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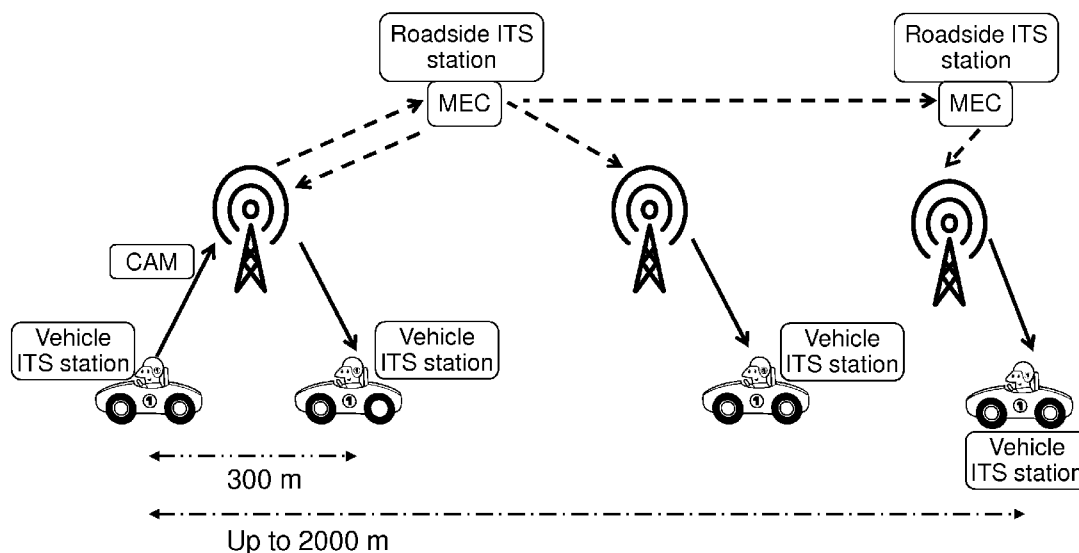


Fig. 9

(57) Abstract: There are provided measures for dissemination of cooperative awareness messages in cellular network environments. Such measures exemplarily comprise receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message, ascertaining, based on said first message, a destination area for said cooperative awareness message, and transmitting a second message including said cooperative awareness message and information indicative of said destination area.



Title

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Dissemination of cooperative awareness messages in cellular network environments

Field

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The present invention relates to dissemination of cooperative awareness messages in cellular network environments. More specifically, the present invention exemplarily relates to measures (including methods, apparatuses and computer program products) for realizing dissemination of cooperative awareness messages in cellular network environments.

Background

The present specification generally relates to handling of cooperative awareness messages (CAM), and more generally, to intelligent transport systems (ITS).

According to the 3rd Generation Partnership Project (3GPP), Long Term Evolution (LTE) is to be opened to Vehicle to Vehicle (V2V) communication and Vehicle to Infrastructure (V2I) communication (summarized as V2X communication) to better address V2X requirements and complement standards developed by European Telecommunications Standards Institute (ETSI) for intelligent transport systems.

According to relevant ETSI standards it is specified that different radio technologies may be used for ITS related messages distribution (e.g. ITS-G5, based on dedicated short range communication (DSRC), and LTE).

Established CAM dissemination requirements are for example that point-to-multipoint communication as specified in ETSI TS 102 636-3 [i.4] shall be used for transmitting CAMs. In case ITS-G5 is used for CAM dissemination, the control channel (G5-CCH) as specified in ETSI EN 302 663 [5] shall be used. The CAM shall be transmitted only from the originating ITS station (ITS-S) in a single hop to the receiving ITS-Ss located in the direct communication range of the originating ITS-S. A received CAM shall not be forwarded to other ITS-Ss. In other words, an originating ITS-S shall transmit the CAM directly to a receiving (addressee) ITS-S.

The CAMs are distributed within the ITS-G5 network and provide information of presence, positions as well as basic status of communicating ITS stations to neighboring ITS stations that are located within a single hop distance. All ITS stations shall be able to generate, send and receive CAMs, as long as they participate in V2X networks. By receiving CAMs, the ITS station is aware of other stations in its neighborhood area as well as their positions, movement, basic attributes and basic sensor information. At receiver side, reasonable efforts can be taken to evaluate the relevance of the messages and the information. This allows ITS stations to get information about its situation and act accordingly.

Transfer of ETSI ITS messages via the infrastructure of e.g. an LTE mobile communications network as an example of a cellular network can be seen as a means to improve reliability, to make more efficient usage of spectrum resources, and to increase the reach of the communication (not only in terms of distance but also behind obstacles).

Namely, network controlled communication is scheduled, such that no contention emerges in usage of resources, and thus, lower interference is caused. Further, the coverage provided by macro cells is way larger and less subject to temporary/permanent obstructions than street level vehicle to vehicle communication.

An exemplary scenario where direct communication is less sufficient is an urban environment with cars approaching a crossing with buildings at the roadside.

- 5 However, it is noted that indirect vehicle communication (i.e., communication via network infrastructure) may have higher latency.

Distributing CAMs utilizing network infrastructure (i.e., indirect vehicle communication) does not fulfill all ETSI ITS requirements regarding CAMs.

- 10 In particular, the single-hop transmission cannot in any case be complied with.

Contrary thereto, forwarding of CAMs would become a basic requirement in a cellular system when transferring ETSI ITS messages between vehicles via the infrastructure.

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Considering the example of a system environment shown in Figure 9, it is understood that e.g. close-by vehicle ITS stations (i.e. ITS-Ss which are embodied by/integrated with a vehicle) can be served by cells belonging to different service areas (i.e. served by e.g. different base stations and/or different mobile edge computing (MEC) entities).

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However, measures are needed to address the relevant (e.g. vehicle) ITS stations (e.g. the close-by stations) in such case of utilizing the network infrastructure without being restricted to a certain service area. Since addressing of ITS stations according to ETSI ITS standard can only be done at the geo-networking layer, it is necessary to deploy close to the radio interface (e.g. on MEC) roadside ITS stations capable of relaying CAMs between source and destination vehicle ITS stations.

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Hence, there is a need to provide for dissemination of cooperative awareness messages in cellular network environments.

Summary

Various exemplary embodiments of the present invention aim at addressing at least part of the above issues and/or problems and drawbacks.

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Various aspects of exemplary embodiments of the present invention are set out in the appended claims.

According to an exemplary aspect of the present invention, there is
10 provided a method of a network side entity in a mobile communications network, the method comprising receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message, ascertaining, based on said first message, a destination area for said cooperative awareness message, and transmitting a second message
15 including said cooperative awareness message and information indicative of said destination area.

According to an exemplary aspect of the present invention, there is
provided a method in a mobile communications network, the method
20 comprising receiving, from an intelligent transport system station, a first message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message, deciding, based on said destination area, whether to forward said first message, and forwarding, if said first message is decided
25 to be forwarded, said first message to a receiving intelligent transport system.

According to an exemplary aspect of the present invention, there is
provided a method in a mobile communications network comprising creating
30 a cooperative awareness message, generating a message including said cooperative awareness message, and transmitting said message to a network side entity in a mobile communications network.

According to an exemplary aspect of the present invention, there is provided an apparatus in a network side entity in a mobile communications network, the apparatus comprising receiving circuitry configured to receive, from an originating intelligent transport system station, a first message including a cooperative awareness message, 5
ascertaining circuitry configured to ascertain, based on said first message, a destination area for said cooperative awareness message, and transmitting circuitry configured to transmit a second message including said cooperative awareness message and information indicative of said destination area.

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According to an exemplary aspect of the present invention, there is provided an apparatus in a mobile communications network, the apparatus comprising receiving circuitry configured to receive, from an intelligent transport system station, a first message including a cooperative awareness 15
message and a message header including information indicative of a destination area for said cooperative awareness message, deciding circuitry configured to decide, based on said destination area, whether to forward said first message, and forwarding circuitry configured to forward, if said first message is decided to be forwarded, said first message to a receiving 20
intelligent transport system.

According to an exemplary aspect of the present invention, there is provided an apparatus in a mobile communications network comprising creating circuitry configured to create a cooperative awareness message, 25
generating circuitry configured to generate a message including said cooperative awareness message, and transmitting circuitry configured to transmit said message to a network side entity in a mobile communications network.

30 According to an exemplary aspect of the present invention, there is provided an apparatus in a network side entity in a mobile communications network, the apparatus comprising at least one processor, at least one memory including computer program code, and at least one interface

configured for communication with at least another apparatus, the at least one processor, with the at least one memory and the computer program code, being configured to cause the apparatus to perform receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message, ascertaining, based on said first message, a destination area for said cooperative awareness message, and transmitting a second message including said cooperative awareness message and information indicative of said destination area.

