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(71) Applicant: **LENOVO (BEIJING) LIMITED** [CN/CN]; 6 Shangdi West Road, Haidian District, Beijing 100085 (CN).

(72) Inventors: **GUO, Xin**; Lenovo HQ East, Building No. 1, No. 10 Xibeiwang East Road, Haidian District, Beijing 100094 (CN). **LEI, Haipeng**; Lenovo HQ East, Building No. 1, No. 10 Xibeiwang East Road, Haidian District, Beijing 100094 (CN). **SUN, Zhennian**; Lenovo HQ East, Building No. 1, No. 10 Xibeiwang East Road, Haidian District, Beijing 100094 (CN). **YU, Xiaodong**; Lenovo HQ East, Building No. 1, No. 10 Xibeiwang East Road, Haidian District, Beijing 100094 (CN).

(74) Agent: **KING & WOOD MALLESONS**; 20th Floor, East Tower, World Financial Centre, No. 1 Dongsanhuan Zhonglu, Chaoyang District, Beijing 100020 (CN).

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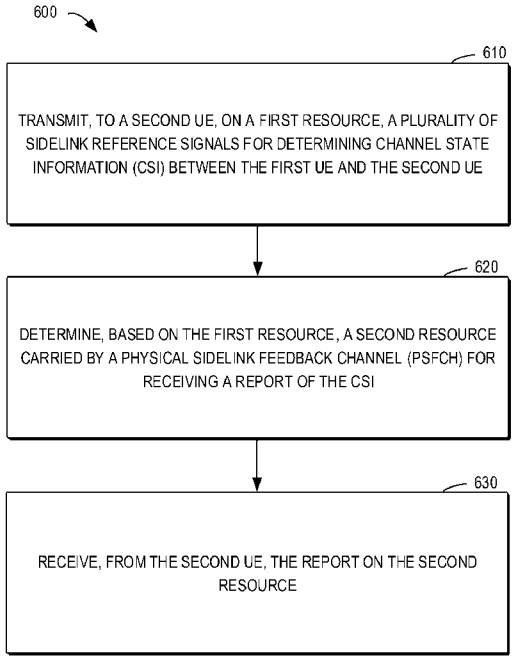


FIG. 6

(57) Abstract: Various aspects of the present disclosure relate to CSI reporting. In some embodiments, a first user equipment (UE) transmits, to a second UE, on a first resource, a plurality of sidelink reference signals for determining CSI between the first UE and the second UE. Then, the first UE determines, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI. Moreover, the first UE receives, from the second UE, the report on the second resource. In this way, it is possible to improve the sidelink communications with enhanced efficiency.

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CHANNEL STATE INFORMATION REPORTING

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to channel state information (CSI) reporting.

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may be otherwise known as an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Each network communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0003] A sidelink reference signal has been introduced to facilitate sidelink communications. For example, a sidelink channel state information reference signal (SL CSI-RS) transmitted by a transmitting (TX) UE is used for measuring channel state information (CSI) at a receiving (RX) UE. The CSI is then reported by the RX UE to the TX UE. The TX UE may adjust its transmission based on the reported CSI. However, enhancements on the CSI reporting are still needed.

SUMMARY

[0004] The present disclosure relates to methods, apparatuses, and systems that support CSI reporting. With the apparatuses and methods, it is possible to improve the sidelink communications with enhanced efficiency.

[0005] In a first aspect, there is provided a first UE. The first UE comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the first UE to: transmit, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and receive, from the second UE, the report on the second resource.

[0006] In a second aspect, there is provided a method performed by the first UE. The method comprises: transmitting, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and receiving, from the second UE, the report on the second resource.

[0007] In a third aspect, there is provided a processor for wireless communication. The at least one processor comprises at least one controller coupled with at least one memory and configured to cause the at least one processor to: transmit, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and receive, from the second UE, the report on the second resource.

[0008] In some implementations of the method and the first UE described herein, determining the second resource comprises: etermining a time-domain resource distribution of the second resource; determining a time interval between the first resource and the second resource; and determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

[0009] In some implementations of the method and the first UE described herein, determining the time-domain resource distribution comprises: determining that there is a same time gap between any two contiguous occasions for CSI reporting in the second resource, the time-domain resource of the second resource comprising a plurality of slots for CSI reporting, a slot of the plurality of slots comprising one occasion for CSI reporting.

[0010] In some implementations of the method and the first UE described herein, determining the time-domain resource distribution comprises: determining that the time-domain resource of the second resource comprises one or more slots for CSI reporting, and a slot of the one or more slots comprises a plurality of occasions for CSI reporting.

[0011] In some implementations of the method and the first UE described herein, the time-domain resource distribution is determined based on configuration information. In some implementations of the method and the first UE described herein, the configuration information is pre-configured or configured by a base station (BS). In some implementations of the method and the first UE described herein, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP). In some implementations of the method and the first UE described herein, the configuration information is configured via a radio resource control (RRC) signaling.

[0012] In some implementations of the method and the first UE described herein, the time interval is: determined by the first UE; or pre-configured or configured by the BS. In some implementations of the method and the first UE described herein, the time interval is determined by the first UE, and some implementations of the method and the first UE described herein may further include: transmitting, to the second UE, the time interval and an indicator of a last slot in the first resource. In some implementations of the method and the first UE described herein, the time interval is determined by the first UE, and some implementations of the method and the first UE described herein may further include: transmitting, to the second UE: an indication of an interval of a first slot in the second resource relative to a reference slot in the first resource; and one of the following for determining the reference slot: an index of the reference slot; remaining number of slots after the reference signal in the first resource; an indicator of a first slot in the first resource; or an indicator of a last slot in the first resource.

[0013] In some implementations of the method and the first UE described herein, determining the second resource comprises: determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting. In some implementations of the method and the first UE described herein, the bitmap is pre-configured or configured by a BS. In some implementations of the method and the first UE described herein, the bitmap is pre-configured or configured

per resource pool (RP), or per bandwidth part (BWP). In some implementations of the method and the first UE described herein, the plurality of PRBs available for CSI reporting are determined based on a payload size for transmitting the plurality of sidelink reference signals and the bitmap. In some implementations of the method and the first UE described herein, determining the frequency-domain resource of the second resource comprises: determining a number of PRBs required for CSI reporting; determining that the plurality of PRBs available for CSI reporting are divided into a plurality of frequency-domain resource groups based on the number of PRBs required for CSI reporting; and selecting a frequency-domain resource group from the plurality of frequency-domain resource groups as the frequency-domain resource of the second resource.

[0014] In some implementations of the method and the first UE described herein, determining the second resource comprises: determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts; determining a target cyclic shift from the plurality of cyclic shifts; and determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

[0015] In some implementations of the method and the first UE described herein, determining the second resource comprises: based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number; determining a target index from the plurality of indexes; and determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index. In some implementations of the method and the first UE described herein, the target index is determined based on one or more time offsets for transmitting the plurality of sidelink reference signals, a time offset of the one or more time offsets representing a time-domain offset of a slot for transmitting one of the plurality of sidelink reference signals within a period relative to a starting boundary of the period. In some implementations of the method and the first UE

described herein,n the one or more time offsets are one of the following: determined by the first UE; or configured by a BS. Some implementations of the method and the first UE described herein may further include transmitting the one or more time offset to the second UE. In some implementations of the method and the first UE described herein, the one or more time offsets are transmitted in one of: sidelink control information (SCI) or a media access control control element (MAC CE) in one of the following: each slot of the plurality of slots; one or more slots of the plurality of slots; a first slot of the plurality of slots; or a last slot of the plurality of slots.

[0016] Some implementations of the method and the first UE described herein may further include determining the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals. In some implementations of the method and the first UE described herein, determining the first resource comprises: determining a plurality of slots for transmitting the plurality of sidelink reference signals based on the periodicity and one or more time offsets. In some implementations of the method and the first UE described herein, a slot of the plurality of slots for transmitting the plurality of sidelink reference signals comprises one or more occasions for transmitting one or more of the plurality of sidelink reference signals.

[0017] In a fourth aspect, there is provided a second UE. The second UE comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the second UE to: receive, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and transmit, to the first UE, the report based on the second resource.

[0018] In a fifth aspect, there is provided a method performed by the second UE. The method comprises: receiving, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and transmitting, to the first UE, the report based on the second resource.

[0019] In a sixth aspect, there is provided a processor for wireless communication. The at least one processor comprises at least one controller coupled with at least one memory and configured to cause the at least one processor to: receive, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and transmit, to the first UE, the report based on the second resource.

[0020] Some implementations of the method and the second UE described herein may further include determining a beam pair of a transmit beam of the first UE and a receive beam of the second UE based on a plurality of measurements of the plurality of sidelink reference signals; determining, from the second resource, based on the beam pair, a third resource for transmitting the report. In some implementations of the method and the second UE described herein, transmitting the report based on the second resource comprises: transmitting, to the first UE, the report on the third resource.

[0021] In some implementations of the method and the second UE described herein, determining the second resource comprises: determining a time-domain resource distribution of the second resource; determining a time interval between the first resource and the second resource; and determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

[0022] In some implementations of the method and the second UE described herein, determining the time-domain resource distribution comprises: determining that there is a same time gap between any two contiguous occasions for CSI reporting in the second resource, the time-domain resource of the second resource comprising a plurality of slots for CSI reporting, a slot of the plurality of slots comprising one occasion for CSI reporting.

[0023] In some implementations of the method and the second UE described herein, determining the time-domain resource distribution comprises: determining that the time-domain resource of the second resource comprises one or more slots for CSI reporting, and a slot of the one or more slots comprises a plurality of occasions for CSI reporting.

[0024] In some implementations of the method and the second UE described herein, the time-domain resource distribution is determined based on based on configuration

information. In some implementations of the method and the second UE described herein, the configuration information is pre-configured or configured by a base station (BS). In some implementations of the method and the second UE described herein, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP). In some implementations of the method and the second UE described herein, the configuration information is configured via a radio resource control (RRC) signaling.

[0025] In some implementations of the method and the second UE described herein, the time interval is: received from the first UE; or pre-configured or configured by the BS. In some implementations of the method and the second UE described herein,n receiving the time interval comprises: receiving, from the first UE, the time interval and an indicator of a last slot in the first resource. In some implementations of the method and the second UE described herein, receiving the time interval comprises: receiving, from the first UE, the following: an indication of an interval of a first slot in the second resource relative to a reference slot in the first resource; and one of the following for determining the reference slot: an index of the reference slot; remaining number of slots after the reference signal in the first resource; an indicator of a first slot in the first resource; or an indicator of a last slot in the first resource.

[0026] In some implementations of the method and the second UE described herein, determining the second resource comprises: determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting. In some implementations of the method and the second UE described herein, the bitmap is pre-configured or configured by a BS. In some implementations of the method and the second UE described herein, the bitmap is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP). In some implementations of the method and the second UE described herein, the plurality of PRBs available for CSI reporting are determined based on a payload size for transmitting the plurality of sidelink reference signals and the bitmap. In some implementations of the method and the second UE described herein, determining the frequency-domain resource of the second resource comprises: determining a number of PRBs required for CSI reporting; determining that the plurality of PRBs available for CSI reporting are divided into a plurality of frequency-domain resource groups based on the number of PRBs

required for CSI reporting; and selecting a frequency-domain resource group from the plurality of frequency-domain resource groups as the frequency-domain resource of the second resource.

[0027] In some implementations of the method and the second UE described herein, determining the second resource comprises: determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts; determining a target cyclic shift from the plurality of cyclic shifts; and determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

[0028] In some implementations of the method and the second UE described herein, determining the second resource comprises: based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number; determining a target index from the plurality of indexes; and determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index. In some implementations of the method and the second UE described herein, the target index is determined based on one or more time offsets for transmitting the plurality of sidelink reference signals, a time offset of the one or more time offsets representing a time-domain offset of a slot for transmitting one of the plurality of sidelink reference signals within a period relative to a starting boundary of the period. In some implementations of the method and the second UE described herein, the one or more time offsets are one of the following: received from the first UE; or configured by a BS. In some implementations of the method and the second UE described herein, the one or more time offsets are received in one of: sidelink control information (SCI) or a media access control control element (MAC CE) in one of the following: each slot of the plurality of slots; one or more slots of the plurality of slots; a first slot of the plurality of slots; or a last slot of the plurality of slots.

[0029] Some implementations of the method and the second UE described herein may further include determining the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals. In some implementations of the method and the second UE described herein, determining the first resource comprises: determining a plurality of slots for receiving the plurality of sidelink reference signals based on the periodicity and one or more time offsets. In some implementations of the method and the second UE described herein, a slot of the plurality of slots for receiving the plurality of sidelink reference signals comprises one or more occasions for receiving one or more of the plurality of sidelink reference signals.

