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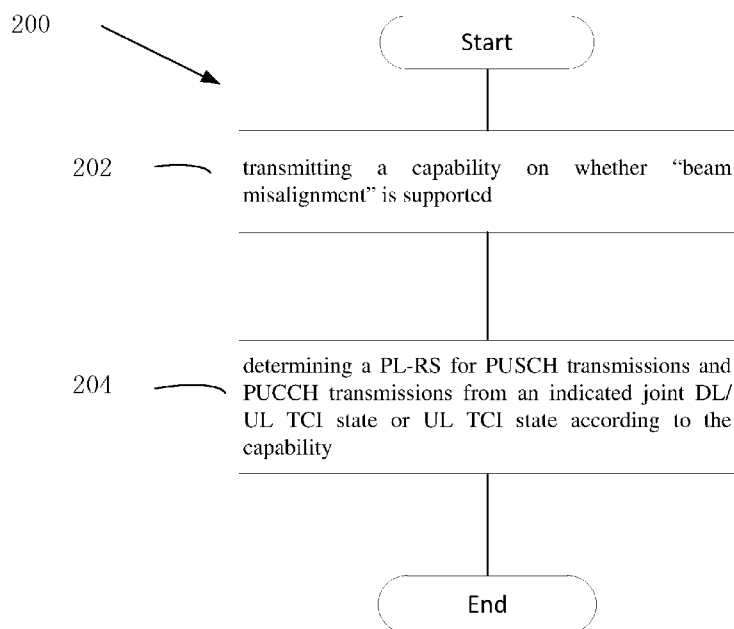


Figure 2

(57) Abstract: Methods and apparatuses for determining power control parameters for UL transmission with unified TCI framework are disclosed. A method at an UE comprises transmitting a capability on whether "beam misalignment" is supported; and determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

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CONFIGURATION AND DETERMINATION OF POWER CONTROL PARAMETERS FOR UL TRANSMISSION WITH UNIFIED TCI FRAMEWORK

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FIELD

[0001] The subject matter disclosed herein generally relates to wireless communications, and more particularly relates to methods and apparatuses for determining power control parameters for UL transmission with unified TCI framework.

BACKGROUND

10

[0002] The following abbreviations are herewith defined, at least some of which are referred to within the following description: New Radio (NR), Very Large Scale Integration (VLSI), Random Access Memory (RAM), Read-Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM or Flash Memory), Compact Disc Read-Only Memory (CD-ROM), Local Area Network (LAN), Wide Area Network (WAN), User Equipment (UE),
15 Evolved Node B (eNB), Next Generation Node B (gNB), Uplink (UL), Downlink (DL), Central Processing Unit (CPU), Graphics Processing Unit (GPU), Field Programmable Gate Array (FPGA), Orthogonal Frequency Division Multiplexing (OFDM), Radio Resource Control (RRC), User Entity/Equipment (Mobile Terminal), Transmitter (TX), Receiver (RX), reference signal (RS), pathloss reference RS (PL-RS), frequency range 2 (FR2): corresponding to
20 24.25GHz~52.6GHz, transmission configuration indication (TCI), Physical Uplink Control Channel (PUCCH), Physical Uplink Shared Channel (PUSCH), medium access control (MAC), MAC control element (MAC CE), Downlink control information (DCI), Physical Downlink Control Channel (PDCCH), Physical Downlink Shared Channel (PDSCH), quasi co-location (QCL), synchronization signal (SS), physical broadcast channel (PBCH), SS/PBCH
25 block (SSB), channel state information (CSI), CSI reference signal (CSI-RS), beam management (BM), tracking reference signal (TRS), sounding reference signal (SRS), non-zero power (NZP), band width part (BWP), control resource set (CORESET), de-modulation reference signal (DM-RS).