10 According to an exemplary aspect of the present invention, there is provided an apparatus in a mobile communications network comprising at least one processor, at least one memory including computer program code, and at least one interface configured for communication with at least another apparatus, the at least one processor, with the at least one
15 memory and the computer program code, being configured to cause the apparatus to perform receiving, from an intelligent transport system station, a first message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message, deciding, based on said destination
20 area, whether to forward said first message, and forwarding, if said first message is decided to be forwarded, said first message to a receiving intelligent transport system.

According to an exemplary aspect of the present invention, there is
25 provided an apparatus in a mobile communications network comprising at least one processor, at least one memory including computer program code, and at least one interface configured for communication with at least another apparatus, the at least one processor, with the at least one memory and the computer program code, being configured to cause the
30 apparatus to perform creating a cooperative awareness message, generating a message including said cooperative awareness message, and transmitting said message to a network side entity in a mobile communications network.

According to an exemplary aspect of the present invention, there is provided a computer program product comprising computer-executable computer program code which, when the program is run on a computer
5 (e.g. a computer of an apparatus according to any one of the aforementioned apparatus-related exemplary aspects of the present invention), is configured to cause the computer to carry out the method according to any one of the aforementioned method-related exemplary aspects of the present invention.

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Such computer program product may comprise (or be embodied) a (tangible) computer-readable (storage) medium or the like on which the computer-executable computer program code is stored, and/or the program may be directly loadable into an internal memory of the computer or a
15 processor thereof.

Any one of the above aspects enables an efficient handling of CAMs (in particular forwarding of CAMs) to thereby solve at least part of the problems and drawbacks identified in relation to the prior art.

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By way of exemplary embodiments of the present invention, there is provided dissemination of cooperative awareness messages in cellular network environments. More specifically, by way of exemplary embodiments of the present invention, there are provided measures and mechanisms for
25 realizing dissemination of cooperative awareness messages in cellular network environments.

Thus, improvement is achieved by methods, apparatuses and computer program products enabling/realizing dissemination of cooperative
30 awareness messages in cellular network environments.

Brief description of the drawings

In the following, the present invention will be described in greater detail by way of non-limiting examples with reference to the accompanying drawings, in which

5 Figure 1 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

Figure 2 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

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Figure 3 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

Figure 4 is a block diagram illustrating an apparatus according to exemplary
15 embodiments of the present invention,

Figure 5 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention,

20 Figure 6 is a schematic diagram of a procedure according to exemplary embodiments of the present invention,

Figure 7 is a schematic diagram of a procedure according to exemplary embodiments of the present invention,

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Figure 8 is a schematic diagram of a procedure according to exemplary embodiments of the present invention,

Figure 9 shows a schematic diagram of an example of a system
30 environment with signaling,

Figure 10 shows a structure of a portion of a message header according to exemplary embodiments of the present invention,

Figure 11 shows a structure of a portion of a message header according to exemplary embodiments of the present invention, and

- 5 Figure 12 is a block diagram alternatively illustrating apparatuses according to exemplary embodiments of the present invention.

Detailed description of drawings and embodiments of the present invention

- 10 The present invention is described herein with reference to particular non-limiting examples and to what are presently considered to be conceivable embodiments of the present invention. A person skilled in the art will appreciate that the invention is by no means limited to these examples, and may be more broadly applied.

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- It is to be noted that the following description of the present invention and its embodiments mainly refers to specifications being used as non-limiting examples for certain exemplary network configurations and deployments. Namely, the present invention and its embodiments are mainly described in relation to 3GPP and ETSI specifications being used as non-limiting examples for certain exemplary network configurations and deployments. In particular, ITS communication is used as a non-limiting example for the applicability of thus described exemplary embodiments. As such, the description of exemplary embodiments given herein specifically refers to terminology which is directly related thereto. Such terminology is only used in the context of the presented non-limiting examples, and does naturally not limit the invention in any way. Rather, any other communication or communication related system deployment, etc. may also be utilized as long as compliant with the features described herein.

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Hereinafter, various embodiments and implementations of the present invention and its aspects or embodiments are described using several variants and/or alternatives. It is generally noted that, according to certain

needs and constraints, all of the described variants and/or alternatives may be provided alone or in any conceivable combination (also including combinations of individual features of the various variants and/or alternatives).

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According to exemplary embodiments of the present invention, in general terms, there are provided measures and mechanisms for (enabling/realizing) dissemination of cooperative awareness messages in cellular network environments.

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As mentioned above, ETSI ITS standard does not consider forwarding of CAM messages.

A possible approach to address the above-mentioned addressing need is to have centralized implementations of network deployed geo-networking services, not yet taking into account the availability of MEC.

According to further approaches, a destination area is provided, and the destination area is used for decisions how a received CAM is to be handled, in particular, whether the content thereof is to be evaluated, and to which ITS-Ss the CAM is to be forwarded. The destination area may be hardcoded in a geo-networking service deployed on MEC. This is the simplest approach and is perfectly appropriate for the case when few instances of geo-networking service are deployed (where configuration errors are unlikely) and all of the instances of geo-networking service are from the same vendor and in the same administrative domain.

However, this is a rather limited field of application.

Hence, according to exemplary embodiments of the present invention, a CAM destination area is dynamically determined and is provided to CAM recipients. The CAM destination area may be introduced into relevant ETSI standards.

In particular, according to exemplary embodiments of the present invention, a CAM basic service of the originating (vehicle) ITS Station may provide destination area information to the ITS networking & transport layer.

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Adding a destination area for CAMs (via e.g. a geo-networking header) enables forwarding via an infrastructure based geoservice. However, due to the need to include this destination area information into a transmission between the originating ITS-S and the network (potentially via a radio interface), a packet size would be increased.

10

Hence, according to exemplary embodiments of the present invention, in order to reduce the overhead due to the geo-networking header on the cellular system radio interface, the geo-networking service at the (vehicle) ITS-S may support a “short version” of a geo-networking header including at least a geo-location of the originating ITS-S. According to this concept, the CAM basic service at the roadside ITS-S may provide the geo-networking service with a definition of the CAM destination area. This destination area together with the received geo-location of the originating ITS-S may be used by the geo-networking to perform the forwarding decision. In addition the destination area may be included in the outgoing message header (message header of a forwarded message including the CAM). It is noted that this operation may require removing the original geo-networking header and adding a new one, including valid security certificates available at the roadside ITS-S.

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According to further exemplary embodiments of the present invention, in order to avoid overhead of the geo-networking header on the cellular system radio interface, the CAM message may be transmitted over the cellular radio interface using the TCP or UDP/IP stack. Here, the receiving roadside ITS-S may decode the CAM, extract the originating ITS-S geo location, and then resubmit the CAM to the networking layer adding appropriate destination area information.

30

According to still further exemplary embodiments of the present invention, in order to even further reduce the overhead of sending CAM on the cellular system radio interface, the CAM message may be transmitted using a non-
5 IP PDN connectivity specified in 3GPP Rel. 13. This may apply only to LTE (and similar) access.

In the following, the above outlined concepts of exemplary embodiments of the present invention are discussed in other words in more details.

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Figure 1 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention. The apparatus may be a network node 10 such as an intermediate intelligent traffic system (ITS) station between an originating ITS station and a receiving ITS station. It is noted
15 that an intermediate ITS station may also be disposed between further intermediate ITS stations or between a further intermediate ITS station and one of an originating ITS station and a receiving ITS station. The intermediate ITS station may preferably be a roadside ITS station which may be arranged at a mobile edge computing's side. The intermediate
20 intelligent traffic system station comprises a receiving circuitry 11, an ascertaining circuitry 12, and a transmitting circuitry 13. The receiving circuitry 11 receives, from an originating intelligent transport system station, a first message including a cooperative awareness message. The ascertaining circuitry 12 ascertains, based on said first message, a
25 destination area for said cooperative awareness message. The transmitting circuitry 13 transmits a second message including said cooperative awareness message and information indicative of said destination area. Figure 6 is a schematic diagram of a procedure according to exemplary embodiments of the present invention. The apparatus according to Figure 1
30 may perform the method of Figure 6 but is not limited to this method. The method of Figure 6 may be performed by the apparatus of Figure 1 but is not limited to being performed by this apparatus.

As shown in Figure 6, a procedure according to exemplary embodiments of the present invention comprises an operation of receiving (S61), from an originating intelligent transport system station, a first message including a cooperative awareness message, an operation of ascertaining (S62), based
5 on said first message, a destination area for said cooperative awareness message, and an operation of transmitting (S63) a second message including said cooperative awareness message and information indicative of said destination area.

10 Figure 2 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention. In particular, Figure 2 illustrates a variation of the apparatus shown in Figure 1. The apparatus according to Figure 2 may thus further comprise an adopting circuitry 21, a generating circuitry 22, a determining circuitry 23, an adding circuitry 24, a decoding
15 circuitry 25, and/or a deriving circuitry 26.

In an embodiment at least some of the functionalities of the apparatus shown in Figure 1 may be shared between two physically separate devices forming one operational entity. Therefore, the apparatus may be seen to
20 depict the operational entity comprising one or more physically separate devices for executing at least some of the described processes.

According to exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 6, said second message
25 comprises a message header including said information indicative of said destination area.

