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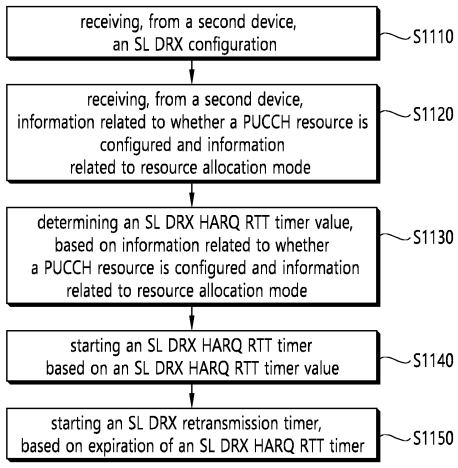
(54) **METHOD FOR OPERATING SL DRX IN CONSIDERATION OF MODE 1 OPERATION OF TRANSMISSION TERMINAL IN NR V2X**

(57) A method for operating a first device (100) in a wireless communication system is presented. The method may comprise the steps of: receiving a SL DRX setting from a second device (200); receiving, from the second device (200), information related to whether a physical uplink control channel (PUCCH) resource has been set and information related to a resource allocation mode; determining an SL DRX hybrid automatic repeat request (HARQ) round trip time (RTT) timer value on the basis of the information related to whether the PUCCH resource has been set and the information related to a resource allocation mode; initiating an SL DRX HARQ RTT timer on the basis of the SL DRX HARQ RTT timer value; and initiating an SL DRX retransmission timer on the basis of the expiration of the SL DRX HARQ RTT timer.

FIG. 11



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Description

TECHNICAL FIELD

[0001] This disclosure relates to a wireless communication system.

BACKGROUND ART

[0002] Sidelink (SL) communication is a communication scheme in which a direct link is established between User Equipments (UEs) and the UEs exchange voice and data directly with each other without intervention of an evolved Node B (eNB). SL communication is under consideration as a solution to the overhead of an eNB caused by rapidly increasing data traffic. Vehicle-to-everything (V2X) refers to a communication technology through which a vehicle exchanges information with another vehicle, a pedestrian, an object having an infrastructure (or infra) established therein, and so on. The V2X may be divided into 4 types, such as vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N), and vehicle-to-pedestrian (V2P). The V2X communication may be provided via a PC5 interface and/or Uu interface.

[0003] Meanwhile, as a wider range of communication devices require larger communication capacities, the need for mobile broadband communication that is more enhanced than the existing Radio Access Technology (RAT) is rising. Accordingly, discussions are made on services and user equipment (UE) that are sensitive to reliability and latency. And, a next generation radio access technology that is based on the enhanced mobile broadband communication, massive Machine Type Communication (MTC), Ultra-Reliable and Low Latency Communication (URLLC), and so on, may be referred to as a new radio access technology (RAT) or new radio (NR). Herein, the NR may also support vehicle-to-everything (V2X) communication.

DISCLOSURE

TECHNICAL SOLUTION

[0004] According to an embodiment, an operation method of a first device 100 in wireless communication system is proposed. The method may comprise: receiving, from a second device 200, the SL DRX configuration; receiving, from the second device 200, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode; determining an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode; starting an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and starting an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer.

ADVANTAGEOUS EFFECTS

[0005] A UE may efficiently perform sidelink communication.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 shows a structure of an NR system, based on an embodiment of the present disclosure.
FIG. 2 shows a radio protocol architecture, based on an embodiment of the present disclosure.
FIG. 3 shows a structure of a radio frame of an NR, based on an embodiment of the present disclosure.
FIG. 4 shows a structure of a slot of an NR frame, based on an embodiment of the present disclosure.
FIG. 5 shows an example of a BWP, based on an embodiment of the present disclosure.
FIG. 6 shows a procedure of performing V2X or SL communication by a UE based on a transmission mode, based on an embodiment of the present disclosure.
FIG. 7 shows three cast types, based on an embodiment of the present disclosure.
FIG. 8 shows a problem in the prior art that is the basis for the proposal of the present disclosure.
FIG. 9 shows an embodiment in which an active time period remains in an inactive time period based on a timer, according to an embodiment of the present disclosure.
FIG. 10 shows an embodiment in which an active time period remains in an inactive time period based on SCI associated with an initial transmission, according to an embodiment of the present disclosure.
FIG. 11 shows a procedure for a first device to perform wireless communication based on a sidelink, SL, discontinuous

reception, DRX, configuration, according to an embodiment of the present disclosure.

FIG. 12 shows a procedure for a second device to perform wireless communication, according to an embodiment of the present disclosure.

FIG. 13 shows a communication system 1, based on an embodiment of the present disclosure.

FIG. 14 shows wireless devices, based on an embodiment of the present disclosure.

FIG. 15 shows a signal process circuit for a transmission signal, based on an embodiment of the present disclosure.

FIG. 16 shows another example of a wireless device, based on an embodiment of the present disclosure.

FIG. 17 shows a hand-held device, based on an embodiment of the present disclosure.

FIG. 18 shows a vehicle or an autonomous vehicle, based on an embodiment of the present disclosure.

MODE FOR INVENTION

[0007] In the present disclosure, "A or B" may mean "only A", "only B" or "both A and B." In other words, in the present disclosure, "A or B" may be interpreted as "A and/or B". For example, in the present disclosure, "A, B, or C" may mean "only A", "only B", "only C", or "any combination of A, B, C".

[0008] A slash (/) or comma used in the present disclosure may mean "and/or". For example, "A/B" may mean "A and/or B". Accordingly, "A/B" may mean "only A", "only B", or "both A and B". For example, "A, B, C" may mean "A, B, or C".

[0009] In the present disclosure, "at least one of A and B" may mean "only A", "only B", or "both A and B". In addition, in the present disclosure, the expression "at least one of A or B" or "at least one of A and/or B" may be interpreted as "at least one of A and B".

[0010] In addition, in the present disclosure, "at least one of A, B, and C" may mean "only A", "only B", "only C", or "any combination of A, B, and C". In addition, "at least one of A, B, or C" or "at least one of A, B, and/or C" may mean "at least one of A, B, and C".

[0011] In addition, a parenthesis used in the present disclosure may mean "for example". Specifically, when indicated as "control information (PDCCH)", it may mean that "PDCCH" is proposed as an example of the "control information". In other words, the "control information" of the present disclosure is not limited to "PDCCH", and "PDCCH" may be proposed as an example of the "control information". In addition, when indicated as "control information (i.e., PDCCH)", it may also mean that "PDCCH" is proposed as an example of the "control information".

[0012] In the following description, 'when, if, or in case of' may be replaced with 'based on'.

[0013] A technical feature described individually in one figure in the present disclosure may be individually implemented, or may be simultaneously implemented.

[0014] In the present disclosure, a higher layer parameter may be a parameter which is configured, pre-configured or pre-defined for a UE. For example, a base station or a network may transmit the higher layer parameter to the UE. For example, the higher layer parameter may be transmitted through radio resource control (RRC) signaling or medium access control (MAC) signaling.

[0015] The technology described below may be used in various wireless communication systems such as code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), single carrier frequency division multiple access (SC-FDMA), and so on. The CDMA may be implemented with a radio technology, such as universal terrestrial radio access (UTRA) or CDMA-2000. The TDMA may be implemented with a radio technology, such as global system for mobile communications (GSM)/general packet ratio service (GPRS)/enhanced data rate for GSM evolution (EDGE). The OFDMA may be implemented with a radio technology, such as institute of electrical and electronics engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, evolved UTRA (E-UTRA), and so on. IEEE 802.16m is an evolved version of IEEE 802.16e and provides backward compatibility with a system based on the IEEE 802.16e. The UTRA is part of a universal mobile telecommunication system (UMTS). 3rd generation partnership project (3GPP) long term evolution (LTE) is part of an evolved UMTS (E-UMTS) using the E-UTRA. The 3GPP LTE uses the OFDMA in a downlink and uses the SC-FDMA in an uplink. LTE-advanced (LTE-A) is an evolution of the LTE.

[0016] 5G NR is a successive technology of LTE-A corresponding to a new Clean-slate type mobile communication system having the characteristics of high performance, low latency, high availability, and so on. 5G NR may use resources of all spectrum available for usage including low frequency bands of less than 1GHz, middle frequency bands ranging from 1GHz to 10GHz, high frequency (millimeter waves) of 24GHz or more, and so on.

[0017] For clarity in the description, the following description will mostly focus on LTE-A or 5G NR. However, technical features according to an embodiment of the present disclosure will not be limited only to this.

[0018] For terms and techniques not specifically described among terms and techniques used in this specification, a wireless communication standard document published before the present specification is filed may be referred to.

[0019] FIG. 1 shows a structure of an NR system, based on an embodiment of the present disclosure. The embodiment of FIG. 1 may be combined with various embodiments of the present disclosure.

[0020] Referring to FIG. 1, a next generation-radio access network (NG-RAN) may include a BS 20 providing a UE

10 with a user plane and control plane protocol termination. For example, the BS 20 may include a next generation-Node B (gNB) and/or an evolved-NodeB (eNB). For example, the UE 10 may be fixed or mobile and may be referred to as other terms, such as a mobile station (MS), a user terminal (UT), a subscriber station (SS), a mobile terminal (MT), wireless device, and so on. For example, the BS may be referred to as a fixed station which communicates with the UE 10 and may be referred to as other terms, such as a base transceiver system (BTS), an access point (AP), and so on.

[0021] The embodiment of FIG. 1 exemplifies a case where only the gNB is included. The BSs 20 may be connected to one another via Xn interface. The BS 20 may be connected to one another via 5th generation (5G) core network (5GC) and NG interface. More specifically, the BSs 20 may be connected to an access and mobility management function (AMF) 30 via NG-C interface, and may be connected to a user plane function (UPF) 30 via NG-U interface.

[0022] Layers of a radio interface protocol between the UE and the network can be classified into a first layer (layer 1, L1), a second layer (layer 2, L2), and a third layer (layer 3, L3) based on the lower three layers of the open system interconnection (OSI) model that is well-known in the communication system. Among them, a physical (PHY) layer belonging to the first layer provides an information transfer service by using a physical channel, and a radio resource control (RRC) layer belonging to the third layer serves to control a radio resource between the UE and the network. For this, the RRC layer exchanges an RRC message between the UE and the BS.

[0023] FIG. 2 shows a radio protocol architecture, based on an embodiment of the present disclosure. The embodiment of FIG. 2 may be combined with various embodiments of the present disclosure. Specifically, (a) of FIG. 2 shows a radio protocol stack of a user plane for Uu communication, and (b) of FIG. 2 shows a radio protocol stack of a control plane for Uu communication, (c) of FIG. 2 shows a radio protocol stack of a user plane for SL communication, and (d) of FIG. 2 shows a radio protocol stack of a control plane for SL communication.

[0024] Referring to FIG. 2, a physical layer provides an upper layer with an information transfer service through a physical channel. The physical layer is connected to a medium access control (MAC) layer which is an upper layer of the physical layer through a transport channel. Data is transferred between the MAC layer and the physical layer through the transport channel. The transport channel is classified according to how and with what characteristics data is transmitted through a radio interface.

[0025] Between different physical layers, i.e., a physical layer of a transmitter and a physical layer of a receiver, data are transferred through the physical channel. The physical channel is modulated using an orthogonal frequency division multiplexing (OFDM) scheme, and utilizes time and frequency as a radio resource.

[0026] The MAC layer provides services to a radio link control (RLC) layer, which is a higher layer of the MAC layer, via a logical channel. The MAC layer provides a function of mapping multiple logical channels to multiple transport channels. The MAC layer also provides a function of logical channel multiplexing by mapping multiple logical channels to a single transport channel. The MAC layer provides data transfer services over logical channels.

[0027] The RLC layer performs concatenation, segmentation, and reassembly of Radio Link Control Service Data Unit (RLC SDU). In order to ensure diverse quality of service (QoS) required by a radio bearer (RB), the RLC layer provides three types of operation modes, i.e., a transparent mode (TM), an unacknowledged mode (UM), and an acknowledged mode (AM). An AM RLC provides error correction through an automatic repeat request (ARQ).

[0028] A radio resource control (RRC) layer is defined only in the control plane. The RRC layer serves to control the logical channel, the transport channel, and the physical channel in association with configuration, reconfiguration and release of RBs. The RB is a logical path provided by the first layer (i.e., the physical layer or the PHY layer) and the second layer (i.e., a MAC layer, an RLC layer, a packet data convergence protocol (PDCP) layer, and a service data adaptation protocol (SDAP) layer) for data delivery between the UE and the network.

[0029] Functions of a packet data convergence protocol (PDCP) layer in the user plane include user data delivery, header compression, and ciphering. Functions of a PDCP layer in the control plane include control-plane data delivery and ciphering/integrity protection.

[0030] A service data adaptation protocol (SDAP) layer is defined only in a user plane. The SDAP layer performs mapping between a Quality of Service (QoS) flow and a data radio bearer (DRB) and QoS flow ID (QFI) marking in both DL and UL packets.

[0031] The configuration of the RB implies a process for specifying a radio protocol layer and channel properties to provide a specific service and for determining respective detailed parameters and operations. The RB can be classified into two types, i.e., a signaling RB (SRB) and a data RB (DRB). The SRB is used as a path for transmitting an RRC message in the control plane. The DRB is used as a path for transmitting user data in the user plane.

[0032] When an RRC connection is established between an RRC layer of the UE and an RRC layer of the E-UTRAN, the UE is in an RRC_CONNECTED state, and, otherwise, the UE may be in an RRC_IDLE state. In case of the NR, an RRC_INACTIVE state is additionally defined, and a UE being in the RRC_INACTIVE state may maintain its connection with a core network whereas its connection with the BS is released.

[0033] Data is transmitted from the network to the UE through a downlink transport channel. Examples of the downlink transport channel include a broadcast channel (BCH) for transmitting system information and a downlink-shared channel (SCH) for transmitting user traffic or control messages. Traffic of downlink multicast or broadcast services or the control

messages can be transmitted on the downlink-SCH or an additional downlink multicast channel (MCH). Data is transmitted from the UE to the network through an uplink transport channel. Examples of the uplink transport channel include a random access channel (RACH) for transmitting an initial control message and an uplink SCH for transmitting user traffic or control messages.

[0034] Examples of logical channels belonging to a higher channel of the transport channel and mapped onto the transport channels include a broadcast channel (BCCH), a paging control channel (PCCH), a common control channel (CCCH), a multicast control channel (MCCH), a multicast traffic channel (MTCH), etc.

[0035] FIG. 3 shows a structure of a radio frame of an NR, based on an embodiment of the present disclosure. The embodiment of FIG. 3 may be combined with various embodiments of the present disclosure.

[0036] Referring to FIG. 3, in the NR, a radio frame may be used for performing uplink and downlink transmission. A radio frame has a length of 10ms and may be defined to be configured of two half-frames (HFs). A half-frame may include five 1ms subframes (SFs). A subframe (SF) may be divided into one or more slots, and the number of slots within a subframe may be determined based on subcarrier spacing (SCS). Each slot may include 12 or 14 OFDM(A) symbols according to a cyclic prefix (CP).

[0037] In case of using a normal CP, each slot may include 14 symbols. In case of using an extended CP, each slot may include 12 symbols. Herein, a symbol may include an OFDM symbol (or CP-OFDM symbol) and a Single Carrier-FDMA (SC-FDMA) symbol (or Discrete Fourier Transform-spread-OFDM (DFT-s-OFDM) symbol).

[0038] Table 1 shown below represents an example of a number of symbols per slot (N^{slot}_{symb}), a number slots per frame ($N^{frame,u}_{slot}$), and a number of slots per subframe ($N^{subframe,u}_{slot}$) based on an SCS configuration (u), in a case where a normal CP is used.

Table 1

SCS ($15*2^u$)	N^{slot}_{symb}	$N^{frame,u}_{slot}$	$N^{subframe,u}_{slot}$
15KHz (u=0)	14	10	1
30KHz (u=1)	14	20	2
60KHz (u=2)	14	40	4
120KHz (u=3)	14	80	8
240KHz (u=4)	14	160	16

[0039] Table 2 shows an example of a number of symbols per slot, a number of slots per frame, and a number of slots per subframe based on the SCS, in a case where an extended CP is used.

[Table 2]

SCS ($15*2^u$)	N^{slot}_{symb}	$N^{frame,u}_{slot}$	$N^{subframe,u}_{slot}$
60KHz (u=2)	12	40	4

[0040] In an NR system, OFDM(A) numerologies (e.g., SCS, CP length, and so on) between multiple cells being integrate to one UE may be differently configured. Accordingly, a (absolute time) duration (or section) of a time resource (e.g., subframe, slot or TTI) (collectively referred to as a time unit (TU) for simplicity) being configured of the same number of symbols may be differently configured in the integrated cells.

[0041] In the NR, multiple numerologies or SCSs for supporting diverse 5G services may be supported. For example, in case an SCS is 15kHz, a wide area of the conventional cellular bands may be supported, and, in case an SCS is 30kHz/60kHz a dense-urban, lower latency, wider carrier bandwidth may be supported. In case the SCS is 60kHz or higher, a bandwidth that is greater than 24.25GHz may be used in order to overcome phase noise.

[0042] An NR frequency band may be defined as two different types of frequency ranges. The two different types of frequency ranges may be FR1 and FR2. The values of the frequency ranges may be changed (or varied), and, for example, the two different types of frequency ranges may be as shown below in Table 3. Among the frequency ranges that are used in an NR system, FR1 may mean a "sub 6GHz range", and FR2 may mean an "above 6GHz range" and may also be referred to as a millimeter wave (mmW).

[Table 3]

Frequency Range designation	Corresponding frequency range	Subcarrier Spacing (SCS)
FR1	450MHz - 6000MHz	15, 30, 60kHz
FR2	24250MHz - 52600MHz	60, 120, 240kHz

[0043] As described above, the values of the frequency ranges in the NR system may be changed (or varied). For example, as shown below in Table 4, FR1 may include a band within a range of 410MHz to 7125MHz. More specifically, FR1 may include a frequency band of 6GHz (or 5850, 5900, 5925 MHz, and so on) and higher. For example, a frequency band of 6GHz (or 5850, 5900, 5925 MHz, and so on) and higher being included in FR1 mat include an unlicensed band. The unlicensed band may be used for diverse purposes, e.g., the unlicensed band for vehicle-specific communication (e.g., automated driving).

[Table 4]

Frequency Range designation	Corresponding frequency range	Subcarrier Spacing (SCS)
FR1	410MHz - 7125MHz	15, 30, 60kHz
FR2	24250MHz - 52600MHz	60, 120, 240kHz

[0044] FIG. 4 shows a structure of a slot of an NR frame, based on an embodiment of the present disclosure. The embodiment of FIG. 4 may be combined with various embodiments of the present disclosure.

[0045] Referring to FIG. 4, a slot includes a plurality of symbols in a time domain. For example, in case of a normal CP, one slot may include 14 symbols. However, in case of an extended CP, one slot may include 12 symbols. Alternatively, in case of a normal CP, one slot may include 7 symbols. However, in case of an extended CP, one slot may include 6 symbols.

[0046] A carrier includes a plurality of subcarriers in a frequency domain. A Resource Block (RB) may be defined as a plurality of consecutive subcarriers (e.g., 12 subcarriers) in the frequency domain. A Bandwidth Part (BWP) may be defined as a plurality of consecutive (Physical) Resource Blocks ((P)RBs) in the frequency domain, and the BWP may correspond to one numerology (e.g., SCS, CP length, and so on). A carrier may include a maximum of N number BWPs (e.g., 5 BWPs). Data communication may be performed via an activated BWP. Each element may be referred to as a Resource Element (RE) within a resource grid and one complex symbol may be mapped to each element.

[0047] Hereinafter, a bandwidth part (BWP) and a carrier will be described.

[0048] The BWP may be a set of consecutive physical resource blocks (PRBs) in a given numerology. The PRB may be selected from consecutive sub-sets of common resource blocks (CRBs) for the given numerology on a given carrier For example, the BWP may be at least any one of an active BWP, an initial BWP, and/or a default BWP. For example, the UE may not monitor downlink radio link quality in a DL BWP other than an active DL BWP on a primary cell (PCell). For example, the UE may not receive PDCCH, physical downlink shared channel (PDSCH), or channel state information - reference signal (CSI-RS) (excluding RRM) outside the active DL BWP. For example, the UE may not trigger a channel state information (CSI) report for the inactive DL BWP. For example, the UE may not transmit physical uplink control channel (PUCCH) or physical uplink shared channel (PUSCH) outside an active UL BWP. For example, in a downlink case, the initial BWP may be given as a consecutive RB set for a remaining minimum system information (RMSI) control resource set (CORESET) (configured by physical broadcast channel (PBCH)). For example, in an uplink case, the initial BWP may be given by system information block (SIB) for a random access procedure. For example, the default BWP may be configured by a higher layer. For example, an initial value of the default BWP may be an initial DL BWP. For energy saving, if the UE fails to detect downlink control information (DCI) during a specific period, the UE may switch the active BWP of the UE to the default BWP.