[0030] In a seventh aspect, there is provided a BS. The BS comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the BS to: transmit, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

[0031] In an eighth aspect, there is provided a method performed by the BS. The method comprises: transmitting, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

[0032] In a ninth aspect, there is provided a processor for wireless communication. The at least one processor comprises at least one controller coupled with at least one memory and configured to cause the at least one processor to: transmit, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

[0033] In some implementations of the method and the BS described herein, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0034] In some implementations of the method and the BS described herein, the configuration information is configured via a radio resource control (RRC) signaling.

[0035] In some implementations of the method and the BS described herein, the configuration information further comprises one of the following: a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals; a payload size for transmitting the plurality of sidelink reference signals; a minimum time interval between a resource for transmitting the plurality of sidelink reference signals and the resource for transmitting the report; a bitmap for determining a plurality of physical resource blocks (PRBs) available for transmitting the report; a number of PRBs required for transmitting the report; or a number of cyclic shifts in a code-domain for transmitting the report.

[0036] It is to be understood that the summary section is not intended to identify key or essential features of embodiments of the present disclosure, nor is it intended to be used to limit the scope of the present disclosure. Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] FIG. 1 illustrates an example of a wireless communications system that supports CSI reporting in accordance with aspects of the present disclosure;

[0038] FIGS. 2A and 2B illustrate example process flows in accordance with some example embodiments of the present disclosure;

[0039] FIG. 3A illustrates an example resource configuration for CSI-RS transmissions in accordance with some example embodiments of the present disclosure;

[0040] FIG. 3B illustrates a first example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure;

[0041] FIG. 3C illustrates a second example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure;

[0042] FIG. 3D illustrates a third example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure;

[0043] FIG. 3E illustrates an example resource configuration for CSI reporting with frequency-domain resource division and code-domain resource division in accordance with some example embodiments of the present disclosure;

[0044] FIG. 4 illustrates an example of a device that supports CSI reporting in accordance with aspects of the present disclosure;

[0045] FIG. 5 illustrates an example of a processor that supports CSI reporting in accordance with aspects of the present disclosure; and

[0046] FIGS. 6 through 8 illustrate flowcharts of methods that support CSI reporting in accordance with aspects of the present disclosure.

[0047] Throughout the drawings, the same or similar reference numerals represent the same or similar elements.

DETAILED DESCRIPTION

[0048] Principles of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. The disclosure described herein can be implemented in various manners other than the ones described below.

[0049] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0050] References in the present disclosure to "one embodiment," "an example embodiment," "an embodiment," "some embodiments," and the like indicate that the

embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0051] It shall be understood that although the terms "first" and "second" or the like may be used hereto describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term "and/or" includes any and all combinations of one or more of the listed terms. In some examples, values, procedures, or apparatuses are referred to as "best," "lowest," "highest," "minimum," "maximum," or the like. It will be appreciated that such descriptions are intended to indicate that a selection among many used functional alternatives can be made, and such selections need not be better, smaller, higher, or otherwise preferable to other selections.

[0052] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of embodiments. As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises," "comprising," "has," "having," "includes" and/or "including," when used herein, specify the presence of stated features, elements, components and/or the like, but do not preclude the presence or addition of one or more other features, elements, components and/or combinations thereof. For example, the term "includes" and its variants are to be read as open terms that mean "includes, but is not limited to." The term "based on" is to be read as "based at least in part on." The term "one embodiment" and "an embodiment" are to be read as "at least one embodiment." The term "another embodiment" is to be read as "at least one other embodiment." The use of an expression such as "A and/or B" can mean either "only A" or "only B" or "both A and B." Other definitions, explicit and implicit, may be included below.

[0053] As mentioned above, the sidelink (SL) CSI-RS is used for measuring the CSI at the RX UE that is then fed back to the TX UE. The TX UE may adjust its transmission based on the fed-back CSI. The SL CSI-RS is sent within a physical sidelink shared channel (PSSCH) region of a slot.

[0054] In new radio (NR) vehicle to everything (V2X), the transmission of the SL CSI-RS is supported for unicast transmissions only. The NR V2X also supports CSI reporting in unicast communications. The RX UE can measure the CSI and report it back to the TX UE via CSI reporting carried within a PSSCH. To request the CSI feedback (FB) from the RX UE, a one-bit CSI request is sent in the 2nd-stage SCI with SCI format 2-A.

[0055] The transmission of the SL CSI-RS by the TX UE along with a CSI request sent in the 2nd-stage SCI triggers the RX UE of a unicast link to feed back a CSI report. The TX UE may configure aperiodic CSI reporting from the RX UE. The RX UE may measure the CSI based on the SL CSI-RS sent by the TX UE. The RX UE feeds back to the TX UE the CSI (for example, a channel quality indicator (CQI) or a rank indicator (RI)) via CSI reporting over a PSSCH. The CSI report is carried in a media access control (MAC) control element (CE) over a PSSCH sent from the RX UE to the TX UE.

[0056] To avoid outdated CSI, the RX UE is expected to feed back the CSI report within a maximum amount of time. This maximum amount of time is referred to as a latency bound. The latency bound is determined by the TX UE and signaled to the RX UE via a proximity services (ProSe) Communication 5 (PC5) radio resource control (PC5-RRC) signaling.

[0057] The design of the SL CSI-RS is based on the CSI-RS design of Rel-15 NR Uu. In addition, the resource mapping of the SL CSI-RS in a PRB is based on a CSI-RS resource mapping pattern in NR Uu, which support up to two antenna ports (as in NR V2X SL, where up to two streams may be supported in a PSSCH). Each physical resource block (PRB) within the PSSCH uses the same pattern for the SL CSI-RS. The SL CSI-RS is not transmitted on symbols containing a physical sidelink control channel (PSCCH), the 2nd-stage SCI, or a PSSCH DMRS.

[0058] The SL CSI-RS configuration includes a resource mapping pattern and the number of antenna ports for the SL CSI-RS. The SL CSI-RS configuration is selected by

the TX UE and provided to the RX UE via a proximity services (ProSe) Communication 5 (PC5)-RRC configuration.

[0059] Moreover, in release 18 (Rel-18), a new study item description (SID) on sidelink evolution was approved, which includes an objective of an enhanced operation on the frequency range 2 (FR2) licensed spectrum. More considerations on supporting beam management (for example, initial beam pairing (IBP)) over sidelink in the FR2 need to be given.

[0060] Before or during unicast sidelink communication established between the TX UE and the RX UE, both the TX UE and the RX UE have no information to determine which TX/RX beam(s) to be used between them. In such a case, prior knowledge related to beaming-sweeping is needed for UEs to perform initial beam paring. The knowledge includes the TX beam-sweeping pattern (e.g., resources for transmitting reference signals and TX beams used for the transmission) of the TX UE for monitoring reference signal(s) and RX beam-sweeping pattern of the RX UE for indicating the selected beam or beam pair. That is to say, a beam-sweeping pattern(s) based on the (pre-)configuration is needed for the TX UE and the RX UE to perform initial beam pairing before/during unicast sidelink communication establishment. In NR V2X as specified in third generation partnership project (3GPP) Rel-16/release 17 (Rel-17), the transmission of SL CSI-RS supported for unicast transmissions is used for beam management.

[0061] Inventors have noticed that from signaling overhead perspectives, beam-sweeping pattern configuration supporting periodic reference signal transmission is efficient in this scenario. To support the periodic SL CSI-RS framework, standalone CSI-RS transmission is needed. The standalone SL CSI-RS transmission means at least no accompanying sidelink data (SL MAC service data unit (SDU)) transmissions in the same slot.

[0062] In the case of resource allocation mode 2, a dedicated resource pool is needed to support periodic SL CSI-RS transmission. The reason is that since the sidelink resources are determined based on sensing, each CSI-RS transmission may experience intolerable latency due to resource selection if the network is in a heavy traffic load.

[0063] In the case of resource allocation mode 1, a resource pool shared between periodic SL CSI-RS transmission and PSSCH/ physical sidelink control channel (PSCCH)

transmissions may be possible. In addition, a dedicated resource pool may be applied for standalone SL CSI-RS.

[0064] However, as of now, there is no effective approach to allow both the TX UE and the RX UE to determine the resources for CSI reporting. For this issue, inventors have noticed that a PSFCH may be used to carry an SL CSI report.

[0065] As specified in 3GPP Rel-17, a PSFCH was used to carry hybrid automatic repeat request (HARQ) feedback, and PSFCH symbols are located periodically within a resource pool for sidelink, where the PSSCH and the PSFCH are associated by one-to-one mapping. In SL FR2 beam management, multiple-to-multiple mapping is needed between the SL CSI-RS occasions and SL CSI reporting occasions. On this basis, determining an association between resources for the PSSCH-carried SL CSI-RSs and the PSFCH-carried SL CSI report is still an urgent problem to be solved.

[0066] To fulfill the above requirements, a new configuration of a resource carried by the PSFCH for SL CSI reporting is needed, for example, in supporting beam management (including initial beam pairing, or beam maintenance) over sidelink in FR2. There is a need for a efficient approach to determine the resource carried by the PSFCH for CSI reporting.

[0067] Embodiments of the present disclosure provide a solution for CSI reporting. In one aspect of the solution of the present disclosure, a first UE transmits, to a second UE, on a first resource, a plurality of sidelink reference signals for determining CSI between the first UE and the second UE. Then, the first UE determines, based on the first resource, a second resource carried by a PSFCH for receiving a report of the CSI. Moreover, the first UE receives, from the second UE, the report on the second resource.

[0068] By determining an association between the first resource and the second resource carried by the PSFCH, this solution can facilitate efficient alignment of the resource for CSI reporting between the first UE and the second UE. In this way, it is possible to improve the sidelink communications with enhanced efficiency.

[0069] Principles and implementations of embodiments of the present disclosure will be described in detail below with reference to the figures.

[0070] FIG. 1 illustrates an example of a wireless communications system 100 that supports CSI reporting in accordance with aspects of the present disclosure. The wireless

communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as a long term evolution (LTE) network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a 5G network, such as a new radio (NR) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0071] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0072] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities

102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0073] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0074] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in FIG. 1. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the packet data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in FIG. 1. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100.

[0075] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink (SL). For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0076] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0077] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open RAN (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN Intelligent Controller (RIC) (e.g., a Near-Real Time RIC (Near-RT RIC), a Non-Real Time RIC (Non-RT RIC)), a Service Management and Orchestration (SMO) system, or any combination thereof.

[0078] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0079] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer

functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., Radio Resource Control (RRC), service data adaption protocol (SDAP), Packet Data Convergence Protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU.

[0080] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0081] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1 c, F1 u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links .

[0082] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity

(MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0083] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N3, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0084] In the wireless communications system 100, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0085] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15

kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., μ=0) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., μ=1) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., μ=2) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., μ=3) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., μ=4) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0086] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0087] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., μ=0, μ=1, μ=2, μ=3, μ=4) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., μ=0) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0088] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0089] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., μ=0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., μ=1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., μ=3), which includes 120 kHz subcarrier spacing.

[0090] Reference is now made to FIGS. 2A and 2B, which illustrate example process flows 200A and 200B in accordance with some example embodiments of the present disclosure. The process flows 200A and 200B may involve UEs 201 and 202 (also referred to as a first UE 201 and a second UE 202), and a BS 203. The process flows 200A and 200B may be applied to the wireless communications system 100 with reference to FIG. 1. For example, the UEs 201 and 202 may be UEs 104, and the BS 203 may be a network entity 102. It would be appreciated that the process flows 200A and 200B may be applied to other communication scenarios, which will not be described in detail.

[0091] Reference is first made to FIG. 2A, as shown in FIG. 2A, the first UE 201 transmits (205), to the second UE 202, on a first resource, a plurality of sidelink reference

signals for determining CSI between the first UE 201 and the second UE 202. For example, the sidelink reference signals may comprise CSI-RSs. Alternatively or additionally, the sidelink reference signals may comprise any other types of reference signals, for example, for a purpose of beam management or any other purpose, such as determining CSI. The scope of the present disclosure is not limited in this regard. Hereinafter, in some embodiments, the CSI-RSs will be taken as an example of the sidelink reference signals for providing more details about example embodiments of the present disclosure.

[0092] In the time domain, the plurality of sidelink reference signals may be configured as periodic, or semi-persistent. In some embodiments, the first UE 201 may determine the first resource based on configuration information. The configuration information may be pre-configured or configured by the BS 203. The configuration information may be pre-configured or configured per RP, or per BWP. For example, the configuration information may be configured via an RRC signaling. The configuration information may comprise a periodicity (denoted as, $T_{periodicity}$) for transmitting the plurality of sidelink reference signals, for example, a periodicity of CSI-RS transmissions. Thus, the periodicity may be pre-configured or configured per RP, or per BWP. The periodicity may be pre-configured or configured to accommodate the coexistence of multiple UEs.

[0093] In some example embodiments, the first UE 201 may determine the first resource based on the periodicity and one or more time offsets (denoted as, T_{offset}). The time offsets may be referred to as time-domain offsets. A time offset of the one or more time offsets may represent a time-domain offset of a slot for transmitting a sidelink reference signal within a period relative to a starting boundary of the period. As an example, a time offset may define a time-domain offset of an SL CSI-RS slot within a period relative to the starting boundary of the period. A plurality of time offsets may correspond to multiple configurations, respectively. This is beneficial in increasing sidelink reference signal resource density and achieving flexible resource utilization.