According to a variation of the procedure shown in Figure 6, said first message comprises a first message header including said information
30 indicative of said destination area, and exemplary details of the transmitting operation (S63) are given, which are inherently independent from each other as such.

Such exemplary transmitting operation (S63) according to exemplary embodiments of the present invention may comprise an operation of adopting said first message as said second message.

5 According to a variation of the procedure shown in Figure 6, exemplary additional operations are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of generating said second message including said cooperative
10 awareness message and said information indicative of said destination area.

According to a variation of the procedure shown in Figure 6, said first message comprises a first message header including information indicative of a position of said originating intelligent transport system station, and
15 exemplary details of the ascertaining operation (S62) are given, which are inherently independent from each other as such.

Such exemplary ascertaining operation (S62) according to exemplary embodiments of the present invention may comprise an operation of
20 determining, based on said position of said originating intelligent transport system station, said destination area for said cooperative awareness message.

According to a variation of the procedure shown in Figure 6, exemplary
25 details of the generating operation are given, which are inherently independent from each other as such.

Such exemplary generating operation according to exemplary embodiments of the present invention may comprise an operation of adding at least one
30 security certificate to said second message.

According to a variation of the procedure shown in Figure 6, exemplary additional operations and exemplary details of the ascertaining operation

(S62) are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of decoding said cooperative awareness message, and an operation of
5 deriving, from a result of said decoding, information indicative of a position of said originating intelligent transport system station. Further, such exemplary ascertaining operation (S62) according to exemplary embodiments of the present invention may comprise an operation of determining, based on said position of said originating intelligent transport
10 system station, said destination area for said cooperative awareness message.

According to further exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 6, said first
15 message is received via one of a transmission control protocol internet protocol (TCP/IP) transmission, a user datagram protocol internet protocol (UDP/IP) transmission, and a non internet protocol packet data network (non-IP PDN) transmission.

20 According to still further exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 6, said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

25 Figure 3 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention. The apparatus may be a network node 30 such as an intermediate intelligent traffic system (ITS) station between ITS stations. The intermediate ITS station may preferably be a roadside ITS station which may be arranged at a mobile edge computing's side and in contact with a receiving ITS station (which may for example be
30 a vehicle side ITS). It is noted the network node may also be a receiving ITS station e.g. on a vehicle's side. The intermediate intelligent traffic system station comprises a receiving circuitry 31, a deciding circuitry 32,

and a forwarding circuitry 33. The receiving circuitry 31 receives, from an intelligent transport system station, a first message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message. The deciding
5 circuitry 32 decides, based on said destination area, whether to forward said first message. The forwarding circuitry 33 forwards, if said first message is decided to be forwarded, said first message to a receiving intelligent transport system. Figure 7 is a schematic diagram of a procedure according to exemplary embodiments of the present invention. The apparatus
10 according to Figure 3 may perform the method of Figure 7 but is not limited to this method. The method of Figure 7 may be performed by the apparatus of Figure 3 but is not limited to being performed by this apparatus.

As shown in Figure 7, a procedure according to exemplary embodiments of the present invention comprises an operation of receiving (S71), from an
15 intelligent transport system station, a first message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message, an operation of deciding (S72), based on said destination area, whether to forward said
20 first message, and an operation of forwarding (S63), if said first message is decided to be forwarded, said first message to a receiving intelligent transport system.

Figure 4 is a block diagram illustrating an apparatus according to exemplary
25 embodiments of the present invention. In particular, Figure 4 illustrates a variation of the apparatus shown in Figure 3. The apparatus according to Figure 4 may thus further comprise a determining circuitry 41 and/or a removing circuitry 42.

30 In an embodiment at least some of the functionalities of the apparatus shown in Figure 3 may be shared between two physically separate devices forming one operational entity. Therefore, the apparatus may be seen to

depict the operational entity comprising one or more physically separate devices for executing at least some of the described processes.

5 According to a variation of the procedure shown in Figure 7, exemplary additional operations are given, which are inherently independent from each other as such. According to such variation, an exemplary method according to exemplary embodiments of the present invention may comprise an operation of determining, on the basis of said deciding, whether said first message is to be forwarded via a radio interface between the network side
10 entity and said receiving intelligent transport system station, and an operation of removing, if said first message is determined to be forwarded via said radio interface, said message header from said first message.

Alternatively, only a part of the header may be removed. The removed part
15 of the header may correspond to the part of the header added by a previous intermediate ITS (i.e. destination area information) to a message received from an originating ITS having only the above-mentioned "short version" header.

20 According to a variation of the procedure shown in Figure 7, said first message is forwarded via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network transmission.

25 According to a variation of the procedure shown in Figure 7, said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

Figure 5 is a block diagram illustrating an apparatus according to exemplary embodiments of the present invention. The apparatus may be a network
30 node 50 such as an originating intelligent traffic system station comprising a creating circuitry 51, a generating circuitry 52, and a transmitting circuitry 53. The creating circuitry 51 creates a cooperative awareness message. The generating circuitry 52 generates a message including said cooperative

awareness message. The transmitting circuitry 53 transmits said message to a network side entity (e.g. apparatus 10 which may be a mobile edge computing side intelligent traffic system station) in a mobile communications network. Figure 8 is a schematic diagram of a procedure according to exemplary embodiments of the present invention. The apparatus according to Figure 5 may perform the method of Figure 8 but is not limited to this method. The method of Figure 8 may be performed by the apparatus of Figure 5 but is not limited to being performed by this apparatus.

As shown in Figure 8, a procedure according to exemplary embodiments of the present invention comprises an operation of creating (S81) a cooperative awareness message, an operation of generating (S82) a message including said cooperative awareness message, and an operation of transmitting (S83) said message to a network side entity in a mobile communications network.

Optionally, the message including said cooperative awareness message may include location information. Generally, location information may, for example, be information indicative of a destination area for a cooperative awareness message or information indicative of a position of the creating of a cooperative awareness message. Said location information may be included in a message header comprised in the message.

In an embodiment at least some of the functionalities of the apparatus shown in Figure 5 may be shared between two physically separate devices forming one operational entity. Therefore, the apparatus may be seen to depict the operational entity comprising one or more physically separate devices for executing at least some of the described processes.

According to exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 8, said message comprises a

message header including information indicative of a destination area for said cooperative awareness message.

5 According to further exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 8, said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

10 According to still further exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 8, said message comprises a message header including information indicative of a position of said creating of said cooperative awareness message.

15 According to still further exemplary embodiments of the present invention according to a variation of the procedure shown in Figure 8, said message is transmitted via one of a transmission control protocol internet protocol (TCP/IP) transmission, a user datagram protocol internet protocol (UDP/IP) transmission, and a non internet protocol packet data network (non-IP PDN) transmission.

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In more specific terms, adding a destination area for CAMs enables forwarding via an infrastructure based geoservice. The disadvantage is the increase in packet size due to the need to include both common and extended parts of the geo-networking header.

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Here, a CAM destination area definition may be guided by a respective definition specified for a decentralized environmental notification message (DEMN).

30 In particular, information passed by CAM basic service over the facilities-network layer interface can be included in the existing geo-networking header.

The geo-networking header may be divided into a common header and an extended header. In case geo-anycast/broadcast is used, the common header may include appropriate values for a header/sub-header type (HT/HST).

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An exemplary common header is illustrated in Figure 10. It is noted that the common header may be present in every geo-networking packet and may consist of several fields.

10 The HST may indicate the shape of the dissemination/destination area.

The extended header may include information necessary to characterize the destination area. An exemplary extended header is illustrated in Figure 11.

15 Established decentralized environmental notification message (DEMN) destination area specifications define for example that the destination area used by the ITS networking & transport layer for the DENM transmission may have three geometric shapes (circular shape, rectangular shape, elliptical shape); each shape is represented by the combination of one or
20 several geographical point and distance information. The DEMN basic service of the originating ITS-S shall provide the destination area information to the ITS networking & transport layer in a format compliant to the one as specified in ETSI EN 302 931 [4].

25 According to exemplary embodiments of the present invention, two means are proposed to reduce overhead on the air (radio) interface, more specifically, a "short version" of the geo-networking header, and a method for adding destination information only at the roadside ITS-S (i.e. the ITS station responsible for relaying CAMs between vehicle ITSs).

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As a means to reduce the overhead on the radio interface, according to exemplary embodiments of the present invention, the originating ITS station simply adds the geo-coordinates of the vehicle itself (24 bytes). In

most cases, the geo-coordinates of the vehicle itself correspond to a position of a creation of a respective CAM. If both do not correspond, either of both may be added to the message including the CAM as mentioned above. According to exemplary embodiments of the present invention, the full geo-networking header is added by the receiving roadside ITS station geo-networking layer. The full header is only used for the forwarding of messages across instances of the geo-networking layer deployed at the cellular infrastructure (e.g. at MEC) and may be removed by the last roadside ITS station before message dissemination over the radio interface).