30

[0003] The transmit power of a UL signal is calculated according to a set of power control parameters including PL-RS, P₀, alpha and closeLoopIndex. PL-RS (pathloss reference RS) is a DL RS used to estimate DL pathloss. A target receiving power is configured as P₀. Partial power compensation is adopted by a pathloss compensation factor alpha ($0 < \alpha \leq 1$). In FR2, UL signal is transmitted using a UL TX spatial filter (i.e., a UL beam). The channel

characteristics for different beams are usually different. So, beam specific power control is supported in FR2 in NR Release 15. For example, each UL beam (which is configured by RRC parameter *PUCCH-SpatialRelationInfo*) used for PUCCH is associated with a set of power control parameters.

5 [0004] In NR Release 17, unified TCI framework is supported, where a common UL beam for PUCCH and PUSCH transmissions in a serving cell is directly indicated by a joint DL/UL TCI state or a UL TCI state contained in a DCI or be activated by a MAC CE.

[0005] The following issues are to be address. If the joint DL/UL TCI state or the UL TCI state is not associated with a PL-RS, how the PL-RS for the PUCCH and PUSCH
10 transmissions with the indicated joint DL/UL TCI state or the UL TCI state is determined? If a set of power control parameters including P0, alpha and closedLoopIndex (which indicates a closed loop index for closed power control if more than one closed loop is configured) is not configured for the joint DL/UL TCI state or the UL TCI state, how the set of power control parameters for the PUCCH and PUSCH transmissions with the indicated joint DL/UL TCI state
15 or UL TCI state is determined? Whether the unified TCI state can apply to SRS, and if yes, how the unified TCI state applies to SRS.

[0006] This invention targets the above issues.

BRIEF SUMMARY

[0007] Methods and apparatuses for determining power control parameters for UL
20 transmission with unified TCI framework are disclosed.

[0008] In one embodiment, a method at an UE comprises transmitting a capability on whether “beam misalignment” is supported; and determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

25 [0009] In one embodiment, the method may further comprise determining power control parameters including P0, alpha and closedLoopIndex for the PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUSCH power control setting; and determining power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated
30 with a PUCCH power control setting. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-*

PowerControl-Config-Id=0. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUCCH power control setting, *P0* and *closedLoopIndex* for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.

5 [0010] In another embodiment, the method may further comprise determining a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured. A PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS
10 resource set without configured PL-RS. When associatedCSI-RS is configured for the SRS resource set for non-codebook, the QCL-TypeD RS configured for the associatedCSI-RS is QCLed with the RS used to determine the UL TX spatial filter in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD, and the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the
15 source spatialRelationInfo RS in the indicated UL TCI state.

[0011] In some embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources, a capability to support “beam misalignment” is transmitted. In some other embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same
20 source QCL-TypeD SSB resource, a capability not to support “beam misalignment” is transmitted.

[0012] When the capability to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS. When the capability not to support “beam misalignment” is transmitted, a periodic DL
25 RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

[0013] When the capability not to support “beam misalignment” is transmitted, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined in
30 different conditions: in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a second condition that

an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

[0014] When the capability not to support “beam misalignment” is transmitted, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS; in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS; in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS; in a fifth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP

CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS; and in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

5 [0015] In one embodiment, a method at a base unit comprises receiving a capability on whether “beam misalignment” is supported; and determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[0016] In another embodiment, a remote unit (UE) comprises a transmitter that transmits
10 a capability on whether “beam misalignment” is supported; and a processor that determines a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[0017] In yet another embodiment, a base unit comprises a receiver that receives a capability on whether “beam misalignment” is supported; and a processor that determines a PL-
15 RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] A more particular description of the embodiments briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings.
20 Understanding that these drawings depict only some embodiments, and are not therefore to be considered to be limiting of scope, the embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

[0019] Figure 1 illustrates an example of the first embodiment;

[0020] Figure 2 is a schematic flow chart diagram illustrating an embodiment of a
25 method;

[0021] Figure 3 is a schematic flow chart diagram illustrating a further embodiment of a method; and

[0022] Figure 4 is a schematic block diagram illustrating apparatuses according to one embodiment.

