and exemplary embodiments. Advantageous embodiments are subject to the dependent claims.

[0036a] In a first aspect, the present disclosure provides a transmitting device comprising: circuitry, which, in operation, obtains one or more quality of service configurations provisioned to the transmitting device by a network; generates vehicular data in an application layer and forwards the vehicular data together with a priority indication to a transmission layer; determines, in the transmission layer, one of the one or more quality of service configurations depending on the priority indication forwarded from the application layer; and performs autonomous radio resource allocation for transmitting the vehicular data via a sidelink interface based on the determined one quality of service configuration, and a transmitter, which is coupled to the circuitry and which, in operation, transmits the vehicular data via the sidelink interface to one or more receiving devices according to the autonomous radio resource allocation, wherein, in case different sidelink logical channels are multiplexed in one transport block (TB) to transmit the vehicular data, transmission of the TB via the sidelink interface is performed based on a sidelink logical channel associated with the highest priority indication among the different sidelink logical channels associated with priority indications.

[0036b] In a second aspect, the present disclosure provides a method implemented in a transmitting device, the method comprising: obtaining one or more quality of service configurations provisioned to the transmitting device by a network; generating vehicular data in an application layer and forwarding the vehicular data together with a priority indication to a transmission layer; determining, in the transmission layer, one of the one or more quality of service configurations depending on the priority indication forwarded from the application layer, performing autonomous radio resource allocation for transmitting the vehicular data via a sidelink interface based on the determined one quality of service configuration; and transmitting the vehicular data via the sidelink interface to one or more receiving devices according to the autonomous radio resource allocation, wherein, in case different sidelink logical channels are multiplexed in one transport block (TB) to transmit the vehicular data, transmission of the TB via the sidelink interface is performed based on a sidelink logical channel associated with the highest priority indication among the different sidelink logical channels associated with priority indications.

[0037] Several embodiments are provided on how to support particular quality of service requirements for the vehicular communication via the sidelink interface, particularly when the UE is responsible for the radio resource allocation. The underlying scenario is that a transmitting device (such as a vehicular UE) shall transmit vehicular data via a sidelink interface to other devices. The vehicular UE shall support UE autonomous resource allocation as well as base station controlled resource allocation.

[0038] Correspondingly, according to a first embodiment, necessary quality of service parameters are transmitted together with the vehicular data to lower layers responsible for the transmission of the vehicular data. The quality of service parameters are then used in the UE autonomous resource allocation performed by the vehicular UE so as to obtain suitable transmission parameters to be used for the transmission of the vehicular data

while at the same time trying to enforce the quality of service requirements. The vehicular data is then transmitted according to the obtained transmission parameters.

[0039] According to a second embodiment, different quality of service configurations (respectively with quality of service parameters) are defined, and the vehicular UE performs resource allocation and transmission of the vehicular data according to one of the quality of service configurations. In particular, the application layer generates the vehicular data as well as an QoS configuration indication and forwards both to the responsible transmission layer. In turn, the transmission layer determines the corresponding quality of service configuration and quality of service parameters and performs the UE autonomous radio resource allocation based thereon so as to obtain the necessary transmission parameters. Then, the transmission layer transmits the vehicular data via the sidelink interface.

[0040] According to a third embodiment, performing the UE autonomous resource allocation or the base station controlled resource allocation is made dependent on the data that is to be transmitted. Correspondingly, the vehicular UE supports both resource allocation modes provided for the sidelink interface, however performs one of the two depending on the data that is to be transmitted. It is assumed, that quality of service is only supported by the base station controlled resource allocation. In particular, the application layer generates the vehicular data and may for instance generate a corresponding quality of service support indication, indicating whether quality of service should be supported by the lower layers or not. The quality of service indication can be forwarded together with vehicular data to the corresponding transmission layer of the vehicular UE, which then performs the resource allocation is indicated by the quality of service indication. The thus obtained transmission parameters (considering or not considering quality of service requirements) are then used for actually transmitting the

vehicular data.

[0041] According to a fourth embodiment, the sidelink logical channel prioritization procedure is improved by additionally taken into account an aggregate maximum bit rate for the vehicular UE which indicates a maximum throughput of vehicular data transmitted by the vehicular UE via the sidelink interface. This additional parameter limits the throughput of vehicular data to be transmitted by the transmitting device via the sidelink interface.