[0094] FIG. 3A illustrates an example resource configuration for SCI-RS transmissions in accordance with some example embodiments of the present disclosure. As shown in FIG. 3A, parameters of two time offsets (also referred to as offset 1 and

offset 2) may be (pre-)configured. Offset 1 and offset 2 may correspond to two configurations (also referred to as, configuration 1 and configuration 2), respectively.

[0095] The one or more time offsets may be determined in a variety of ways. For example, the one or more time offsets may be determined by the first UE 201. For example, the UE 201 may select one or multiple time offsets within periodically configured resources for SL CSI-RSs. The resource selection may be performed randomly, be based on sensing, or be based on directional sensing. As another example, the one or more time offsets may be allocated to the UE 201. For example, the one or more time offsets may be configured by the BS 203 via a DCI or a MAC CE.

[0096] After determining the one or more time offsets, the first UE 201 may determine a plurality of slots for transmitting the plurality of sidelink reference signals based on the one or more time offsets according to the periodicity. A slot of the plurality of slots for transmitting the plurality of sidelink reference signals may comprise one or more occasions for transmitting one or more of the plurality of sidelink reference signals. The multiple slots with the one or more time offsets (for example, different time offsets) within a period may be either consecutive or not. To achieve flexible resource allocation, each UE (for example, the first UE 201) may select or be allocated at least one offset for a given periodicity within an RP or BWP. Thus, it is possible to accommodate multiple TX UEs coexisting within the same resource pool or BWP.

[0097] In some embodiments, the first UE 201 may transmit, to the second UE 202, the one or more time offsets, for example, in some examples, for the second UE 202 to identify the resource to receive the plurality of sidelink reference signals. For example, the one or more time offsets may be transmitted in a SCI or a MAC CE in one of the following: each slot of the plurality of slots, one or more slots (in other words, partial slots) of the plurality of slots, a first slot of the plurality of slots, or a last slot of the plurality of slots. For instance, a list of time offset(s) determined by the first UE 201 or allocated by the BS 203 may be transmitted along with the SL CSI-RSs for the second UE to identify the resources used for transmitting the SL CSI-RSs, and such a list may be carried by an SCI, or a MAC CE in SL CSI-RS slot(s). Moreover, to indicate beam information, TX beam information and/or RX beam information may be transmitted along with the SL CSI-RSs.

[0098] Referring back to FIG. 2A, the first UE 201 determines (210), based on the first resource, a second resource carried by a PSFCH for receiving a report of the CSI. Likewise, the second UE 202 determines (215) the second resource carried by the PSFCH for CSI reporting based on the first resource. Hereinafter, in some embodiments, determining the second resource at the first UE 201 will be taken as an example for providing more details about example embodiments of the present disclosure. Determining the second resource at the second UE 202 may apply likewise.

[0099] In some embodiments, when determining a time-domain resource of the second resource, the first device 201 may determine that there is a time interval (denoted as, $T_{interval}$), or in other words, a (pre-)configured number of slots) between the first resource and the second resource (for example, also referred to as, a time interval between the SL CSI-RS window and the SL CSI reporting window). In other words, there is a time interval between the first slot in the second resource (i.e., the first SL CSI reporting slot) and the last slot in the first resource (i.e. the last sidelink reference signal slot). Thus, the first slot within the SL CSI reporting window may be determined based on the time interval. The time interval may be used for the second UE 202 to determine a pair of a TX beam and a RX beam between the first UE 201 and the second UE 202 based on the measurements performed in the SL CSI-RS window. The time interval may be set to provide sufficient processing delay for the second UE 202 between measuring the SL CSI-RSs and transmitting the SL CSI feedback. Thus, to determine the time-domain resource of the second resource, the first UE 201 may need to obtain the time interval.

[0100] As an example, the time interval may be determined by the first UE 201. In this case, the first UE 201 may further indicate the time interval to the second UE 202. As an example implementation, the first UE 201 may transmit, to the second UE 202, the time interval together with an indicator of a last slot in the first resource. Then, based on the time interval and the indicator of the last slot in the first resource, the second UE 120 may determine the position of the first slot in the second resource. As another example implementation, the first UE 201 may transmit, to the second UE 202, an indication of an interval of a first slot in the second resource relative to a reference slot in the first resource, to allow the second UE to determine the time interval between the first resource and the second resource. The first UE 201 may indicate the reference slot by transmitting one of the following: an index of the reference slot (alternatively or additionally, an index of each slot of the plurality of slots in the first resource), a remaining number of slots after

the reference signal in the first resource, an indicator of a first slot in the first resource, or an indicator of a last slot in the first resource. The above additional information associated with the time interval may be transmitted to the second UE 202 together with the one or more time offsets. Thus, related details are omitted for brevity.

[0101] As another example, the time interval may be pre-configured or configured by the BS 203. For example, the time interval may be configured via an RRC signaling. Moreover, the last slot in the first resource may be indicated to the second UE 202. For example, the time interval may be required to be equal to or greater than a processing latency (denoted as, T_{pro}) for determining the TX-RX beam pair between the first UE 201 and the second UE 202, i.e., $T_{interval} \geq T_{pro}$. The parameter of T_{pro} may reflect UE capability, which may be (pre-)configured. As an example, the minimal time interval between the SL CSI-RS window and the SL CSI reporting window may be comprised in the configuration information.

[0102] Moreover, the first device 201 may determine a time-domain resource distribution of the second resource. The time-domain resources for the PSFCH may be (pre-)configured periodically. For example, the time-domain resource distribution of the second resource may be indicated in configuration information. As an example, possible values of the period may include 1, 2, 4, or 8 slot(s). In other words, there may be a slot with a PSFCH every 1, 2, 4, or 8 slot(s). The configuration of the time-domain resource distribution may be per RP, or per BWP.

[0103] In some embodiments, the time-domain resource of the second resource may comprise a plurality of slots for CSI reporting. A slot of the plurality of slots may comprise one occasion for CSI reporting. In this case, there may be a same time gap (or in other words, a fixed time gap) between any two contiguous occasions for CSI reporting in the second resource. The plurality of slots for CSI reporting (i.e., the plurality of PSFCH symbols (or occasions)) may correspond to a plurality of TX beams, respectively.

[0104] Reference now is made to FIGS. 3B and 3C to discuss examples of resource configurations for CSI-RS transmissions and CSI reporting. Reference is made to FIG. 3B first, which illustrates a first example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure. As shown in FIG. 3B, each SL slot is used for transmitting one SL CSI-RS using one beam. The number of TX beams of the first UE 201 is denoted by M1, and the

number of repetitions for each TX beam is denoted by M2. In the SL CSI-RS window, the number of SL slots used for transmitting SL CSI-RSs is multiple of M1 and M2, i.e., M1*M2. In the time domain, PSFCH symbols that can be used for feedback of M1*M2 SL CSI-RS transmissions with one or more time offsets correspond to a set of M1 contiguous PSFCH slots, where the first slot within the SL CSI reporting window is after the time interval after the last SL CSI-RS slot within the SL CSI-RS window. In this case, one PSFCH slot comprises one PSFCH symbol. During the time interval, the second UE 202 may determine a pair of a TX beam and a RX beam between the first UE 201 and the second UE 202 based on the measurements performed in the SL CSI-RS window. The M1 PSFCH symbols (occasions) correspond to M1 TX beams, respectively.

[0105] FIG. 3C illustrates a second example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure. In this case, each SL CSI slot contains multiple SL CSI-RS occasions, and only one PSFCH symbol is contained in the PSFCH slot. For example, as shown in FIG. 3C, each SL CSI-RS slot may contain at least M2 SL CSI-RS occasions, and M1 SL CSI-RS slots are sufficient to carry M1*M2 SL CSI-RS transmissions. The transmission configuration of CSI reporting may be the same as configured in FIG. 3B.

[0106] In some other embodiments, the time-domain resource of the second resource may comprise one or more slots for CSI reporting. A slot of the one or more slots may comprise a plurality of occasions for CSI reporting. Therefore, the PSFCH symbols used for feedback of SL CSI-RS transmissions with one or more time offsets may correspond to a set of N contiguous PSFCH slots, where the N slots is the least number of slots providing sufficient PSFCH symbols for multiple TX beams. Moreover, the first M1 PSFCH symbols (occasions) may correspond to the M1 TX beams (where M1 is the number of TX beams), respectively.

[0107] FIG. 3D illustrates a third example resource configuration for CSI-RS transmissions and CSI reporting in accordance with some example embodiments of the present disclosure. As shown in FIG. 3D, the transmission configuration of SL CSI-RSs may be the same as configured in FIG. 3B. In the time domain, each PSFCH slot contains multiple PSFCH symbols. For example, each PSFCH slot may contain M1 PSFCH symbols, and the SL CSI feedback transmission corresponding to a TX beam may occupy one PSFCH symbol. In this case, one PSFCH slot is sufficient for the SL CSI-RS

feedback, where M1 TX beams are associated with M1 PSFCH symbols in the PSFCH slot.

[0108] As another example, multiple beams may be contained within one SL CSI slot, and multiple PSFCH symbols may be contained in the slot carrying PSFCH. In other words, in this case, each SL CSI slot may contain multiple SL CSI-RS occasions, and each PSFCH slot may contain multiple PSFCH occasions (i.e. multiple CSI reporting occasions). The above time-domain resource distribution determination approach may apply. Related details are omitted for brevity.

[0109] After obtaining the time interval and the time-domain resource distribution of the second resource as described above, the first UE 201 may determine the time-domain resource of the second resource based on the time interval and the time-domain resource distribution. The second UE 202 may determine the time-domain resource of the second resource similarly.

[0110] In some embodiments, considering that in the frequency domain, the resource for each sidelink reference signal transmission may be in units of sub-channel, and each sub-channel may comprise one or more consecutive PRBs, when determining a frequency-domain resource of the second resource, in a PSFCH symbol, a set of PRBs (i.e. one or more PRBs) that are available for CSI feedback may need to be determined. The available PRB(s) may be indicated using a bitmap. For example, the first device 201 may determine a plurality of PRBs available for CSI reporting based on the bitmap, and then determine a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting. The bitmap may be pre-configured or configured by a BS. The bitmap may be comprised in the configuration information. The bitmap may be pre-configured or configured per RP, or per BWP.

[0111] As an example, a subchannel(s) for CSI reporting may be determined considering a subchannel(s) used for sidelink reference signal transmissions. For example, the first UE 201 may determine subchannel information for CSI reporting based on a payload size (in units of PRBs) for transmitting the plurality of sidelink reference signals. In this case, the plurality of PRBs available for CSI reporting may be determined based on the payload size for transmitting the plurality of sidelink reference signals and the bitmap. The payload size for transmitting the plurality of sidelink reference signals may be indicated in the configuration information.

[0112] Moreover, compared to carrying HARQ feedback, to carry CSI feedback, more resources in the frequency domain may be needed to increase the payload size for supporting CSI reporting. There is a need to introduce a new parameter indicating the number of PRBs required for CSI reporting. This new parameter may be comprised in the configuration information. For example, a configuration of a new parameter of NumPRBforCSIFB, referred to as $N_{PRB}^{SL\text{-}CSI\text{-}FB}$, may be introduced, indicating the number of PRBs mapped to the SL CSI report of associated SL CSI-RS transmissions.

[0113] In some implementations, the plurality of PRBs available for CSI reporting may be grouped. For example, the plurality of PRBs available for CSI reporting may be divided into a plurality of frequency-domain resource groups based on the number of PRBs required for CSI reporting. Then, the first UE 201 may select a frequency-domain resource group from the plurality of frequency-domain resource groups as the frequency-domain resource of the second resource for CSI reporting.

[0114] The plurality of frequency-domain resource groups may be indexed or labeled and thus may be associated with a plurality of indexes (or labels). The first UE 201 may determine a target index from the plurality of indexes, and then determine the frequency-domain resource of the second resource from the third number of sub-resource groups based on the target index. In some implementations, the mapping between a resource for sidelink reference signals and a resource for CSI reporting may be done by an association between one or more time offsets for transmitting the plurality of sidelink reference signals and indexes of the resource for SL CSI feedback. In this case, the target index may be determined based on one or more time offsets for transmitting the plurality of sidelink reference signals. For example, the index ($I^{SL\text{-}CSI\text{-}FB}$) of the resource for SL CSI feedback may be determined based on the time offset ($Offset^{SL\text{-}CSI\text{-}RS}$) of the resource for SL CSI-RSs. As an example, when one time offset is used, the target index may be set as the same as the time offset, i.e., $I^{SL\text{-}CSI\text{-}FB} = Offset^{SL\text{-}CSI\text{-}RS}$, if $\max\{I^{SL\text{-}CSI\text{-}FB}\} >= \max\{Offset^{SL\text{-}CSI\text{-}RS}\}$. As another example, when more than one time offset is used, the resource with more than one target index may be used for CSI reporting, and the more than one target index may determined as the same as the more than more time offset if $\max\{I^{SL\text{-}CSI\text{-}FB}\} >= \max\{Offset^{SL\text{-}CSI\text{-}RS}\}$.