[0049] Meanwhile, the BWP may be defined for SL. The same SL BWP may be used in transmission and reception. For example, a transmitting UE may transmit an SL channel or an SL signal on a specific BWP, and a receiving UE may receive the SL channel or the SL signal on the specific BWP. In a licensed carrier, the SL BWP may be defined separately from a Uu BWP, and the SL BWP may have configuration signaling separate from the Uu BWP. For example, the UE may receive a configuration for the SL BWP from the BS/network. For example, the UE may receive a configuration for the Uu BWP from the BS/network. The SL BWP may be (pre-)configured in a carrier with respect to an out-of-coverage NR V2X UE and an RRC_IDLE UE. For the UE in the RRC_CONNECTED mode, at least one SL BWP may be activated in the carrier.

[0050] FIG. 5 shows an example of a BWP, based on an embodiment of the present disclosure. The embodiment of FIG. 5 may be combined with various embodiments of the present disclosure. It is assumed in the embodiment of FIG.

5 that the number of BWPs is 3.

[0051] Referring to FIG. 5, a common resource block (CRB) may be a carrier resource block numbered from one end of a carrier band to the other end thereof. In addition, the PRB may be a resource block numbered within each BWP. A point A may indicate a common reference point for a resource block grid.

[0052] The BWP may be configured by a point A, an offset N^{start}_{BWP} from the point A, and a bandwidth N^{size}_{BWP}. For example, the point A may be an external reference point of a PRB of a carrier in which a subcarrier 0 of all numerologies (e.g., all numerologies supported by a network on that carrier) is aligned. For example, the offset may be a PRB interval between a lowest subcarrier and the point A in a given numerology. For example, the bandwidth may be the number of PRBs in the given numerology.

[0053] Hereinafter, V2X or SL communication will be described.

[0054] A sidelink synchronization signal (SLSS) may include a primary sidelink synchronization signal (PSSS) and a secondary sidelink synchronization signal (SSSS), as an SL-specific sequence. The PSSS may be referred to as a sidelink primary synchronization signal (S-PSS), and the SSSS may be referred to as a sidelink secondary synchronization signal (S-SSS). For example, length-127 M-sequences may be used for the S-PSS, and length-127 gold sequences may be used for the S-SSS. For example, a UE may use the S-PSS for initial signal detection and for synchronization acquisition. For example, the UE may use the S-PSS and the S-SSS for acquisition of detailed synchronization and for detection of a synchronization signal ID.

[0055] A physical sidelink broadcast channel (PSBCH) may be a (broadcast) channel for transmitting default (system) information which must be first known by the UE before SL signal transmission/reception. For example, the default information may be information related to SLSS, a duplex mode (DM), a time division duplex (TDD) uplink/downlink (UL/DL) configuration, information related to a resource pool, a type of an application related to the SLSS, a subframe offset, broadcast information, or the like. For example, for evaluation of PSBCH performance, in NR V2X, a payload size of the PSBCH may be 56 bits including 24-bit cyclic redundancy check (CRC).

[0056] The S-PSS, the S-SSS, and the PSBCH may be included in a block format (e.g., SL synchronization signal (SS)/PSBCH block, hereinafter, sidelink-synchronization signal block (S-SSB)) supporting periodical transmission. The S-SSB may have the same numerology (i.e., SCS and CP length) as a physical sidelink control channel (PSCCH)/physical sidelink shared channel (PSSCH) in a carrier, and a transmission bandwidth may exist within a (pre-)configured sidelink (SL) BWP. For example, the S-SSB may have a bandwidth of 11 resource blocks (RBs). For example, the PSBCH may exist across 11 RBs. In addition, a frequency position of the S-SSB may be (pre-)configured. Accordingly, the UE does not have to perform hypothesis detection at frequency to discover the S-SSB in the carrier.

[0057] FIG. 6 shows a procedure of performing V2X or SL communication by a UE based on a transmission mode, based on an embodiment of the present disclosure. The embodiment of FIG. 6 may be combined with various embodiments of the present disclosure. In various embodiments of the present disclosure, the transmission mode may be called a mode or a resource allocation mode. Hereinafter, for convenience of explanation, in LTE, the transmission mode may be called an LTE transmission mode. In NR, the transmission mode may be called an NR resource allocation mode.

[0058] For example, (a) of FIG. 6 shows a UE operation related to an LTE transmission mode 1 or an LTE transmission mode 3. Alternatively, for example, (a) of FIG. 6 shows a UE operation related to an NR resource allocation mode 1. For example, the LTE transmission mode 1 may be applied to general SL communication, and the LTE transmission mode 3 may be applied to V2X communication.

[0059] For example, (b) of FIG. 6 shows a UE operation related to an LTE transmission mode 2 or an LTE transmission mode 4. Alternatively, for example, (b) of FIG. 6 shows a UE operation related to an NR resource allocation mode 2.

[0060] Referring to (a) of FIG. 6, in the LTE transmission mode 1, the LTE transmission mode 3, or the NR resource allocation mode 1, a base station may schedule SL resource(s) to be used by a UE for SL transmission. For example, in step S600, a base station may transmit information related to SL resource(s) and/or information related to UL resource(s) to a first UE. For example, the UL resource(s) may include PUCCH resource(s) and/or PUSCH resource(s). For example, the UL resource(s) may be resource(s) for reporting SL HARQ feedback to the base station.

[0061] For example, the first UE may receive information related to dynamic grant (DG) resource(s) and/or information related to configured grant (CG) resource(s) from the base station. For example, the CG resource(s) may include CG type 1 resource(s) or CG type 2 resource(s). In the present disclosure, the DG resource(s) may be resource(s) configured/allocated by the base station to the first UE through a downlink control information (DCI). In the present disclosure, the CG resource(s) may be (periodic) resource(s) configured/allocated by the base station to the first UE through a DCI and/or an RRC message. For example, in the case of the CG type 1 resource(s), the base station may transmit an RRC message including information related to CG resource(s) to the first UE. For example, in the case of the CG type 2 resource(s), the base station may transmit an RRC message including information related to CG resource(s) to the first UE, and the base station may transmit a DCI related to activation or release of the CG resource(s) to the first UE.

[0062] In step S610, the first UE may transmit a PSCCH (e.g., sidelink control information (SCI) or 1st-stage SCI) to a second UE based on the resource scheduling. In step S620, the first UE may transmit a PSSCH (e.g., 2nd-stage SCI, MAC PDU, data, etc.) related to the PSCCH to the second UE. In step S630, the first UE may receive a PSFCH related

to the PSCCH/PSSCH from the second UE. For example, HARQ feedback information (e.g., NACK information or ACK information) may be received from the second UE through the PSFCH. In step S640, the first UE may transmit/report HARQ feedback information to the base station through the PUCCH or the PUSCH. For example, the HARQ feedback information reported to the base station may be information generated by the first UE based on the HARQ feedback information received from the second UE. For example, the HARQ feedback information reported to the base station may be information generated by the first UE based on a pre-configured rule. For example, the DCI may be a DCI for SL scheduling. For example, a format of the DCI may be a DCI format 3_0 or a DCI format 3_1.

[0063] Referring to (b) of FIG. 6, in the LTE transmission mode 2, the LTE transmission mode 4, or the NR resource allocation mode 2, a UE may determine SL transmission resource(s) within SL resource(s) configured by a base station/network or pre-configured SL resource(s). For example, the configured SL resource(s) or the pre-configured SL resource(s) may be a resource pool. For example, the UE may autonomously select or schedule resource(s) for SL transmission. For example, the UE may perform SL communication by autonomously selecting resource(s) within the configured resource pool. For example, the UE may autonomously select resource(s) within a selection window by performing a sensing procedure and a resource (re)selection procedure. For example, the sensing may be performed in a unit of subchannel(s). For example, in step S610, a first UE which has selected resource(s) from a resource pool by itself may transmit a PSCCH (e.g., sidelink control information (SCI) or 1st-stage SCI) to a second UE by using the resource(s). In step S620, the first UE may transmit a PSSCH (e.g., 2nd-stage SCI, MAC PDU, data, etc.) related to the PSCCH to the second UE. In step S630, the first UE may receive a PSFCH related to the PSCCH/PSSCH from the second UE.

[0064] Referring to (a) or (b) of FIG. 6, for example, the first UE may transmit a SCI to the second UE through the PSCCH. Alternatively, for example, the first UE may transmit two consecutive SCIs (e.g., 2-stage SCI) to the second UE through the PSCCH and/or the PSSCH. In this case, the second UE may decode two consecutive SCIs (e.g., 2-stage SCI) to receive the PSSCH from the first UE. In the present disclosure, a SCI transmitted through a PSCCH may be referred to as a 1st SCI, a first SCI, a 1st-stage SCI or a 1st-stage SCI format, and a SCI transmitted through a PSSCH may be referred to as a 2nd SCI, a second SCI, a 2nd-stage SCI or a 2nd-stage SCI format. For example, the 1st-stage SCI format may include a SCI format 1-A, and the 2nd-stage SCI format may include a SCI format 2-A and/or a SCI format 2-B.

[0065] Hereinafter, an example of SCI format 1-A will be described.

[0066] SCI format 1-A is used for the scheduling of PSSCH and 2nd-stage-SCI on PSSCH.

[0067] The following information is transmitted by means of the SCI format 1-A:

- Priority - 3 bits
- Frequency resource assignment - ceiling ($\log_2(N^{SL}_{subChannel}(N^{SL}_{subChannel}+1)/2)$) bits when the value of the higher layer parameter sl-MaxNumPerReserve is configured to 2; otherwise ceiling $\log_2(N^{SL}_{subChannel}(N^{SL}_{subChannel}+1)(2N^{SL}_{subChannel}+1)/6)$ bits when the value of the higher layer parameter sl-MaxNumPerReserve is configured to 3
- Time resource assignment - 5 bits when the value of the higher layer parameter sl-MaxNumPerReserve is configured to 2; otherwise 9 bits when the value of the higher layer parameter sl-MaxNumPerReserve is configured to 3
- Resource reservation period - ceiling ($\log_2 N_{rsv_period}$) bits, where N_{rsv_period} is the number of entries in the higher layer parameter sl-ResourceReservePeriodList, if higher layer parameter sl-MultiReserveResource is configured; 0 bit otherwise
- DMRS pattern - ceiling ($\log_2 N_{pattern}$) bits, where $N_{pattern}$ is the number of DMRS patterns configured by higher layer parameter sl-PSSCH-DMRS-TimePatternList
- 2nd-stage SCI format - 2 bits as defined in Table 5
- Beta_offset indicator - 2 bits as provided by higher layer parameter sl-BetaOffsets2ndSCI
- Number of DMRS port - 1 bit as defined in Table 6
- Modulation and coding scheme - 5 bits
- Additional MCS table indicator - 1 bit if one MCS table is configured by higher layer parameter sl-Additional-MCS-Table; 2 bits if two MCS tables are configured by higher layer parameter sl- Additional-MCS-Table; 0 bit otherwise
- PSFCH overhead indication - 1 bit if higher layer parameter sl-PSFCH-Period = 2 or 4; 0 bit otherwise
- Reserved - a number of bits as determined by higher layer parameter sl-NumReservedBits, with value set to zero.

Table 5]

Value of 2nd-stage SCI format field	2nd-stage SCI format
00	SCI format 2-A

(continued)

Value of 2nd-stage SCI format field	2nd-stage SCI format
01	SCI format 2-B
10	Reserved
11	Reserved

Table 6

Value of the Number of DMRS port field	Antenna ports
0	1000
1	1000 and 1001

[0068] Hereinafter, an example of SCI format 2-A will be described. SCI format 2-A is used for the decoding of PSSCH, with HARQ operation when HARQ-ACK information includes ACK or NACK, when HARQ-ACK information includes only NACK, or when there is no feedback of HARQ-ACK information.

[0069] The following information is transmitted by means of the SCI format 2-A:

- HARQ process number - 4 bits
- New data indicator - 1 bit
- Redundancy version - 2 bits
- Source ID - 8 bits
- Destination ID - 16 bits
- HARQ feedback enabled/disabled indicator - 1 bit
- Cast type indicator - 2 bits as defined in Table 7
- CSI request - 1 bit

Table 7]

Value of Cast type indicator	Cast type
00	Broadcast
01	Groupcast when HARQ-ACK information includes ACK or NACK
10	Unicast
11	Groupcast when HARQ-ACK information includes only NACK

[0070] Hereinafter, an example of SCI format 2-B is described. SCI format 2-B is used to decode PSSCH and is used in conjunction with HARQ operation when HARQ-ACK information includes only NACK or when there is no feedback of HARQ-ACK information.

[0071] In HARQ operation, if HARQ-ACK information includes only NACK, or if there is no feedback of HARQ-ACK information, SCI format 2-B is used to decode a PSSCH.

[0072] The following information is transmitted by means of the SCI format 2-B:

- HARQ process number - 4 bits
- New data indicator - 1 bit
- Redundancy version - 2 bits
- Source ID - 8 bits
- Destination ID - 16 bits
- HARQ feedback enabled/disabled indicator - 1 bit
- Zone ID - 12 bits
- Communication range requirement - 4 bits determined by higher layer parameter sl-ZoneConfigMCR-Index

[0073] Referring to (a) or (b) of FIG. 6, in step S630, the first UE may receive the PSFCH. For example, the first UE

and the second UE may determine a PSFCH resource, and the second UE may transmit HARQ feedback to the first UE using the PSFCH resource.

[0074] Referring to (a) of FIG. 6, in step S640, the first UE may transmit SL HARQ feedback to the base station through the PUCCH and/or the PUSCH.

[0075] Hereinafter, a UE procedure for reporting HARQ-ACK in the sidelink will be described.

[0076] A UE can be indicated by an SCI format scheduling a PSSCH reception, in one or more sub-channels from a number of N^{PSSCH}_{subch} sub-channels, to transmit a PSFCH with HARQ-ACK information in response to the PSSCH reception. The UE provides HARQ-ACK information that includes ACK or NACK, or only NACK.

[0077] A UE can be provided, by sl-PSFCH-Period-r16, a number of slots in a resource pool for a period of PSFCH transmission occasion resources. If the number is zero, PSFCH transmissions from the UE in the resource pool are disabled. A UE expects that a slot t'^{SL}_k ($0 \le k < T'_{max}$) has a PSFCH transmission occasion resource if k mod N^{PSFCH}_{PSSCH} = 0, where t'^{SL}_k is a slot that belongs to the resource pool, T'_{max} is a number of slots that belong to the resource pool within 10240 msec, and N^{PSFCH}_{PSSCH} is provided by sl-PSFCH-Period-r16. A UE may be indicated by higher layers to not transmit a PSFCH in response to a PSSCH reception. If a UE receives a PSSCH in a resource pool and the HARQ feedback enabled/disabled indicator field in an associated SCI format 2-A or a SCI format 2-B has value 1, the UE provides the HARQ-ACK information in a PSFCH transmission in the resource pool. The UE transmits the PSFCH in a first slot that includes PSFCH resources and is at least a number of slots, provided by sl-MinTimeGapPSFCH-r16, of the resource pool after a last slot of the PSSCH reception.

[0078] A UE is provided by sl-PSFCH-RB-Set-r16 a set of $M^{PSFCH}_{PRB,set}$ PRBs in a resource pool for PSFCH transmission in a PRB of the resource pool. For a number of N_{subch} sub-channels for the resource pool, provided by sl-NumSubchannel, and a number of PSSCH slots related to a PSFCH slot that is less than or equal to N^{PSFCH}_{PSSCH}, the UE allocates the $[(i+j\cdot N^{PSFCH}_{PSSCH})\cdot M^{PSFCH}_{subch,slot},\ (i+1+j\cdot N^{PSFCH}_{PSSCH})\cdot M^{PSFCH}_{subch,slot}-1]$ PRBs from the $M_{PRB,set}{}^{PSFCH}$ PRBs to slot i among the PSSCH slots related to the PSFCH slot and sub-channel j, where $M^{PSFCH}_{subch,slot} = M^{PSFCH}_{PRB,set} / (N_{subch}\cdot N^{PSFCH}_{PSSCH})$, $0 \le i < N^{PSFCH}_{PSSCH}$, $0 \le j < N_{subch}$, and the allocation starts in an ascending order of i and continues in an ascending order of j. The UE expects that $M^{PSFCH}_{PRB,set}$ is a multiple of $N_{subch}\cdot N^{PSFCH}_{PSSCH}$.

[0079] A UE determines a number of PSFCH resources available for multiplexing HARQ-ACK information in a PSFCH transmission as $R^{PSFCH}_{PRB,CS} = N^{PSFCH}_{type}\cdot M^{PSFCH}_{subch,slot}\cdot N^{PSFCH}_{CS}$ where N^{PSFCH}_{CS} is a number of cyclic shift pairs for the resource pool and, based on an indication by higher layers,

- N^{PSFCH}_{type} = 1 and the $M^{PSFCH}_{subch,slot}$ PRBs are related to the starting sub-channel of the corresponding PSSCH
- $N^{PSFCH}_{type} = N^{PSSCH}_{subch}$ and the $N^{PSSCH}_{subch}\cdot M^{PSFCH}_{subch,slot}$ PRBs are related to one or more sub-channels from the N^{PSSCH}_{subch} sub-channels of the corresponding PSSCH

[0080] The PSFCH resources are first indexed according to an ascending order of the PRB index, from the $N^{PSFCH}_{type}\cdot M^{PSFCH}_{subch,slot}$ PRBs, and then according to an ascending order of the cyclic shift pair index from the N^{PSFCH}_{CS} cyclic shift pairs.

[0081] A UE determines an index of a PSFCH resource for a PSFCH transmission in response to a PSSCH reception as $(P_{ID} + M_{ID}) \bmod R^{PSFCH}_{PRB,CS}$ where P_{ID} is a physical layer source ID provided by SCI format 2-A or 2-B scheduling the PSSCH reception, and M_{ID} is the identity of the UE receiving the PSSCH as indicated by higher layers if the UE detects a SCI format 2-A with Cast type indicator field value of "01"; otherwise, M_{ID} is zero.

[0082] A UE determines a m_0 value, for computing a value of cyclic shift α, from a cyclic shift pair index corresponding to a PSFCH resource index and from N^{PSFCH}_{CS} using Table 8.

Table 8

N^{PSFCH}_{CS}	m_0					
	cyclic shift pair index 0	cyclic shift pair index 1	cyclic shift pair index 2	cyclic shift pair index 3	cyclic shift pair index 4	cyclic shift pair index 5
1	0	-	-	-	-	-
2	0	3	-	-	-	-
3	0	2	4	-	-	-
6	0	1	2	3	4	5

[0083] A UE determines a m_{cs} value, for computing a value of cyclic shift α, as in Table 9 if the UE detects a SCI format 2-A with Cast type indicator field value of "01" or "10", or as in Table 10 if the UE detects a SCI format 2-B or a

SCI format 2-A with Cast type indicator field value of "11". The UE applies one cyclic shift from a cyclic shift pair to a sequence used for the PSFCH transmission.

[Table 9]

HARQ-ACK Value	0 (NACK)	1 (ACK)
Sequence cyclic shift	0	6

Table 10

HARQ-ACK Value	0 (NACK)	1 (ACK)
Sequence cyclic shift	0	N/A

[0084] FIG. 7 shows three cast types, in accordance with an embodiment of the present disclosure. The embodiment of FIG. 7 may be combined with various embodiments of the present disclosure. Specifically, FIG. 7(a) shows broadcast-type SL communication, FIG. 7(b) shows unicast type-SL communication, and FIG. 7(c) shows groupcast-type SL communication. In case of the unicast-type SL communication, a UE may perform one-to-one communication with respect to another UE. In case of the groupcast-type SL transmission, the UE may perform SL communication with respect to one or more UEs in a group to which the UE belongs. In various embodiments of the present disclosure, SL groupcast communication may be replaced with SL multicast communication, SL one-to-many communication, or the like. In this specification, the word "configuration or definition" may be interpreted as being configured (in advance) by a base station or network (via predefined signaling (e.g., SIB signaling, MAC signaling, RRC signaling). For example, "A may be configured" may include "a base station or network (pre)configures/defines or informs a UE of A". Alternatively, the word "configuration or definition" may be interpreted as being pre-configured or predefined by the system. For example, "A may be configured" may include "A is pre-configured/predefined by the system".

[0085] Referring to standard documents, some procedures and technical specifications related to this disclosure may be as follows.