According to further exemplary embodiments of the present invention, no geo-networking header is used on the radio interface between vehicle and infrastructure, and the receiving roadside ITS-S decodes the CAM message, extract the vehicle geo location and then resubmits the CAM message to the networking layer adding the appropriate destination area information. The full header is only used for the forwarding of messages across instances of the geo-networking layer deployed at the cellular infrastructure (e.g. at MEC) and may be removed by the last roadside ITS station before message dissemination over the radio interface).

According to still further embodiments of the present invention, the CAM message is transferred over an LTE connection using non-IP PDN connectivity, which would require specifying a new media profile in ETSI ITS specification.

The above-described procedures and functions may be implemented by respective functional elements, processors, or the like, as described below.

In the foregoing exemplary description of the network entity, only the units that are relevant for understanding the principles of the invention have been described using functional blocks. The network entity may comprise further units that are necessary for its respective operation. However, a

description of these units is omitted in this specification. The arrangement of the functional blocks of the devices is not construed to limit the invention, and the functions may be performed by one block or further split into sub-blocks.

5

When in the foregoing description it is stated that the apparatus, i.e. network node/entity (or some other means) is configured to perform some function, this is to be construed to be equivalent to a description stating that a (i.e. at least one) processor or corresponding circuitry, potentially in
10 cooperation with computer program code stored in the memory of the respective apparatus, is configured to cause the apparatus to perform at least the thus mentioned function. Also, such function is to be construed to be equivalently implementable by specifically configured circuitry or means for performing the respective function (i.e. the expression "unit configured
15 to" is construed to be equivalent to an expression such as "means for").

In Figure 12, an alternative illustration of apparatuses according to exemplary embodiments of the present invention is depicted. As indicated in Figure 12, according to exemplary embodiments of the present invention,
20 the apparatus (network node) 10' (corresponding to the network node 10) comprises a processor 121, a memory 122 and an interface 123, which are connected by a bus 124 or the like. Further, according to exemplary embodiments of the present invention, the apparatus (network node) 30' (corresponding to the network node 30) comprises a processor 131, a
25 memory 132 and an interface 133, which are connected by a bus 134 or the like. Further, according to exemplary embodiments of the present invention, the apparatus (network node) 50' (corresponding to the network node 50) comprises a processor 141, a memory 142 and an interface 143, which are connected by a bus 144 or the like. The apparatuses may be connected via
30 links 125, respectively. Furthermore, e.g. an apparatus 200 corresponding to a receiving ITS (in particular, an interface 201 thereof) may be connected to the apparatus (network node) 30' (corresponding to the network node 30).

The processor 121/131/141 and/or the interface 123/133/143 may also include a modem or the like to facilitate communication over a (hardwire or wireless) link, respectively. The interface 123/133/143 may include a
5 suitable transceiver coupled to one or more antennas or communication means for (hardwire or wireless) communications with the linked or connected device(s), respectively. The interface 123/133/143 is generally configured to communicate with at least one other apparatus, i.e. the interface thereof.

10

The memory 122/132/142 may store respective programs assumed to include program instructions or computer program code that, when executed by the respective processor, enables the respective electronic device or apparatus to operate in accordance with the exemplary
15 embodiments of the present invention.

In general terms, the respective devices/apparatuses (and/or parts thereof) may represent means for performing respective operations and/or exhibiting respective functionalities, and/or the respective devices (and/or
20 parts thereof) may have functions for performing respective operations and/or exhibiting respective functionalities.

When in the subsequent description it is stated that the processor (or some other means) is configured to perform some function, this is to be construed
25 to be equivalent to a description stating that at least one processor, potentially in cooperation with computer program code stored in the memory of the respective apparatus, is configured to cause the apparatus to perform at least the thus mentioned function. Also, such function is to be construed to be equivalently implementable by specifically configured
30 means for performing the respective function (i.e. the expression “processor configured to [cause the apparatus to] perform xxx-ing” is construed to be equivalent to an expression such as “means for xxx-ing”).

According to exemplary embodiments of the present invention, an apparatus representing the network node 10 comprises at least one processor 121, at least one memory 122 including computer program code, and at least one interface 123 configured for communication with at least another apparatus. The processor (i.e. the at least one processor 121, with the at least one memory 122 and the computer program code) is configured to perform receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message (thus the apparatus comprising corresponding means for receiving), to perform
5 ascertaining, based on said first message, a destination area for said cooperative awareness message (thus the apparatus comprising corresponding means for ascertaining), and to perform transmitting a second message including said cooperative awareness message and information indicative of said destination area (thus the apparatus
10 comprising corresponding means for transmitting).

Further, according to exemplary embodiments of the present invention, an apparatus representing the network node 30 comprises at least one processor 131, at least one memory 132 including computer program code, and at least one interface 133 configured for communication with at least another apparatus. The processor (i.e. the at least one processor 131, with the at least one memory 132 and the computer program code) is configured to perform receiving, from an intelligent transport system station, a first message including a cooperative awareness message and a message header
20 including information indicative of a destination area for said cooperative awareness message (thus the apparatus comprising corresponding means for receiving), to perform deciding, based on said destination area, whether to forward said first message (thus the apparatus comprising corresponding means for deciding), and to perform forwarding, if said first message is
25 decided to be forwarded, said first message to a receiving intelligent transport system (thus the apparatus comprising corresponding means for forwarding).

Further, according to exemplary embodiments of the present invention, an apparatus representing the network node 50 comprises at least one processor 141, at least one memory 142 including computer program code, and at least one interface 143 configured for communication with at least another apparatus. The processor (i.e. the at least one processor 141, with the at least one memory 142 and the computer program code) is configured to perform creating a cooperative awareness message (thus the apparatus comprising corresponding means for creating), to perform generating a message including said cooperative awareness message (thus the apparatus comprising corresponding means for generating), and to perform transmitting said message to a network side entity in a mobile communications network (thus the apparatus comprising corresponding means for transmitting).

For further details regarding the operability/functionality of the individual apparatuses, reference is made to the above description in connection with any one of Figures 1 to 11, respectively.

For the purpose of the present invention as described herein above, it should be noted that

- method steps likely to be implemented as software code portions and being run using a processor at a network server or network entity (as examples of devices, apparatuses and/or modules thereof, or as examples of entities including apparatuses and/or modules therefore), are software code independent and can be specified using any known or future developed programming language as long as the functionality defined by the method steps is preserved;
- generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the embodiments and its modification in terms of the functionality implemented;
- method steps and/or devices, units or means likely to be implemented as hardware components at the above-defined apparatuses, or any module(s) thereof, (e.g., devices carrying out the functions of the apparatuses

- according to the embodiments as described above) are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS),
- 5 BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components;
- 10 - devices, units or means (e.g. the above-defined network entity or network register, or any one of their respective units/means) can be implemented as individual devices, units or means, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device, unit or means is preserved;
- 15 - an apparatus like the user equipment and the network entity /network register may be represented by a semiconductor chip, a chipset, or a (hardware) module comprising such chip or chipset; this, however, does not exclude the possibility that a functionality of an apparatus or module, instead of being hardware implemented, be implemented as software in a
- 20 (software) module such as a computer program or a computer program product comprising executable software code portions for execution/being run on a processor;
- a device may be regarded as an apparatus or as an assembly of more than one apparatus, whether functionally in cooperation with each other or
- 25 functionally independently of each other but in a same device housing, for example.

In general, it is to be noted that respective functional blocks or elements according to above-described aspects can be implemented by any known

30 means, either in hardware and/or software, respectively, if it is only adapted to perform the described functions of the respective parts. The mentioned method steps can be realized in individual functional blocks or by

individual devices, or one or more of the method steps can be realized in a single functional block or by a single device.

Generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the present invention. Devices and means can be implemented as individual devices, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device is preserved. Such and similar principles are to be considered as known to a skilled person.

Software in the sense of the present description comprises software code as such comprising code means or portions or a computer program or a computer program product for performing the respective functions, as well as software (or a computer program or a computer program product) embodied on a tangible medium such as a computer-readable (storage) medium having stored thereon a respective data structure or code means/portions or embodied in a signal or in a chip, potentially during processing thereof.

The present invention also covers any conceivable combination of method steps and operations described above, and any conceivable combination of nodes, apparatuses, modules or elements described above, as long as the above-described concepts of methodology and structural arrangement are applicable.

In view of the above, there are provided measures for dissemination of cooperative awareness messages in cellular network environments. Such measures exemplarily comprise receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message, ascertaining, based on said first message, a destination area for said cooperative awareness message, and transmitting a second message including said cooperative awareness message and information indicative of said destination area.

Even though the invention is described above with reference to the examples according to the accompanying drawings, it is to be understood that the invention is not restricted thereto. Rather, it is apparent to those skilled in the art that the present invention can be modified in many ways without departing from the scope of the inventive idea as disclosed herein.