[0115] In some embodiments, a code-domain resource available for CSI reporting may be divided into a plurality of code-domain resource groups. For example, a sequence

used to transmit the CSI feedback may comprise a Zadoff-Chu sequence. The plurality of code-domain resource groups may be associated with a plurality of cyclic shifts, or in other words, each of the plurality of code-domain resource groups may be associated with a respective cyclic shift. The number of cyclic shifts may be comprised in the configuration information. In this case, to determine the code-domain resource of the second resource, the first UE 201 may determine a target cyclic shift from the plurality of cyclic shifts. The code-domain resource of the second resource may be determined from the plurality of code-domain resource groups based on the target cyclic shift. The plurality of code-domain resource groups may be indexed similarly as discussed above with reference to frequency-domain resource division.

[0116] In some embodiments, the above frequency-domain resource division and code-domain resource division may be combined. In other words, considering that a plurality of PRBs available for CSI reporting may be divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting may be divided into a second number of code-domain resource groups, a resource available for CSI reporting in the frequency-domain and the code-domain may be divided into a third number of sub-resource groups. The third number may be determined based on the first number and the second number. In this case, the transmission of CSI feedback may correspond to a resource with a PSFCH symbol in the time domain, a set of PRBs (for example, one or more PRBs) in the frequency domain, and a cyclic shift in the code domain. The third number of sub-resource groups may be indexed similarly as discussed above with reference to frequency-domain resource division.

[0117] Reference now is made to FIG. 3E to give an example of how resources of a symbol in the time domain and a sub-channel in the frequency domain are organized for SL CSI feedback. FIG. 3E illustrates an example resource configuration for CSI reporting with frequency-domain resource division and code-domain resource division in accordance with some example embodiments of the present disclosure. The sub-channel comprises 12 PRBs, and NumPRBforCSIFB, which indicates the number of PRBs mapped to the SL CSI report of associated SL CSI-RS transmissions as described above, is set as 4. In this case, a sub-channel may be divided into 3 sets, each of which comprises 4 PRBs, as illustrated on the left side of FIG. 3E. Considering 2 cyclic shifts are used in the code domain, a sub-channel may be organized into 6 sets of resources for SL CSI

feedback, which are labeled from 0 to 6 as illustrated on the right side of FIG. 3E. When there are multiple sub-channels, the resources may be organized in a similar way and labeled in the frequency domain first and then in the code domain.

[0118] After determining the second resource as described above, referring back to FIG. 2A, the second UE 202 transmits (220), to the first UE 201, the report of the CSI based on the second resource. Accordingly, the first UE 201 may monitor the CSI reporting and thus receive the report on the second resource. The report of the CSI may comprise one or more of (for example, a combination of) a channel quality indicator (CQI), a rank indicator (RI), and a precoder-matrix indicator (PMI), received signal strength, more formally referred to as reference-signal received power (RSRP).

[0119] In some embodiments, the second UE 202 may deduce the required CSI and determine a beam pair of a transmit beam of the first UE 201 and a receive beam of the second UE 202 based on a plurality of measurements (i.e. measurement results) of the plurality of sidelink reference signals. The second UE 202 may then determine, from the second resource, based on the determined beam pair, a third resource for transmitting the report of CSI. Then, the second UE 202 may transmit to the first UE 201, the report of CSI on the third resource. The location of the CSI feedback occasion may implicitly indicate the TX beam within the selected beam pair determined by the second UE 201. For example, the $N_{PRB}^{SL\text{-}CSI\text{-}FB}$ PRBs for the CSI feedback may be used to indicate the CSI related to the selected TX beam. The transmission of the report of CSI may occupy an SL slot.

[0120] Reference is now made to FIG. 2B, as shown in FIG. 2B, the BS 203 transmits (225) configuration information to the first UE 201 and transmits (230) configuration information to the second UE 202. The configuration information may be pre-configured or configured per RP, or per BWP. The configuration information may be configured via an RRC signaling.

[0121] The configuration information may comprise a time-domain resource distribution of a resource carried by a PSFCH for transmitting a report associated with a plurality of measurements of a plurality of sidelink reference signals for determining CSI between the first UE 201 and the second UE 202. Alternatively or additionally. the configuration information may comprise one or more of the following:

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- a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals;

- a payload size for transmitting the plurality of sidelink reference signals;

- a minimum time interval between a resource for transmitting the plurality of sidelink reference signals and the resource for transmitting the report;

- a bitmap for determining a plurality of physical resource blocks (PRBs) available for transmitting the report;

- a number of PRBs required for transmitting the report; or

- a number of cyclic shifts in a code-domain for transmitting the report.

[0122] The above one or more parameters comprised in the configuration information may be configured if needed as discussed above. Related details are omitted for brevity.

[0123] According to some embodiments with reference to FIGS.2A to 3E, by determining an association between the first resource and the second resource, this solution can facilitate efficient alignment of the resource for CSI reporting between the first UE and the second UE. In this way, it is possible to improve the sidelink communications with enhanced efficiency.

[0124] FIG. 4 illustrates an example of a device 400 that supports CSI reporting in accordance with aspects of the present disclosure. The device 400 may be an example of a UE 104 or a network entity 102 as described herein. The device 400 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 400 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 402, a memory 404, a transceiver 406, and, optionally, an I/O controller 408. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0125] The processor 402, the memory 404, the transceiver 406, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 402, the memory 404, the transceiver 406, or various combinations or

components thereof may support a method for performing one or more of the operations described herein.

[0126] In some implementations, the processor 402, the memory 404, the transceiver 406, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 402 and the memory 404 coupled with the processor 402 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 402, instructions stored in the memory 404).

[0127] For example, the processor 402 may support wireless communication at the device 400 in accordance with examples as disclosed herein. The processor 402 may be configured to operable to support a means for transmitting, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; means for determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and means for receiving, from the second UE, the report on the second resource. The processor 402 may be configured to operable to support a means for receiving, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; means for determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and means for transmitting, to the first UE, the report based on the second resource. The processor 402 may be configured to operable to support a means for transmitting, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

[0128] The processor 402 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 402 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 402. The processor 402 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 404) to cause the device 400 to perform various functions of the present disclosure.

[0129] The memory 404 may include random access memory (RAM) and read-only memory (ROM). The memory 404 may store computer-readable, computer-executable code including instructions that, when executed by the processor 402 cause the device 400 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 402 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 404 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0130] The I/O controller 408 may manage input and output signals for the device 400. The I/O controller 408 may also manage peripherals not integrated into the device M02. In some implementations, the I/O controller 408 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 408 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 408 may be implemented as part of a processor, such as the processor 406. In some implementations, a user may interact with the device 400 via the I/O controller 408 or via hardware components controlled by the I/O controller 408.

[0131] In some implementations, the device 400 may include a single antenna 410. However, in some other implementations, the device 400 may have more than one antenna 410 (i.e., multiple antennas), including multiple antenna panels or antenna arrays,

which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 406 may communicate bi-directionally, via the one or more antennas 410, wired, or wireless links as described herein. For example, the transceiver 406 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 406 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 410 for transmission, and to demodulate packets received from the one or more antennas 410. The transceiver 406 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0132] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 410 for transmitting the amplified signal into the air or wireless medium.

[0133] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 410 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0134] FIG. 5 illustrates an example of a processor 500 that supports CSI reporting in accordance with aspects of the present disclosure. The processor 500 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 500 may include a controller 502 configured

to perform various operations in accordance with examples as described herein. The processor 500 may optionally include at least one memory 504, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 500 may optionally include one or more arithmetic-logic units (ALUs) 500. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0135] The processor 500 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 500) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0136] The controller 502 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 500 to cause the processor 500 to support various operations in accordance with examples as described herein. For example, the controller 502 may operate as a control unit of the processor 500, generating control signals that manage the operation of various components of the processor 500. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0137] The controller 502 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 504 and determine subsequent instruction(s) to be executed to cause the processor 500 to support various operations in accordance with examples as described herein. The controller 502 may be configured to track memory address of instructions associated with the memory 504. The controller 502 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 502 may be configured to interpret the instruction and

determine control signals to be output to other components of the processor 500 to cause the processor 500 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 502 may be configured to manage flow of data within the processor 500. The controller 502 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 500.

[0138] The memory 504 may include one or more caches (e.g., memory local to or included in the processor 500 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 504 may reside within or on a processor chipset (e.g., local to the processor 500). In some other implementations, the memory 504 may reside external to the processor chipset (e.g., remote to the processor 500).

[0139] The memory 504 may store computer-readable, computer-executable code including instructions that, when executed by the processor 500, cause the processor 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 502 and/or the processor 500 may be configured to execute computer-readable instructions stored in the memory 504 to cause the processor 500 to perform various functions. For example, the processor 500 and/or the controller 502 may be coupled with or to the memory 504, and the processor 500, the controller 502, and the memory 504 may be configured to perform various functions described herein. In some examples, the processor 500 may include multiple processors and the memory 504 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0140] The one or more ALUs 500 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more ALUs 500 may reside within or on a processor chipset (e.g., the processor 500). In some other implementations, the one or more ALUs 500 may reside external to the processor chipset (e.g., the processor 500). One or more ALUs 500 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 500 may receive input operands and an operation code,

which determines an operation to be executed. One or more ALUs 500 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 500 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 500 to handle conditional operations, comparisons, and bitwise operations.

[0141] The processor 500 may support wireless communication in accordance with examples as disclosed herein. The processor 500 may be configured to or operable to support a means for transmitting, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; means for determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and means for receiving, from the second UE, the report on the second resource. The processor 500 may be configured to or operable to support a means for receiving, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE; means for determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and means for transmitting, to the first UE, the report based on the second resource. The processor 500 may be configured to or operable to support a means for transmitting, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

[0142] FIG. 6 illustrates a flowchart of a method 600 that supports CSI reporting in accordance with aspects of the present disclosure. The operations of the method 600 may be implemented by a device or its components as described herein. For example, the operations of the method 600 may be performed by a UE 201 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0143] At 610, the method may include transmitting, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE. The operations of 610 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 610 may be performed by a UE 201 as described with reference to FIGS. 2A and 2B.

[0144] At 620, the method may include determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI. The operations of 620 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 620 may be performed by a UE 201 as described with reference to FIGS. 2A and 2B.

[0145] At 630, the method may include receiving, from the second UE, the report on the second resource. The operations of 630 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 630 may be performed by a UE 201 as described with reference to FIGS. 2A and 2B.

[0146] In some implementations, determining the second resource comprises: determining a time-domain resource distribution of the second resource; determining a time interval between the first resource and the second resource; and determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

[0147] In some implementations, determining the time-domain resource distribution comprises: determining that there is a same time gap between any two contiguous occasions for CSI reporting in the second resource, the time-domain resource of the second resource comprising a plurality of slots for CSI reporting, a slot of the plurality of slots comprising one occasion for CSI reporting.

[0148] In some implementations, determining the time-domain resource distribution comprises: determining that the time-domain resource of the second resource comprises one or more slots for CSI reporting, and a slot of the one or more slots comprises a plurality of occasions for CSI reporting.

[0149] In some implementations, the time-domain resource distribution is determined based on configuration information.

[0150] In some implementations, the configuration information is pre-configured or configured by a base station (BS).

[0151] In some implementations, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0152] In some implementations, the configuration information is configured via a radio resource control (RRC) signaling.

[0153] In some implementations, the time interval is: determined by the first UE; or pre-configured or configured by the BS.

[0154] In some implementations, the time interval is determined by the first UE, and the method may further include transmitting, to the second UE, the time interval and an indicator of a last slot in the first resource.

[0155] In some implementations, the time interval is determined by the first UE, and the method may further include transmitting, to the second UE: an indication of an interval of a first slot in the second resource relative to a reference slot in the first resource; and one of the following for determining the reference slot: an index of the reference slot; remaining number of slots after the reference signal in the first resource; an indicator of a first slot in the first resource; or an indicator of a last slot in the first resource.

[0156] In some implementations, determining the second resource comprises: determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting.

[0157] In some implementations, the bitmap is pre-configured or configured by a BS.

[0158] In some implementations, the bitmap is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0159] In some implementations, the plurality of PRBs available for CSI reporting are determined based on a payload size for transmitting the plurality of sidelink reference signals and the bitmap.

[0160] In some implementations, determining the frequency-domain resource of the second resource comprises: determining a number of PRBs required for CSI reporting;

determining that the plurality of PRBs available for CSI reporting are divided into a plurality of frequency-domain resource groups based on the number of PRBs required for CSI reporting; and selecting a frequency-domain resource group from the plurality of frequency-domain resource groups as the frequency-domain resource of the second resource.