[Table 11]

3GPP TS 38.321 V16.2.1
The MAC entity may be configured by RRC with a DRX functionality that controls the UE's PDCCH monitoring activity for the MAC entity's C-RNTI, CI-RNTI, CS-RNTI, INT-RNTI, SFI-RNTI, SP-CSI-RNTI, TPC-PUCCH-RNTI, TPC-PUSCH-RNTI, TPC-SRS-RNTI, and AI-RNTI. When using DRX operation, the MAC entity shall also monitor PDCCH according to requirements found in other clauses of this specification. When in RRC_CONNECTED, if DRX is configured, for all the activated Serving Cells, the MAC entity may monitor the PDCCH discontinuously using the DRX operation specified in this clause; otherwise the MAC entity shall monitor the PDCCH as specified in TS 38.213 [6]. NOTE 1: If Sidelink resource allocation mode 1 is configured by RRC, a DRX functionality is not configured. RRC controls DRX operation by configuring the following parameters: - *drx-onDurationTimer*: the duration at the beginning of a DRX cycle; - *drx-SiotOffset*: the delay before starting the *drx-onDurationTimer*; - *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL or DL transmission for the MAC entity; - *drx-RetransmissionTimerDL* (per DL HARQ process except for the broadcast process): the maximum duration until a DL retransmission is received; - *drx-RetransmissionTimerUL* (per UL HARQ process): the maximum duration until a grant for UL retransmission is received; - *drx-LongCycleStar-tOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX cycle starts; - *drx-ShortCycle* (optional): the Short DRX cycle; - *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle; - *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;

(continued)

3GPP TS 38.321 V16.2.1
- *drx-HARQ-RTT-TimerUL* (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity; - *ps-Wakeup* (optional): the configuration to start associated *drx-onDurationTimer* in case DCP is monitored but not detected; - *ps-TransmitOtherPeriodicCSI* (optional): the configuration to report periodic CSI that is not L1-RSRP on PUCCH during the time duration indicated by *drx-onduration Timer in* case DCP is configured but associated *drx-ondurationTimer* is not started; - *ps-TransmitPeriodicL1-RSRP* (optional): the configuration to transmit periodic CSI that is L1-RSRP on PUCCH during the time duration indicated by *drx-ondurationTimer* in case DCP is configured but associated *drx-ondurationTimer* is not started.

[Table 12]

Serving Cells of a MAC entity may be configured by RRC in two DRX groups with separate DRX parameters. When RRC does not configure a secondary DRX group, there is only one DRX group and all Serving Cells belong to that one DRX group. When two DRX groups are configured, each Serving Cell is uniquely assigned to either of the two groups. The DRX parameters that are separately configured for each DRX group are: *drx-onDurationTimer, drx-InactivityTimer*. The DRX parameters that are common to the DRX groups are: *drx-SlotOffset, drx-RetransmissionTimerDL, drx-RetransmissionTimerUL, drx-LongCycleStartOffset, drx-ShortCycle* (optional), *drx-ShortCycleTimer* (optional), *drx-HARQ-RTT-TimerDL,* and *drx-HARQ-RTT-TimerUL.* When a DRX cycle is configured, the Active Time for Serving Cells in a DRX group includes the time while: - *drx-onDurationTimer* or *drx-InactivityTimer* configured for the DRX group is running; or - *drx-RetransmissionTimerDL* or *drx-RetransmissionTimerUL* is running on any Serving Cell in the DRX group; or - *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or - a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4); or - a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a). When DRX is configured, the MAC entity shall: 1> if a MAC PDU is received in a configured downlink assignment: 2> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback; 2> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process. 1> if a MAC PDU is transmitted in a configured uplink grant and LBT failure indication is not received from lower layers: 2> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission; 2> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process. 1> if a *drx-HARQ-RTT-TimerDL* expires: 2> if the data of the corresponding HARQ process was not successfully decoded: 3> start the *drx-RetransmissionTimerDL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT TimerDL.* 1> if a *drx-HARQ-RTT-TimerUL* expires: 2> start the *drx-RetransmissionTimerUL* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT TimerUL.* 1> if a DRX Command MAC CE or a Long DRX Command MAC CE is received: 2> stop *drx-onDurationTimer* for each DRX group; 2> stop *drx-InactivityTimerfor* each DRX group. 1> if *drx-InactivityTimerfor* a DRX group expires:

(continued)

2> if the Short DRX cycle is configured: 3> start or restart *drx-ShortCycleTimer* for this DRX group in the first symbol after the expiry of *drx-InactivityTimer*; 3> use the Short DRX cycle for this DRX group. 2> else: 3> use the Long DRX cycle for this DRX group. 1> if a DRX Command MAC CE is received: 2> if the Short DRX cycle is configured: 3> start or restart *drx-ShortCycleTimer* for each DRX group in the first symbol after the end of DRX Command MAC CE reception; 3> use the Short DRX cycle for each DRX group. 2> else: 3> use the Long DRX cycle for each DRX group.

Table 13]

1> if *drx-ShortCycleTimer* for a DRX group expires: 2> use the Long DRX cycle for this DRX group. 1> if a Long DRX Command MAC CE is received: 2> stop *drx-ShortCycleTimer* for each DRX group; 2> use the Long DRX cycle for each DRX group. 1> if the Short DRX cycle is used for a DRX group, and [(SFN × 10) + subframe number] modulo (*drx-ShortCycle*) = (*drx-StartOffset*) modulo (*drx-ShortCycle*): 2> start *drx-onDurationTimer* for this DRX group after *drx-StotOffset* from the beginning of the subframe. 1> if the Long DRX cycle is used for a DRX group, and [(SFN × 10) + subframe number] modulo (*drx-LongCycle*) = *drx-StartOffset*: 2> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3: 3> if DCP indication associated with the current DRX cycle received from lower layer indicated to start *drx-onDurationTimer,* as specified in TS 38.213 [6]; or 3> if all DCP occasion(s) in time domain, as specified in TS 38.213 [6], associated with the current DRX cycle occurred in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to start of the last DCP occasion, or within BWP switching interruption length, or during a measurement gap, or when the MAC entity monitors for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while the *ra-ResponseWindow* is running (as specified in clause 5.1.4); or 3> if *ps-Wakeup* is configured with value *true* and DCP indication associated with the current DRX cycle has not been received from lower layers: 4> start *drx-onDurationTimer* after *drx-SlotOffset* from the beginning of the subframe. 2> else: 3> start *drx-onDurationTimer* for this DRX group after *drx-SlotOffset* from the beginning of the subframe. NOTE 2: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration. 1> if a DRX group is in Active Time: 2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6]; 2> if the PDCCH indicates a DL transmission: 3> start the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback; NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ_feedback timing indicating a non-numerical k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback. 3> stop the *drx-RetransmissionTimerDL* for the corresponding HARQ process. 3> if the PDSCH-to-HARQ_feedback timing indicate a non-numerical k1 value as specified in TS 38.213 [6]:

(continued)

4> start the *drx-RetransmissionTimerDL* in the first symbol after the PDSCH transmission for the corresponding HARQ process. 2> if the PDCCH indicates a UL transmission: 3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first repetition of the corresponding PUSCH transmission; 3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process. 2> if the PDCCH indicates a new transmission (DL or UL) on a Serving Cell in this DRX group: 3> start or restart *drx-InactivityTimer* for this DRX group in the first symbol after the end of the PDCCH reception. 2> if a HARQ process receives downlink feedback information and acknowledgement is indicated: 3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.

[Table 14]

1> if DCP monitoring is configured for the active DL BWP as specified in TS 38.213 [6], clause 10.3; and 1> if the current symbol n occurs within *drx-onDurationTimer* duration; and 1> if *drx-onDurationTimer* associated with the current DRX cycle is not started as specified in this clause: 2> if the MAC entity would not be in Active Time considering grants/assignments/DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause: 3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7]; 3> not report semi-persistent CSI configured on PUSCH; 3> if *ps-TransmitPeriodicLI-RSRPis* not configured with value *true:* 4> not report periodic CSI that is L1-RSRP on PUCCH. 3> if *ps-TransmitOtherPeriodicCSI* is not configured with value *true:* 4> not report periodic CSI that is not L1-RSRP on PUCCH. 1> else: 2> in current symbol n, if a DRX group would not be in Active Time considering grants/assignments scheduled on Serving Cell(s) in this DRX group and DRX Command MAC CE/Long DRX Command MAC CE received and Scheduling Request sent until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause: 3> not transmit periodic SRS and semi-persistent SRS defined in TS 38.214 [7] in this DRX group; 3> not report CSI on PUCCH and semi-persistent CSI configured on PUSCH in this DRX group. 2> if CSI masking (*csi-Mask*) is setup by upper layers: 3> in current symbol n, if *drx-onDurationTimerof* a DRX group would not be running considering grants/assignments scheduled on Serving Cell(s) in this DRX group and DRX Command MAC CE/Long DRX Command MAC CE received until 4 ms prior to symbol n when evaluating all DRX Active Time conditions as specified in this clause; and 4> not report CSI on PUCCH in this DRX group. NOTE 4: If a UE multiplexes a CSI configured on PUCCH with other overlapping UCI(s) according to the procedure specified in TS 38.213 [6] clause 9.2.5 and this CSI multiplexed with other UCI(s) would be reported on a PUCCH resource outside DRX Active Time of the DRX group in which this PUCCH is configured, it is up to UE implementation whether to report this CSI multiplexed with other UCI(s). Regardless of whether the MAC entity is monitoring PDCCH or not on the Serving Cells in a DRX group, the MAC entity transmits HARQ feedback, aperiodic CSI on PUSCH, and aperiodic SRS defined in TS 38.214 [7] on the Serving Cells in the DRX group when such is expected. The MAC entity needs not to monitor the PDCCH if it is not a complete PDCCH occasion (e.g. the Active Time starts or ends in the middle of a PDCCH occasion).

[0086] On the other hand, NR V2X in Release 16 did not support power saving operation of a UE, and Release 17 NR V2X will support power saving operation of a UE (e.g., a power saving UE).

[0087] For example, for power saving operation of a UE (e.g., sidelink (SL) DRX operation), an SL DRX configuration (SL DRX cycle, SL DRX on-duration, SL DRX off-duration, a timer to support SL DRX operation, etc.) to be used by a P-UE (power-saving UE) shall be defined, and an operation of a transmitting UE and a receiving UE in an on-duration (duration where sidelink reception/transmission can be performed) and off-duration (duration of operating in sleep mode)

may have to be defined.

[0088] In the embodiment(s) of the present disclosure, a method is proposed in which a receiving UE receives an SCI transmitted by a transmitting UE (including reserved transmission resource information) and PSSCH (SL data) associated with the SCI, and performs an SL power saving operation based on the reserved transmission resource information included in the SCI. In the following description, "when, if, in case of" may be replaced by "based on".

[0089] FIG. 8 shows a problem in the prior art that is the basis for the proposal of the present disclosure.

[0090] Referring to FIG. 8, a receiving UE supporting SL DRX operation may receive a SCI transmitted by a transmitting UE (SCI including reserved transmission schedule information for receiving PSSCH (e.g., SL data)), determine the location of a reserved transmission resource, and monitor the SL data transmitted by the transmitting UE at the location of the reserved transmission resource. For example, if a receiving UE is a UE that performs SL DRX operation, it can wake up in the transmission interval scheduled through SCI even if the location of the next transmission resource scheduled through the SCI is during an SL DRX inactive time (the interval in which PSCCH/PSSCH does not need to be monitored, and the interval in which it can operate in SL sleep mode) and monitor and receive SL data transmitted by the transmitting UE. However, in the prior art of NR V2X Rel 16, when a transmitting UE reserves transmission resources that are consecutive through multiple SCIs, the interval between the previous transmission resource and the next transmission resource is limited to the case that falls within 32 slots.

[0091] As in the embodiment of FIG. 8, when a base station allocates a mode 1 resource to a transmitting UE, the base station may allocate the next transmission resource at a location where the interval between the previous transmission resource and the next transmission resource is greater than 32 slots. In this case, the transmitting UE may not include reservation information for the fourth transmission resource in the SCI associated with the third transmission resource. That is, when a receiving UE receives the SCI associated with the third transmission resource, it may consider the third transmission resource to be the last transmission resource and transition to sleep mode for the remaining SL inactive time interval. In this case, the receiving UE may not receive the fourth transmission from the transmitting UE.

[0092] In this disclosure, a method is proposed to solve the problem previously mentioned as a problem in the prior art, wherein a receiving UE misses SL data transmitted by a transmitting UE (SL data transmitted using a Mode 1 resource).

[0093] FIG. 9 shows an embodiment in which an active time period remains in an inactive time period based on a timer, according to an embodiment of the present disclosure. The embodiment of FIG. 9 may be combined with various embodiments of the present disclosure.

[0094] Referring to FIG. 9, a method is proposed in which a mode 1 resource indication (or, a resource allocation mode indication) is included in SCI, and the SCI is transmitted to a receiving UE when a transmitting UE delivers an SCI associated with SL data, when the transmitting UE transmits the SL data using a resource of a sidelink transmission resource allocation mode 1 to the receiving UE.

[0095] Resource allocation mode (transmission resource allocation mode) indication

0: indicates transmission resource allocation mode 1 operation
1: indicates transmission resource allocation mode 2 operation

[0096] According to an embodiment of the present disclosure, when a receiving UE receives an SCI transmitted by a transmitting UE and determines that a mode 1 indication is configured to true and that only resources related to the current SL data transmission are reserved in SCI (i.e., that the SCI is the last SCI in which a chain is broken), a method of starting an SL DRX timer (a newly proposed timer in the present disclosure. For example, a timer that is started when a receiving UE receives SCI including only the reservation information related to the current SL data transmission. For example, a receiving UE may operate as an SL active time while the timer is running), and operating as an active time (a period during which a PSCCH/PSSCH, SL channel, or SL signal can be monitored) until the timer expires is proposed. For example, according to the proposed method, a problem that occurs when a base station allocates a mode 1 resource to a transmitting UE, because the next transmitting resource is allocated at a position outside the 32 slots between the previous transmitting resource and the next transmitting resource, in which a transmitting UE cannot continue to transmit the next scheduled transmitting resource in a chain format of SCI through the previous transmitting resource, causing the receiving UE to miss the SL data transmitted by the transmitting UE as a problem in the prior art, may be solved. That is, for example, when a receiving UE receives the last SCI in the chain of SCIs (or an SCI for which only resources are reserved for the current transmission) and starts the timer, the receiving UE can operate as an SL active time and thus receive the SL data transmitted by a transmitting UE without missing the SL data.

[0097] And, for example, when the timer that is started by the receiving UE after receiving the last SCI in which the SCI chain is broken (or an SCI for which only a resource is reserved for the current transmission) expires, the receiving UE may operate in sleep mode for the remaining SL inactivity time period.

[0098] FIG. 10 shows an embodiment in which an active time period remains in an inactive time period based on SCI associated with an initial transmission, according to an embodiment of the present disclosure. The embodiment of FIG. 10 may be combined with various embodiments of the present disclosure.

[0099] Referring to FIG. 10, a method is proposed in which, when a receiving UE receives SCI (or, initial SL data) associated with the initial SL data, the receiving UE starts an SL DRX timer (the timer that is newly proposed in this disclosure. For example, the receiving UE may operate as SL active time while the timer is running.) and operates as an active time until the timer expires. For example, when a transmitting UE receives SCI (or, initial SL data) associated with the initial SL data, the transmitting UE may determine that a receiving UE will initiate an SL DRX timer, and the transmitting UE may transmit all SL data (the fourth transmission in FIG. 10) to the receiving UE before the timer expires, so that the receiving UE can receive all SL data transmitted by the transmitting UE without missing any SL data.

[0100] According to an embodiment of the present disclosure, a UE may indicate to a counterpart UE via SCI whether it is operating in resource allocation mode 1 (e.g., transmit mode 1 resource-based SL data) or resource allocation mode 2 (e.g., transmit mode 2 resource-based SL data) via a resource allocation mode indication. For example, a resource allocation mode indication value of 0 may indicate transmission resource allocation mode 1 operation of the UE, and a resource allocation mode indication value of 1 may indicate transmission resource allocation mode 2 operation of the UE.

[0101] According to an embodiment of the present disclosure, by causing a transmitting UE to transmit a PUCCH resource configuration indication to a counterpart receiving UE via SCI, the receiving UE may refer to the PUCCH resource configuration indication to perform an SL DRX operation. For example, a PUCCH resource configuration indication value of 0 may indicate that a transmitting UE has no PUCCH resource (without PUCCH), i.e., that the transmitting UE has no PUCCH resource for reporting an SL HARQ NACK and requesting a sidelink retransmission resource to a base station, and a PUCCH resource configuration indication value of 1 may indicate that the transmitting UE has a PUCCH resource (with PUCCH), i.e., the transmitting UE has a PUCCH resource to report SL HARQ NACK and request sidelink retransmission resources to the base station.

[0102] For example, the resource allocation mode indication and the PUCCH resource configuration indication of the present disclosure may be considered to configure a value of an SL DRX timer (e.g., an SL DRX HARQ RTT timer) operated by a UE as follows. For example, an SL DRX HARQ RTT timer may be used for the following purposes.

[0103] For example, an SL DRX HARQ RTT timer may represent an interval during which a UE performing SL DRX operation may operate in sleep mode until it receives a retransmission packet (or PSSCH assignment) transmitted by a counterpart UE. That is, the UE may start an SL DRX HARQ RTT timer, determine that the counterpart UE will not transmit a sidelink retransmission packet to it until the SL DRX HARQ RTT timer expires, and operate in sleep mode while the timer is running.

[0104] According to an embodiment of the present disclosure, a UE (e.g., a receiving UE) operating an SL DRX HARQ RTT timer may receive SCI (a resource allocation mode indication) transmitted by a counterpart transmitting UE, confirm that the transmission of SL data (PSSCH) associated with the SCI is transmitted based on mode 1 of the resource allocation mode, and confirm that the transmitting UE has been configured a PUCCH resource by a base station, through a PUCCH resource configuration indication.

[0105] In this case, for example, if the receiving UE receives a PSSCH and fails to decode it, it may transmit an SL HARQ NACK to the transmitting UE and start an SL DRX HARQ RTT timer. In this case, for example, a method in which the receiving UE applies and starts an SL HART RTT timer value by the minimum time gap (common value) between "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" is proposed. For example, the "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from the receiving UE, request a retransmission resource from a base station via PUCCH, and generate/transmit a PSCCH/PSSCH using the a retransmission resource allocated by the base station. In other words, the receiving UE may apply the SL HARQ RTT timer value as a common value that is the minimum time gap between "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time".

[0106] According to an embodiment of the present disclosure, a UE (e.g., a receiving UE) operating an SL DRX HARQ RTT timer may receive SCI (a resource allocation mode indication) transmitted by a counterpart transmitting UE, confirm that the transmission of SL data (PSSCH) associated with the SCI is transmitted based on mode 1 of the resource allocation mode, and confirm that the transmitting UE has not been configured with a PUCCH resource from a base station, through a PUCCH resource configuration indication.

[0107] In this case, for example, if the receiving UE receives a PSSCH and fails to decode it, it may transmit an SL HARQ NACK to the transmitting UE and start an SL DRX HARQ RTT timer. In this case, for example, a method in which the receiving UE applies and starts an SL HART RTT timer value by the minimum time gap (common value) between "PSFCH reception - PSCCH/PSSCH retransmission transmission time" is proposed. For example, the "PSFCH reception - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from the receiving UE, and to generate/transmit a PSCCH/PSSCH using a retransmission resource. In other words, the receiving UE may apply the SL HARQ RTT timer value as a common value that is the minimum time gap between "PSFCH reception - PUCCH transmission (or, without PUCCH transmission) - PSCCH/PSSCH retransmission transmission time".

[0108] According to an embodiment of the present disclosure, a UE may use the minimum time gap between "PSFCH

reception - PUCCH transmission (or, without PUCCH transmission) - PSCCH/PSSCH retransmission transmission time" as an SL HARQ RTT timer value, rather than using an SL HARQ RTT timer value transferred from a base station.

[0109] According to an embodiment of the present disclosure, a UE may use a common value delivered from a base station rather than a common value used by the UE itself. For example, the common value of the SL HARQ RTT timer used by a receiving UE in the mode 1 operation proposed in the present disclosure may be configured to a common value per QoS class (e.g., PQI) that is mapped to a service (PSDI, ITS-AID) per cast type (unicast, groupcast, or broadcast), and may be used by a UE. For example, the common value configured for each QoS class may be configured by a base station and delivered to a UE (in a dedicated RRC message, or via a SIB, or pre-configuration).

[0110] Alternatively, for example, the common value of an SL HARQ RTT timer used by a receiving UE in Mode 1 operation, as proposed in this disclosure, may be configured to a common value per cast type, and may be used by a UE.

[0111] Alternatively, for example, as proposed in this disclosure, the common value of an SL HARQ RTT timer used by a receiving UE in Mode 1 operation may be configured to a value common to each unicast, groupcast, or broadcast service (PSID, ITS-AID) and used by a UE.

[0112] According to an embodiment of the present disclosure, a UE (e.g., a receiving UE) operating an SL DRX HARQ RTT timer may receive SCI (a resource allocation mode indication) transmitted by a counterpart transmitting UE, and confirm that the transmission of SL data (PSSCH) linked to the SCI is transmitted based on mode 2 of the resource allocation mode.