[0042] Correspondingly, in one general first embodiment, the techniques disclosed here feature a transmitting device for transmitting vehicular data via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. An application layer of the transmitting device generates the vehicular data and forwards the vehicular data together with a priority indication and one or more quality of service parameters to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer performs autonomous radio resource allocation based on the received priority indication and the one or more quality of service parameters. The transmission layer transmits the vehicular data via the sidelink interface to the one or more receiving devices according to the performed autonomous radio resource allocation. Correspondingly, in one general first embodiment, the techniques disclosed here feature a method for transmitting vehicular data from a transmitting device via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. The method comprises the following steps performed by the transmitting device. The vehicular data is generated in an application layer and forwarded together with a priority indication and one or more quality of service parameters to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer performs autonomous radio resource allocation based on the received priority indication and the one or more quality of service parameters. The transmission layer transmits the vehicular data via the sidelink interface to the one or more receiving devices according to the performed autonomous radio resource allocation.

[0043] Correspondingly, in one general first embodiment, the techniques disclosed here feature a transmitting device for transmitting vehicular data via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. A receiver of the transmitting device receives system information broadcast by a radio base station in its radio cell, the system information comprising one or more quality of service configurations. An application layer of the transmitting device, generates the vehicular data

and forwards the generated vehicular data together with an indication to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer determines one of the received one or more quality of service configurations depending on the indication received together with the vehicular data. The transmission layer performs the autonomous radio resource allocation based on the determined one quality of service configuration. The transmission layer transmits the vehicular data via the sidelink interface to the one or more receiving devices according to the performed autonomous radio resource allocation.

[0044] Correspondingly, in one general first aspect, the techniques disclosed here feature a method for transmitting vehicular data from a transmitting device via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. The method comprises the following steps performed by the transmitting device. System information broadcast by a radio base station in its radio cell is received by the transmitting device, the system information comprising one or more quality of service configurations. The vehicular data is generated in an application layer and forwarded together with an indication to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer determines one of the received one or more quality of service configurations depending on the indication received together with the vehicular data, and performs the autonomous radio resource allocation based on the determined one quality of service configuration. The vehicular data is transmitted via the sidelink interface to the one or more receiving devices according to the performed autonomous radio resource allocation.

[0045] Correspondingly, in one general first embodiment, the techniques disclosed here feature a transmitting device for transmitting vehicular data via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. An aggregate maximum bit rate is defined for the transmitting device, indicating the maximum-allowed total vehicular data throughput of the transmitting device via the sidelink interface. An application layer of the transmitting device generates the vehicular data and forwards the vehicular data to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer performs the autonomous radio resource allocation for the vehicular data, including the selection of frequency-time radio resources. The transmission layer performs a sidelink logical channel prioritization procedure for allocating the selected frequency-time radio resources to generate a data packet carrying the vehicular data, the sidelink logical channel procedure considering the aggregate maximum bit rate as a limit to the

throughput of vehicular data to be transmitted by the transmitting device via the sidelink interface. The transmission layer transmits the generated data packet carrying the vehicular data to the one or more receiving devices using the allocated frequency-time radio resources.

[0046] Correspondingly, in one general first embodiment, the techniques disclosed here feature a method for transmitting vehicular data from a transmitting device via a sidelink interface to one or more receiving devices. The transmitting device performs autonomous radio resource allocation for transmitting the vehicular data via the sidelink interface. An aggregate maximum bit rate is defined for the transmitting device, indicating the maximum-allowed total vehicular data throughput of the transmitting device via the sidelink interface. The method comprises the following steps performed by the transmitting device. An application layer generates the vehicular data, which is to a transmission layer responsible for transmission of the vehicular data via the sidelink interface. The transmission layer performs the autonomous radio resource allocation for the vehicular data, including the selection of frequency-time radio resources. The transmission layer performs a sidelink logical channel prioritization procedure for allocating the selected frequency-time radio resources to generate a data packet carrying the vehicular data, the sidelink logical channel procedure considering the aggregate maximum bit rate as a limit to the throughput of vehicular data to be transmitted by the transmitting device via the sidelink interface. The transmission layer transmits the generated data packet carrying the vehicular data to the one or more receiving devices using the allocated frequency-time radio resources.

[0047] Additional benefits and advantages of the disclosed embodiments will be apparent from the specification and Figures. The benefits and/or advantages may be individually provided by the various embodiments and features of the specification and drawings disclosure, and need not all be provided in order to obtain one or more of the same.

[0048] These general and specific aspects may be implemented using a system, a method, and a computer program, and any combination of systems, methods, and computer programs.

Brief Description of Drawings

[0049] In the following exemplary embodiments are described in more detail with reference to the attached figures and drawings.

[fig.1]Fig. 1 shows an exemplary architecture of a 3GPP LTE system.

[fig.2]Fig. 2 shows an exemplary downlink resource grid of a downlink slot of a subframe as defined for 3GPP LTE (Release 8/9).