[0161] In some implementations, determining the second resource comprises: determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts; determining a target cyclic shift from the plurality of cyclic shifts; and determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

[0162] In some implementations, determining the second resource comprises: based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number; determining a target index from the plurality of indexes; and determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index.

[0163] In some implementations, the target index is determined based on one or more time offsets for transmitting the plurality of sidelink reference signals, a time offset of the one or more time offsets representing a time-domain offset of a slot for transmitting one of the plurality of sidelink reference signals within a period relative to a starting boundary of the period.

[0164] In some implementations, the one or more time offsets are one of the following: determined by the first UE; or configured by a BS.

[0165] The method may further include transmitting the one or more time offset to the second UE.

[0166] In some implementations, the one or more time offsets are transmitted in one of: sidelink control information (SCI) or a media access control control element (MAC CE) in one of the following: each slot of the plurality of slots; one or more slots of the plurality of slots; a first slot of the plurality of slots; or a last slot of the plurality of slots.

[0167] The method may further include determining the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals.

[0168] In some implementations, determining the first resource comprises: determining a plurality of slots for transmitting the plurality of sidelink reference signals based on the periodicity and one or more time offsets.

[0169] In some implementations, a slot of the plurality of slots for transmitting the plurality of sidelink reference signals comprises one or more occasions for transmitting one or more of the plurality of sidelink reference signals.

[0170] FIG. 7 illustrates a flowchart of a method 700 that supports CSI reporting in accordance with aspects of the present disclosure. The operations of the method 700 may be implemented by a device or its components as described herein. For example, the operations of the method 700 may be performed by a UE 202 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0171] At 710, the method may include receiving, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE. The operations of 710 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 710 may be performed by a UE 202 as described with reference to FIGS. 2A and 2B.

[0172] At 720, the method may include determining, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with

transmitting a report of the CSI. The operations of 720 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 720 may be performed by a UE 202 as described with reference to FIGS. 2A and 2B.

[0173] At 730, the method may include transmitting, to the first UE, the report based on the second resource. The operations of 730 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 730 may be performed by a UE 202 as described with reference to FIGS. 2A and 2B.

[0174] The method may further include determining a beam pair of a transmit beam of the first UE and a receive beam of the second UE based on a plurality of measurements of the plurality of sidelink reference signals; determining, from the second resource, based on the beam pair, a third resource for transmitting the report, and in some implementations, transmitting the report based on the second resource comprises: transmitting, to the first UE, the report on the third resource.

[0175] In some implementations, determining the second resource comprises: determining a time-domain resource distribution of the second resource; determining a time interval between the first resource and the second resource; and determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

[0176] In some implementations, determining the time-domain resource distribution comprises: determining that there is a same time gap between any two contiguous occasions for CSI reporting in the second resource, the time-domain resource of the second resource comprising a plurality of slots for CSI reporting, a slot of the plurality of slots comprising one occasion for CSI reporting.

[0177] In some implementations, determining the time-domain resource distribution comprises: determining that the time-domain resource of the second resource comprises one or more slots for CSI reporting, and a slot of the one or more slots comprises a plurality of occasions for CSI reporting.

[0178] In some implementations, the time-domain resource distribution is determined based on based on configuration information.

[0179] In some implementations, the configuration information is pre-configured or configured by a base station (BS).

[0180] In some implementations, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0181] In some implementations, the configuration information is configured via a radio resource control (RRC) signaling.

[0182] In some implementations, the time interval is: received from the first UE; or pre-configured or configured by the BS.

[0183] In some implementations, receiving the time interval comprises: receiving, from the first UE, the time interval and an indicator of a last slot in the first resource.

[0184] In some implementations, receiving the time interval comprises: receiving, from the first UE, the following: an indication of an interval of a first slot in the second resource relative to a reference slot in the first resource; and one of the following for determining the reference slot: an index of the reference slot; remaining number of slots after the reference signal in the first resource; an indicator of a first slot in the first resource; or an indicator of a last slot in the first resource.

[0185] In some implementations, determining the second resource comprises: determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting.

[0186] In some implementations, the bitmap is pre-configured or configured by a BS.

[0187] In some implementations, the bitmap is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0188] In some implementations, the plurality of PRBs available for CSI reporting are determined based on a payload size for transmitting the plurality of sidelink reference signals and the bitmap.

[0189] In some implementations, determining the frequency-domain resource of the second resource comprises: determining a number of PRBs required for CSI reporting; determining that the plurality of PRBs available for CSI reporting are divided into a plurality of frequency-domain resource groups based on the number of PRBs required for CSI reporting; and selecting a frequency-domain resource group from the plurality of

frequency-domain resource groups as the frequency-domain resource of the second resource.

[0190] In some implementations, determining the second resource comprises: determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts; determining a target cyclic shift from the plurality of cyclic shifts; and determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

[0191] In some implementations, determining the second resource comprises: based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number; determining a target index from the plurality of indexes; and determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index.

[0192] In some implementations, the target index is determined based on one or more time offsets for transmitting the plurality of sidelink reference signals, a time offset of the one or more time offsets representing a time-domain offset of a slot for transmitting one of the plurality of sidelink reference signals within a period relative to a starting boundary of the period.

[0193] In some implementations, the one or more time offsets are one of the following: received from the first UE; or configured by a BS.

[0194] In some implementations, the one or more time offsets are received in one of: sidelink control information (SCI) or a media access control control element (MAC CE) in one of the following: each slot of the plurality of slots; one or more slots of the plurality of slots; a first slot of the plurality of slots; or a last slot of the plurality of slots.

[0195] The method may further include determining the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals.

[0196] In some implementations, determining the first resource comprises: determining a plurality of slots for receiving the plurality of sidelink reference signals based on the periodicity and one or more time offsets.

[0197] In some implementations, a slot of the plurality of slots for receiving the plurality of sidelink reference signals comprises one or more occasions for receiving one or more of the plurality of sidelink reference signals.

[0198] FIG. 8 illustrates a flowchart of a method 800 that supports CSI reporting in accordance with aspects of the present disclosure. The operations of the method 800 may be implemented by a device or its components as described herein. For example, the operations of the method 800 may be performed by a BS 203 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0199] At 810, the method may include transmitting, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE. The operations of 810 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 810 may be performed by a BS 203 as described with reference to FIGS. 2A and 2B.

[0200] In some implementations, the configuration information is pre-configured or configured per resource pool (RP), or per bandwidth part (BWP).

[0201] In some implementations, the configuration information is configured via a radio resource control (RRC) signaling.

[0202] In some implementations, configuration information further comprises one of the following: a periodicity associated with a time-domain resource for transmitting the

plurality of sidelink reference signals; a payload size for transmitting the plurality of sidelink reference signals; a minimum time interval between a resource for transmitting the plurality of sidelink reference signals and the resource for transmitting the report; a bitmap for determining a plurality of physical resource blocks (PRBs) available for transmitting the report; a number of PRBs required for transmitting the report; or a number of cyclic shifts in a code-domain for transmitting the report.

[0203] It should be noted that the methods described herein describe possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0204] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0205] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0206] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a

computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[0207] As used herein, including in the claims, an article "a" before an element is unrestricted and understood to refer to "at least one" of those elements or "one or more" of those elements. The terms "a," "at least one," "one or more," and "at least one of one or more" may be interchangeable. As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of" or "one or both of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as "based on condition A" may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on. Further, as used herein, including in the claims, a "set" may include one or more elements.

[0208] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A first user equipment (UE) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the first UE to:

transmit, to a second UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE;

determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) for receiving a report of the CSI; and

receive, from the second UE, the report on the second resource.

2. The first UE of claim 1, wherein determining the second resource comprises:

determining a time-domain resource distribution of the second resource;

determining a time interval between the first resource and the second resource; and

determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

3. The first UE of claim 2, wherein determining the time-domain resource distribution comprises:

determining that there is a same time gap between any two contiguous occasions for CSI reporting in the second resource, the time-domain resource of the second resource comprising a plurality of slots for CSI reporting, a slot of the plurality of slots comprising one occasion for CSI reporting.

4. The first UE of claim 2, wherein determining the time-domain resource distribution comprises:

determining that the time-domain resource of the second resource comprises one or more slots for CSI reporting, and a slot of the one or more slots comprises a plurality of occasions for CSI reporting.

5. The first UE of claim 2, wherein the time-domain resource distribution is determined based on configuration information.

6. The first UE of claim 1, wherein determining the second resource comprises:

determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and

determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting.

7. The first UE of claim 6, wherein determining the frequency-domain resource of the second resource comprises:

determining a number of PRBs required for CSI reporting;

determining that the plurality of PRBs available for CSI reporting are divided into a plurality of frequency-domain resource groups based on the number of PRBs required for CSI reporting; and

selecting a frequency-domain resource group from the plurality of frequency-domain resource groups as the frequency-domain resource of the second resource.

8. The first UE of claim 1, wherein determining the second resource comprises:

determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts;

determining a target cyclic shift from the plurality of cyclic shifts; and

determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

9. The first UE of claim 1, wherein determining the second resource comprises:

based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain

resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number;

determining a target index from the plurality of indexes; and

determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index.

10. The first UE of claim 9, wherein the target index is determined based on one or more time offsets for transmitting the plurality of sidelink reference signals, a time offset of the one or more time offsets representing a time-domain offset of a slot for transmitting one of the plurality of sidelink reference signals within a period relative to a starting boundary of the period.

11. The first UE of claim 1, wherein the at least one processor is further configured to cause the first UE to:

determine the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals.

12. A second user equipment (UE) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the second UE to:

receive, from a first UE, on a first resource, a plurality of sidelink reference signals for determining channel state information (CSI) between the first UE and the second UE;

determine, based on the first resource, a second resource carried by a physical sidelink feedback channel (PSFCH) associated with transmitting a report of the CSI; and

transmit, to the first UE, the report based on the second resource.

13. The second UE of claim 12,

wherein the at least one processor is further configured to cause the second UE to:

determine a beam pair of a transmit beam of the first UE and a receive beam of the second UE based on a plurality of measurements of the plurality of sidelink reference signals;

determine, from the second resource, based on the beam pair, a third resource for transmitting the report, and

wherein transmitting the report based on the second resource comprises:

transmitting, to the first UE, the report on the third resource.

14. The second UE of claim 12, wherein determining the second resource comprises:

determining a time-domain resource distribution of the second resource;

determining a time interval between the first resource and the second resource; and

determining a time-domain resource of the second resource based on the time interval and the time-domain resource distribution.

15. The second UE of claim 12, wherein determining the second resource comprises:

determining a plurality of physical resource blocks (PRBs) available for CSI reporting based on a bitmap; and

determining a frequency-domain resource of the second resource from the plurality of PRBs available for CSI reporting.

16. The second UE of claim 12, wherein determining the second resource comprises:

determining that a code-domain resource available for CSI reporting is divided into a plurality of code-domain resource groups, the plurality of code-domain resource groups being associated with a plurality of cyclic shifts;

determining a target cyclic shift from the plurality of cyclic shifts; and

determining a code-domain resource of the second resource from the plurality of code-domain resource groups based on the target cyclic shift.

17. The second UE of claim 12, wherein determining the second resource

comprises:

based on determining that a plurality of PRBs available for CSI reporting are divided into a first number of frequency-domain resource groups, and a code-domain resource available for CSI reporting is divided into a second number of code-domain resource groups, determining that a resource available for CSI reporting in the frequency-domain and the code-domain is divided into a third number of sub-resource groups, the third number of sub-resource groups being associated with a plurality of indexes, the third number being determined based on the first number and the second number;

determining a target index from the plurality of indexes; and

determining a frequency-domain and code-domain resource of the second resource from the third number of sub-resource groups based on the target index.

18. The second UE of claim 12, wherein the at least one processor is further configured to cause the second UE to:

determine the first resource based on a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals.

19. A base station (BS) comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the BS to:

transmit, to a user equipment (UE), configuration information comprising a time-domain resource distribution of a resource carried by a physical sidelink feedback channel (PSFCH) for transmitting a report, the report being associated with a plurality of measurements of a plurality of sidelink reference signals for determining channel state information (CSI) between a first UE and a second UE.

20. The BS of claim 19, wherein the configuration information further comprises one of the following:

a periodicity associated with a time-domain resource for transmitting the plurality of sidelink reference signals;

a payload size for transmitting the plurality of sidelink reference signals;

a minimum time interval between a resource for transmitting the plurality of

sidelink reference signals and the resource for transmitting the report;

a bitmap for determining a plurality of physical resource blocks (PRBs) available for transmitting the report;

a number of PRBs required for transmitting the report; or

a number of cyclic shifts in a code-domain for transmitting the report.

