 22 that is configured to receive signals from the satellite telecommunications system on which the second communication channel 12 resides. Each of the first and second receivers 20, 22 are coupled to a microprocessor 24 within the communication server. Also coupled to the microprocessor 24 is a further transceiver 26 that is configured to enable the communication server 10 to establish a further communication channel 16 with at least one third party recipient 14. The further communication channel may be established using any conventional communications network.

Figure 3 schematically illustrates a vehicle 30 that includes first and second transceivers 2, 4 shown in Figure 1. In at least some embodiments of the present invention, a phased array satellite antenna 32 is mounted on an external surface of the vehicle 30 in communication with the second transceiver 4. The first and second transceivers 2, 4 are connected to one or more further systems of the vehicle 30, although this is not shown in Figure 3.

In an embodiment of the current invention a vehicle operator may choose to instigate a voice call from within the vehicle using telephony equipment such as microphones and speakers integrated with the vehicle systems. The voice data generated by the telephony

systems is input to both the first and second transceivers 2, 4 which each establish first and second wireless communication channels to the communications server 10. At the communication server, the microprocessor 24 receives the signals from both communication channels via respective transceivers 20, 22. The microprocessor 24 compares the voice data received via each of the separate communication channels. Based on this comparison, the microprocessor 24 may perform various further signal processing functions.

In some embodiments one or more signal quality metrics for each of the received signals are determined by the microprocessor 24 and whichever of the first and second signals is considered to have the greater of the one or more signal quality metrics is subsequently re-transmitted by the communication server to the originally intended recipient for the voice data. The one or more signal quality metrics may comprise any one or more of bandwidth, throughput, a number of dropped data packets, latency and jitter, for example. In some embodiments the signal quality metric used may be determined in dependence on the type of data contained within the first and/or second signal.

In other embodiments, received data from both the first and second signals is used by the microprocessor 24 in order to perform error correction on one of the received signals so as to generate at least one corrected signal that preferably has better overall signal quality than either of the received first and second signals. The single corrected signal may then be transmitted by the communication server to the originally intended recipient of the voice data. Methods of error correction are known in the art and will be readily understood.

In other embodiments both voice data and data relating to the status of the vehicle may be independently but simultaneously transmitted using respective ones of the first and second transceivers 2, 4. For example, in the case that the vehicle is involved in an accident, or an emergency situation is otherwise indicated, a voice call may be established to the communication server 10 using a first one of the first and second transceivers and wireless communication channels, for example using the cellular network, whilst vehicle status data, such as location or diagnostic data, may be communicated to the communication server 10 via the second of the transceivers 4, for example via the satellite communication channel. Equally, both voice data and vehicle status data may be combined and transmitted over both of the separately available communication channels simultaneously, with the microprocessor 24 at the communication server 10 being configured to extract and separate the voice data and vehicle status data from each of the received signals and, if

necessary, perform any appropriate error correction before forwarding each of the voice and vehicle data signals to appropriate further third parties.

The ability to send the same information simultaneously via two separate communications channels (or potentially more channels) enables the overall vehicle communications to be particularly robust, either through simple redundancy of the communication channels, or through the ability of the communication server 10 to use both received signals to perform improved error correction.

For purposes of this disclosure, it is to be understood that the system described herein may comprise a computational device or signal processor having one or more electronic processors. The system may comprise a single computational device or signal processor or alternatively different functions of the system may be embodied in, or hosted in, different computational devices or signal processors. A set of instructions could be provided which, when executed, cause said computational device(s) or signal processors to implement the techniques described herein, including the described methods. The set of instructions may be embedded in one or more electronic processors, or alternatively, the set of instructions could be provided as software to be executed by one or more electronic processors. For example, a first signal processor may be implemented in software run on one or more electronic processors, and one or more other signal processors may also be implemented in software run on one or more electronic processors, optionally the same one or more processors as the first signal processor. It will be appreciated, however, that other arrangements are also useful, and therefore, the present disclosure is not intended to be limited to any particular arrangement. In any event, the set of instructions described above may be embedded in a computer-readable storage medium (e.g., a non-transitory storage medium) that may comprise any mechanism for storing information in a form readable by a machine or electronic processors/computational device, including, without limitation: a magnetic storage medium (e.g., floppy diskette); optical storage medium (e.g., CD-ROM); magneto optical storage medium; read only memory (ROM); random access memory (RAM); erasable programmable memory (e.g., EPROM and EEPROM); flash memory; or electrical or other types of medium for storing such information/instructions.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features, whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not. Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance, it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings, whether or not particular emphasis has been placed thereon.