[fig.3]Fig. 3 schematically illustrates how to establish a layer-2 link over the PC5 for ProSe communication.

CLAIMS

1. A transmitting device comprising:

circuitry, which, in operation,

obtains one or more quality of service configurations provisioned to the transmitting device by a network;

generates vehicular data in an application layer and forwards the vehicular data together with a priority indication to a transmission layer;

determines, in the transmission layer, one of the one or more quality of service configurations depending on the priority indication forwarded from the application layer; and

performs autonomous radio resource allocation for transmitting the vehicular data via a sidelink interface based on the determined one quality of service configuration, and

a transmitter, which is coupled to the circuitry and which, in operation, transmits the vehicular data via the sidelink interface to one or more receiving devices according to the autonomous radio resource allocation,

wherein, in case different sidelink logical channels are multiplexed in one transport block (TB) to transmit the vehicular data, transmission of the TB via the sidelink interface is performed based on a sidelink logical channel associated with the highest priority indication among the different sidelink logical channels associated with priority indications.

2. The transmitting device according to claim 1, wherein each of the one or more quality of service configurations indicates at least one of:

a packet delay budget: indicating an upper time limit allowed for transmitting the vehicular data upon becoming available for transmission,

a packet error loss rate: indicating an allowed rate of lost vehicular data,

a resource type: having or not having a guaranteed bit rate.

3. The transmitting device according to claim 1,

wherein the priority indication forwarded together with the vehicular data to the transmission layer indicates the priority of the vehicular data, and

wherein the circuitry determines the one quality of service configuration using the forwarded priority indication and a mapping stored in the transmitting device associating each of the one or more quality of service configurations with a priority indication value.

4. The transmitting device according to claim 1,

wherein the circuitry generates a quality of service class indication (QCI) indicating the determined one quality of service configuration, and

wherein the priority indication forwarded together with the vehicular data to the transmission layer corresponds to the generated QCI.

5. A method implemented in a transmitting device, the method comprising:

obtaining one or more quality of service configurations provisioned to the transmitting device by a network;

generating vehicular data in an application layer and forwarding the vehicular data together with a priority indication to a transmission layer;

determining, in the transmission layer, one of the one or more quality of service configurations depending on the priority indication forwarded from the application layer,

performing autonomous radio resource allocation for transmitting the vehicular data via a sidelink interface based on the determined one quality of service configuration; and

transmitting the vehicular data via the sidelink interface to one or more receiving devices according to the autonomous radio resource allocation,

wherein, in case different sidelink logical channels are multiplexed in one transport block (TB) to transmit the vehicular data, transmission of the TB via the sidelink interface is performed based on a sidelink logical channel associated with the highest priority indication among the different sidelink logical channels associated with priority indications.

6. The method according to claim 5, wherein each of the one or more quality of service configurations indicates at least one of:

a packet delay budget: indicating an upper time limit allowed for transmitting the vehicular data upon becoming available for transmission,

a packet error loss rate: indicating an allowed rate of lost vehicular data,

a resource type: having or not having a guaranteed bit rate.

7. The transmitting device according to claim 1, wherein each of the one or more quality of service configurations is associated with a quality of service class identifier (QCI) value.

8. The transmission device according to claim 7, wherein the priority indication associated with the vehicular data is used to determine a QCI value associated with the priority indication and to determine the one quality of service configuration associated with the determined QCI value.

9. The transmission device according to claim 3, wherein the mapping is received in system information broadcast from a radio base station.

10. The transmission device according to claim 3, wherein the mapping is provided to the transmission layer from the application layer.

11. The method according to claim 5,

wherein the priority indication forwarded together with the vehicular data to the transmission layer indicates the priority of the vehicular data, and

wherein the one quality of service configuration is determined based on the priority indication and a mapping stored in the transmitting device associating each of the one or more quality of service configurations with a priority indication value.

12. The method according to claim 11, comprising:

receiving the mapping in system information broadcast from a radio base station.

13. The method according to claim 11, comprising:

the transmission layer receiving the mapping from the application layer.

14. The method according to claim 5, comprising:

generating a quality of service class indication (QCI) indicating the determined one quality of service configuration,

wherein the priority indication forwarded together with the vehicular data to the transmission layer corresponds to the generated QCI.

15. The method according to claim 5, wherein each of the one or more quality of service configurations is associated with a quality of service class identifier (QCI) value.

16. The method according to claim 15, wherein the priority indication associated with the vehicular data is used to determine a QCI value associated with the priority indication and to determine the one quality of service configuration associated with the determined QCI value.