[0113] In this case, for example, if the receiving UE receives a PSSCH and fails to decode it, it may transmit SL HARQ NACK to the transmitting UE and start an SL DRX HARQ RTT timer. In this case, for example, a method in which that the receiving UE applies and starts an SL HART RTT timer value by the minimum time gap (UE implementation) between "PSFCH reception - PSCCH/PSSCH retransmission transmission time" is proposed. For example, the "PSFCH reception - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from the receiving UE and generate/transmit the PSCCH/PSSCH using a retransmission resource. In other words, for mode 2, a method is proposed to select an SL HARQ RTT timer value by a UE self-selection to a value less than or equal to the minimum time gap (common value) between "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time". For example, the "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from a receiving UE, request a retransmission resource from a base station via PUCCH, and generate/transmit a PSCCH/PSSCH using the retransmission resource allocated by the base station.

[0114] According to an embodiment of the present disclosure, a UE may use the minimum time gap between "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" as an SL HARQ RTT timer value, rather than using an SL HARQ RTT timer value delivered from a base station.

[0115] According to an embodiment of the present disclosure, a method is proposed in which a UE uses a common value delivered from a base station, rather than a common value used by the UE itself. For example, the value of an SL HARQ RTT timer used by a receiving UE in the mode 2 operation proposed in this disclosure may be configured to a common value for each QoS class mapped to a service (PSID, ITS-AID) per cast type, and may be used by a UE.

[0116] Alternatively, for example, a value of an SL HARQ RTT timer used by a receiving UE in Mode 2 operation, as proposed in this disclosure, may be configured to a value common to each cast type, and may be used by a UE.

[0117] Alternatively, for example, as proposed in this disclosure, the value of an SL HARQ RTT timer used by a receiving UE in Mode 2 operation may be configured to a value common to each unicast, groupcast, or broadcast service (PSID, ITS-AID) and used by a UE.

[0118] According to an embodiment of the present disclosure, in the resource allocation mode 1 operation, a method is proposed in which an SL DRX HARQ RTT timer value is configured differently according to whether a PUCCH resource for requesting an SL retransmission resource is configured to a transmitting UE. For example, a receiving UE may receives SCI from a transmitting UE, and through a PUCCH resource configuration indication included in the SCI, the receiving UE may confirm whether a PUCCH resource to request a retransmission resource has been allocated from a base station to the transmitting UE, by the transmitting UE transmitting SL HARQ feedback.

[0119] According to an embodiment of the present disclosure, a UE (e.g., a receiving UE) operating an SL DRX HARQ RTT timer may receive SCI (a resource allocation mode indication) transmitted by a counterpart transmitting UE, and determine that the transmission of SL data (PSSCH) linked to the SCI is transmitted based on mode 1 of the resource allocation mode.

[0120] In this case, for example, if a PUCCH resource for requesting an SL retransmission resource is configured, when the receiving UE receives a PSSCH and fails to decode it, the receiving UE may transmit SL HARQ NACK to a transmitting UE and start an SL DRX HARQ RTT timer. In this case, for example, a method in which the receiving UE applies and starts an SL HART RTT timer value by the minimum time gap (common value) between "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" is proposed. For example, the "PSFCH reception - PUCCH transmission - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from the receiving UE, request a retransmission resource from a base

station via PUCCH, and generate/transmit a PSCCH/PSSCH using the retransmission resource allocated by the base station.

[0121] According to an embodiment of the present disclosure, a UE (e.g., a receiving UE) operating an SL DRX HARQ RTT timer may receive SCI (a resource allocation mode indication) transmitted by a counterpart transmitting UE, and confirm that the transmission of SL data (PSSCH) linked to the SCI is transmitted based on mode 1 of the resource allocation mode.

[0122] In this case, for example, if a PUCCH resource for requesting an SL retransmission resource is not configured, when the receiving UE receives a PSSCH and fails to decode it, the receiving UE may transmit SL HARQ NACK to a transmitting UE and start an SL DRX HARQ RTT timer. In this case, for example, a method in which that the receiving UE applies and starts an SL HART RTT timer value equal by the minimum time gap (common value) between "PSFCH reception - PSCCH/PSSCH retransmission transmission time" is proposed. For example, the "PSFCH reception - PSCCH/PSSCH retransmission transmission time" may be the time taken by a transmitting UE to receive/decode a PSFCH from a receiving UE and to generate/transmit a PSCCH/PSSCH using a retransmission resource allocated by a base station.

[0123] For example, the proposals of this disclosure may be limited to SL HARQ feedback disabled mode. Alternatively, the solutions proposed in this disclosure may be equally applicable in SL HARQ feedback enabled mode.

[0124] An embodiment of the present disclosure may be a solution applicable when a UE receives SCI from a counterpart UE at the end of an SL active time (an interval which a UE monitors an SL channel or SL signal), and a transmission resource reserved through SCI received within an active time is within an SL inactive time (an interval during which a UE is not required to monitor an SL channel or SL signal, or during which a UE may operate in a power saving mode). Further, for example, the solutions proposed in this disclosure may be equally applicable in SL active and SL inactive time periods of a UE.

[0125] The SL DRX configuration referred to in this disclosure may include at least one of the following parameters.

[Table 15]

• Sidelink DRX configurations • *SL drx-onDurationTimer*: the duration at the beginning of a SL DRX Cycle; • *SL drx-SiotOffset*: the delay before starting the sl *drx-onDurationTimer*; • *SL drx-InactivityTimer*: the duration after the PSCCH occasion in which a PSCCH indicates a new SL transmission for the MAC entity; • *SL drx-StartOffset*: the subframe where the SL DRX cycle start; • *SL drx-Cycle*: the SL DRX cycle; • *SL drx-HARQ-RTT-Timer* (per HARQ process or per sidelink process): the minimum duration before an assignment for HARQ retransmission is expected by the MAC entity. • *SL drx-RetransmissionTimer* (per HARQ process or per sidelink process): the maximum duration until a retransmission is received

[0126] The following SL DRX timers mentioned in this disclosure may be used for the following purposes.

[0127] SL DRX on-duration timer: It may indicate an interval during which a UE performing SL DRX operation should operate as the default active time to receive PSCCH/PSSCH from a counterpart UE.

[0128] SL DRX inactivity timer: It may represent an interval that extends an SL DRX on-duration interval, which is the interval during which the UE performing SL DRX operation must basically operate as an active time to receive PSCCH/PSSCH from a counterpart UE. That is,the SL DRX on-duration timer may be extended by the SL DRX inactivity timer interval. Furthermore, when a UE receives a new packet (new PSSCH transmission) from a counterpart UE, the UE may extend the SL DRX on-duration timer by starting an SL DRX inactivity timer.

[0129] SL DRX HARQ RTT timer: It may indicate an interval during which a UE performing SL DRX operation may operate in sleep mode until it receives a retransmission packet (or PSSCH allocation) transmitted by a counterpart UE. In other words, if a UE starts an SL DRX HARQ RTT timer, the UE may determine that the counterpart UE will not transmit a sidelink retransmission packet to it until the SL DRX HARQ RTT timer expires and may operate in sleep mode during that timer.

[0130] SL DRX retransmission timer: It may represent an interval of time during which a UE performing SL DRX operation operates as an active time to receive retransmission packets (or PSSCH allocations) transmitted by a counterpart UE. During this timer period, a UE may monitor the reception of retransmission sidelink packets (or PSSCH allocations) transmitted by a counterpart UE.

[0131] For example, in the following description, the names of timers (SL DRX on-duration timer, SL DRX inactivity timer, HARQ RTT timer, SL DRX retransmission timer, etc.) are exemplary, and timers that perform the same/similar

functions based on what is described in each timer may be considered to be the same/similar timer regardless of their names.

[0132] For example, the proposals in this disclosure may extend to parameters (and timers) included in default/common SL DRX configurations or default/common SL DRX patterns or default/common SL DRX configurations, as well as parameters (and timers) included in UE-pair specific SL DRX configurations or UE-pair specific SL DRX patterns or UE-pair specific SL DRX configurations.

[0133] Furthermore, for example, the on-duration term referred to in the present disclosure may be extended to an active time period, and the off-duration term may be extended to a sleep time period. For example, active time may refer to a period of time when a UE is operating in a wake up state (RF module is on) to receive/transmit radio signals. For example, sleep time may refer to an interval during which a UE operates in a sleep mode state (RF module is off) to save power. For example, a sleep period does not imply that a transmitting UE is obligated to operate in sleep mode, i.e., the UE may be allowed to operate as active time for a short period of time to perform a sensing operation/transmission operation if necessary, even during a sleep period.

[0134] Further, for example, whether (some of) the proposed schemes/rules of this disclosure apply and/or the related parameters (e.g., thresholds) may be configured specifically (or differently or independently) according to the resource pool, congestion, service priority (and/or type), requirements (e.g., delay, reliability), traffic type (e.g., (a)periodic generation), SL transmission resource allocation mode (Mode 1, Mode 2), etc.

[0135] For example, whether the proposed rules of this disclosure apply (and/or the associated parameter configuration values) may be configured specifically (and/or independently, and/or differently) for at least one of resource pool, service/packet type (and/or priority), QoS requirements (e.g., URLLC/EMBB traffic, reliability, delay), cast type (e.g., unicast, groupcast, broadcast), (Resource pool) Congestion level (e.g., CBR), SL HARQ feedback scheme (e.g., NACK Only feedback, ACK/NACK feedback), a case of transmitting HARQ feedback enabled MAC PDU (and/or HARQ feedback disabled MAC PDU, the case of PUCCH-based SL HARQ feedback reporting operation configuration, pre-emption (and/or re-evaluation) performance (or resource reselection based on it), (L2 or L1) (source and/or destination) identifier, PC5 RRC connection/link, a case of performing SL DRX, SL mode type (resource allocation mode 1, resource allocation mode2), a case of (a)periodic resource reservation.

[0136] For example, the term a certain time referred to in proposals of this disclosure may refer to a time when a UE operates as active time for a predefined amount of time to receive sidelink signaling or sidelink data from a counterpart UE, or operates as active time by a time or a specific timer (SL DRX retransmission timer, SL DRX inactivity timer, or a timer that guarantees that the receiving UE will operate as active time in DRX operation) time.

[0137] Further, for example, whether the proposals and proposed rules in this disclosure apply (and/or the related parameter configuration values) may also apply to mmWave SL operation.

[0138] According to an embodiment of the present disclosure, a UE performing SL DRX operation may configure a value for an SL HARQ RTT timer in consideration of the time it takes for a transmitting UE to be allocated a retransmission resource, thereby preventing an SL DRX retransmission timer from being started earlier than necessary, thereby enabling more efficient power-saving operation.

[0139] FIG. 11 shows a procedure for a first device to perform wireless communication based on a sidelink, SL, discontinuous reception, DRX, configuration, according to an embodiment of the present disclosure. The embodiment of FIG. 11 may be combined with various embodiments of the present disclosure.

[0140] Referring to FIG. 11, in step S1110, a first device performing wireless communication based on a sidelink, SL, discontinuous reception, DRX, configuration may receive, from a second device, the SL DRX configuration. In step S1120, the first device may receive, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode. In step S1130, the first device may determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode. In step S1140, the first device may start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value. In step S1150, the first device may start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer. For example, the first device may be in active mode, based on the SL DRX retransmission timer being running, and the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0141] For example, the information related to whether a PUCCH resource is configured and the information related to resource allocation mode may be received through sidelink control information (SCI).

[0142] For example, additionally, the first device may receive, from the second device, a physical sidelink control channel, PSCCH, including SCI for scheduling of a physical sidelink shared channel, PSSCH; determine decoding failure for a medium access control, MAC, protocol data unit, PDU, transmitted, from the second device, through the PSSCH; transmit, to the second device, HARQ negative acknowledge, NACK, related to the MAC PDU through a physical sidelink feedback channel, PSFCH, related to the PSSCH, based on the decoding failure; and receive, from the second device, a retransmission of the MAC PDU based on a retransmission resource.

[0143] For example, the SL DRX HARQ RTT timer may be started based on the SL DRX HARQ RTT timer value and the transmission of the HARQ NACK.

[0144] For example, the information related to whether a PUCCH resource is configured may represent that a PUCCH resource is configured to the second device, the information related to resource allocation mode may represent that the resource allocation mode is mode 1, a resource allocation request for the retransmission resource may be transmitted, to a base station, through the PUCCH resource between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU, the retransmission resource may be an allocated resource allocated from the base station, based on the resource allocation request, and the timer value may be the minimum time gap between the first time point and the second time point.

[0145] For example, the resource allocation request may be performed based on decoding for the PSFCH by the first device.

[0146] For example, the information related to whether a PUCCH resource is configured represents that a PUCCH resource may be not configured to the second device, the information related to resource allocation mode may represent that the resource allocation mode is mode 1, and the timer value may be the minimum time gap between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU.

[0147] For example, the retransmission of the MAC PDU may be received based on the first device being in active mode.

[0148] For example, the information related to resource allocation mode may represent that the resource allocation mode is mode 2, the timer value may be the minimum time gap between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU.

[0149] For example, the SCI may include information representing that a HARQ feedback for the MAC PDU is enabled.

[0150] For example, the SCI may include information representing that a HARQ feedback for the MAC PDU is disabled.

[0151] For example, the SCI may be received based on the first device being in active mode, the SCI may include resource information related to a first resource in which the SCI is received and a second resource after the first resource, and the second resource may exist within a time duration after expiration of an on-duration timer of the SL DRX configuration.

[0152] For example, the SL DRX HARQ RTT timer may be started based on the existence of the second resource within the time duration after the expiration of the on-duration timer and the SL DRX HARQ RTT timer value.

[0153] The embodiments described above may be applied to a various devices described below. For example, a processor 102 of a first device 100 may control a transceiver 106 to receive, from a second device 200, the SL DRX configuration. And, the processor 102 of the first device 100 may control the transceiver 106 to receive, from the second device 200, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode. And, the processor 102 of the first device 100 may determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode. And, the processor 102 of the first device 100 may start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value. And, the processor 102 of the first device 100 may start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer. For example, the first device 100 may be in active mode, based on the SL DRX retransmission timer being running, and the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0154] According to an embodiment of the present disclosure, a first device for performing wireless communication may be proposed. For example, the first device may comprise: one or more memories storing instructions; one or more transceivers; and one or more processors connected to the one or more memories and the one or more transceivers. For example, the one or more processors may execute the instructions to: receive, from a second device, a sidelink, SL, discontinuous reception, DRX, configuration; receive, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode; determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode; start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer, wherein the first device may be in active mode, based on the SL DRX retransmission timer being running, and wherein the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0155] According to an embodiment of the present disclosure, a device adapted to control a first user equipment, UE, may be proposed. For example, the device may comprise: one or more processors; and one or more memories operably connectable to the one or more processors and storing instructions. For example, the one or more processors may execute the instructions to: receive, from a second UE, a sidelink, SL, discontinuous reception, DRX, configuration; receive, from the second UE, information related to whether a physical uplink control channel, PUCCH, resource is

configured and information related to resource allocation mode; determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode; start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer, wherein the first UE may be in active mode, based on the SL DRX retransmission timer being running, and wherein the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0156] According to an embodiment of the present disclosure, a non-transitory computer-readable storage medium storing instructions may be proposed. For example, the instructions, when executed, may cause a first device to: receive, from a second device, a sidelink, SL, discontinuous reception, DRX, configuration; receive, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode; determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode; start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer, wherein the first device may be in active mode, based on the SL DRX retransmission timer being running, and wherein the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0157] FIG. 12 shows a procedure for a second device to perform wireless communication, according to an embodiment of the present disclosure. The embodiment of FIG. 12 may be combined with various embodiments of the present disclosure.

[0158] Referring to FIG. 12, in step S1210, a second device performing wireless communication may transmit, to a first device, a sidelink, SL, discontinuous reception, DRX, configuration. In step S1220, the second device may transmit, to the first device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode. For example, an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value may be determined based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode, an SL DRX HARQ RTT timer may be started based on the SL DRX HARQ RTT timer value, an SL DRX retransmission timer may be started based on expiration of the SL DRX HARQ RTT timer, the first device may be in active mode, based on the SL DRX retransmission timer being running, and the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0159] For example, the information related to whether a PUCCH resource is configured and the information related to resource allocation mode may be transmitted through sidelink control information, SCI.

[0160] The embodiments described above may be applied to a various devices described below. For example, a processor 202 of a second device 200 may control a transceiver 206 to transmit, to a first device 100, a sidelink, SL, discontinuous reception, DRX, configuration. And, the processor 202 of the second device 200 may control the transceiver 206 to transmit, to the first device 100, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode. For example, an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value may be determined based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode, an SL DRX HARQ RTT timer may be started based on the SL DRX HARQ RTT timer value, an SL DRX retransmission timer may be started based on expiration of the SL DRX HARQ RTT timer, the first device 100 may be in active mode, based on the SL DRX retransmission timer being running, and the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0161] According to an embodiment of the present disclosure, a second device for performing wireless communication may be proposed. For example, the second device may comprise: one or more memories storing instructions; one or more transceivers; and one or more processors connected to the one or more memories and the one or more transceivers. For example, the one or more processors may execute the instructions to: transmit, to a first device, a sidelink, SL, discontinuous reception, DRX, configuration; and transmit, to the first device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode, wherein an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value may be determined based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode, wherein an SL DRX HARQ RTT timer may be started based on the SL DRX HARQ RTT timer value, wherein an SL DRX retransmission timer is started based on expiration of the SL DRX HARQ RTT timer, wherein the first device may be in active mode, based on the SL DRX retransmission timer being running, and wherein the SL DRX configuration may include information related to an SL DRX cycle and information related to an SL DRX active time.

[0162] For example, the information related to whether a PUCCH resource is configured and the information related to resource allocation mode may be transmitted through sidelink control information, SCI.

[0163] Various embodiments of the present disclosure may be combined with each other.

[0164] Hereinafter, device(s) to which various embodiments of the present disclosure can be applied will be described.

[0165] The various descriptions, functions, procedures, proposals, methods, and/or operational flowcharts of the present disclosure described in this document may be applied to, without being limited to, a variety of fields requiring wireless communication/connection (e.g., 5G) between devices.

[0166] Hereinafter, a description will be given in more detail with reference to the drawings. In the following drawings/description, the same reference symbols may denote the same or corresponding hardware blocks, software blocks, or functional blocks unless described otherwise.

[0167] FIG. 13 shows a communication system 1, based on an embodiment of the present disclosure. The embodiment of FIG. 13 may be combined with various embodiments of the present disclosure.

[0168] Referring to FIG. 13, a communication system 1 to which various embodiments of the present disclosure are applied includes wireless devices, Base Stations (BSs), and a network. Herein, the wireless devices represent devices performing communication using Radio Access Technology (RAT) (e.g., 5G New RAT (NR)) or Long-Term Evolution (LTE)) and may be referred to as communication/radio/5G devices. The wireless devices may include, without being limited to, a robot 100a, vehicles 100b-1 and 100b-2, an extended Reality (XR) device 100c, a hand-held device 100d, a home appliance 100e, an Internet of Things (IoT) device 100f, and an Artificial Intelligence (AI) device/server 400. For example, the vehicles may include a vehicle having a wireless communication function, an autonomous vehicle, and a vehicle capable of performing communication between vehicles. Herein, the vehicles may include an Unmanned Aerial Vehicle (UAV) (e.g., a drone). The XR device may include an Augmented Reality (AR)/Virtual Reality (VR)/Mixed Reality (MR) device and may be implemented in the form of a Head-Mounted Device (HMD), a Head-Up Display (HUD) mounted in a vehicle, a television, a smartphone, a computer, a wearable device, a home appliance device, a digital signage, a vehicle, a robot, etc. The hand-held device may include a smartphone, a smartpad, a wearable device (e.g., a smartwatch or a smartglasses), and a computer (e.g., a notebook). The home appliance may include a TV, a refrigerator, and a washing machine. The IoT device may include a sensor and a smartmeter. For example, the BSs and the network may be implemented as wireless devices and a specific wireless device 200a may operate as a BS/network node with respect to other wireless devices.

[0169] Here, wireless communication technology implemented in wireless devices 100a to 100f of the present disclosure may include Narrowband Internet of Things for low-power communication in addition to LTE, NR, and 6G. In this case, for example, NB-IoT technology may be an example of Low Power Wide Area Network (LPWAN) technology and may be implemented as standards such as LTE Cat NB1, and/or LTE Cat NB2, and is not limited to the name described above. Additionally or alternatively, the wireless communication technology implemented in the wireless devices 100a to 100f of the present disclosure may perform communication based on LTE-M technology. In this case, as an example, the LTE-M technology may be an example of the LPWAN and may be called by various names including enhanced Machine Type Communication (eMTC), and the like. For example, the LTE-M technology may be implemented as at least any one of various standards such as 1) LTE CAT 0, 2) LTE Cat M1, 3) LTE Cat M2, 4) LTE non-Bandwidth Limited (non-BL), 5) LTE-MTC, 6) LTE Machine Type Communication, and/or 7) LTE M, and is not limited to the name described above. Additionally or alternatively, the wireless communication technology implemented in the wireless devices 100a to 100f of the present disclosure may include at least one of Bluetooth, Low Power Wide Area Network (LPWAN), and ZigBee considering the low-power communication, and is not limited to the name described above. As an example, the ZigBee technology may generate personal area networks (PAN) related to small/low-power digital communication based on various standards including IEEE 802.15.4, and the like, and may be called by various names.