CLAIMS

1. A vehicle communication system for wireless communication from a vehicle, the system comprising;
a first transceiver configured to establish a first communication channel via a first wireless communications system and transmit a first signal to a communications server; and
a second transceiver configured to establish a second communication channel via a second wireless communications system and transmit a second signal to the communications server, the second communication channel comprising a satellite telecommunications channel,
wherein the first and second transceivers are configured to transmit respective first and second signals simultaneously.
2. The vehicle communication system of claim 1, wherein the first communication channel comprises a cellular telecommunications channel.
3. The vehicle communication system of any preceding claim, wherein the first and second signals comprise the same information content.
4. The vehicle communication system of any preceding claim, wherein the first and/or second signal comprise a voice signal.
5. The vehicle communication system of any preceding claim, wherein the first and/or second signal comprise a data signal relating to a status of a vehicle.
6. The vehicle communication system of any preceding claim, wherein at least one of the first and second transceivers is arranged to receive a third signal from the communications server.
7. The vehicle communications system
of any one of claims 1 to 6 further comprising a communications server having a first receiver configured to receive the first signal and a second receiver configured to receive the second signal, and having a processor configured to compare the first and second signals.
8. The vehicle communications system of claim 7, wherein the first and second signals comprise the same information content and the processor is configured to determine, for a given portion of the received signals, which of the first and second signals has the greater of one or more signal quality metrics.

9. The vehicle communications system of claim 8 wherein the processor is configured to provide an output indicative of the determination.
10. The vehicle communications system of claim 9 wherein the processor is configured to transmit one of the first and second signals to a specified recipient in dependence on the output indicative of the signal quality metrics determination.
11. The vehicle communications system of claim 10, wherein the processor is configured to transmit the signal having the greater of the one or more signal quality metrics.
12. The vehicle communications system of claim 7, wherein the first and second signals comprise the same information content and the processor is configured to utilise one of the first and second signals to perform an error correction of the other respective signal.
13. The vehicle communications system of any one of claims 7 to 12 wherein the processor is configured to correct a latency error between the received first and second signals.
14. A vehicle comprising the vehicle communication system of any one of claims 1 to 6.
15. The vehicle of claim 14 comprising a phased array satellite antenna.
16. A method of wireless communication from a vehicle, the method comprising:
 - establishing a first communication channel via a first wireless communications system;
 - transmitting a first signal from the vehicle to a communications server;
 - establishing a second communication channel via a second wireless communications system, the second communication channel comprising a satellite telecommunications channel; and
 - transmitting a second signal from the vehicle to the communications server;wherein the first and second signals are transmitted simultaneously.
17. The method of claim 16, comprising receiving by at least one of the first and second communications systems a third signal from the communications server.