30 [0023] DETAILED DESCRIPTION

[0024] As will be appreciated by one skilled in the art that certain aspects of the embodiments may be embodied as a system, apparatus, method, or program product.

Accordingly, embodiments may take the form of an entirely hardware embodiment, an entirely software embodiment (including firmware, resident software, micro-code, etc.) or an embodiment combining software and hardware aspects that may generally all be referred to herein as a “circuit”, “module” or “system”. Furthermore, embodiments may take the form of a program product embodied in one or more computer readable storage devices storing machine-readable code, computer readable code, and/or program code, referred to hereafter as “code”. The storage devices may be tangible, non-transitory, and/or non-transmission. The storage devices may not embody signals. In a certain embodiment, the storage devices only employ signals for accessing code.

[0025] Certain functional units described in this specification may be labeled as “modules”, in order to more particularly emphasize their independent implementation. For example, a module may be implemented as a hardware circuit comprising custom very-large-scale integration (VLSI) circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

[0026] Modules may also be implemented in code and/or software for execution by various types of processors. An identified module of code may, for instance, include one or more physical or logical blocks of executable code which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but, may include disparate instructions stored in different locations which, when joined logically together, include the module and achieve the stated purpose for the module.

[0027] Indeed, a module of code may contain a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules and may be embodied in any suitable form and organized within any suitable type of data structure. This operational data may be collected as a single data set, or may be distributed over different locations including over different computer readable storage devices. Where a module or portions of a module are implemented in software, the software portions are stored on one or more computer readable storage devices.

[0028] Any combination of one or more computer readable medium may be utilized. The computer readable medium may be a computer readable storage medium. The computer readable storage medium may be a storage device storing code. The storage device may be, for example, but need not necessarily be, an electronic, magnetic, optical, electromagnetic, infrared, holographic, micromechanical, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing.

[0029] A non-exhaustive list of more specific examples of the storage device would include the following: an electrical connection having one or more wires, a portable computer diskette, a hard disk, random access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM or Flash Memory), portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing. In the context of this document, a computer-readable storage medium may be any tangible medium that can contain or store a program for use by or in connection with an instruction execution system, apparatus, or device.

[0030] Code for carrying out operations for embodiments may include any number of lines and may be written in any combination of one or more programming languages including an object-oriented programming language such as Python, Ruby, Java, Smalltalk, C++, or the like, and conventional procedural programming languages, such as the "C" programming language, or the like, and/or machine languages such as assembly languages. The code may be executed entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the very last scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).

[0031] Reference throughout this specification to "one embodiment", "an embodiment", or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, appearances of the phrases "in one embodiment", "in an embodiment", and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment, but mean "one or more but not all embodiments" unless expressly specified otherwise. The terms "including", "comprising", "having", and variations thereof mean "including but are not limited to", unless

otherwise expressly specified. An enumerated listing of items does not imply that any or all of the items are mutually exclusive, otherwise unless expressly specified. The terms “a”, “an”, and “the” also refer to “one or more” unless otherwise expressly specified.

[0032] Furthermore, described features, structures, or characteristics of various
5 embodiments may be combined in any suitable manner. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments. One skilled in the relevant art will recognize, however, that embodiments may be practiced
10 without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid any obscuring of aspects of an embodiment.

[0033] Aspects of different embodiments are described below with reference to schematic flowchart diagrams and/or schematic block diagrams of methods, apparatuses, systems,
15 and program products according to embodiments. It will be understood that each block of the schematic flowchart diagrams and/or schematic block diagrams, and combinations of blocks in the schematic flowchart diagrams and/or schematic block diagrams, can be implemented by code. This code may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the
20 instructions, which are executed via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions specified in the schematic flowchart diagrams and/or schematic block diagrams for the block or blocks.

[0034] The code may also be stored in a storage device that can direct a computer, other programmable data processing apparatus, or other devices, to function in a particular manner,
25 such that the instructions stored in the storage device produce an article of manufacture including instructions which implement the function specified in the schematic flowchart diagrams and/or schematic block diagrams block or blocks.