[0170] The wireless devices 100a to 100f may be connected to the network 300 via the BSs 200. An AI technology may be applied to the wireless devices 100a to 100f and the wireless devices 100a to 100f may be connected to the AI server 400 via the network 300. The network 300 may be configured using a 3G network, a 4G (e.g., LTE) network, or a 5G (e.g., NR) network. Although the wireless devices 100a to 100f may communicate with each other through the BSs 200/network 300, the wireless devices 100a to 100f may perform direct communication (e.g., sidelink communication) with each other without passing through the BSs/network. For example, the vehicles 100b-1 and 100b-2 may perform direct communication (e.g. Vehicle-to-Vehicle (V2V)/Vehicle-to-everything (V2X) communication). The IoT device (e.g., a sensor) may perform direct communication with other IoT devices (e.g., sensors) or other wireless devices 100a to 100f.

[0171] Wireless communication/connections 150a, 150b, or 150c may be established between the wireless devices 100a to 100f/BS 200, or BS 200/BS 200. Herein, the wireless communication/connections may be established through various RATs (e.g., 5G NR) such as uplink/downlink communication 150a, sidelink communication 150b (or, D2D communication), or inter BS communication (e.g. relay, Integrated Access Backhaul (IAB)). The wireless devices and the BSs/the wireless devices may transmit/receive radio signals to/from each other through the wireless communication/connections 150a and 150b. For example, the wireless communication/connections 150a and 150b may transmit/receive signals through various physical channels. To this end, at least a part of various configuration information configuring processes, various signal processing processes (e.g., channel encoding/decoding, modulation/demodulation, and resource mapping/demapping), and resource allocating processes, for transmitting/receiving radio signals, may be performed based on the various proposals of the present disclosure.

[0172] FIG. 14 shows wireless devices, based on an embodiment of the present disclosure. The embodiment of FIG. 14 may be combined with various embodiments of the present disclosure.

[0173] Referring to FIG. 14, a first wireless device 100 and a second wireless device 200 may transmit radio signals through a variety of RATs (e.g., LTE and NR). Herein, {the first wireless device 100 and the second wireless device 200} may correspond to {the wireless device 100x and the BS 200} and/or {the wireless device 100x and the wireless device 100x} of FIG. 14.

[0174] The first wireless device 100 may include one or more processors 102 and one or more memories 104 and additionally further include one or more transceivers 106 and/or one or more antennas 108. The processor(s) 102 may control the memory(s) 104 and/or the transceiver(s) 106 and may be configured to implement the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. For example, the processor(s) 102 may process information within the memory(s) 104 to generate first information/signals and then transmit radio signals including the first information/signals through the transceiver(s) 106. The processor(s) 102 may receive radio signals including second information/signals through the transceiver 106 and then store information obtained by processing the second information/signals in the memory(s) 104. The memory(s) 104 may be connected to the processor(s) 102 and may store a variety of information related to operations of the processor(s) 102. For example, the memory(s) 104 may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) 102 or for performing the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. Herein, the processor(s) 102 and the memory(s) 104 may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) 106 may be connected to the processor(s) 102 and transmit and/or receive radio signals through one or more antennas 108. Each of the transceiver(s) 106 may include a transmitter and/or a receiver. The transceiver(s) 106 may be interchangeably used with Radio Frequency (RF) unit(s). In the present disclosure, the wireless device may represent a communication modem/circuit/chip.

[0175] The second wireless device 200 may include one or more processors 202 and one or more memories 204 and additionally further include one or more transceivers 206 and/or one or more antennas 208. The processor(s) 202 may control the memory(s) 204 and/or the transceiver(s) 206 and may be configured to implement the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. For example, the processor(s) 202 may process information within the memory(s) 204 to generate third information/signals and then transmit radio signals including the third information/signals through the transceiver(s) 206. The processor(s) 202 may receive radio signals including fourth information/signals through the transceiver(s) 106 and then store information obtained by processing the fourth information/signals in the memory(s) 204. The memory(s) 204 may be connected to the processor(s) 202 and may store a variety of information related to operations of the processor(s) 202. For example, the memory(s) 204 may store software code including commands for performing a part or the entirety of processes controlled by the processor(s) 202 or for performing the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. Herein, the processor(s) 202 and the memory(s) 204 may be a part of a communication modem/circuit/chip designed to implement RAT (e.g., LTE or NR). The transceiver(s) 206 may be connected to the processor(s) 202 and transmit and/or receive radio signals through one or more antennas 208. Each of the transceiver(s) 206 may include a transmitter and/or a receiver. The transceiver(s) 206 may be interchangeably used with RF unit(s). In the present disclosure, the wireless device may represent a communication modem/circuit/chip.

[0176] Hereinafter, hardware elements of the wireless devices 100 and 200 will be described more specifically. One or more protocol layers may be implemented by, without being limited to, one or more processors 102 and 202. For example, the one or more processors 102 and 202 may implement one or more layers (e.g., functional layers such as PHY, MAC, RLC, PDCP, RRC, and SDAP). The one or more processors 102 and 202 may generate one or more Protocol Data Units (PDUs) and/or one or more Service Data Unit (SDUs) according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. The one or more processors 102 and 202 may generate messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document. The one or more processors 102 and 202 may generate signals (e.g., baseband signals) including PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document and provide the generated signals to the one or more transceivers 106 and 206. The one or more processors 102 and 202 may receive the signals (e.g., baseband signals) from the one or more transceivers 106 and 206 and acquire the PDUs, SDUs, messages, control information, data, or information according to the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document.

[0177] The one or more processors 102 and 202 may be referred to as controllers, microcontrollers, microprocessors, or microcomputers. The one or more processors 102 and 202 may be implemented by hardware, firmware, software, or a combination thereof. As an example, one or more Application Specific Integrated Circuits (ASICs), one or more Digital Signal Processors (DSPs), one or more Digital Signal Processing Devices (DSPDs), one or more Programmable Logic Devices (PLDs), or one or more Field Programmable Gate Arrays (FPGAs) may be included in the one or more

processors 102 and 202. The descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be implemented using firmware or software and the firmware or software may be configured to include the modules, procedures, or functions. Firmware or software configured to perform the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be included in the one or more processors 102 and 202 or stored in the one or more memories 104 and 204 so as to be driven by the one or more processors 102 and 202. The descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document may be implemented using firmware or software in the form of code, commands, and/or a set of commands.

[0178] The one or more memories 104 and 204 may be connected to the one or more processors 102 and 202 and store various types of data, signals, messages, information, programs, code, instructions, and/or commands. The one or more memories 104 and 204 may be configured by Read-Only Memories (ROMs), Random Access Memories (RAMs), Electrically Erasable Programmable Read-Only Memories (EPROMs), flash memories, hard drives, registers, cash memories, computer-readable storage media, and/or combinations thereof. The one or more memories 104 and 204 may be located at the interior and/or exterior of the one or more processors 102 and 202. The one or more memories 104 and 204 may be connected to the one or more processors 102 and 202 through various technologies such as wired or wireless connection.

[0179] The one or more transceivers 106 and 206 may transmit user data, control information, and/or radio signals/channels, mentioned in the methods and/or operational flowcharts of this document, to one or more other devices. The one or more transceivers 106 and 206 may receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document, from one or more other devices. For example, the one or more transceivers 106 and 206 may be connected to the one or more processors 102 and 202 and transmit and receive radio signals. For example, the one or more processors 102 and 202 may perform control so that the one or more transceivers 106 and 206 may transmit user data, control information, or radio signals to one or more other devices. The one or more processors 102 and 202 may perform control so that the one or more transceivers 106 and 206 may receive user data, control information, or radio signals from one or more other devices. The one or more transceivers 106 and 206 may be connected to the one or more antennas 108 and 208 and the one or more transceivers 106 and 206 may be configured to transmit and receive user data, control information, and/or radio signals/channels, mentioned in the descriptions, functions, procedures, proposals, methods, and/or operational flowcharts disclosed in this document, through the one or more antennas 108 and 208. In this document, the one or more antennas may be a plurality of physical antennas or a plurality of logical antennas (e.g., antenna ports). The one or more transceivers 106 and 206 may convert received radio signals/channels etc. from RF band signals into baseband signals in order to process received user data, control information, radio signals/channels, etc. using the one or more processors 102 and 202. The one or more transceivers 106 and 206 may convert the user data, control information, radio signals/channels, etc. processed using the one or more processors 102 and 202 from the base band signals into the RF band signals. To this end, the one or more transceivers 106 and 206 may include (analog) oscillators and/or filters.

[0180] FIG. 15 shows a signal process circuit for a transmission signal, based on an embodiment of the present disclosure. The embodiment of FIG. 15 may be combined with various embodiments of the present disclosure.

[0181] Referring to FIG. 15, a signal processing circuit 1000 may include scramblers 1010, modulators 1020, a layer mapper 1030, a precoder 1040, resource mappers 1050, and signal generators 1060. An operation/function of FIG. 15 may be performed, without being limited to, the processors 102 and 202 and/or the transceivers 106 and 206 of FIG. 14. Hardware elements of FIG. 15 may be implemented by the processors 102 and 202 and/or the transceivers 106 and 206 of FIG. 14. For example, blocks 1010 to 1060 may be implemented by the processors 102 and 202 of FIG. 14. Alternatively, the blocks 1010 to 1050 may be implemented by the processors 102 and 202 of FIG. 14 and the block 1060 may be implemented by the transceivers 106 and 206 of FIG. 14.

[0182] Codewords may be converted into radio signals via the signal processing circuit 1000 of FIG. 15. Herein, the codewords are encoded bit sequences of information blocks. The information blocks may include transport blocks (e.g., a UL-SCH transport block, a DL-SCH transport block). The radio signals may be transmitted through various physical channels (e.g., a PUSCH and a PDSCH).

[0183] Specifically, the codewords may be converted into scrambled bit sequences by the scramblers 1010. Scramble sequences used for scrambling may be generated based on an initialization value, and the initialization value may include ID information of a wireless device. The scrambled bit sequences may be modulated to modulation symbol sequences by the modulators 1020. A modulation scheme may include pi/2-Binary Phase Shift Keying (pi/2-BPSK), m-Phase Shift Keying (m-PSK), and m-Quadrature Amplitude Modulation (m-QAM). Complex modulation symbol sequences may be mapped to one or more transport layers by the layer mapper 1030. Modulation symbols of each transport layer may be mapped (precoded) to corresponding antenna port(s) by the precoder 1040. Outputs z of the precoder 1040 may be obtained by multiplying outputs y of the layer mapper 1030 by an N*M precoding matrix W. Herein, N is the number of antenna ports and M is the number of transport layers. The precoder 1040 may perform precoding after performing

transform precoding (e.g., DFT) for complex modulation symbols. Alternatively, the precoder 1040 may perform precoding without performing transform precoding.

[0184] The resource mappers 1050 may map modulation symbols of each antenna port to time-frequency resources. The time-frequency resources may include a plurality of symbols (e.g., a CP-OFDMA symbols and DFT-s-OFDMA symbols) in the time domain and a plurality of subcarriers in the frequency domain. The signal generators 1060 may generate radio signals from the mapped modulation symbols and the generated radio signals may be transmitted to other devices through each antenna. For this purpose, the signal generators 1060 may include Inverse Fast Fourier Transform (IFFT) modules, Cyclic Prefix (CP) inserters, Digital-to-Analog Converters (DACs), and frequency up-converters.

[0185] Signal processing procedures for a signal received in the wireless device may be configured in a reverse manner of the signal processing procedures 1010 to 1060 of FIG. 15. For example, the wireless devices (e.g., 100 and 200 of FIG. 14) may receive radio signals from the exterior through the antenna ports/transceivers. The received radio signals may be converted into baseband signals through signal restorers. To this end, the signal restorers may include frequency downlink converters, Analog-to-Digital Converters (ADCs), CP remover, and Fast Fourier Transform (FFT) modules. Next, the baseband signals may be restored to codewords through a resource demapping procedure, a postcoding procedure, a demodulation processor, and a descrambling procedure. The codewords may be restored to original information blocks through decoding. Therefore, a signal processing circuit (not illustrated) for a reception signal may include signal restorers, resource demappers, a postcoder, demodulators, descramblers, and decoders.

[0186] FIG. 16 shows another example of a wireless device, based on an embodiment of the present disclosure. The wireless device may be implemented in various forms according to a use-case/service (refer to FIG. 14). The embodiment of FIG. 16 may be combined with various embodiments of the present disclosure.

[0187] Referring to FIG. 16, wireless devices 100 and 200 may correspond to the wireless devices 100 and 200 of FIG. 14 and may be configured by various elements, components, units/portions, and/or modules. For example, each of the wireless devices 100 and 200 may include a communication unit 110, a control unit 120, a memory unit 130, and additional components 140. The communication unit may include a communication circuit 112 and transceiver(s) 114. For example, the communication circuit 112 may include the one or more processors 102 and 202 and/or the one or more memories 104 and 204 of FIG. 14. For example, the transceiver(s) 114 may include the one or more transceivers 106 and 206 and/or the one or more antennas 108 and 208 of FIG. 14. The control unit 120 is electrically connected to the communication unit 110, the memory 130, and the additional components 140 and controls overall operation of the wireless devices. For example, the control unit 120 may control an electric/mechanical operation of the wireless device based on programs/code/commands/information stored in the memory unit 130. The control unit 120 may transmit the information stored in the memory unit 130 to the exterior (e.g., other communication devices) via the communication unit 110 through a wireless/wired interface or store, in the memory unit 130, information received through the wireless/wired interface from the exterior (e.g., other communication devices) via the communication unit 110.

[0188] The additional components 140 may be variously configured according to types of wireless devices. For example, the additional components 140 may include at least one of a power unit/battery, input/output (I/O) unit, a driving unit, and a computing unit. The wireless device may be implemented in the form of, without being limited to, the robot (100a of FIG. 14), the vehicles (100b-1 and 100b-2 of FIG. 14), the XR device (100c of FIG. 14), the hand-held device (100d of FIG. 14), the home appliance (100e of FIG. 14), the IoT device (100f of FIG. 14), a digital broadcast terminal, a hologram device, a public safety device, an MTC device, a medicine device, a fintech device (or a finance device), a security device, a climate/environment device, the AI server/device (400 of FIG. 14), the BSs (200 of FIG. 14), a network node, etc. The wireless device may be used in a mobile or fixed place according to a use-example/service.

[0189] In FIG. 16, the entirety of the various elements, components, units/portions, and/or modules in the wireless devices 100 and 200 may be connected to each other through a wired interface or at least a part thereof may be wirelessly connected through the communication unit 110. For example, in each of the wireless devices 100 and 200, the control unit 120 and the communication unit 110 may be connected by wire and the control unit 120 and first units (e.g., 130 and 140) may be wirelessly connected through the communication unit 110. Each element, component, unit/portion, and/or module within the wireless devices 100 and 200 may further include one or more elements. For example, the control unit 120 may be configured by a set of one or more processors. As an example, the control unit 120 may be configured by a set of a communication control processor, an application processor, an Electronic Control Unit (ECU), a graphical processing unit, and a memory control processor. As another example, the memory 130 may be configured by a Random Access Memory (RAM), a Dynamic RAM (DRAM), a Read Only Memory (ROM)), a flash memory, a volatile memory, a non-volatile memory, and/or a combination thereof.

[0190] Hereinafter, an example of implementing FIG. 16 will be described in detail with reference to the drawings.

[0191] FIG. 17 shows a hand-held device, based on an embodiment of the present disclosure. The hand-held device may include a smartphone, a smartpad, a wearable device (e.g., a smartwatch or a smartglasses), or a portable computer (e.g., a notebook). The hand-held device may be referred to as a mobile station (MS), a user terminal (UT), a Mobile Subscriber Station (MSS), a Subscriber Station (SS), an Advanced Mobile Station (AMS), or a Wireless Terminal (WT).

The embodiment of FIG. 17 may be combined with various embodiments of the present disclosure.

[0192] Referring to FIG. 17, a hand-held device 100 may include an antenna unit 108, a communication unit 110, a control unit 120, a memory unit 130, a power supply unit 140a, an interface unit 140b, and an I/O unit 140c. The antenna unit 108 may be configured as a part of the communication unit 110. Blocks 110 to 130/140a to140c correspond to the blocks 110 to 130/140 of FIG. 16, respectively.

[0193] The communication unit 110 may transmit and receive signals (e.g., data and control signals) to and from other wireless devices or BSs. The control unit 120 may perform various operations by controlling constituent elements of the hand-held device 100. The control unit 120 may include an Application Processor (AP). The memory unit 130 may store data/parameters/programs/code/commands needed to drive the hand-held device 100. The memory unit 130 may store input/output data/information. The power supply unit 140a may supply power to the hand-held device 100 and include a wired/wireless charging circuit, a battery, etc. The interface unit 140b may support connection of the hand-held device 100 to other external devices. The interface unit 140b may include various ports (e.g., an audio I/O port and a video I/O port) for connection with external devices. The I/O unit 140c may input or output video information/signals, audio information/signals, data, and/or information input by a user. The I/O unit 140c may include a camera, a microphone, a user input unit, a display unit 140d, a speaker, and/or a haptic module.

[0194] As an example, in the case of data communication, the I/O unit 140c may acquire information/signals (e.g., touch, text, voice, images, or video) input by a user and the acquired information/signals may be stored in the memory unit 130. The communication unit 110 may convert the information/signals stored in the memory into radio signals and transmit the converted radio signals to other wireless devices directly or to a BS. The communication unit 110 may receive radio signals from other wireless devices or the BS and then restore the received radio signals into original information/signals. The restored information/signals may be stored in the memory unit 130 and may be output as various types (e.g., text, voice, images, video, or haptic) through the I/O unit 140c.

[0195] FIG. 18 shows a vehicle or an autonomous vehicle, based on an embodiment of the present disclosure. The vehicle or autonomous vehicle may be implemented by a mobile robot, a car, a train, a manned/unmanned Aerial Vehicle (AV), a ship, etc. The embodiment of FIG. 18 may be combined with various embodiments of the present disclosure.

[0196] Referring to FIG. 18, a vehicle or autonomous vehicle 100 may include an antenna unit 108, a communication unit 110, a control unit 120, a driving unit 140a, a power supply unit 140b, a sensor unit 140c, and an autonomous driving unit 140d. The antenna unit 108 may be configured as a part of the communication unit 110. The blocks 110/130/140a to 140d correspond to the blocks 110/130/140 of FIG. 16, respectively.

[0197] The communication unit 110 may transmit and receive signals (e.g., data and control signals) to and from external devices such as other vehicles, BSs (e.g., gNBs and road side units), and servers. The control unit 120 may perform various operations by controlling elements of the vehicle or the autonomous vehicle 100. The control unit 120 may include an Electronic Control Unit (ECU). The driving unit 140a may cause the vehicle or the autonomous vehicle 100 to drive on a road. The driving unit 140a may include an engine, a motor, a powertrain, a wheel, a brake, a steering device, etc. The power supply unit 140b may supply power to the vehicle or the autonomous vehicle 100 and include a wired/wireless charging circuit, a battery, etc. The sensor unit 140c may acquire a vehicle state, ambient environment information, user information, etc. The sensor unit 140c may include an Inertial Measurement Unit (IMU) sensor, a collision sensor, a wheel sensor, a speed sensor, a slope sensor, a weight sensor, a heading sensor, a position module, a vehicle forward/backward sensor, a battery sensor, a fuel sensor, a tire sensor, a steering sensor, a temperature sensor, a humidity sensor, an ultrasonic sensor, an illumination sensor, a pedal position sensor, etc. The autonomous driving unit 140d may implement technology for maintaining a lane on which a vehicle is driving, technology for automatically adjusting speed, such as adaptive cruise control, technology for autonomously driving along a determined path, technology for driving by automatically setting a path if a destination is set, and the like.

[0198] For example, the communication unit 110 may receive map data, traffic information data, etc. from an external server. The autonomous driving unit 140d may generate an autonomous driving path and a driving plan from the obtained data. The control unit 120 may control the driving unit 140a such that the vehicle or the autonomous vehicle 100 may move along the autonomous driving path according to the driving plan (e.g., speed/direction control). In the middle of autonomous driving, the communication unit 110 may aperiodically/periodically acquire recent traffic information data from the external server and acquire surrounding traffic information data from neighboring vehicles. In the middle of autonomous driving, the sensor unit 140c may obtain a vehicle state and/or surrounding environment information. The autonomous driving unit 140d may update the autonomous driving path and the driving plan based on the newly obtained data/information. The communication unit 110 may transfer information regarding a vehicle position, the autonomous driving path, and/or the driving plan to the external server. The external server may predict traffic information data using AI technology, etc., based on the information collected from vehicles or autonomous vehicles and provide the predicted traffic information data to the vehicles or the autonomous vehicles.