18. The method of claim 16 or 17, wherein the first communication channel comprises a cellular telecommunications channel.
19. The method of any one of claims 16 to 18, wherein the first and second signals have the same information content.
20. The method of any one of claims 16 to 19, wherein the first and/or second signal comprise a voice signal.
21. The method of any one of claims 16 to 20, wherein the first and/or second signal comprise a data signal relating to a status of a vehicle.
22. The method of any one of claims 16 to 21 comprising receiving the first and second signals at the communications server and comparing the first and second signals.
23. The method of claim 19, or any claim directly or indirectly dependent thereon, comprising determining, for a given portion of the received signals, which of the first and second signals has the greater of one or more signal quality metrics.
24. The method of claim 23 comprising providing an output indicative of the determination.
25. The method of claim 24, comprising transmitting the one of the first and second signals having the greater of the one or more signal quality metrics to a specified recipient in dependence on the output indicative of the determination.
26. The method of claim 19, or any claim dependent thereon, comprising utilising one of the first and second signals to perform an error correction of the other respective signal.
27. The method of claim 19, or any claim directly or indirectly dependent thereon, wherein the method comprises correcting a latency error between the received first and second signals.
28. A computer program product comprising computer-readable instructions which, when

executed on a processor of a vehicle cause the processor to carry out the method of any of claims 17 to 27.