[0035] The code may also be loaded onto a computer, other programmable data processing apparatus, or other devices, to cause a series of operational steps to be performed on
30 the computer, other programmable apparatus or other devices to produce a computer implemented process such that the code executed on the computer or other programmable

apparatus provides processes for implementing the functions specified in the flowchart and/or block diagram block or blocks.

[0036] The schematic flowchart diagrams and/or schematic block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of apparatuses, systems, methods and program products according to various embodiments. In this regard, each block in the schematic flowchart diagrams and/or schematic block diagrams may represent a module, segment, or portion of code, which includes one or more executable instructions of the code for implementing the specified logical function(s).

[0037] It should also be noted that in some alternative implementations, the functions noted in the block may occur out of the order noted in the Figures. For example, two blocks shown in succession may substantially be executed concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more blocks, or portions thereof, to the illustrated Figures.

[0038] Although various arrow types and line types may be employed in the flowchart and/or block diagrams, they are understood not to limit the scope of the corresponding embodiments. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the depicted embodiment. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted embodiment. It will also be noted that each block of the block diagrams and/or flowchart diagrams, and combinations of blocks in the block diagrams and/or flowchart diagrams, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and code.

[0039] The description of elements in each Figure may refer to elements of proceeding figures. Like numbers refer to like elements in all figures, including alternate embodiments of like elements.

[0040] In NR Release 17, DCI based unified TCI framework is supported. When joint DL/UL TCI (which means DL RX spatial filter and UL TX spatial filter are determined by a same indicated TCI state) is configured, the DL RX spatial filter for a set of dedicated PDCCH receptions (a dedicated PDCCH reception is the PDCCH reception in RRC-connected mode) and all PDSCH receptions and the UL TX spatial filter for a set of dedicated PUCCH transmissions (a dedicated PUCCH transmission is the PUCCH transmission in RRC-connected mode) and all

PUSCH transmissions are both determined by the QCL-TypeD RS contained in the joint DL/UL TCI state indicated by a transmission configuration indicator (TCI) field contained in a DCI or in a MAC CE (the MAC CE only activates one TCI state configured by RRC signaling). When separate DL/UL TCI (which means DL TCI state and UL TCI state are updated or activated separately) is configured, the DL RX spatial filter for a set of dedicated PDCCH receptions and all PDSCH receptions is determined by the QCL-TypeD RS contained in the DL TCI state indicated by a transmission configuration indicator (TCI) field in a DCI or a MAC CE, while the UL TX spatial filter for a set of dedicated PUCCH transmissions and all PUSCH transmissions is directly indicated by the UL TCI state (i.e. the spatialRelationInfo RS contained in the UL TX state) indicated by a UL TCI field in a DCI or a MAC CE.

[0041] The joint DL/UL TCI state or the DL TCI state can be configured by the following RRC signaling

TCI state

The IE *TCI state* associates one or two DL reference signals with a corresponding quasi-colocation (QCL) type.

TCI state information element

```

TCI state ::=
    TCI stateId
    qcl-Type1
    qcl-Type2
    ...
}

QCL-Info ::=
    cell
    bwp-Id
    referenceSignal
        csi-rs
        ssb
    },
    qcl-Type
    ...
}

SEQUENCE {
    TCI stateId,
    QCL-Info,
    QCL-Info

SEQUENCE {
    ServCellIndex
    BWP-Id
    CHOICE {
        NZP-CSI-RS-ResourceId,
        SSB-Index

ENUMERATED {typeA, typeB, typeC, typeD},

```

[0042] Each TCI state contains parameters for configuring a quasi co-location (QCL) relationship between one or two downlink reference signals and the DM-RS ports of the PDSCH, the DM-RS port of PDCCH or the CSI-RS port(s) of a CSI-RS resource. The quasi co-location relationship is configured by the higher layer parameter qcl-Type1 for the first DL RS, and qcl-Type2 for the second DL RS (if configured). For the case of two DL RSs, the QCL types shall not be the same, regardless of whether the references are to the same DL RS or different DL RSs. The quasi co-location types corresponding to each DL RS are given by the higher layer parameter qcl-Type in QCL-Info and may take one of the following values:

- 'QCL-TypeA': {Doppler shift, Doppler spread, average delay, delay spread}

- 'QCL-TypeB': {Doppler shift, Doppler spread}
- 'QCL-TypeC': {Doppler shift, average delay}
- 'QCL-TypeD': {Spatial Rx parameter}

[0043] If a DL RS is configured in a TCI state with QCL-TypeD, this DL RS is called as the QCL-TypeD RS. If a TCI state is configured for a DL signal or a DL channel, it means that the DL signal or the DL channel is QCLed with the RS(s) contained in the TCI state with a QCL type as indicated in the TCI state. The UE shall determine the DL RX spatial filter and the UL TX spatial filter according to the QCL-TypeD RS in the joint DL/UL TCI state.

[0044] For the case that the UE determine the UL TX spatial filter for a UL signal according to a DL RS, it means that the UE shall transmit the UL signal with the same spatial domain transmission filter used for the reception of the DL RS. The UL TCI state for separate DL/UL TCI indication contains at least a RS as the spatialRelationInfo by the following RRC signalling:

	TCI state information element
15	UL TCI state ::=
	SEQUENCE {
	UL TCI stateId,
	spatialRelationInfo
	CHOICE {
	csi-rs
	ssb
20	srs
	NZP-CSI-RS-ResourceId,
	SSB-Index
	srs-ResourceId
	},
	...
	}

[0045] The RS configured as the spatialRelationInfo is called spatialRelationInfo RS, which is used to determine the UL TX spatial filter for a UL signal. When a DL RS, e.g., CSI-RS or a SSB, is configured as the spatialRelationInfo RS, the UE shall transmit the UL signal with the same spatial domain transmission filter used for the reception of the DL RS. When a SRS resource is configured as the spatialRelationInfo RS, the UE shall transmit the UL signal with the same spatial domain transmission filter used for the transmission of the SRS resource.

[0046] CSI-RS is a type of DL RS used for DL channel measurement. Multiple CSI-RS resource sets each of which contains one or more CSI-RS resources can be configured in a BWP in a serving cell. Each CSI-RS resource that has a unique ID can be transmitted aperiodically, or periodically or semi-persistently according to RRC configuration. Each CSI-RS resource can be used for different purposes. For a CSI-RS resource in an NZP-CSI-RS-ResourceSet configured without higher layer parameter trs-Info and without the higher layer parameter repetition, the CSI-RS resource is used for CSI acquisition. For a CSI-RS resource in an NZP-CSI-RS-ResourceSet configured with higher layer parameter repetition, the CSI-RS resource is used for

beam management. For a CSI-RS resource in an NZP-CSI-RS-ResourceSet configured with higher layer parameter trs-Info, the CSI-RS resource is used for tracking. The CSI-RS resource used for tracking is also called TRS.

[0047] SRS is a type of UL RS used for UL channel measurement. Multiple SRS resource sets, each of which contains one or more SRS resource, can be configured in a BWP of a serving cell. SRS resource in each SRS resource set can be used for different purposes according to the higher layer parameter usage configured for the SRS resource set.

[0048] For the UL transmission in FR2, a UL TX beam is needed to be indicated for a UL channel or a UL signal (maybe abbreviated as a UL channel/signal) for the UE to determine the UL TX spatial filter. In addition, a PL-RS is needed to be indicated along with the indicated UL TX beam for DL pathloss estimation.

[0049] It has been agreed that in NR Release 17 unified TCI framework, a SS/PBCH block (SSB) resource or a CSI-RS resource used for beam management (BM) or a CSI-RS resource used for tracking (which is refers to as TRS) or an SRS resource for BM can be configured or be indicated as the RS to determine the UL TX spatial filter for a UL channel/signal. Note that CSI-RS resource mentioned in this application refers to periodic NZP CSI-RS resource. An SSB resource or a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with single antenna port can be configured as the PL-RS for a UL channel/signal.