[0199] Claims in the present description can be combined in a various way. For instance, technical features in method claims of the present description can be combined to be implemented or performed in an apparatus, and technical features in apparatus claims can be combined to be implemented or performed in a method. Further, technical features

in method claim(s) and apparatus claim(s) can be combined to be implemented or performed in an apparatus. Further, technical features in method claim(s) and apparatus claim(s) can be combined to be implemented or performed in a method.

Claims

1. A method for performing, by a first device, wireless communication based on a sidelink, SL, discontinuous reception, DRX, configuration, the method comprising:

   receiving, from a second device, the SL DRX configuration;
   receiving, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode;
   determining an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode;
   starting an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and
   starting an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer,
   wherein the first device is in active mode, based on the SL DRX retransmission timer being running, and
   wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

2. The method of claim 1, wherein the information related to whether a PUCCH resource is configured and the information related to resource allocation mode are received through sidelink control information (SCI).

3. The method of claim 1, further comprising:

   receiving, from the second device, a physical sidelink control channel, PSCCH, including SCI for scheduling of a physical sidelink shared channel, PSSCH;
   determining decoding failure for a medium access control, MAC, protocol data unit, PDU, transmitted, from the second device, through the PSSCH;
   transmitting, to the second device, HARQ negative acknowledge, NACK, related to the MAC PDU through a physical sidelink feedback channel, PSFCH, related to the PSSCH, based on the decoding failure; and
   receiving, from the second device, a retransmission of the MAC PDU based on a retransmission resource.

4. The method of claim 3, wherein the SL DRX HARQ RTT timer is started based on the SL DRX HARQ RTT timer value and the transmission of the HARQ NACK.

5. The method of claim 3, wherein the information related to whether a PUCCH resource is configured represents that a PUCCH resource is configured to the second device,

   wherein the information related to resource allocation mode represents that the resource allocation mode is mode 1,
   wherein a resource allocation request for the retransmission resource is transmitted, to a base station, through the PUCCH resource between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU,
   wherein the retransmission resource is an allocated resource allocated from the base station, based on the resource allocation request, and
   wherein the timer value is a minimum time gap between the first time point and the second time point.

6. The method of claim 5, wherein the resource allocation request is performed based on decoding for the PSFCH by the first device.

7. The method of claim 3, wherein the information related to whether a PUCCH resource is configured represents that a PUCCH resource is not configured to the second device,

   wherein the information related to resource allocation mode represents that the resource allocation mode is mode 1, and

wherein the timer value is a minimum time gap between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU.

8. The method of claim 3, wherein the retransmission of the MAC PDU is received based on the first device being in active mode.

9. The method of claim 3, wherein the information related to resource allocation mode represents that the resource allocation mode is mode 2,
wherein the timer value is a minimum time gap between a first time point of the second device receiving the HARQ NACK through the PSFCH and a second time point of the second device retransmitting, to the first device, the MAC PDU.

10. The method of claim 3, wherein the SCI includes information representing that a HARQ feedback for the MAC PDU is enabled.

11. The method of claim 3, wherein the SCI includes information representing that a HARQ feedback for the MAC PDU is disabled.

12. The method of claim 3, wherein the SCI is received based on the first device being in active mode,

wherein the SCI includes resource information related to a first resource in which the SCI is received and a second resource after the first resource, and
wherein the second resource exists within a time duration after expiration of an on-duration timer of the SL DRX configuration.

13. The method of claim 3, wherein the SL DRX HARQ RTT timer is started based on the existence of the second resource within the time duration after the expiration of the on-duration timer and the SL DRX HARQ RTT timer value.

14. A first device for performing wireless communication, the first device comprising:

one or more memories storing instructions;
one or more transceivers; and
one or more processors connected to the one or more memories and the one or more transceivers, wherein the one or more processors execute the instructions to:

receive, from a second device, a sidelink, SL, discontinuous reception, DRX, configuration;
receive, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode;
determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode;
start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and
start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer,
wherein the first device is in active mode, based on the SL DRX retransmission timer being running, and
wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

15. A device adapted to control a first user equipment, UE, the device comprising:

one or more processors; and
one or more memories operably connectable to the one or more processors and storing instructions, wherein the one or more processors execute the instructions to:

receive, from a second UE, a sidelink, SL, discontinuous reception, DRX, configuration;
receive, from the second UE, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode;
determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based

on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode;
start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and
start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer,
wherein the first UE is in active mode, based on the SL DRX retransmission timer being running, and
wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

16. A non-transitory computer-readable storage medium storing instructions that, when executed, cause a first device to:

receive, from a second device, a sidelink, SL, discontinuous reception, DRX, configuration;
receive, from the second device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode;
determine an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value, based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode;
start an SL DRX HARQ RTT timer based on the SL DRX HARQ RTT timer value; and
start an SL DRX retransmission timer, based on expiration of the SL DRX HARQ RTT timer,
wherein the first device is in active mode, based on the SL DRX retransmission timer being running, and
wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

17. A method for performing, by a second device, wireless communication, the method comprising:

transmitting, to a first device, a sidelink, SL, discontinuous reception, DRX, configuration; and
transmitting, to the first device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode,
wherein an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value is determined based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode,
wherein an SL DRX HARQ RTT timer is started based on the SL DRX HARQ RTT timer value,
wherein an SL DRX retransmission timer is started based on expiration of the SL DRX HARQ RTT timer,
wherein the first device is in active mode, based on the SL DRX retransmission timer being running, and
wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

18. The method of claim 17, wherein the information related to whether a PUCCH resource is configured and the information related to resource allocation mode are transmitted through sidelink control information, SCI.

19. A second device for performing wireless communication, the second device comprising:

one or more memories storing instructions;
one or more transceivers; and
one or more processors connected to the one or more memories and the one or more transceivers, wherein the one or more processors execute the instructions to:

transmit, to a first device, a sidelink, SL, discontinuous reception, DRX, configuration; and
transmit, to the first device, information related to whether a physical uplink control channel, PUCCH, resource is configured and information related to resource allocation mode,
wherein an SL DRX hybrid automatic repeat request, HARQ, round trip time, RTT, timer value is determined based on the information related to whether a PUCCH resource is configured and the information related to resource allocation mode,
wherein an SL DRX HARQ RTT timer is started based on the SL DRX HARQ RTT timer value,
wherein an SL DRX retransmission timer is started based on expiration of the SL DRX HARQ RTT timer,
wherein the first device is in active mode, based on the SL DRX retransmission timer being running, and
wherein the SL DRX configuration includes information related to an SL DRX cycle and information related to an SL DRX active time.

20. The second device of claim 19, wherein the information related to whether a PUCCH resource is configured and the information related to resource allocation mode are transmitted through sidelink control information, SCI.

FIG. 1

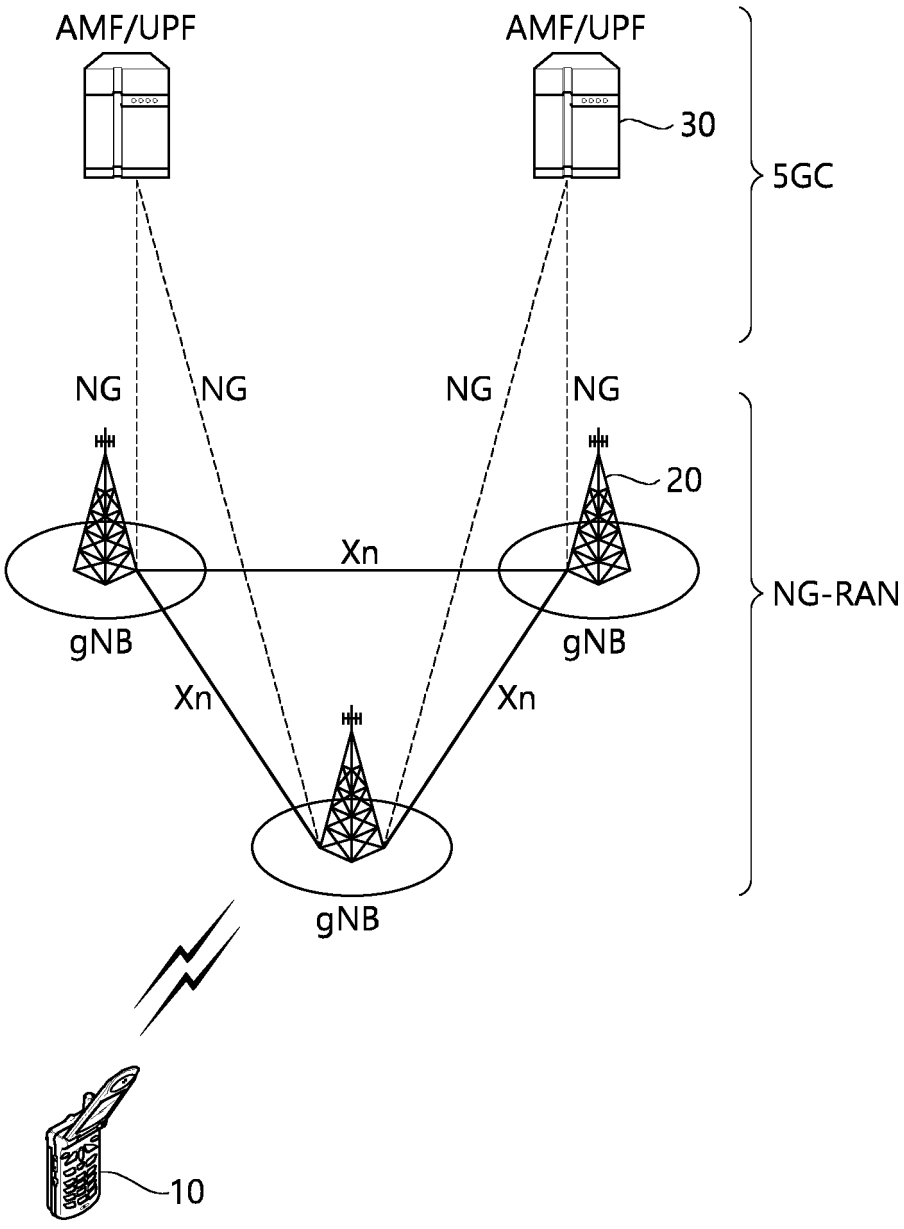


FIG. 2

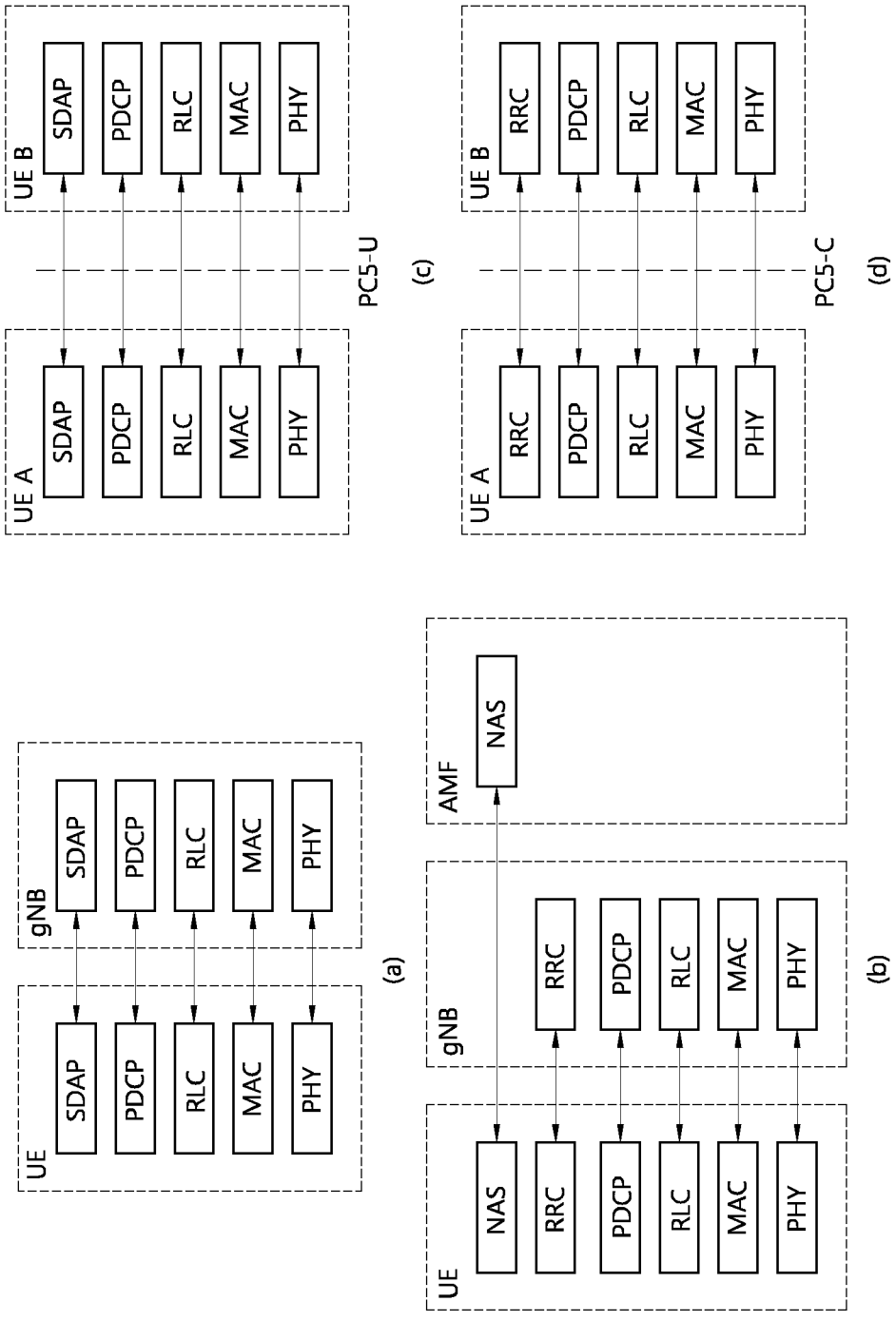


FIG. 3

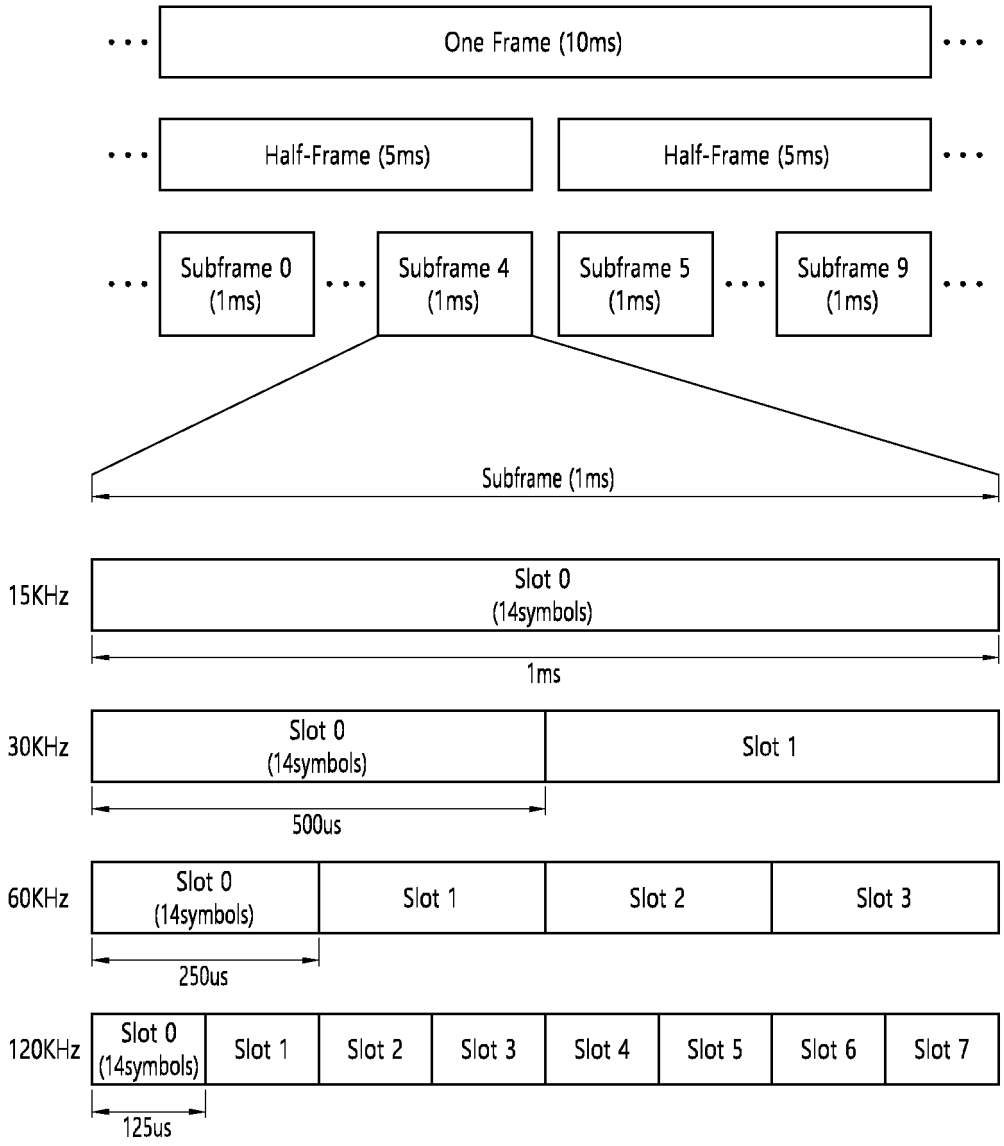

One Frame (10ms)
Half-Frame (5ms)
Half-Frame (5ms)
Subframe 0 (1ms)
Subframe 4 (1ms)
Subframe 5 (1ms)
Subframe 9 (1ms)
Subframe (1ms)
15KHz
Slot 0 (14symbols)
1ms
30KHz
Slot 0 (14symbols)
Slot 1
500us
60KHz
Slot 0 (14symbols)
Slot 1
Slot 2
Slot 3
250us
120KHz
Slot 0 (14symbols)
Slot 1
Slot 2
Slot 3
Slot 4
Slot 5
Slot 6
Slot 7
125us

FIG. 4

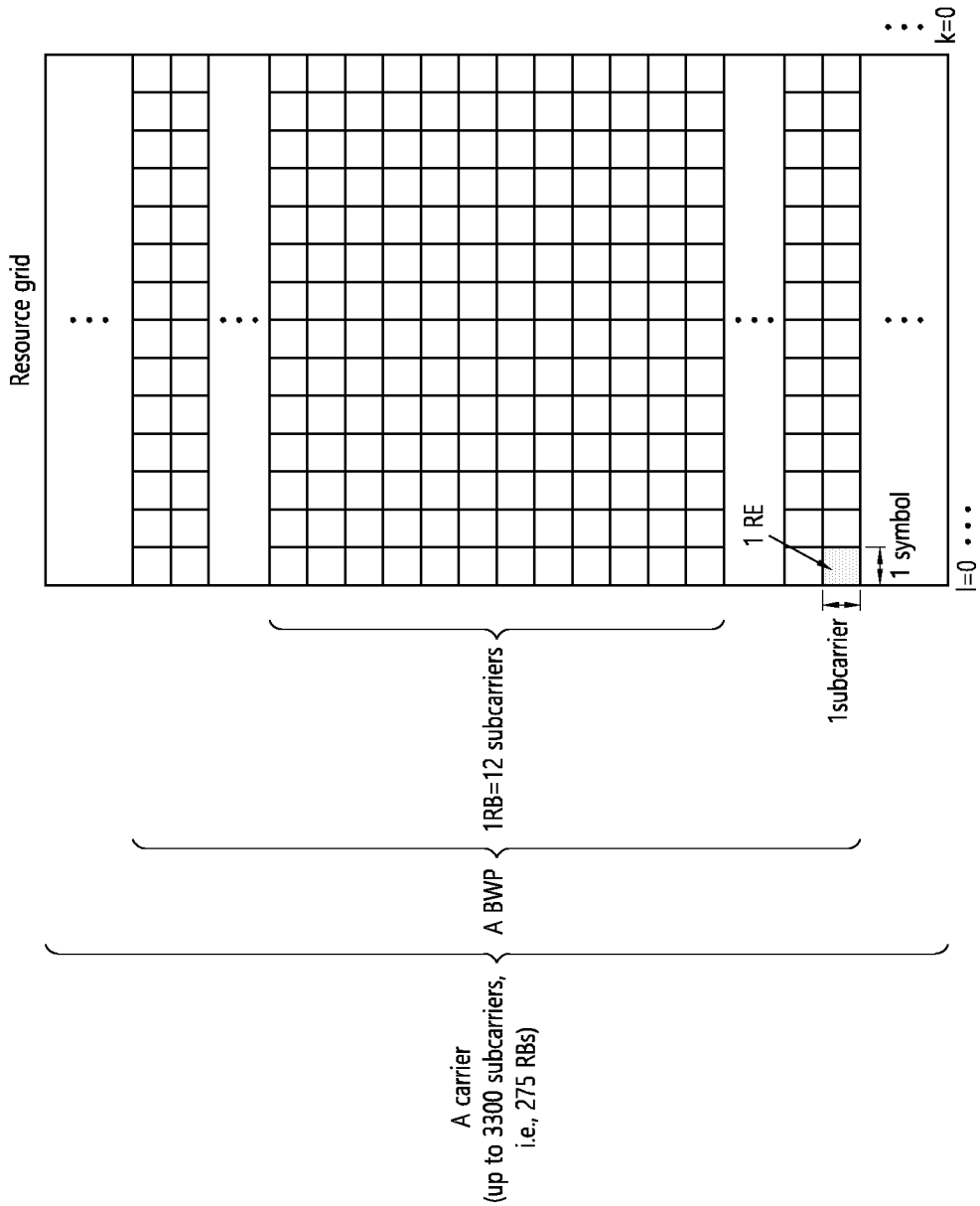

Resource grid
k=0
l=0
1 RE
1 symbol
1subcarrier
1RB=12 subcarriers
A BWP
A carrier
(up to 3300 subcarriers,
i.e., 275 RBs)