List of acronyms and abbreviations

10	3GPP	3rd Generation Partnership Project
	CAM	cooperative awareness message
	DEMN	decentralized environmental notification message
	DSRC	dedicated short range communication
	ETSI	European Telecommunications Standards Institute
15	HT/HST	header/sub-header type
	ITS	intelligent transport system
	ITS-S	ITS station
	LTE	Long Term Evolution
	MEC	mobile edge computing
20	non-IP PDN	non internet protocol packet data network
	TCP/IP	transmission control protocol internet protocol
	UDP/IP	user datagram protocol internet protocol
	V2I	Vehicle to Infrastructure
	V2V	Vehicle to Vehicle
25	V2X	V2I and V2V

Claims

1. A method of a network side entity in a mobile communications network, the method comprising
- 5 receiving, from an originating intelligent transport system station, a first message including a cooperative awareness message,
- ascertaining, based on said first message, a destination area for said cooperative awareness message, and
- transmitting a second message including said cooperative awareness
- 10 message and information indicative of said destination area.
2. The method according to claim 1, wherein
- said second message comprises a message header including said information indicative of said destination area.
- 15
3. The method according to claim 1 or 2, wherein
- said first message comprises a first message header including said information indicative of said destination area, and
- in relation to said transmitting, said method further comprises
- 20 adopting said first message as said second message.
4. The method according to claim 1 or 2, further comprising
- generating said second message including said cooperative awareness message and said information indicative of said destination area.
- 25
5. The method according to claim 4, wherein
- said first message comprises a first message header including information indicative of a position of said originating intelligent transport system station, and
- 30 in relation to said ascertaining, said method further comprises
- determining, based on said position of said originating intelligent transport system station, said destination area for said cooperative awareness message.

6. The method according to claim 5, wherein
in relation to said generating, said method further comprises
adding at least one security certificate to said second message.
- 5
7. The method according to claim 4, further comprising
decoding said cooperative awareness message,
deriving, from a result of said decoding, information indicative of a
position of said originating intelligent transport system station, and
10 in relation to said ascertaining, said method further comprises
determining, based on said position of said originating intelligent
transport system station, said destination area for said cooperative
awareness message.
- 15
8. The method according to claim 7, wherein
said first message is received via one of a transmission control
protocol internet protocol transmission, a user datagram protocol internet
protocol transmission, and a non internet protocol packet data network
transmission.
- 20
9. The method according to claim 2, wherein
said message header comprises information on a shape and a
geographic position of said destination area as said information indicative of
said destination area.
- 25
10. A method in a mobile communications network, the method comprising
receiving, from an intelligent transport system station, a first
message including a cooperative awareness message and a message header
including information indicative of a destination area for said cooperative
30 awareness message,
deciding, based on said destination area, whether to forward said first
message, and

forwarding, if said first message is decided to be forwarded, said first message to a receiving intelligent transport system.

11. The method according to claim 10, further comprising

5 determining, on the basis of said deciding, whether said first message is to be forwarded via a radio interface between the network side entity and said receiving intelligent transport system station, and

 removing, if said first message is determined to be forwarded via said radio interface, said message header from said first message.

10

12. The method according to claim 10 or 11, wherein

 said first message is forwarded via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network
15 transmission.

13. The method according to any of claims 10 to 12, wherein

 said message header comprises information on a shape and a geographic position of said destination area as said information indicative of
20 said destination area.

14. A method in a mobile communications network comprising

 creating a cooperative awareness message,

 generating a message including said cooperative awareness message,

25 and

 transmitting said message to a network side entity in a mobile communications network.

15. The method according to claim 14, wherein

30 said message comprises a message header including information indicative of a destination area for said cooperative awareness message.

16. The method according to claim 15, wherein

said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

5 17. The method according to claim 14, wherein

said message comprises a message header including information indicative of a position of said creating of said cooperative awareness message.

10 18. The method according to claim 14, wherein

said message is transmitted via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network transmission.

15 19. An apparatus in a network side entity in a mobile communications network, the apparatus comprising

receiving circuitry configured to receive, from an originating intelligent transport system station, a first message including a cooperative awareness message,

20 ascertaining circuitry configured to ascertain, based on said first message, a destination area for said cooperative awareness message, and

transmitting circuitry configured to transmit a second message including said cooperative awareness message and information indicative of said destination area.

25

20. The apparatus according to claim 19, wherein

said second message comprises a message header including said information indicative of said destination area.

30 21. The apparatus according to claim 19 or 20, wherein

said first message comprises a first message header including said information indicative of said destination area, and

said apparatus further comprises

adopting circuitry configured to adopt said first message as said second message.

22. The apparatus according to claim 19 or 20, further comprising

5 generating circuitry configured to generate said second message including said cooperative awareness message and said information indicative of said destination area.

23. The apparatus according to claim 22, wherein

10 said first message comprises a first message header including information indicative of a position of said originating intelligent transport system station, and

 said apparatus further comprises

 determining circuitry configured to determine, based on said position
15 of said originating intelligent transport system station, said destination area for said cooperative awareness message.

24. The apparatus according to claim 22, further comprising

 adding circuitry configured to add at least one security certificate to
20 said second message.

25. The apparatus according to claim 22, further comprising

 decoding circuitry configured to decode said cooperative awareness message,

25 deriving circuitry configured to derive, from a result of said decoding circuitry, information indicative of a position of said originating intelligent transport system station, and

 determining circuitry configured to determine, based on said position
of said originating intelligent transport system station, said destination area
30 for said cooperative awareness message.

26. The apparatus according to claim 25, wherein

said first message is received via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network transmission.

5

27. The apparatus according to claim 20, wherein

said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

10

28. An apparatus in a mobile communications network, the apparatus comprising

receiving circuitry configured to receive, from an intelligent transport system station, a first message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message,

15

deciding circuitry configured to decide, based on said destination area, whether to forward said first message, and

forwarding circuitry configured to forward, if said first message is decided to be forwarded, said first message to a receiving intelligent transport system.

20

29. The apparatus according to claim 28, further comprising

determining circuitry configured to determine, on the basis of said deciding circuitry, whether said first message is to be forwarded via a radio interface between the network side entity and said receiving intelligent transport system station, and

25

removing circuitry configured to remove, if said first message is determined to be forwarded via said radio interface, said message header from said first message.

30

30. The apparatus according to claim 28 or 29, wherein

said first message is forwarded via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network transmission.

5

31. The apparatus according to any of claims 28 to 30, wherein

said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

10

32. An apparatus in a mobile communications network comprising

creating circuitry configured to create a cooperative awareness message,

generating circuitry configured to generate a message including said cooperative awareness message, and

15

transmitting circuitry configured to transmit said message to a network side entity in a mobile communications network.

33. The apparatus according to claim 32, wherein

said message comprises a message header including information indicative of a destination area for said cooperative awareness message.

20

34. The apparatus according to claim 33, wherein

said message header comprises information on a shape and a geographic position of said destination area as said information indicative of said destination area.

25

35. The apparatus according to claim 32, wherein

said message comprises a message header including information indicative of a position of said creating of said cooperative awareness message.

30

36. The apparatus according to claim 32, wherein

said message is transmitted via one of a transmission control protocol internet protocol transmission, a user datagram protocol internet protocol transmission, and a non internet protocol packet data network transmission.

- 5 37. An apparatus in a network side entity in a mobile communications network, the apparatus comprising
- at least one processor,
 - at least one memory including computer program code, and
 - at least one interface configured for communication with at least
- 10 another apparatus,
- the at least one processor, with the at least one memory and the computer program code, being configured to cause the apparatus to perform:
- receiving, from an originating intelligent transport system station, a
- 15 first message including a cooperative awareness message,
- ascertaining, based on said first message, a destination area for said cooperative awareness message, and
 - transmitting a second message including said cooperative awareness message and information indicative of said destination area.
- 20
38. An apparatus in a mobile communications network comprising
- at least one processor,
 - at least one memory including computer program code, and
 - at least one interface configured for communication with at least
- 25 another apparatus,
- the at least one processor, with the at least one memory and the computer program code, being configured to cause the apparatus to perform:
- receiving, from an intelligent transport system station, a first
- 30 message including a cooperative awareness message and a message header including information indicative of a destination area for said cooperative awareness message,

deciding, based on said destination area, whether to forward said first message, and

forwarding, if said first message is decided to be forwarded, said first message to a receiving intelligent transport system.

5

39. An apparatus in a mobile communications network comprising

at least one processor,

at least one memory including computer program code, and

at least one interface configured for communication with at least

10 another apparatus,

the at least one processor, with the at least one memory and the computer program code, being configured to cause the apparatus to perform:

creating a cooperative awareness message,

15 generating a message including said cooperative awareness message,
and

transmitting said message to a network side entity in a mobile communications network.

20 40. A computer program product comprising computer-executable computer program code which, when the program is run on a computer, is configured to cause the computer to carry out the method according to any one of claims 1 to 9, 10 to 13 or 14 to 18.

25 41. The computer program product according to claim 40, wherein the computer program product comprises a computer-readable medium on which the computer-executable computer program code is stored, and/or wherein the program is directly loadable into an internal memory of the computer or a processor thereof.