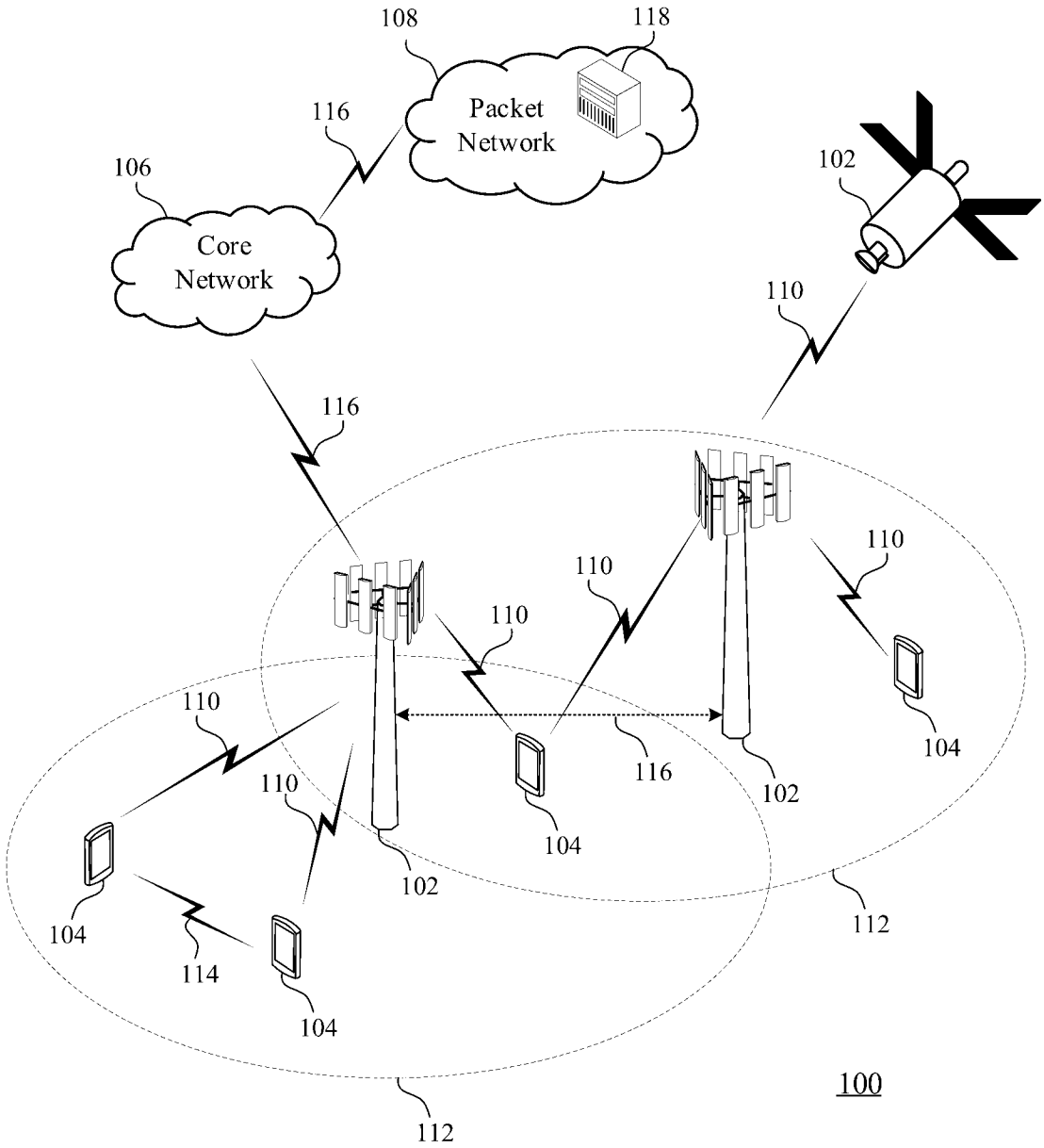

108
118
Packet Network
116
106
Core Network
102
110
116
110
110
110
110
110
104
116
102
104
110
102
104
112
114
104
112
100

FIG. 1

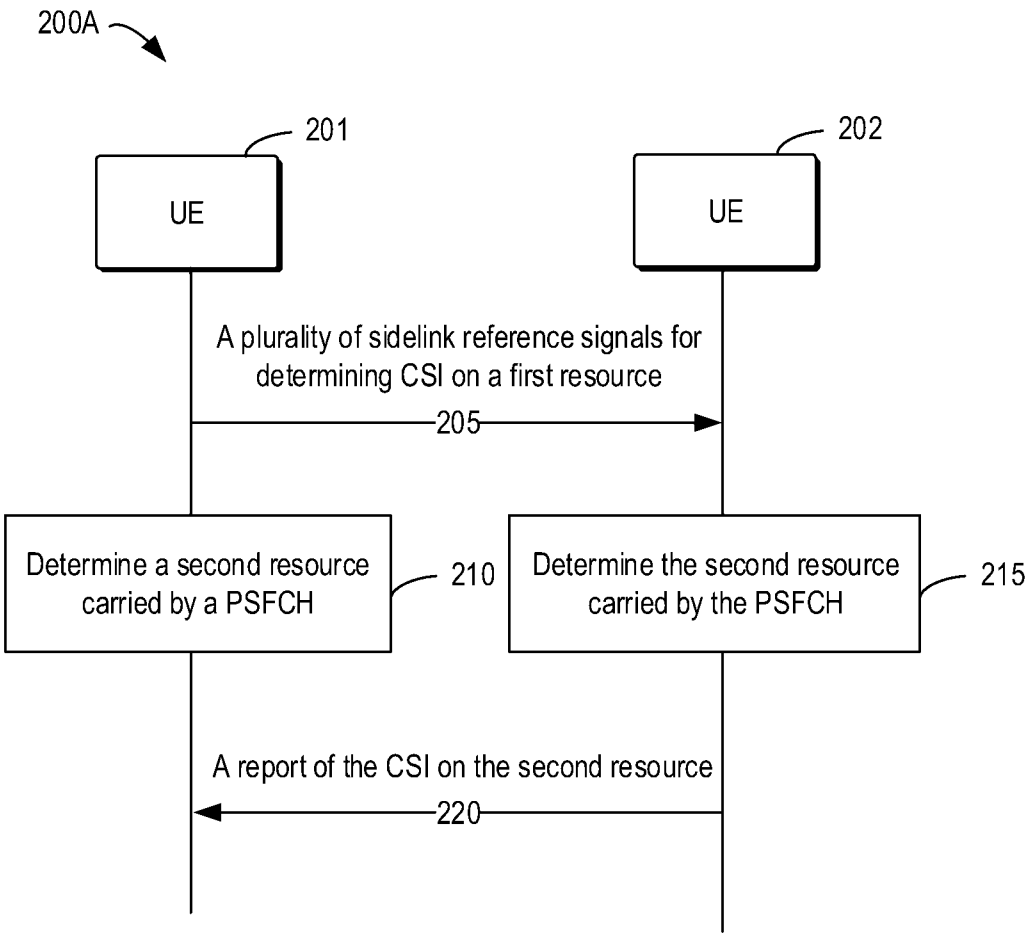

200A
201
UE
202
UE
A plurality of sidelink reference signals for determining CSI on a first resource
205
Determine a second resource carried by a PSFCH
210
Determine the second resource carried by the PSFCH
215
A report of the CSI on the second resource
220

FIG. 2A

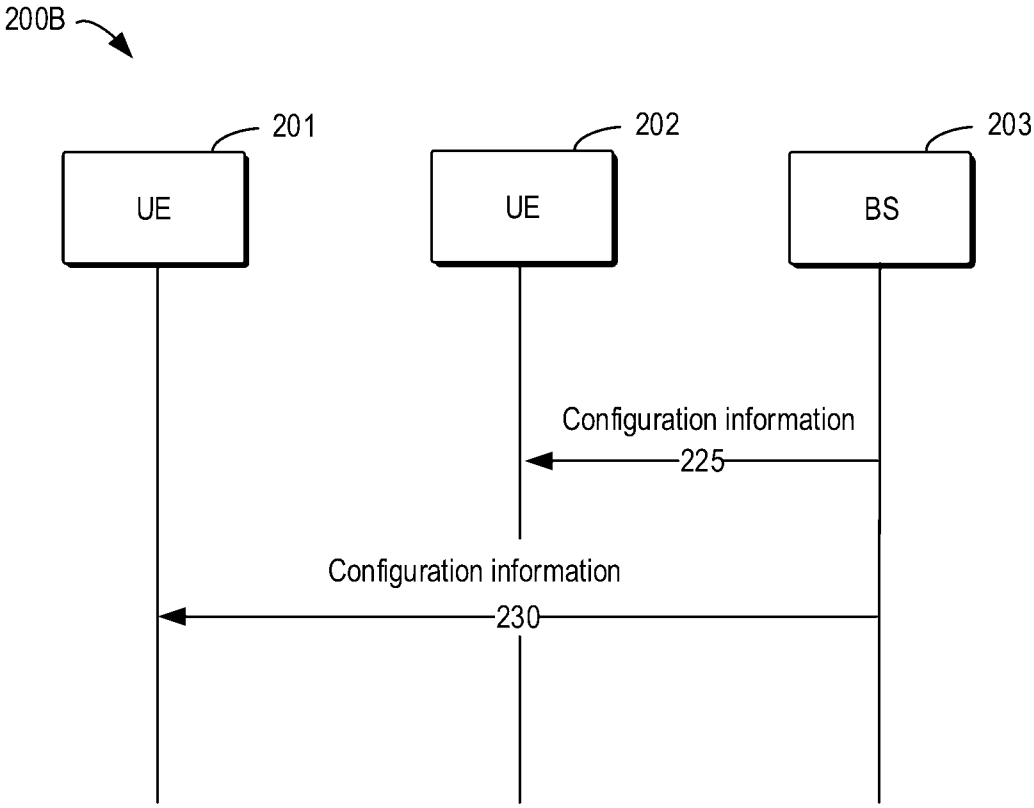

200B
201
UE
202
UE
203
BS
Configuration information
225
Configuration information
230

FIG. 2B

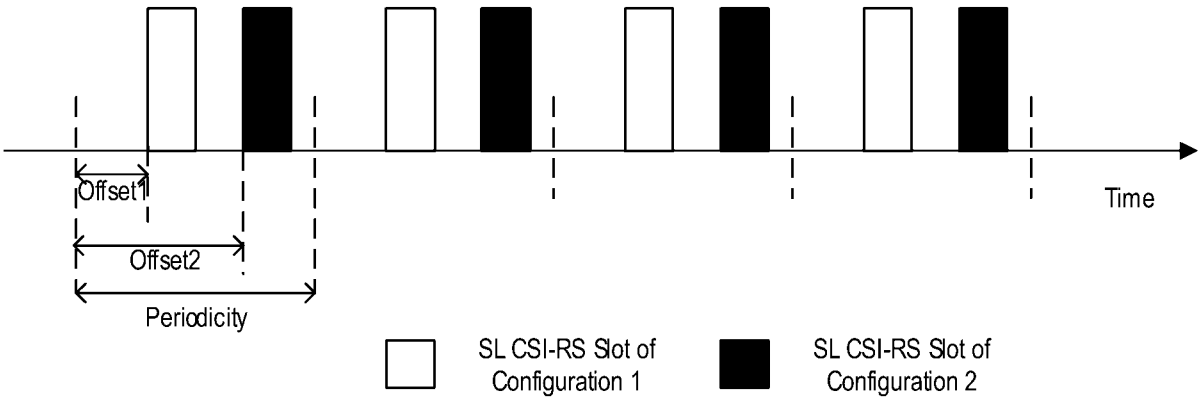

Offset1
Offset2
Periodicity
Time
SL CSI-RS Slot of Configuration 1
SL CSI-RS Slot of Configuration 2

FIG. 3A

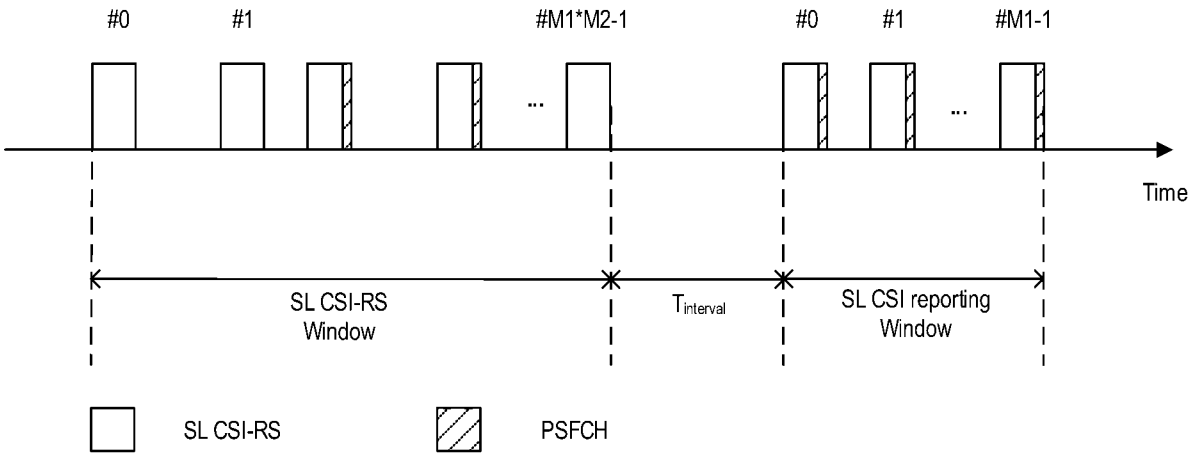

#0
#1
#M1*M2-1
#0
#1
#M1-1
Time
SL CSI-RS Window
$T_{interval}$
SL CSI reporting Window
SL CSI-RS
PSFCH