FIG. 5

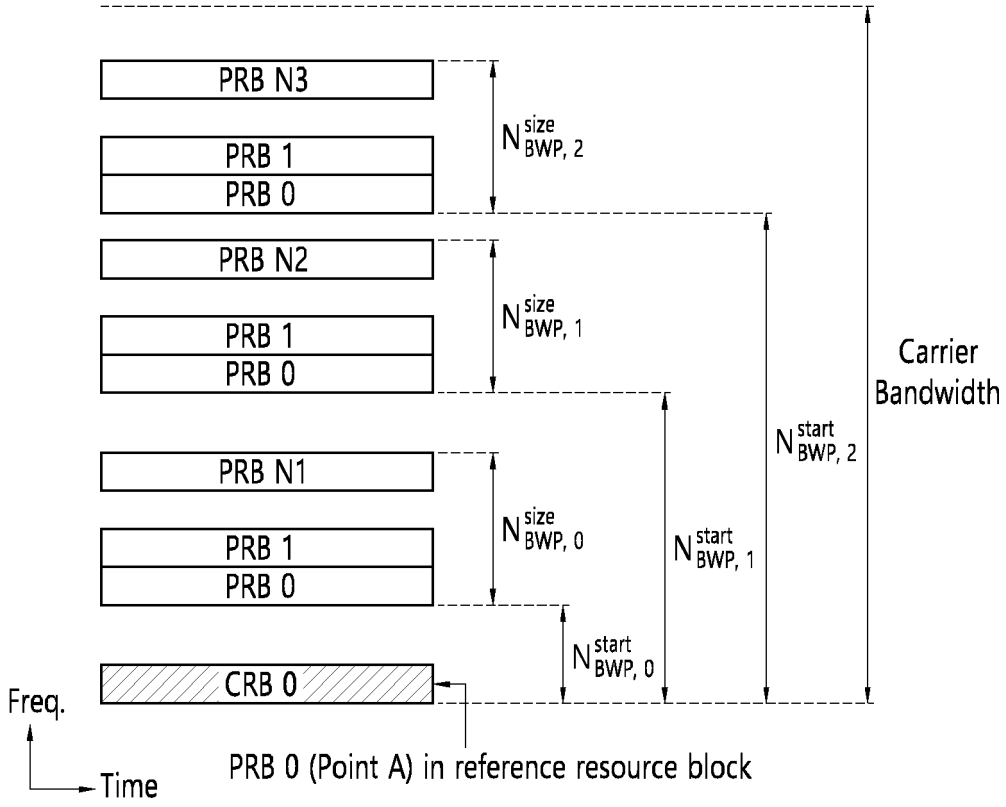

PRB N3
PRB 1
PRB 0
PRB N2
PRB 1
PRB 0
PRB N1
PRB 1
PRB 0
CRB 0
$N^{size}_{BWP,2}$
$N^{size}_{BWP,1}$
$N^{size}_{BWP,0}$
$N^{start}_{BWP,2}$
$N^{start}_{BWP,1}$
$N^{start}_{BWP,0}$
Carrier Bandwidth
Freq.
Time
PRB 0 (Point A) in reference resource block

FIG. 6

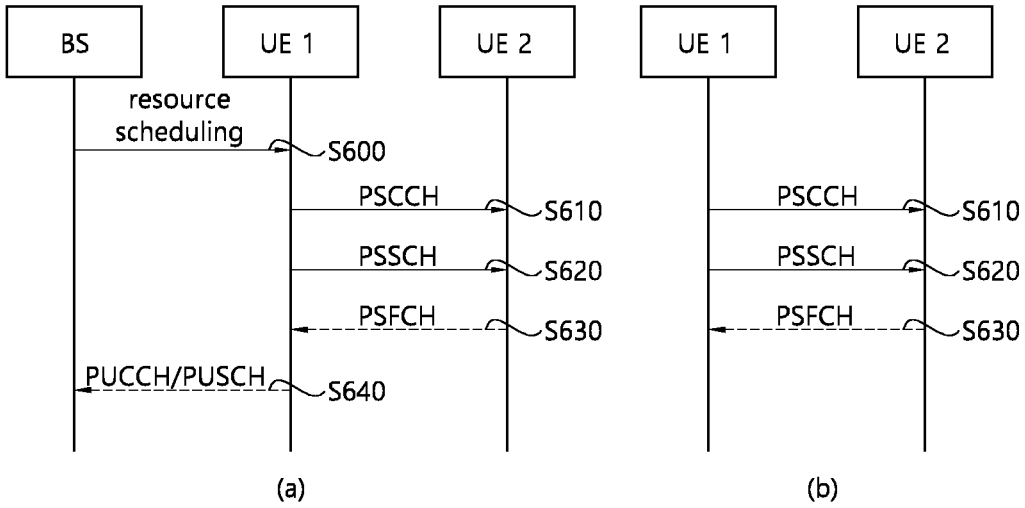

BS
UE 1
UE 2
resource scheduling
S600
PSCCH
S610
PSSCH
S620
PSFCH
S630
PUCCH/PUSCH
S640
(a)
UE 1
UE 2
PSCCH
S610
PSSCH
S620
PSFCH
S630
(b)

FIG. 7

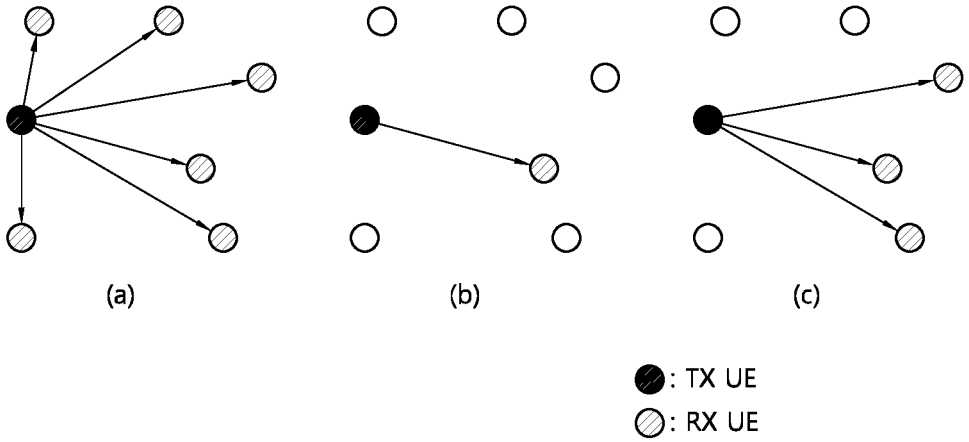

(a)
(b)
(c)
: TX UE
: RX UE

FIG. 8

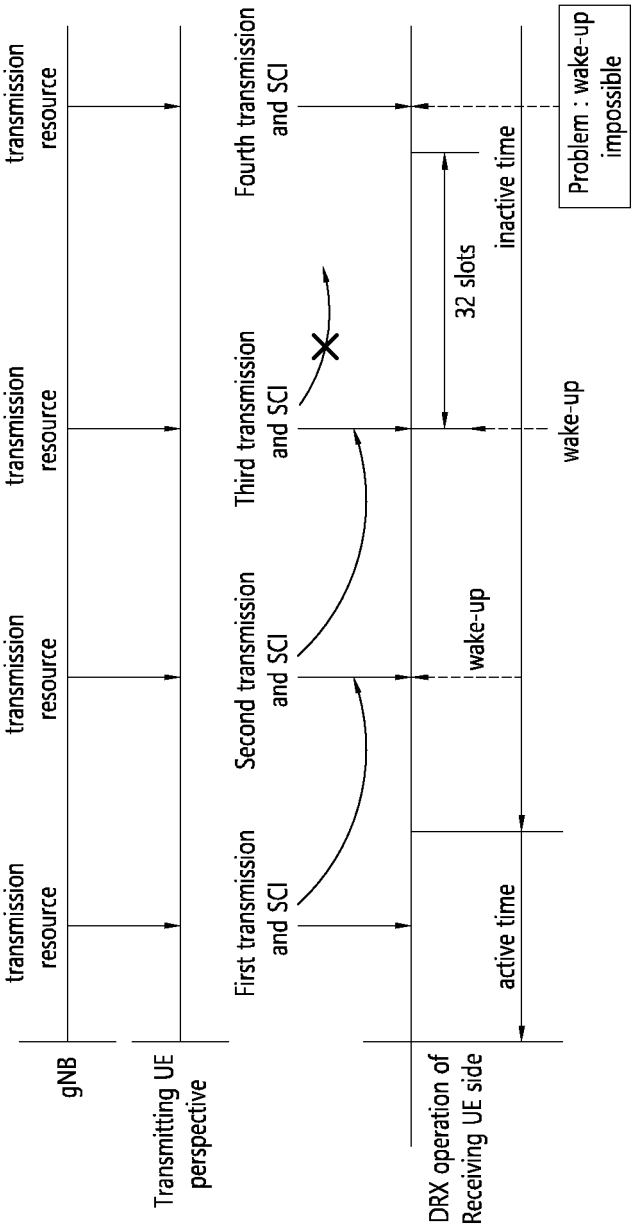

gNB
Transmitting UE perspective
DRX operation of Receiving UE side
First mode 1 transmission resource
Second mode 1 transmission resource
Third mode 1 transmission resource
Fourth mode 1 transmission resource
First transmission and SCI
Second transmission and SCI
Third transmission and SCI
Fourth transmission and SCI
active time
wake-up
32 slots
inactive time
wake-up
Problem : wake-up impossible

FIG. 9

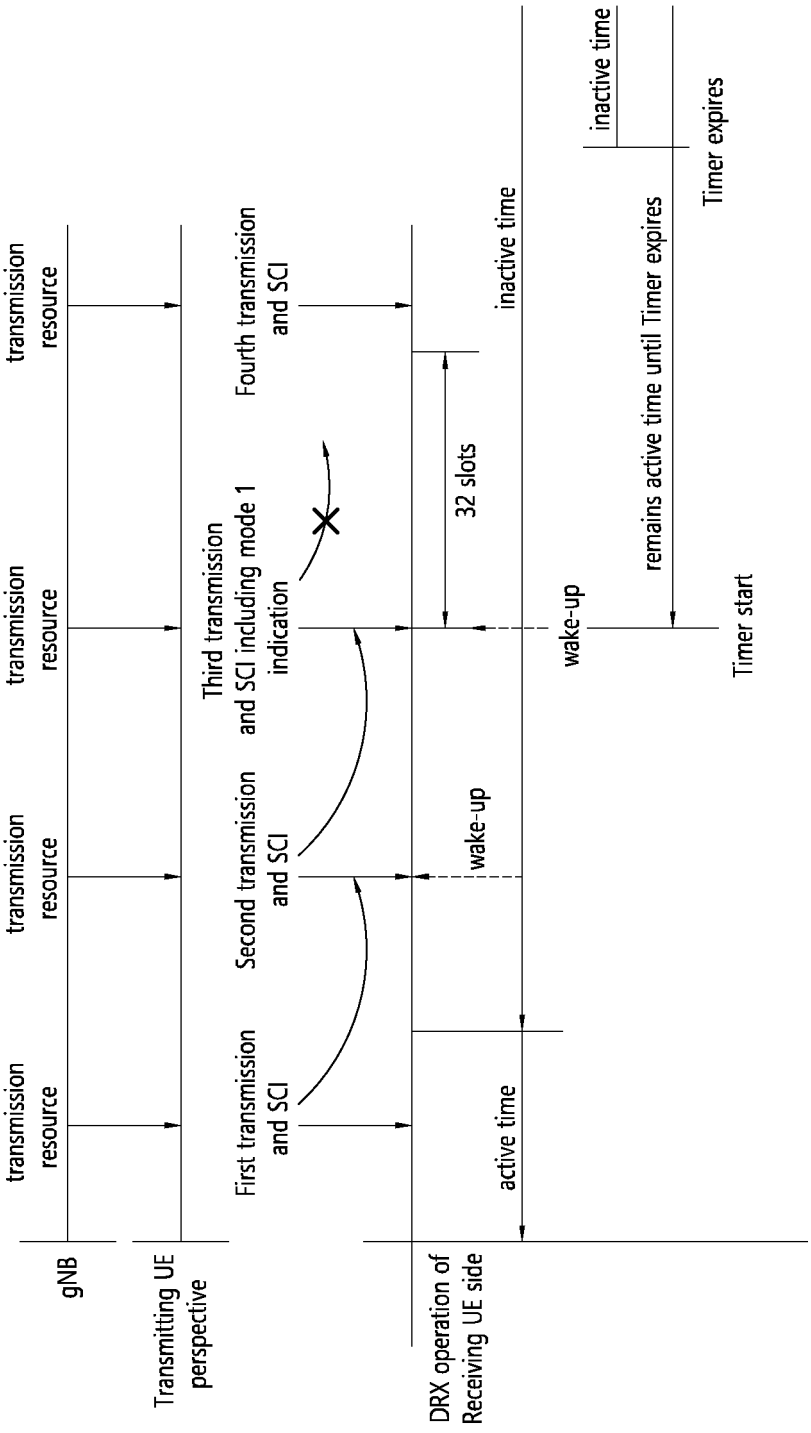

gNB
Transmitting UE perspective
DRX operation of Receiving UE side
First mode 1 transmission resource
Second mode 1 transmission resource
Third mode 1 transmission resource
Fourth mode 1 transmission resource
First transmission and SCI
Second transmission and SCI
Third transmission and SCI including mode 1 indication
Fourth transmission and SCI
active time
wake-up
32 slots
inactive time
wake-up
remains active time until Timer expires
Timer start
Timer expires
inactive time

FIG. 10

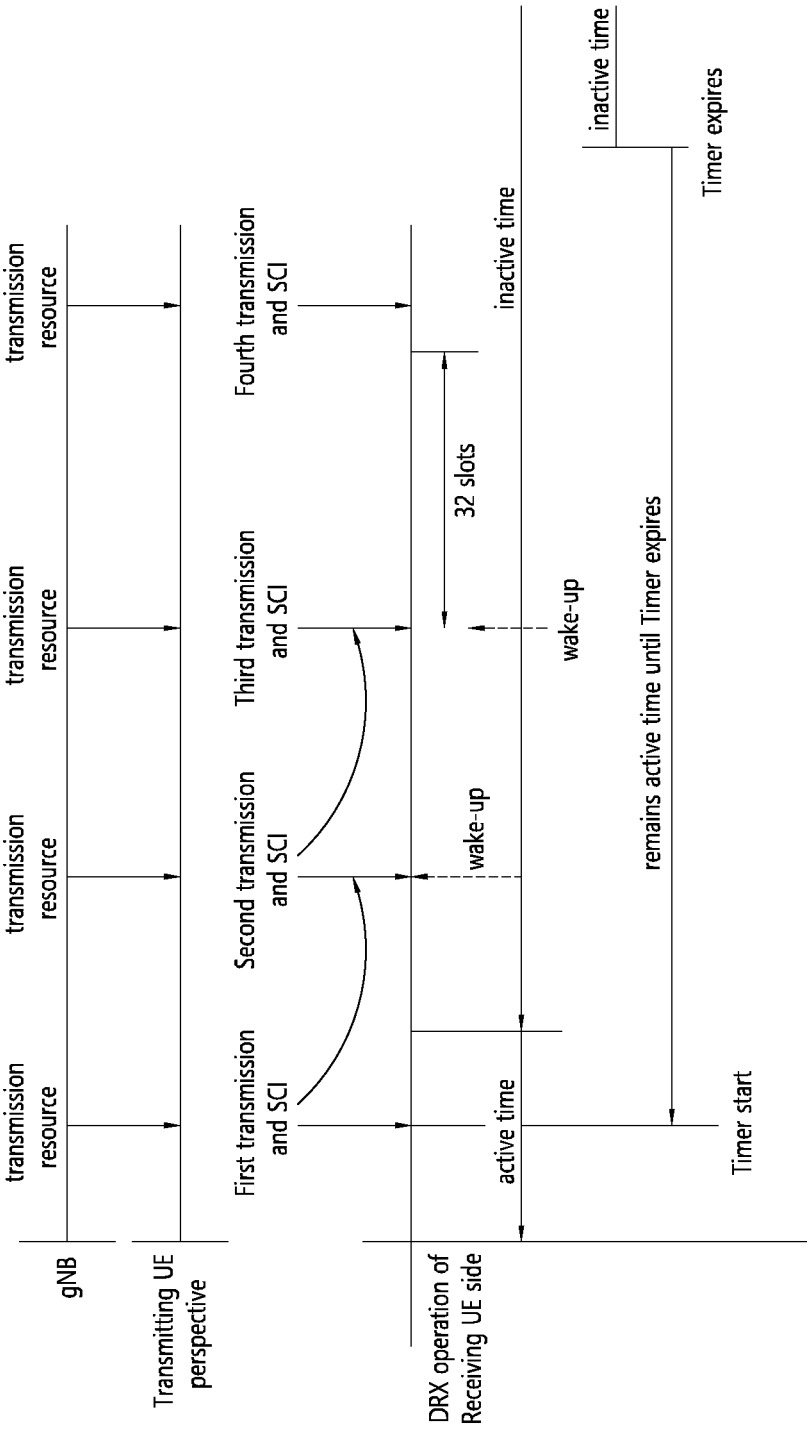

gNB
Transmitting UE perspective
DRX operation of Receiving UE side
First mode 1 transmission resource
Second mode 1 transmission resource
Third mode 1 transmission resource
Fourth mode 1 transmission resource
First transmission and SCI
Second transmission and SCI
Third transmission and SCI
Fourth transmission and SCI
active time
wake-up
32 slots
wake-up
inactive time
inactive time
remains active time until Timer expires
Timer start
Timer expires

FIG. 11

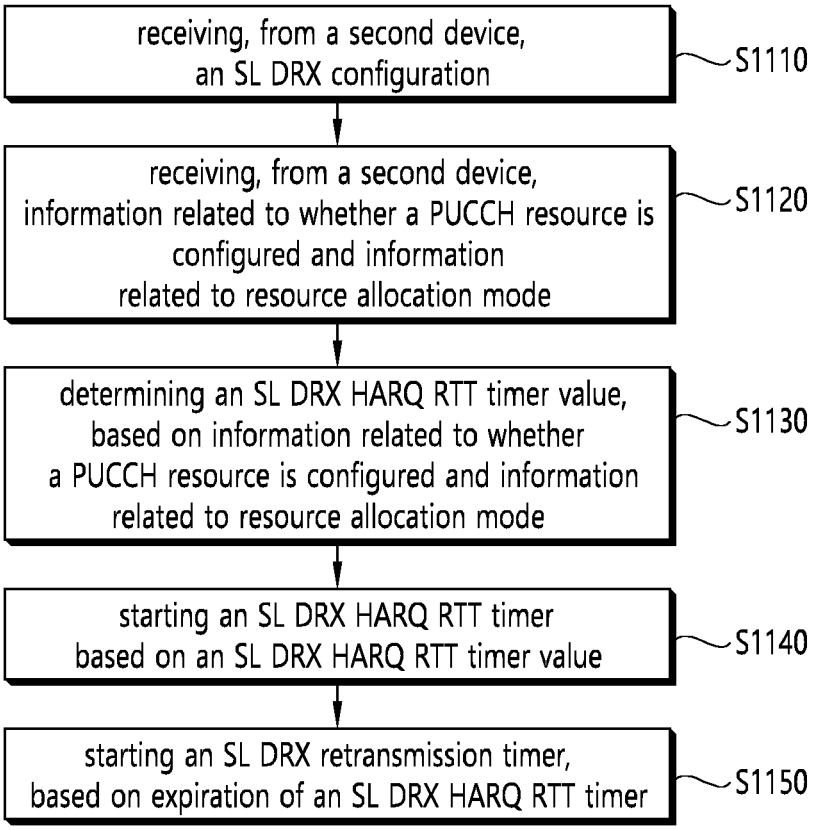

receiving, from a second device, an SL DRX configuration
S1110
receiving, from a second device, information related to whether a PUCCH resource is configured and information related to resource allocation mode
S1120
determining an SL DRX HARQ RTT timer value, based on information related to whether a PUCCH resource is configured and information related to resource allocation mode
S1130
starting an SL DRX HARQ RTT timer based on an SL DRX HARQ RTT timer value
S1140
starting an SL DRX retransmission timer, based on expiration of an SL DRX HARQ RTT timer
S1150