30

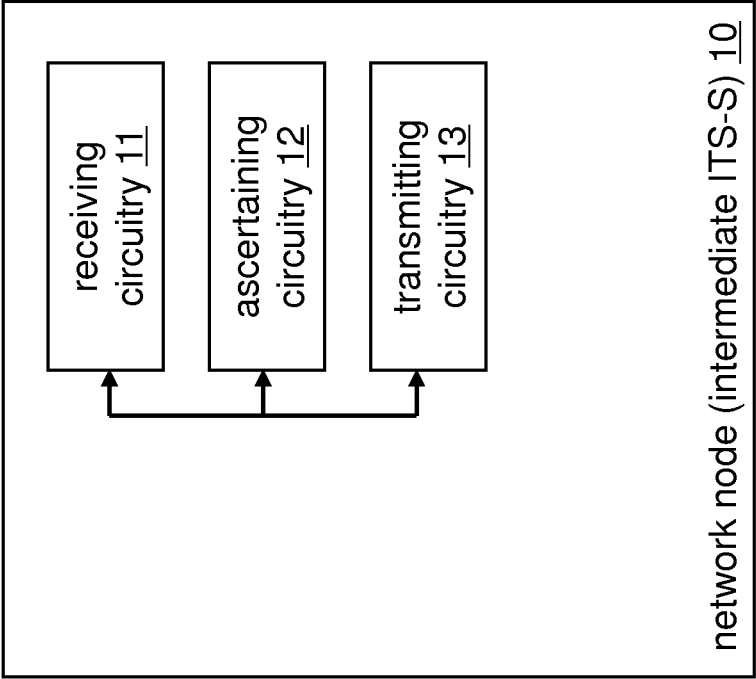


Fig. 1

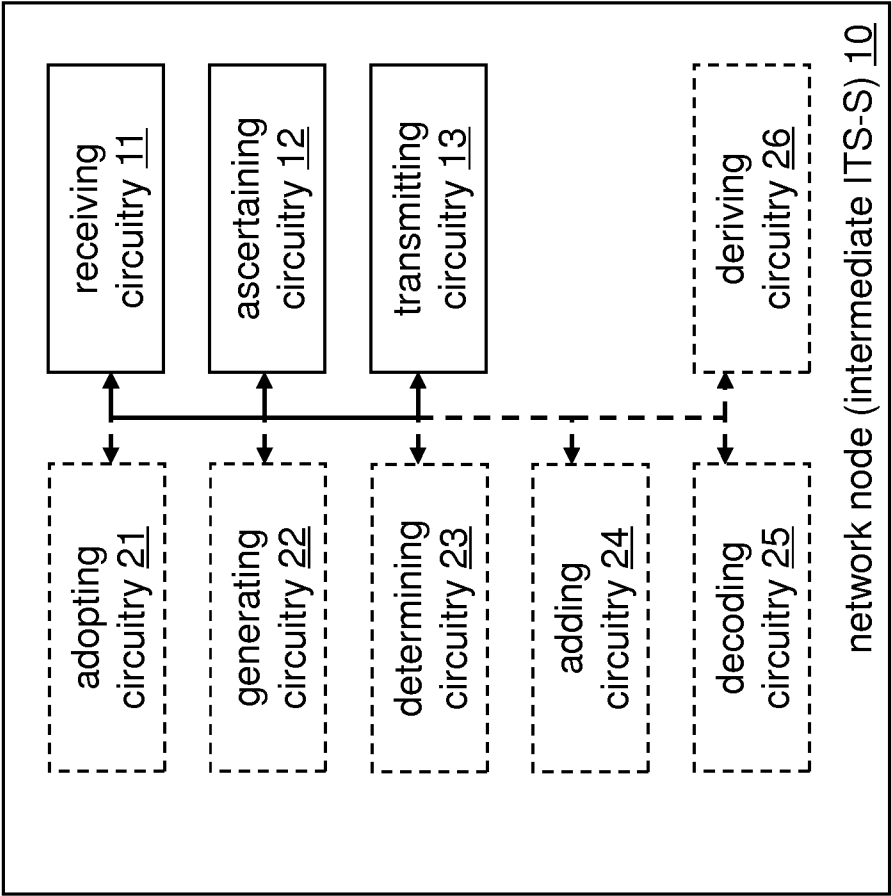


Fig. 2

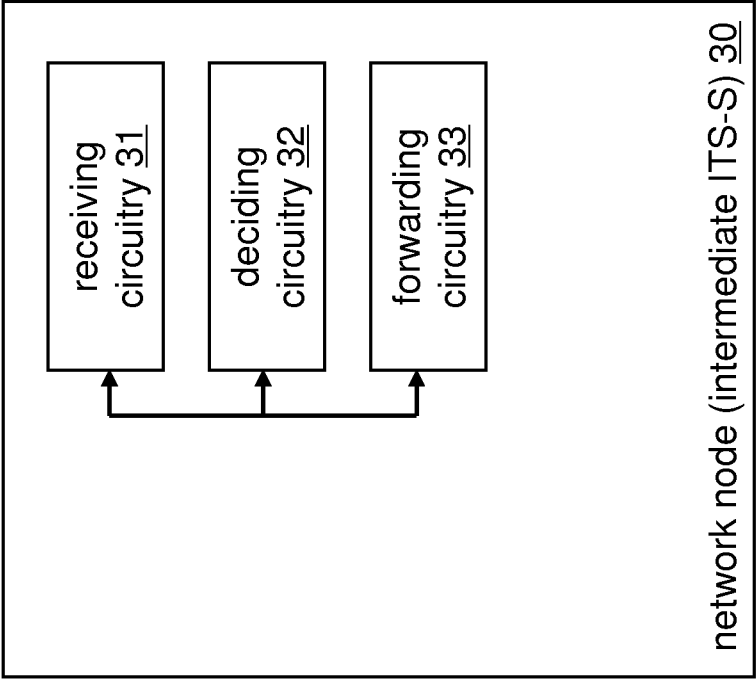


Fig. 3

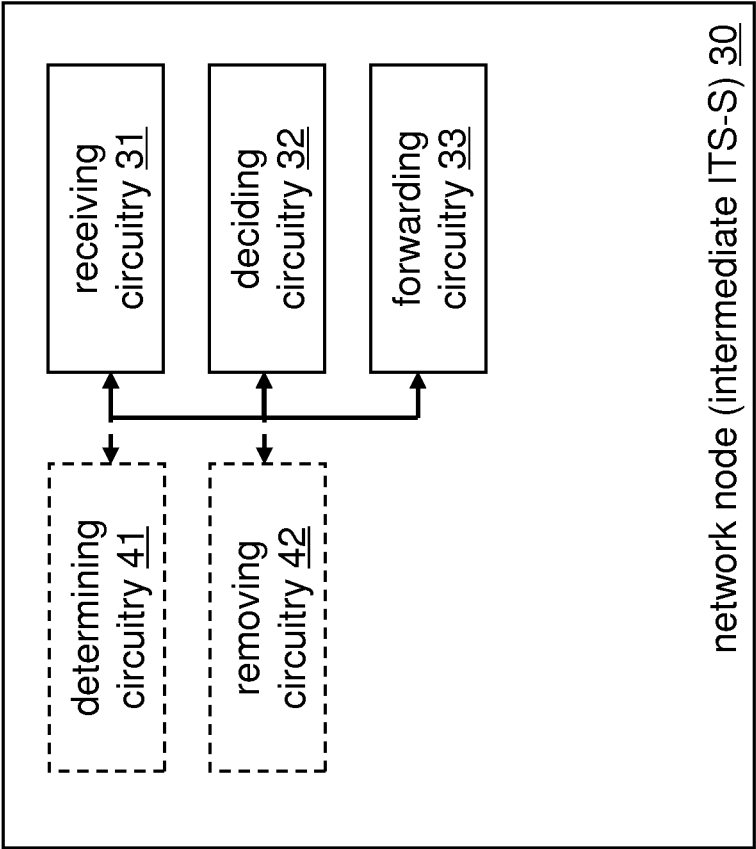


Fig. 4

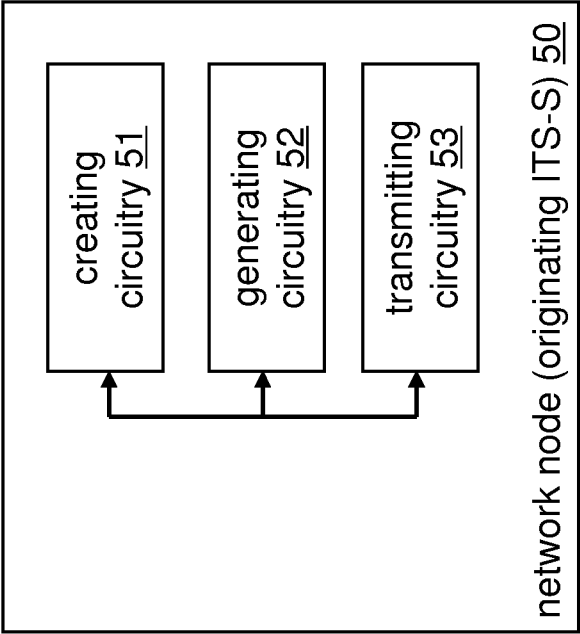


Fig. 5

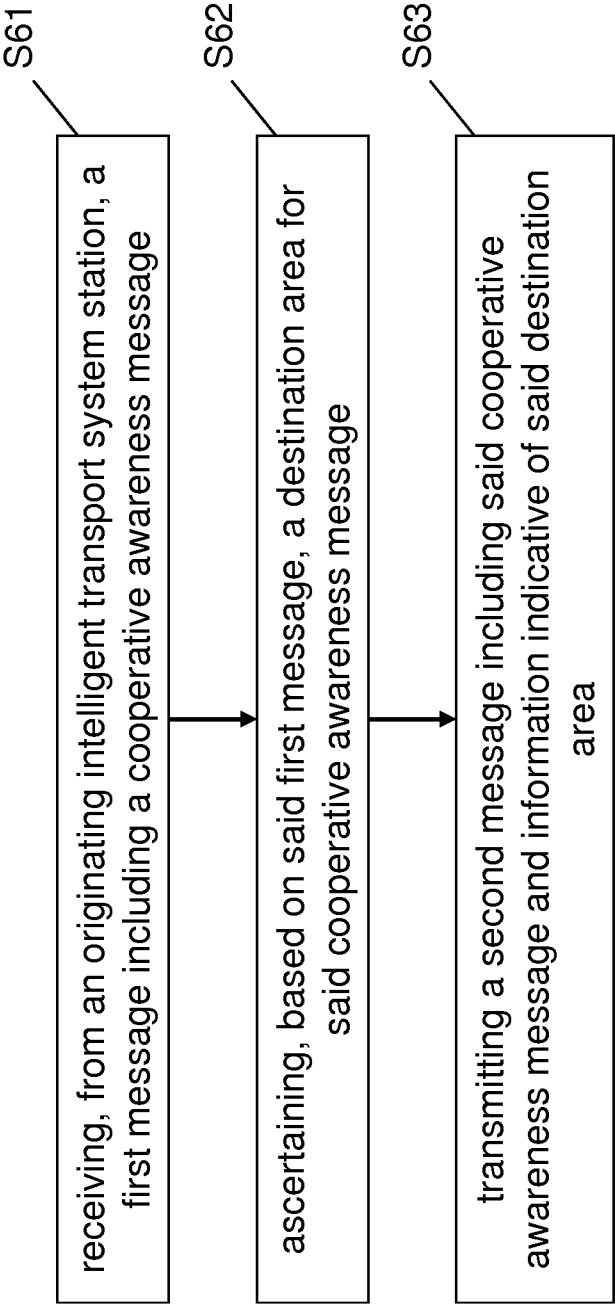


Fig. 6

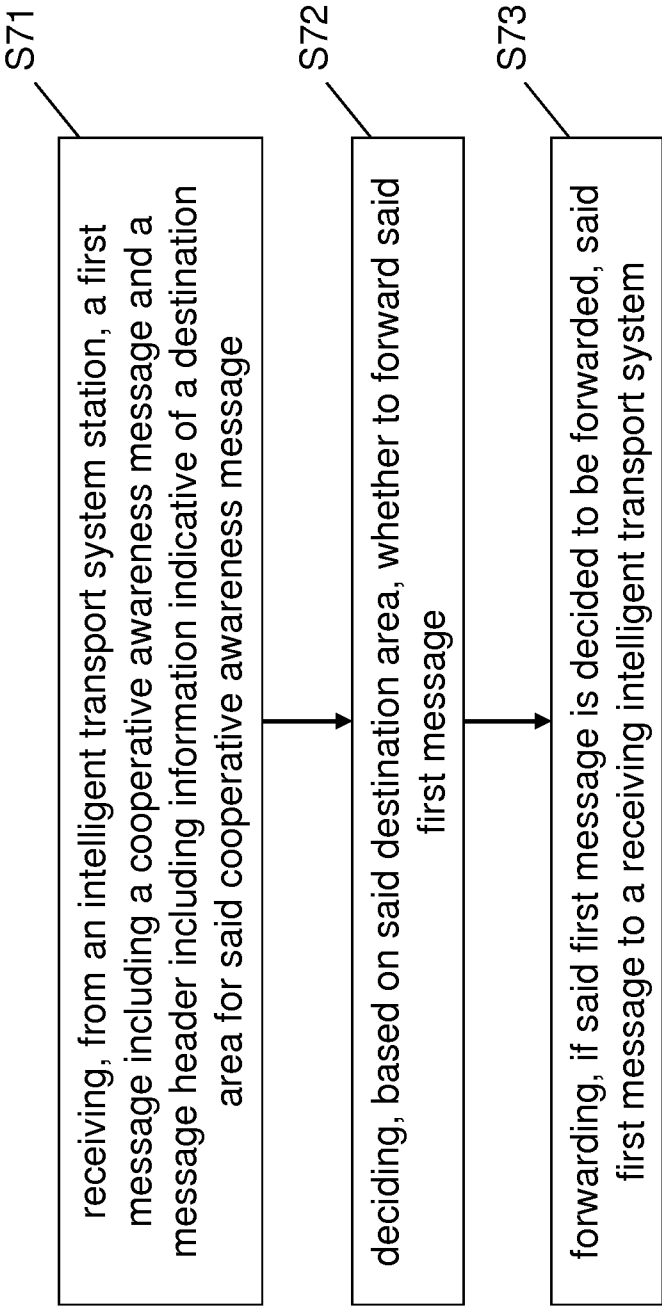


Fig. 7

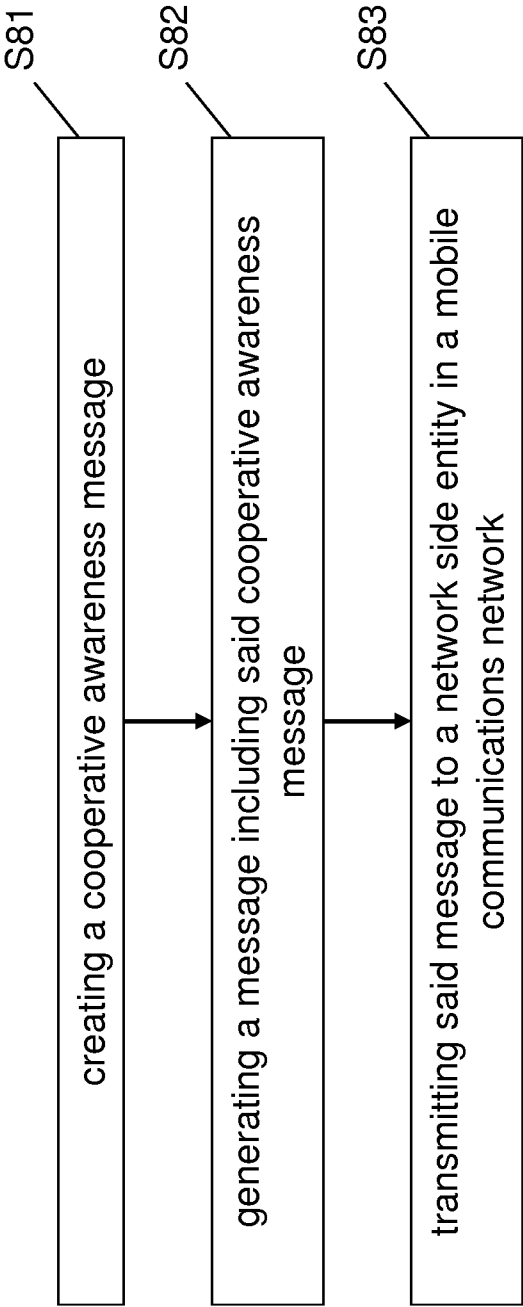


Fig. 8

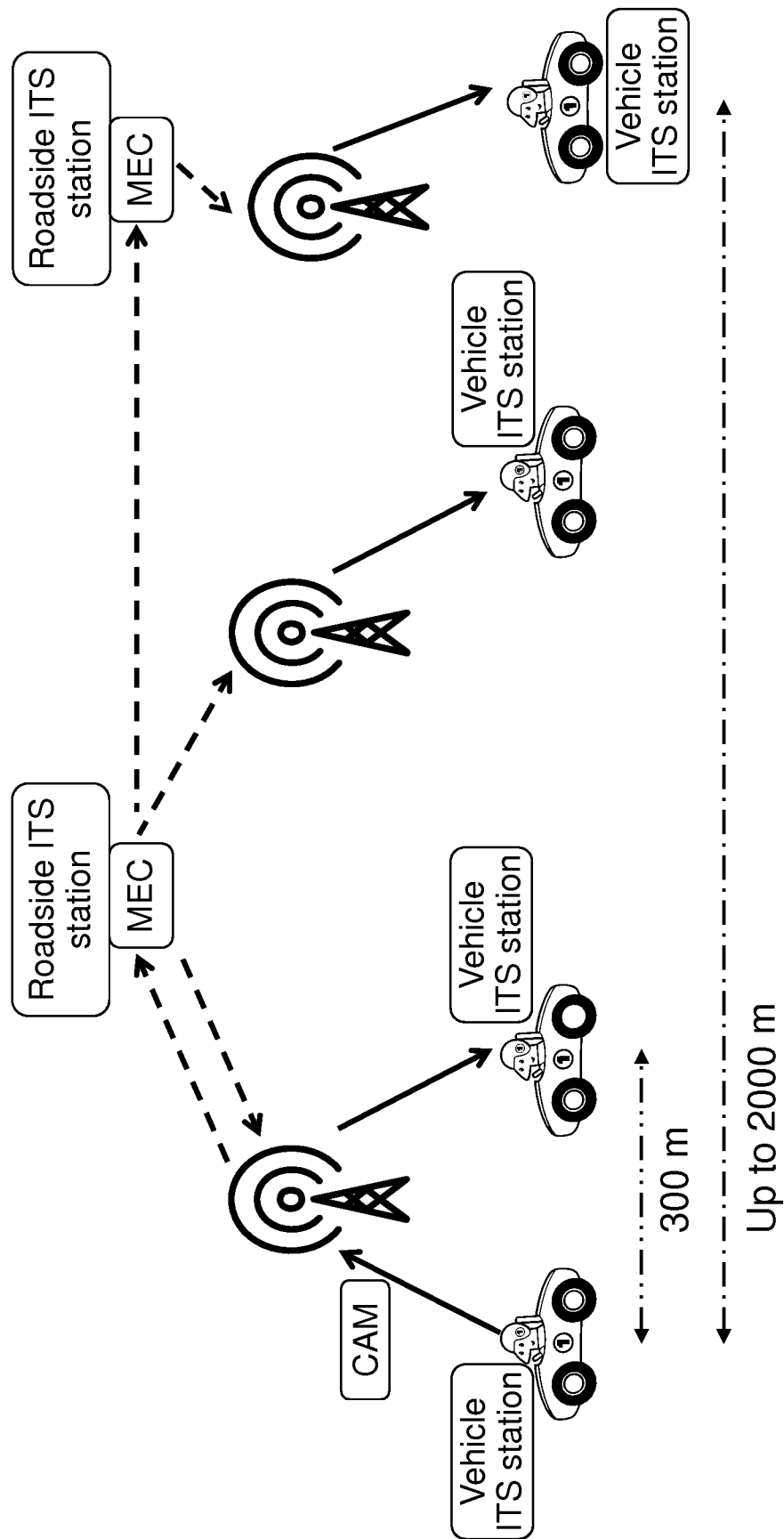


Fig. 9

0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Version								NH								HST							
								HT								Reserved							
								PL								TC							
																Flags							
																HL							
SE PV																							

Fig. 10

0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7																
Common Header																																							
								SN								LT								Reserved															
								SO PV								Reserved																							
GeoAreaPos																																							
								Distance a Angle								Distance b Reserved																							