FIG. 3B

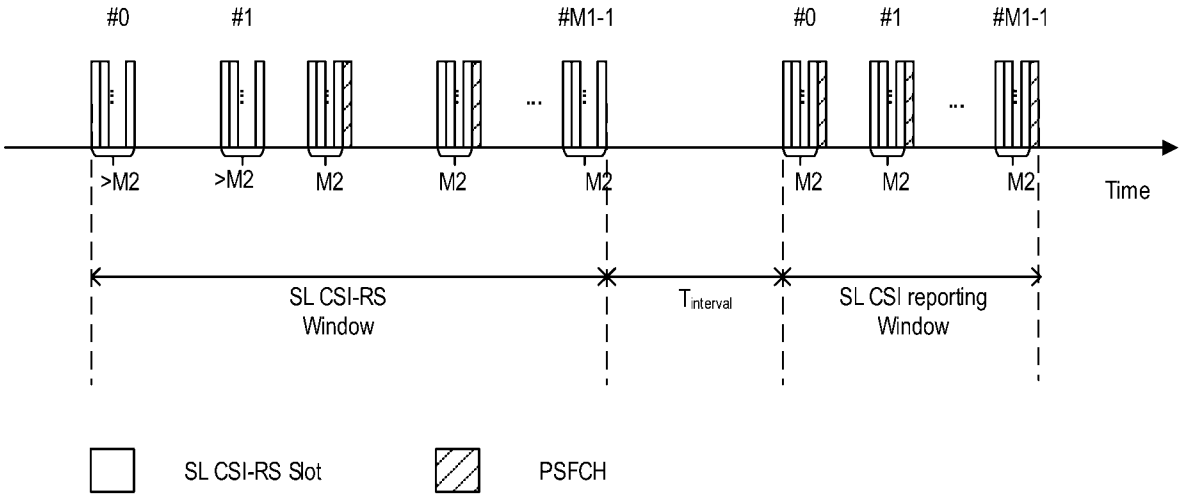

#0
#1
#M1-1
#0
#1
#M1-1
>M2
>M2
M2
M2
M2
M2
M2
M2
Time
SL CSI-RS Window
$T_{interval}$
SL CSI reporting Window
SL CSI-RS Slot
PSFCH

FIG. 3C

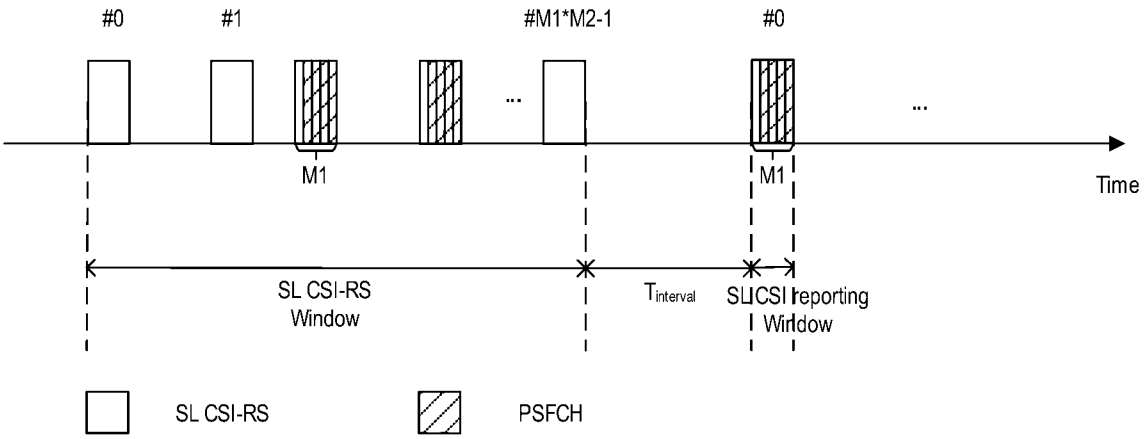

#0
#1
#M1*M2-1
#0
...
...
M1
M1
Time
SL CSI-RS Window
$T_{interval}$
SL CSI reporting Window
SL CSI-RS
PSFCH

FIG. 3D

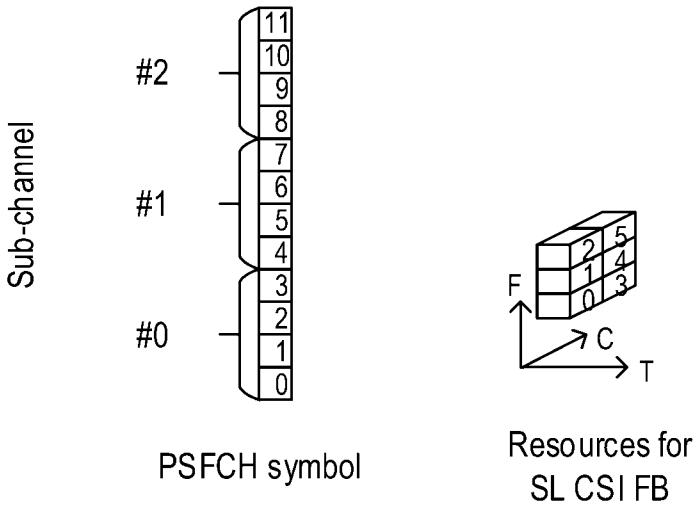

Sub-channel
#2
#1
#0
11
10
9
8
7
6
5
4
3
2
1
0
PSFCH symbol
F
C
T
2
5
1
4
0
3
Resources for
SL CSI FB

FIG. 3E

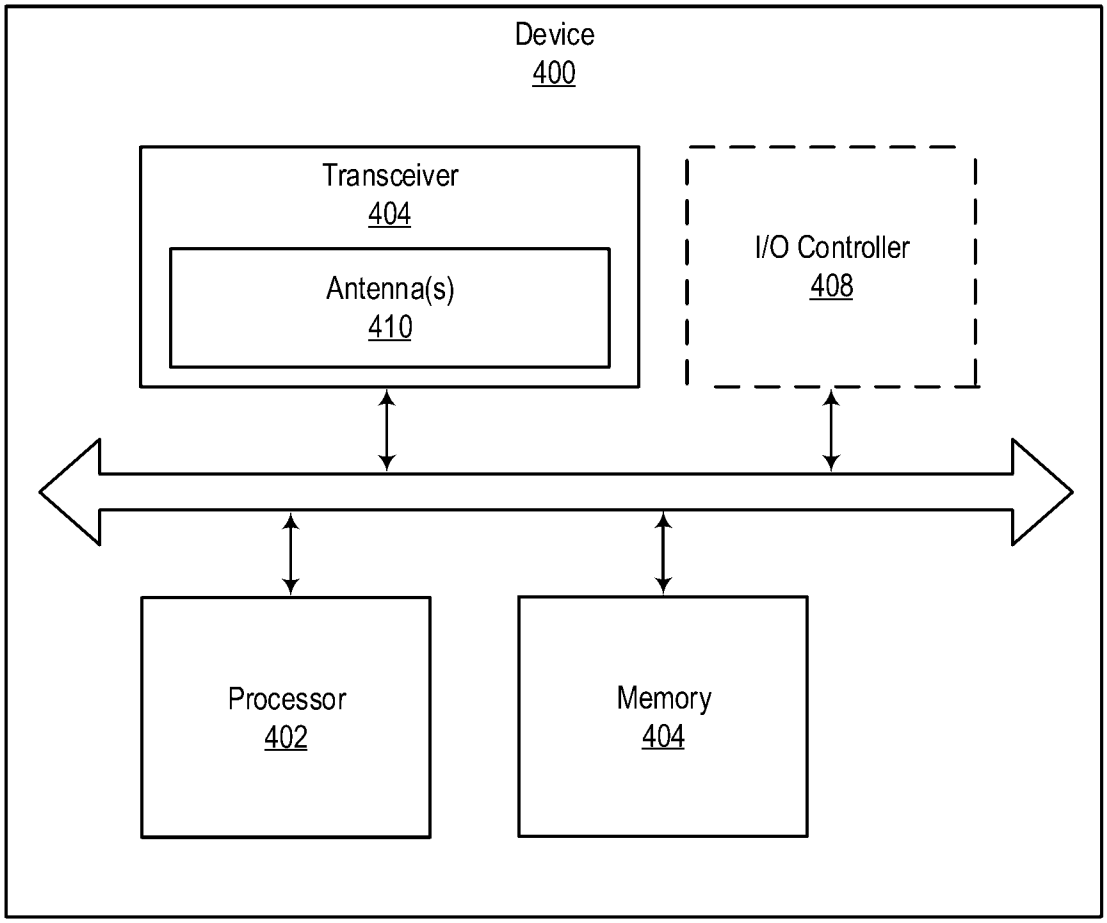

Device
400
Transceiver
404
Antenna(s)
410
I/O Controller
408
Processor
402
Memory
404