FIG. 12

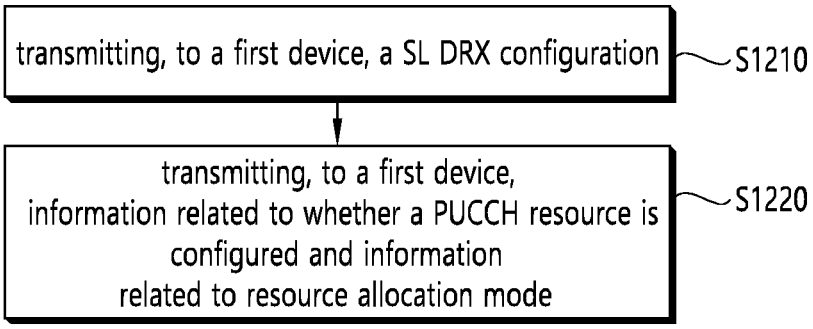

transmitting, to a first device, a SL DRX configuration
S1210
transmitting, to a first device, information related to whether a PUCCH resource is configured and information related to resource allocation mode
S1220

FIG. 13

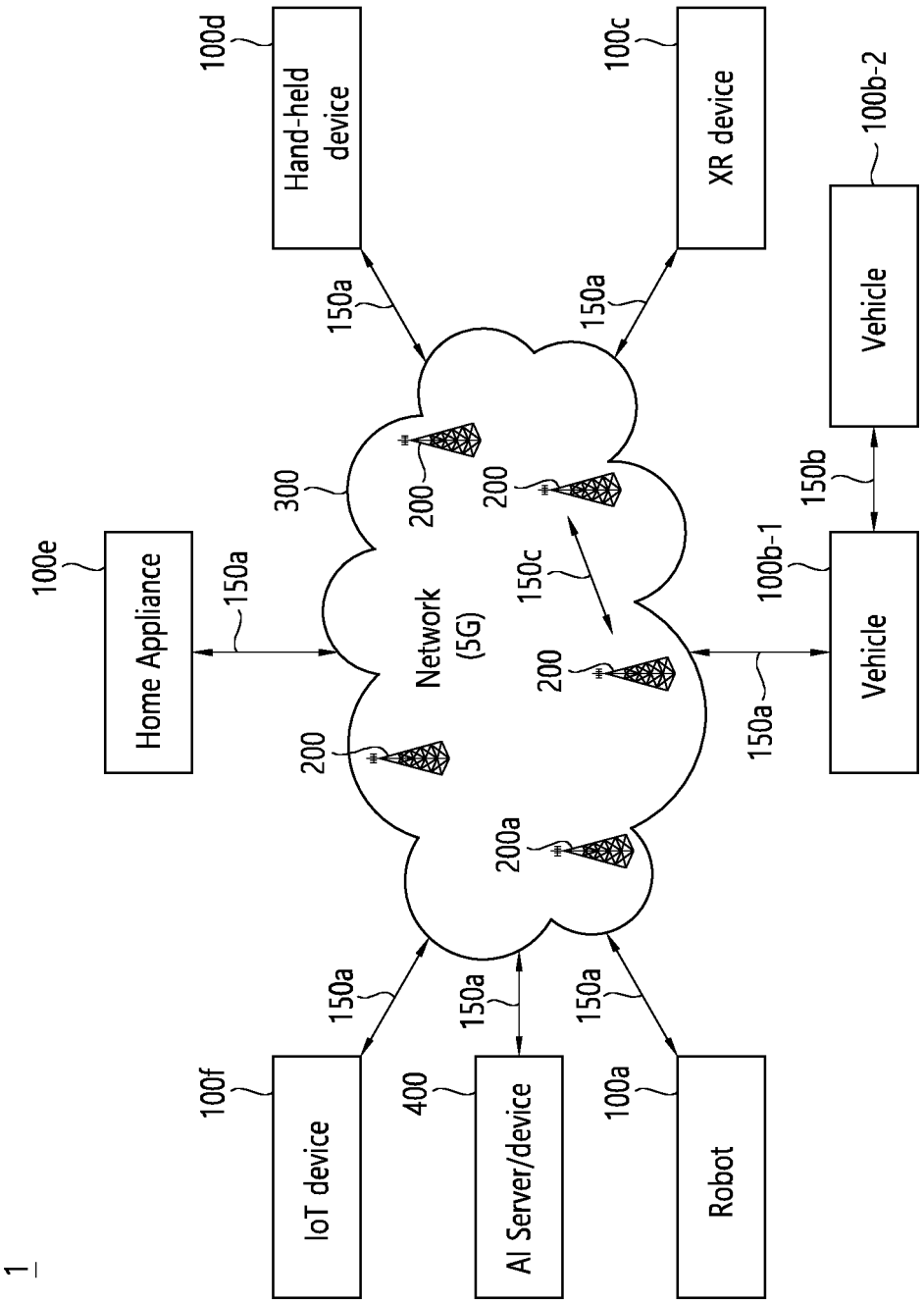

1
Network (5G)
Hand-held device
100d
XR device
100c
Vehicle
100b-2
Home Appliance
100e
Vehicle
100b-1
IoT device
100f
AI Server/device
400
Robot
100a
150a
150b
150c
200
200a
300

FIG. 14

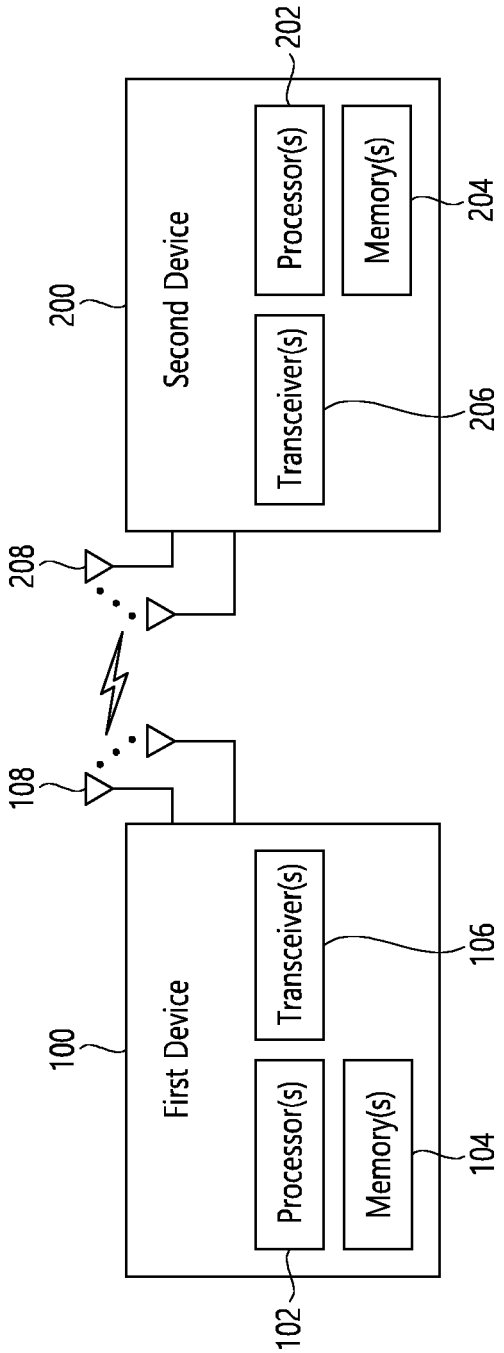

Second Device
200
Processor(s)
202
Memory(s)
204
Transceiver(s)
206
208
108
First Device
100
Transceiver(s)
106
Processor(s)
Memory(s)
104
102

FIG. 15

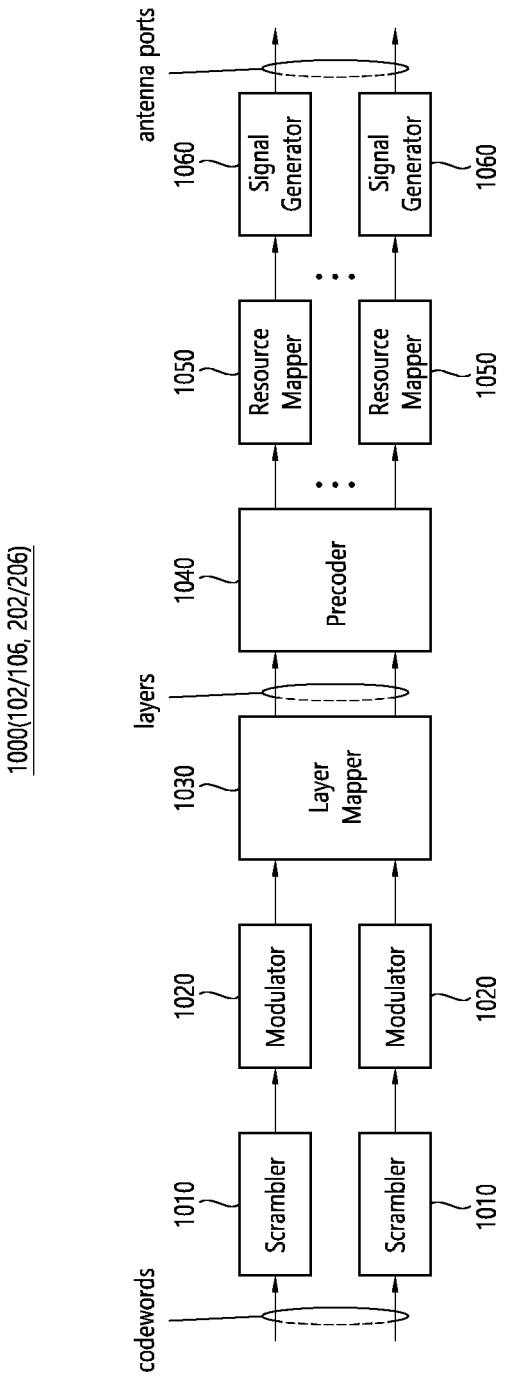

1000(102/106, 202/206)
codewords
1010
Scrambler
1020
Modulator
layers
1030
Layer Mapper
1040
Precoder
1050
Resource Mapper
1060
Signal Generator
antenna ports

FIG. 16

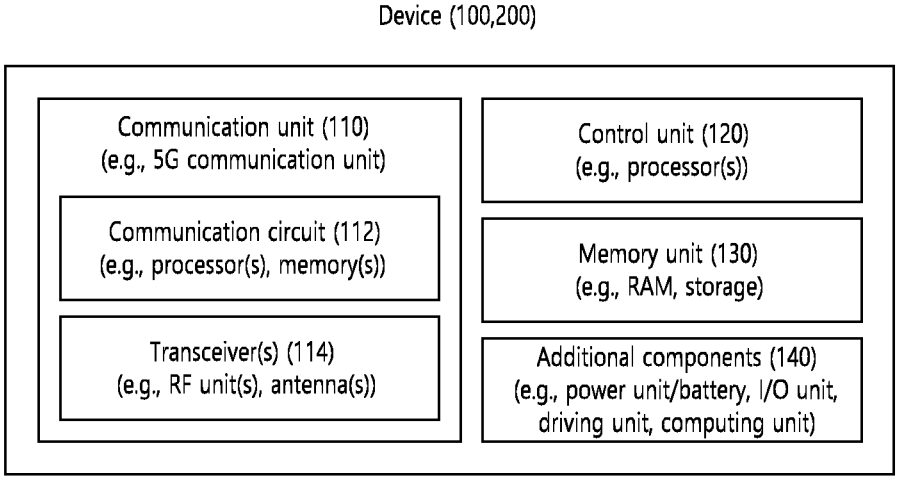

Device (100,200)
Communication unit (110)
(e.g., 5G communication unit)
Communication circuit (112)
(e.g., processor(s), memory(s))
Transceiver(s) (114)
(e.g., RF unit(s), antenna(s))
Control unit (120)
(e.g., processor(s))
Memory unit (130)
(e.g., RAM, storage)
Additional components (140)
(e.g., power unit/battery, I/O unit,
driving unit, computing unit)

FIG. 17

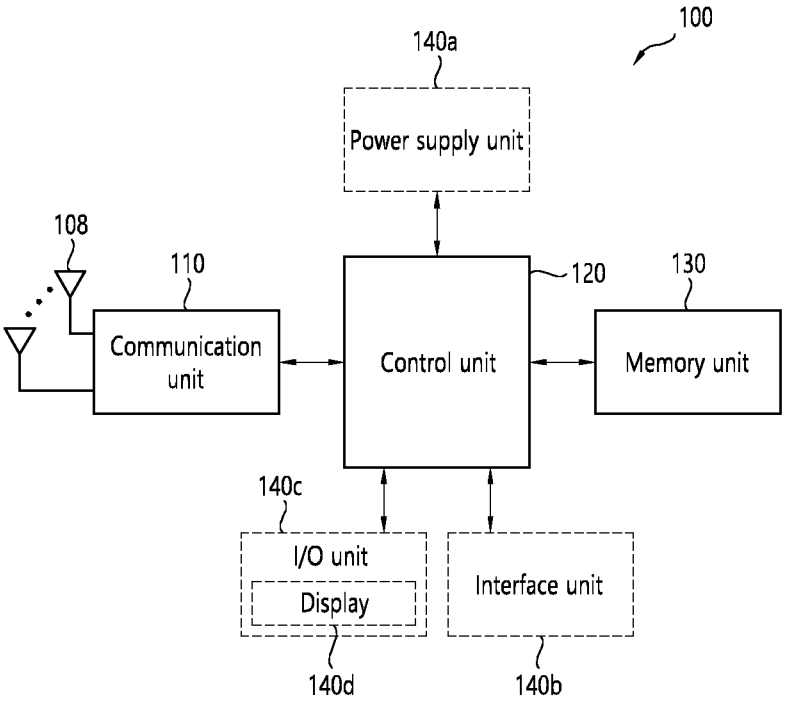
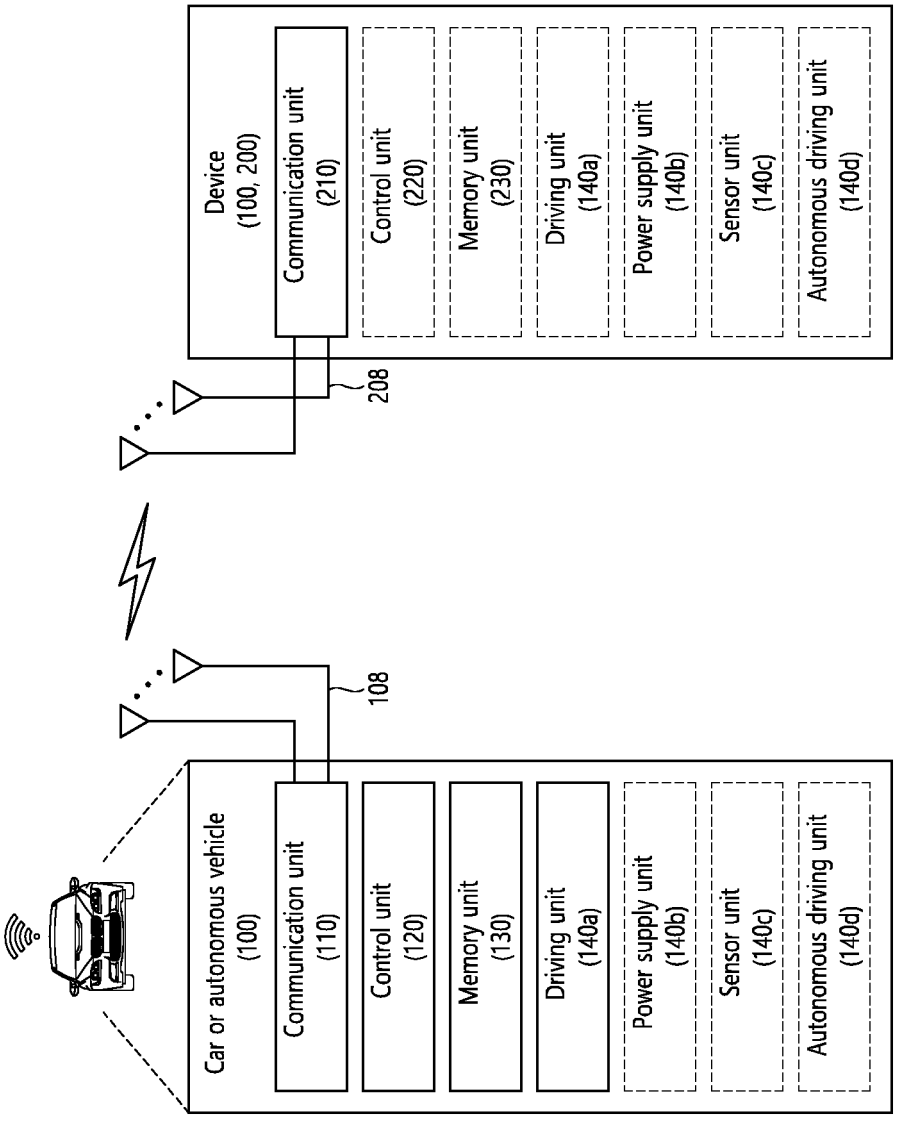

100
140a
Power supply unit
108
110
120
130
Communication unit
Control unit
Memory unit
140c
I/O unit
Display
Interface unit
140d
140b

FIG. 18


Car or autonomous vehicle (100)
Communication unit (110)
Control unit (120)
Memory unit (130)
Driving unit (140a)
Power supply unit (140b)
Sensor unit (140c)
Autonomous driving unit (140d)
108
208
Device (100, 200)
Communication unit (210)
Control unit (220)
Memory unit (230)
Driving unit (140a)
Power supply unit (140b)
Sensor unit (140c)
Autonomous driving unit (140d)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2021/020376

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/12(2009.01)i; **H04W 72/04**(2009.01)i; **H04W 76/28**(2018.01)i; **H04W 4/40**(2018.01)i; **H04W 92/18**(2009.01)i

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 72/12(2009.01); H04W 76/14(2018.01); H04W 76/28(2018.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: SL DRX configuration, PUCCH, 자원 할당 모드(resource allocation mode), SL DRX HARQ RTT timer, SL DRX retransmission timer, active mode, cycle, active time, MAC PDU, NACK, 최소 시간 갭(minimum time gap), HARQ feedback, enabled, disabled, SCI, on-duration

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	LG ELECTRONICS INC. Discussion on Sidelink DRX. R2-2008943, 3GPP TSG-RAN WG2 Meeting #112 electronic. Online. 23 October 2020.	
Y	See sections 2.2-2.9.	1-4,7-20
A		5-6
	HUAWEI et al. Discussion on remaining MAC open issues for 5G V2X with NR SL. R2-2003555, 3GPP TSG-RAN WG2 Meeting #109-bis electronic. 10 April 2020.	
Y	See sections 2.1-2.7.	1-4,7-20
	HUAWEI et al. Discussion on remaining MAC open issues for 5G V2X with NR SL. R2-2005492, 3GPP TSG-RAN WG2 Meeting #110 electronic. 22 May 2020.	
Y	See sections 2.1-2.3, 5.7 and 5.22.1.1.	3-4,7-13
	LG ELECTRONICS. Discussion on physical layer design considering DRX operation. R1-2007897, 3GPP TSG RAN WG1 #103-e, E-Meeting. 01 November 2020.	
A	See sections 2.1-2.4.	1-20

☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 March 2022	**17 March 2022**
Name and mailing address of the ISA/KR **Korean Intellectual Property Office** **Government Complex-Daejeon Building 4, 189 Cheongsa-ro, Seo-gu, Daejeon 35208** Facsimile No. **+82-42-481-8578**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2021/020376

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2019-0039101 A (SONY CORPORATION) 10 April 2019 (2019-04-10) See paragraphs [0024]-[0166]; and claims 1-2 and 15.	1-20

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2021/020376

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2019-0039101 A	10 April 2019	CN 108307486 A	20 July 2018
		CN 109196939 A	11 January 2019
		EP 3500028 A1	19 June 2019
		EP 3500028 B1	24 March 2021
		JP 2019-525607 A	05 September 2019
		US 10708861 B2	07 July 2020
		US 2019-0174411 A1	06 June 2019
		US 2020-0296668 A1	17 September 2020
		WO 2018-028416 A1	15 February 2018

Form PCT/ISA/210 (patent family annex) (July 2019)