Fig. 11

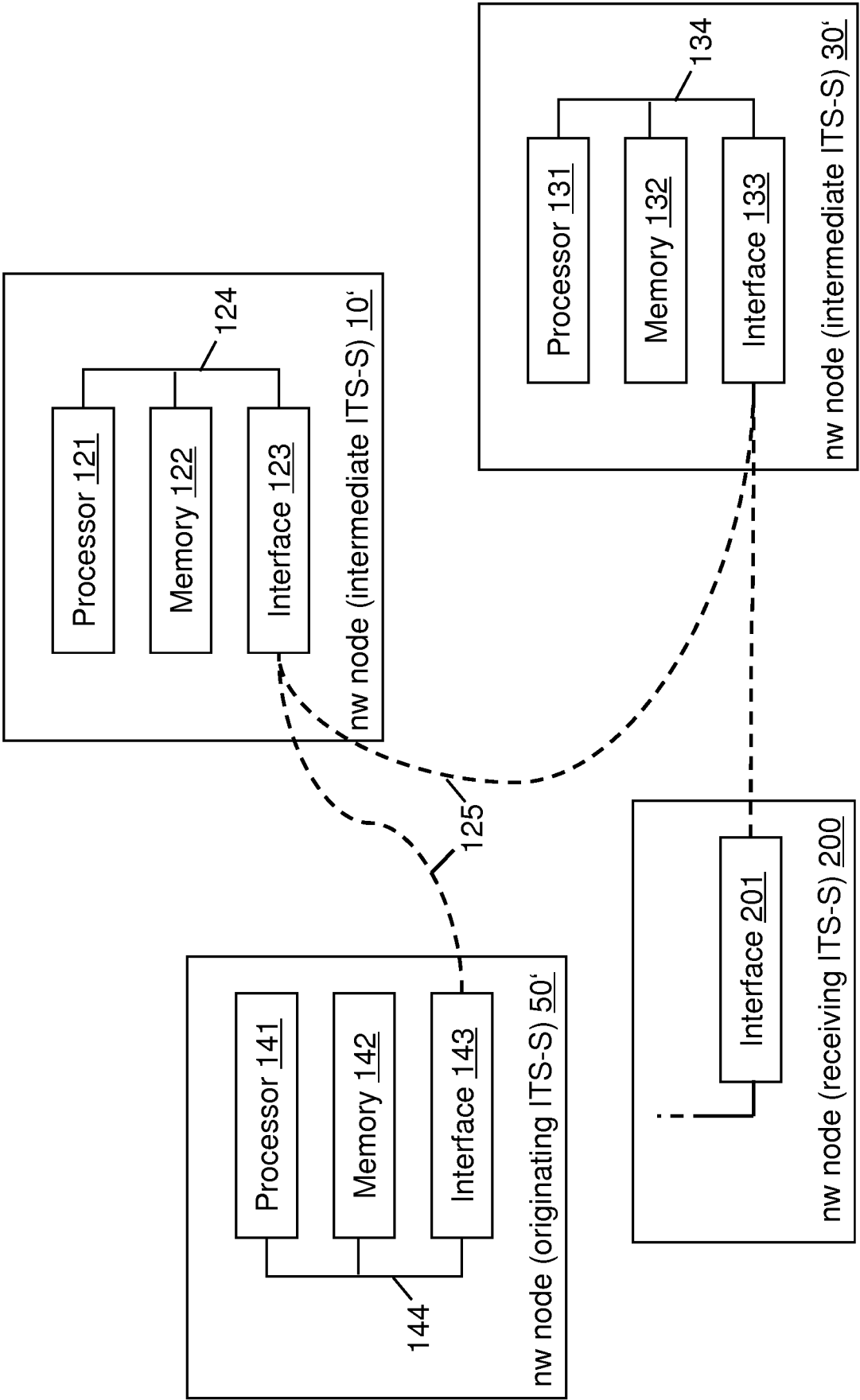


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/072639

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04W4/04

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	"Intelligent Transport Systems (ITS); Framework for Public Mobile Networks in Cooperative ITS (C-ITS)", TECHNICAL REPORT, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI), 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS ; FRANCE, vol. ITS WG2, no. V1.1.1, 1 February 2012 (2012-02-01), XP014069748, paragraph [5.1.1] paragraph [5.2.5.1]; figure 5.4 paragraph [5.4.4] paragraph [06.1]; figures 6.1, 6.2 paragraph [6.1.1] - paragraph [6.1.2] paragraph [6.1.5] - paragraph [6.1.6] paragraph [6.2.2]; figure 6.6 paragraph [6.2.3]; figure 6.8 paragraph [06.3] paragraph [7.2.3] -/--	1-41



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

16 June 2017

Date of mailing of the international search report

27/06/2017

Name and mailing address of the ISA/

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Fax: (+31-70) 340-3016

Authorized officer

Badoi, Cornelia

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/072639

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	----- L Le ET AL: "INFRASTRUCTURE-ASSISTED COMMUNICATION FOR CAR-TO-X COMMUNICATION", Proceedings of 18th ITS World Congress and Exhibition 2011, 18 October 2011 (2011-10-18), pages 1-7, XP055261135, http://festag-net.de/publications.html Retrieved from the Internet: URL:http://festag-net.de/doc/2011_ITSEC_LT_E_le.pdf [retrieved on 2016-03-29] abstract figures 3-5 "Centralized Vehicular Communication"; page 3 - page 6 -----	1-41
X	----- "GeoNetworking Issues", ETSI DRAFT; GEONETWORKING ISSUES, EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI), 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS ; FRANCE, vol. ITS, 20 September 2012 (2012-09-20), pages 1-18, XP014086488, [retrieved on 2012-09-20] figures 1-3 "Geographically-scoped information dissemination"; page 3 - page 5 "Overview of the current GeoNetworking Protocol"; page 5 - page 7 page 8, paragraph 5.1 - page 9 -----	1-41