1/2

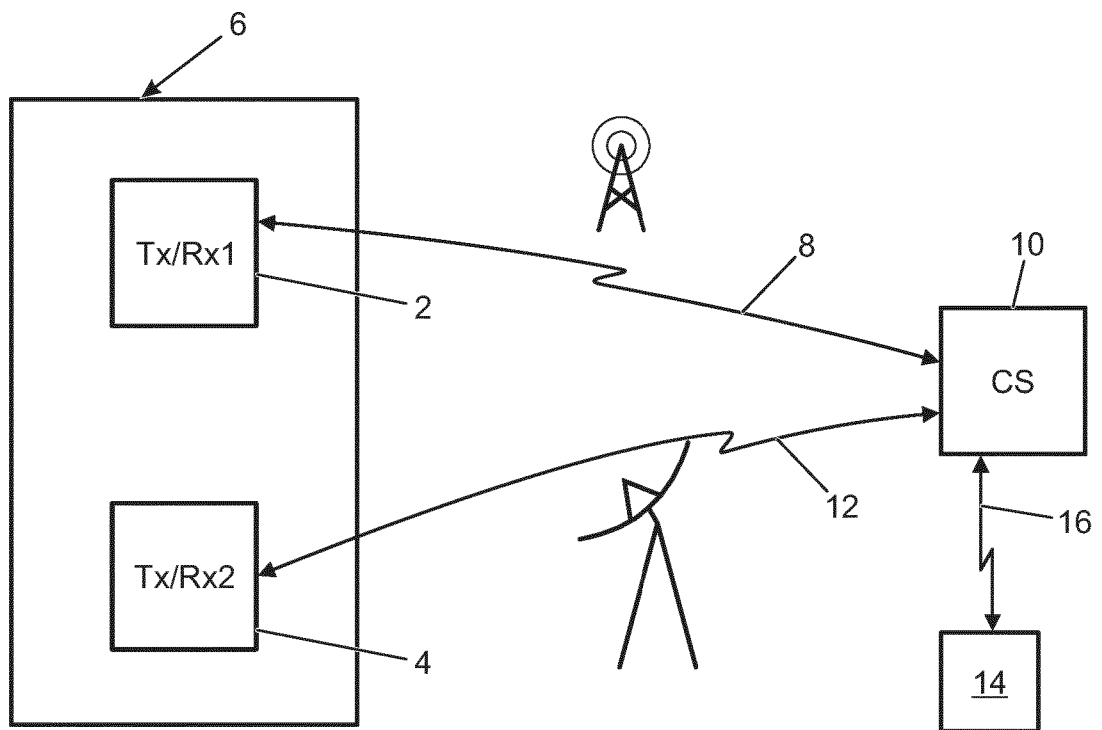


FIG 1

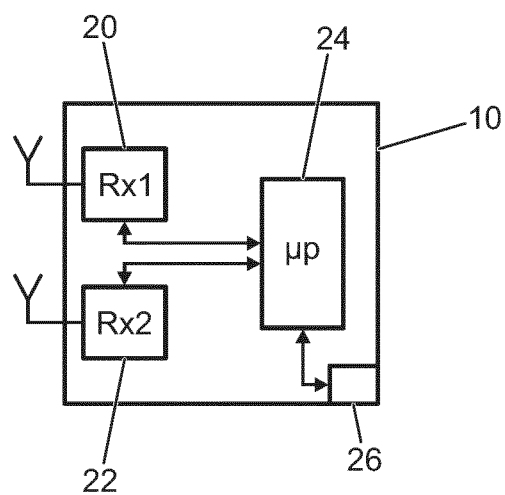


FIG 2

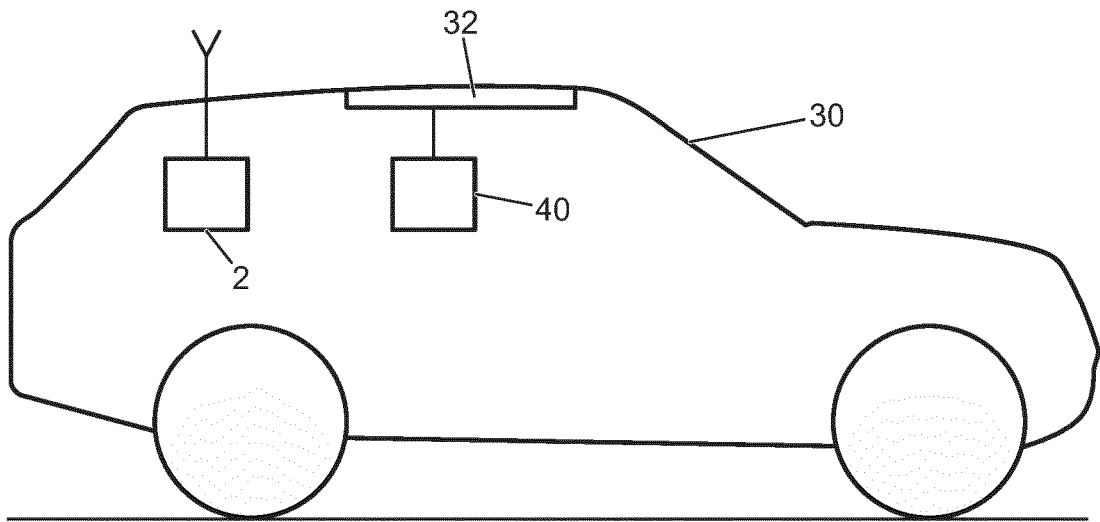


FIG 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/051524

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W76/16
ADD. H04W88/06 H04W4/44 H04W28/04

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	EP 2 153 544 A2 (DBSD SATELLITE SERVICES G P [US]) 17 February 2010 (2010-02-17)	1-6, 14-21,28
Y	paragraph [0003] - paragraph [0054] paragraph [0060] - paragraph [0074]; figure 3 paragraph [0083] - paragraph [0094]	7-13, 22-27
X	WO 2013/016798 A1 (RESEARCH IN MOTION LTD [CA]; PERIYALWAR SHALINI SURESH [CA]; PECEN MAR) 7 February 2013 (2013-02-07)	1-3,7, 14-16, 18,19, 22,28
A	paragraph [0035] - paragraph [0060] paragraph [0061] - paragraph [0097]; figure 5 ----- -/-	4-6, 8-13,17, 20,21, 23-27

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y A	----- FR 2 930 388 A1 (UDCAST SA [FR]) 23 October 2009 (2009-10-23) page 4, line 16 - page 7, line 28 page 9, line 24 - page 11, line 18; figure 1	7,12,13, 22,26,27 1-6, 8-11, 14-21, 23-25,28
A	----- US 2010/272049 A1 (TUNG CHAO-PING [US] ET AL) 28 October 2010 (2010-10-28) paragraph [0012] - paragraph [0027] paragraph [0036] - paragraph [0046] -----	1-28

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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			EP 3197072 A1 26-07-2017
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