FIG. 4

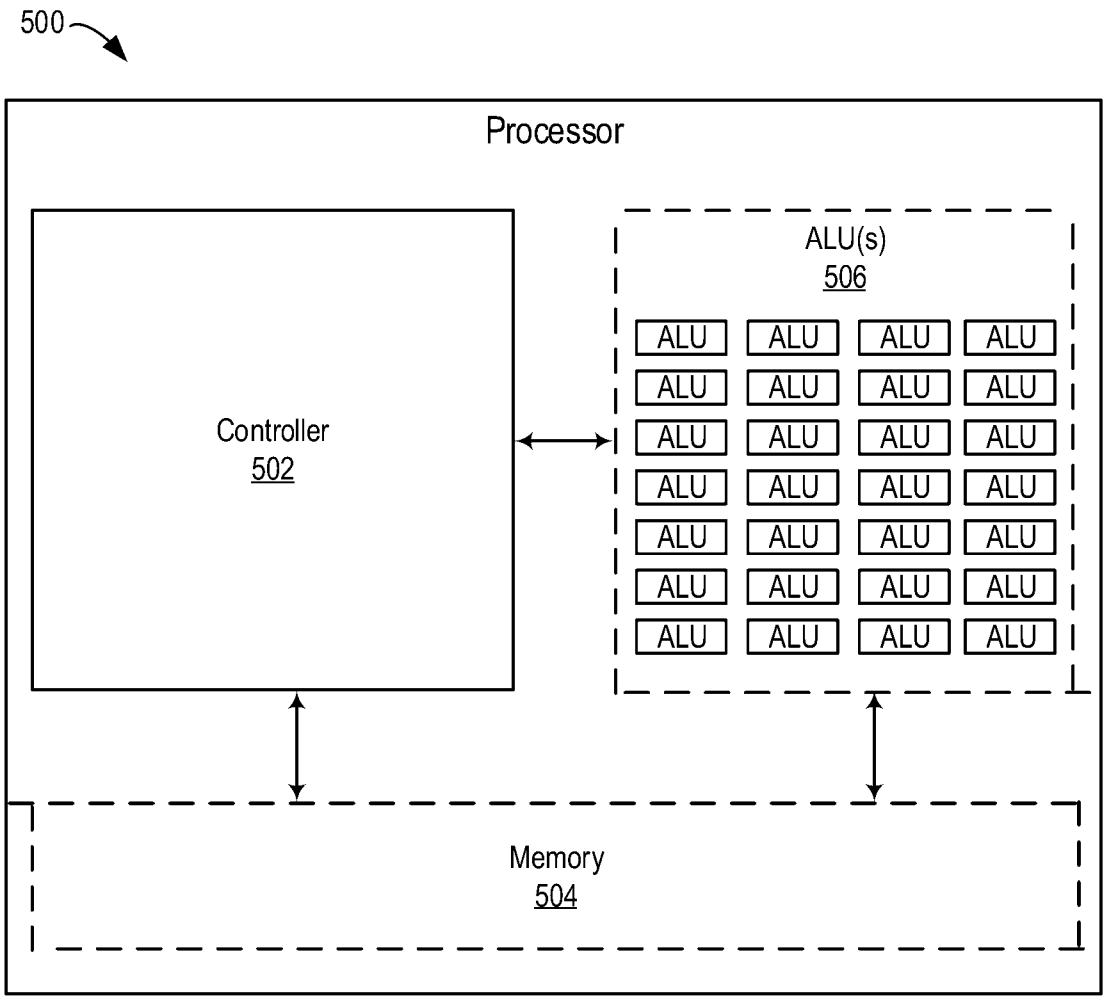


FIG. 5

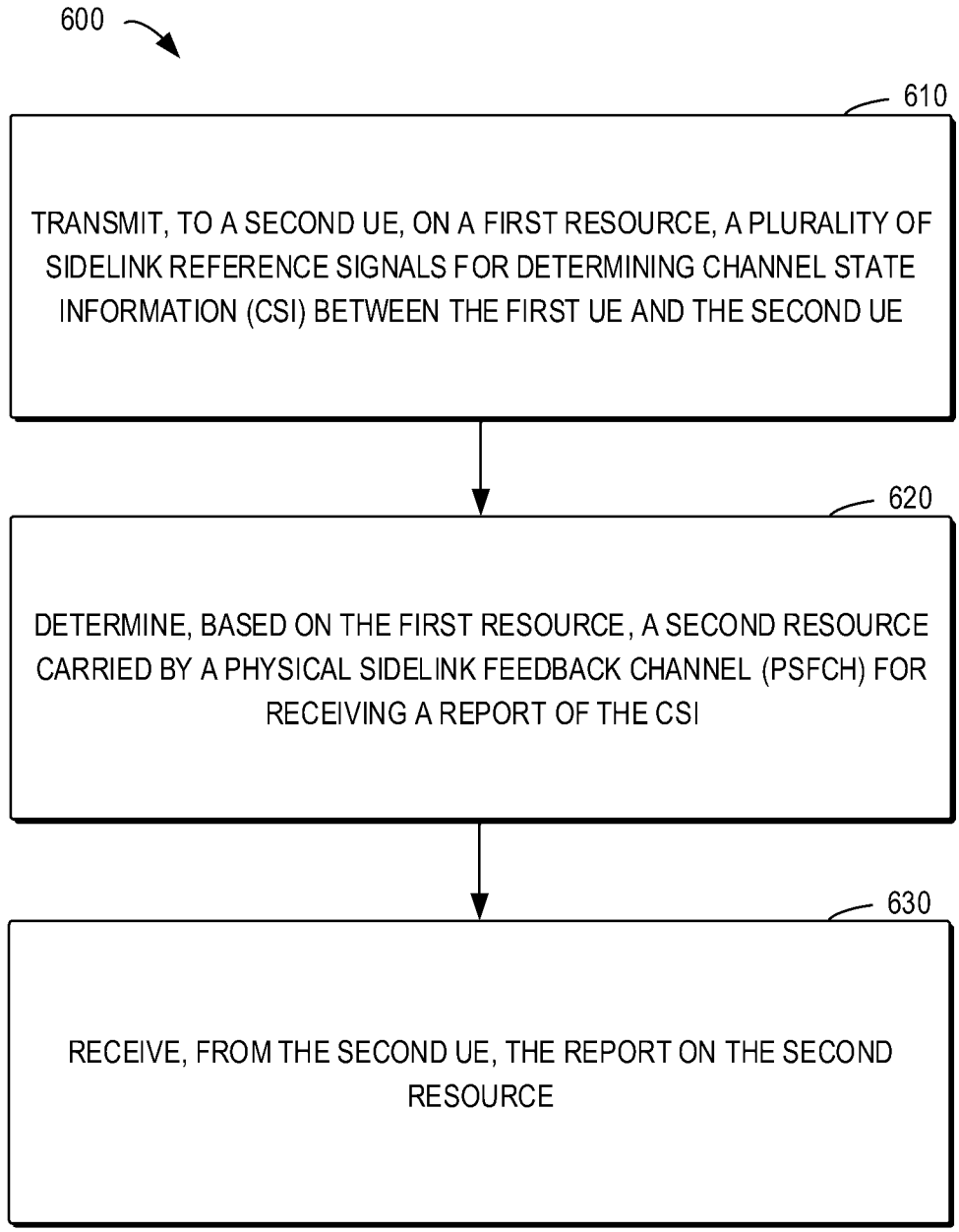

600
610
TRANSMIT, TO A SECOND UE, ON A FIRST RESOURCE, A PLURALITY OF SIDELINK REFERENCE SIGNALS FOR DETERMINING CHANNEL STATE INFORMATION (CSI) BETWEEN THE FIRST UE AND THE SECOND UE
620
DETERMINE, BASED ON THE FIRST RESOURCE, A SECOND RESOURCE CARRIED BY A PHYSICAL SIDELINK FEEDBACK CHANNEL (PSFCH) FOR RECEIVING A REPORT OF THE CSI
630
RECEIVE, FROM THE SECOND UE, THE REPORT ON THE SECOND RESOURCE

FIG. 6

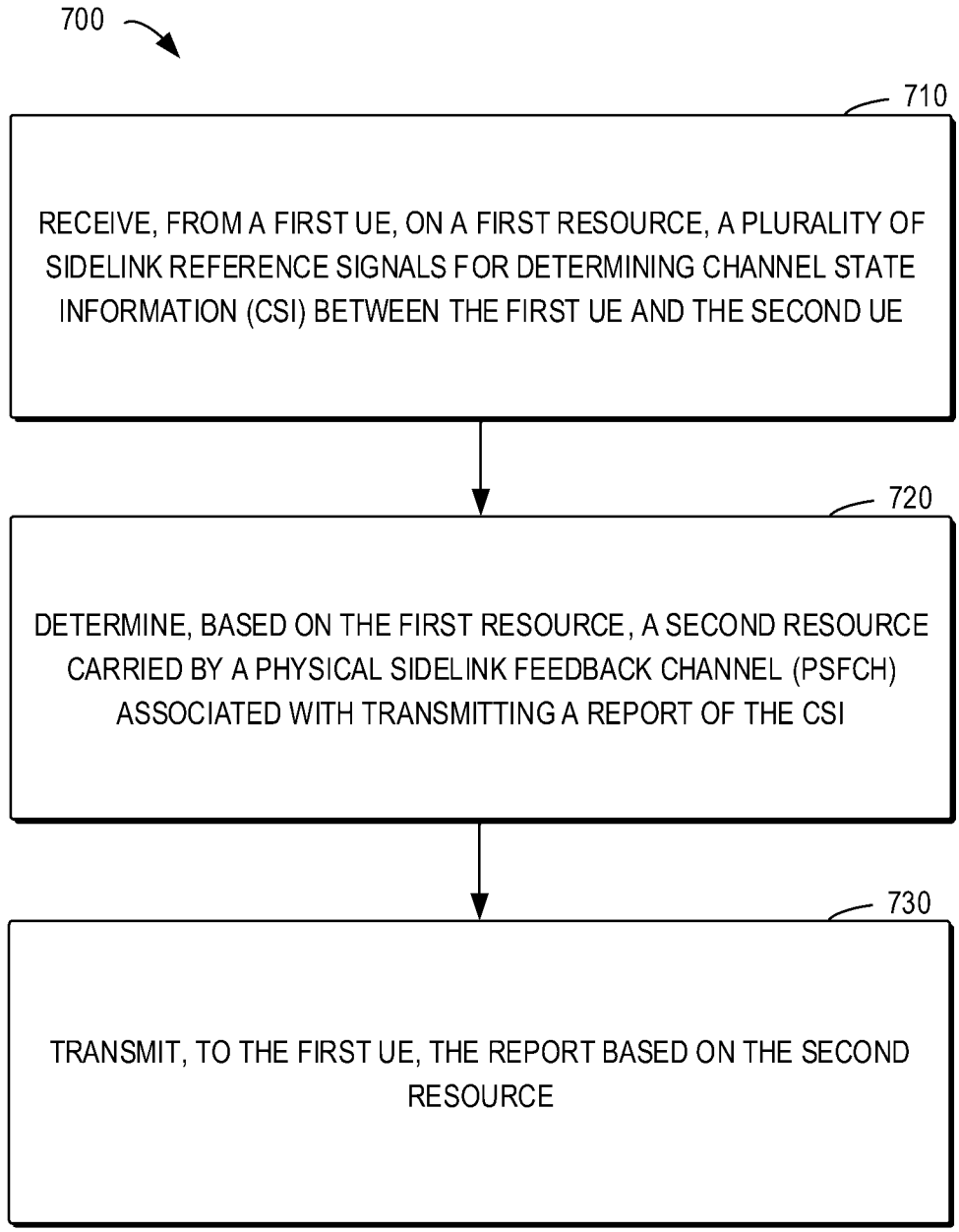

700
710
RECEIVE, FROM A FIRST UE, ON A FIRST RESOURCE, A PLURALITY OF SIDELINK REFERENCE SIGNALS FOR DETERMINING CHANNEL STATE INFORMATION (CSI) BETWEEN THE FIRST UE AND THE SECOND UE
720
DETERMINE, BASED ON THE FIRST RESOURCE, A SECOND RESOURCE CARRIED BY A PHYSICAL SIDELINK FEEDBACK CHANNEL (PSFCH) ASSOCIATED WITH TRANSMITTING A REPORT OF THE CSI
730
TRANSMIT, TO THE FIRST UE, THE REPORT BASED ON THE SECOND RESOURCE

FIG. 7

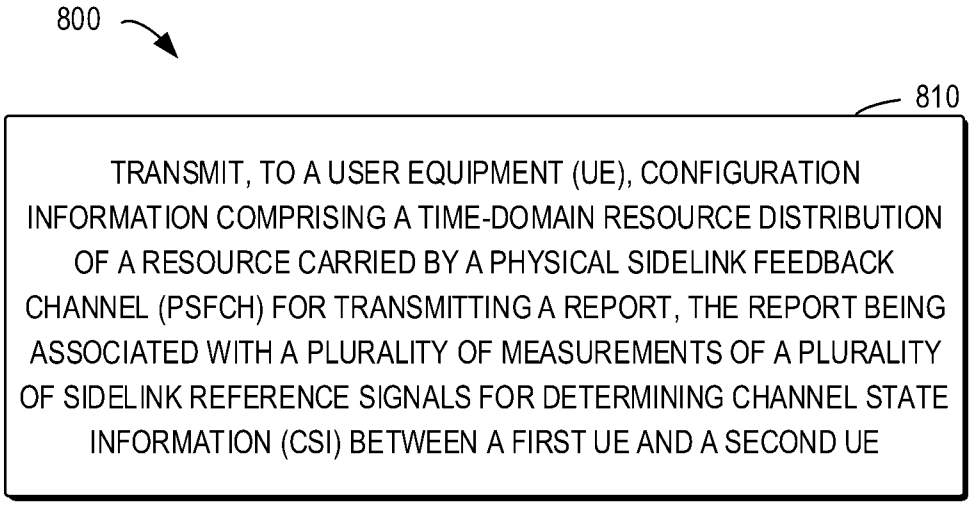

800
810
TRANSMIT, TO A USER EQUIPMENT (UE), CONFIGURATION INFORMATION COMPRISING A TIME-DOMAIN RESOURCE DISTRIBUTION OF A RESOURCE CARRIED BY A PHYSICAL SIDELINK FEEDBACK CHANNEL (PSFCH) FOR TRANSMITTING A REPORT, THE REPORT BEING ASSOCIATED WITH A PLURALITY OF MEASUREMENTS OF A PLURALITY OF SIDELINK REFERENCE SIGNALS FOR DETERMINING CHANNEL STATE INFORMATION (CSI) BETWEEN A FIRST UE AND A SECOND UE

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/071425

A. CLASSIFICATION OF SUBJECT MATTER

H04B7/06(2006.01)i; H04W24/10(2009.01)i; H04W72/12(2023.01)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)

IPC: H04W, H04B, H04L

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

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

3GPP,CNTXT,CNABS, DWPI,VEN,ENTXTC:report+, reference signal, RS, CSI+, channel, stat+, information, sidelink+, SL, receiv+, PSFCH, UE, resource+,time, domain+, slot+, interval+, gap, occasion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 113785612 A (SAMSUNG ELECTRONICS CO LTD) 10 December 2021 (2021-12-10) description paragraphs [0108] to [0109]	19,20
A	CN 113785612 A (SAMSUNG ELECTRONICS CO LTD) 10 December 2021 (2021-12-10) the whole document	1-18
A	CN 114270721 A (QUALCOMM INC) 01 April 2022 (2022-04-01) the whole document	1-20
A	CN 114902719 A (LENOVO SINGAPORE PTE LTD) 12 August 2022 (2022-08-12) the whole document	1-20
A	US 2021328643 A1 (QUALCOMM INC) 21 October 2021 (2021-10-21) the whole document	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
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"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)
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"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
27 September 2024	**29 September 2024**

Name and mailing address of the ISA/CN	Authorized officer
CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China**	**LIU,QiongYan** Telephone No. **(+86) 010-62411261**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/071425

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CN	113785612	A	10 December 2021	EP	3952421	A1	09 February 2022
				EP	3952421	A4	15 June 2022
				EP	3952421	B1	18 September 2024
				WO	2020222532	A1	05 November 2020
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				WO	2021090248	A1	14 May 2021
				MX	2022005586	A	27 October 2022
				US	2024224237	A1	04 July 2024
US	2021328643	A1	21 October 2021	US	11923941	B2	05 March 2024