[0050] The CSI-RS resource for BM can be further QCLed with an SSB resource with QCL-TypeD, or QCLed with another CSI-RS resource for BM with QCL-TypeD.

[0051] The TRS can be further QCLed with an SSB resource with QCL-TypeD, or QCLed with a CSI-RS resource for BM with QCL-TypeD.

[0052] The SRS resource for BM can be configured with a DL signal, e.g., SSB resource or a CSI-RS resource for BM, to determine the UL TX spatial filter.

[0053] It can be seen that an SSB resource can be found for all possible source RSs that can be configured for a UL channel/signal to determine the UL TX spatial filter.

[0054] Based on this observation, “beam misalignment” is defined as that the DL RS configured as PL-RS and the DL RS used to determine UL TX spatial filter can have different source QCL-TypeD SSB resources.

[0055] The UE may indicate a capability to support “beam misalignment” (which means that the DL RS configured as PL-RS and the DL RS or SRS resource used to determine UL TX spatial filter can have different source QCL-TypeD SSB resources), or a capability not to support

“beam misalignment” (which means that the DL RS configured as PL-RS and the DL RS or SRS resource used to determine UL TX spatial filter should have the same source QCL-TypeD SSB resource).

[0056] A first embodiment relates to the configuration of the PL-RS for UL transmission based on different capabilities.

[0057] For joint DL/UL TCI state, if the UE indicates a capability to support “beam misalignment”, each joint DL/UL TCI state should be configured to be associated with a periodic DL RS as the PL-RS. The configured PL-RS can have a different source QCL-TypeD SSB resource from the source QCL-TypeD SSB resource of the QCL-TypeD RS (which can be used to determine the UL TX spatial filter) contained in the joint DL/UL TCI state.

[0058] For joint DL/UL TCI state, if the UE indicates a capability not to support “beam misalignment”, each joint DL/UL TCI state can be configured to be associated with a periodic DL RS as the PL-RS. The configured PL-RS shall have the same source QCL-TypeD SSB resource as the source QCL-TypeD SSB resource of the QCL-TypeD RS (which can be used to determine the UL TX spatial filter) contained in the joint DL/UL TCI state. From UE point of view, the UE is not expected to be configured with a PL-RS that has a different source QCL-TypeD SSB source from the source QCL-TypeD SSB resource of the QCL-TypeD RS contained in the joint DL/UL TCI state.

[0059] For joint DL/UL TCI state, if the UE indicates a capability not to support “beam misalignment”, if the joint DL/UL TCI state does not have an associated PL-RS, the UE shall determine a periodic RS as the PL-RS according to the following rules in different conditions:

[0060] In a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the configured periodic TRS as the PL-RS.

[0061] In a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, another periodic TRS shall be configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, and the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the periodic TRS (that is QCLed with the configured aperiodic TRS with QCL-TypeD) as the PL-RS.

[0062] In a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, the UE shall determine a CSI-RS

resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the configured CSI-RS resource for BM as the PL-RS.

[0063] In a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, there are three sub-conditions:

[0064] In a first sub-condition that a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the configured periodic TRS as the PL-RS.

[0065] In a second sub-condition that an SSB resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the UE shall determine the SSB resource as the PL-RS.

[0066] In a third sub-condition that a CSI-RS resource for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the configured CSI-RS resource for BM as the PL-RS.

[0067] For separate DL/UL TCI state, if the UE indicates a capability to support “beam misalignment”, each UL TCI state should be configured to be associated with a periodic DL RS as the PL-RS. The configured PL-RS can have a different source QCL-TypeD SSB resource from the source QCL-TypeD SSB resource of the spatialRelationInfo RS contained in the UL TCI state to indicate the UL TX spatial filter.

[0068] For separate DL/UL TCI state, if the UE indicates a capability not to support “beam misalignment”, each UL TCI state can be configured to be associated with a periodic DL RS as the PL-RS. The configured PL-RS shall have the same source QCL-TypeD SSB resource as the source QCL-TypeD SSB resource of the spatialRelationInfo RS contained in the UL TCI state to indicate the UL TX spatial filter. From UE point of view, the UE is not expected to be configured with a PL-RS that has a different source QCL-TypeD SSB resource from the source QCL-TypeD SSB resource of the spatialRelationInfo RS contained in the UL TCI state to indicate the UL TX spatial filter.

[0069] For separate DL/UL TCI state, if the UE indicates a capability not to support “beam misalignment”, if the UL TCI state does not have an associated PL-RS, the UE shall determine a periodic RS as the PL-RS according to the following rules in different conditions:

[0070] In a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the periodic TRS as the PL-RS.

[0071] In a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the configured CSI-RS resource for BM as the PL-RS.

[0072] In a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the UE shall determine the configured SSB resource as the PL-RS.

[0073] In a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, there are three sub-conditions:

[0074] In a first sub-condition that an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the UE shall determine the SSB resource as the PL-RS.

[0075] In a second sub-condition that a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, the UE shall determine a CSI-RS resource (i.e. a periodic NZP CSI-RS resource) with the same ID as the CSI-RS resource for BM as the PL-RS.

[0076] In a third sub-condition that a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the UE shall determine the periodic TRS as the PL-RS.

[0077] Figure 1 illustrates an example of the first embodiment. TRS-1 and TRS-2 are QCLed with SSB-1 with QCL-TypeD, i.e., SSB-1 is configured as the QCL-TypeD RS for TRS-1 and TRS-2. TRS-3 and TRS-4 are QCLed with SSB-2 with QCL-TypeD, i.e., SSB-2 is configured as the QCL-TypeD RS for TRS-3 and TRS-4. TRS-2 is configured as the spatialRelationInfo RS for SRS-1. SSB-2 is configured as the spatialRelationInfo RS for SRS-2.

[0078] When joint DL/UL TCI state is configured for a UE indicating a capability not to support “beam misalignment”, if TRS-2 is configured as QCL-TypeD RS in a first joint DL/UL TCI state (e.g., TCI-state-1), the gNB can associate TRS-1 or TRS-2 or SSB1 with the first joint DL/UL TCI state as the PL-RS, since each of TRS-1 and TRS-2 and SSB1 has the same source QCL-TypeD SSB resource as that of TRS-2.

[0079] When joint DL/UL TCI state is configured for a UE indicating a capability not to support “beam misalignment”, if TRS-3 is configured as QCL-TypeD RS in a second joint DL/UL TCI state (e.g., TCI-state-2), and the second joint DL/UL TCI state does not have an associated PL-RS, when the second joint DL/UL TCI state is indicated as the TCI state for PDCCH transmissions and PDSCH transmissions, the PL-RS can be determined in different conditions: If TRS-3 is periodic, the UE shall determine TRS-3 as the PL-RS. If TRS-3 is aperiodic while TRS-4 is periodic and configured as the source QCL-TypeD RS in the TCI state for TRS-3, the UE shall determine TRS-4 (i.e. an NZP CSI-RS resource with the same ID as the periodic TRS (i.e. TRS-4)) as the PL-RS.

[0080] When separate DL/UL TCI state is configured for a UE indicating a capability not to support “beam misalignment”, if SRS-1, that is aperiodic, is configured in UL-TCI-State-1 as the spatialRelationInfo RS for the UE to determine UL TX spatial filter, the gNB can associate TRS-2 or SSB-1 with UL-TCI-State-1 as the PL-RS since TRS-2 is configured as the spatialRelationInfo RS for SRS-1 and TRS-2 is QCLed with SSB-1 with QCL-TypeD.

[0081] When separate DL/UL TCI state is configured for a UE indicating a capability not to support “beam misalignment”, if SRS-2 is configured in UL-TCI-State-2 as the spatialRelationInfo RS and there is no associated PL-RS, the UE shall determine TRS-3 as the PL-RS since TRS-3 is explicitly configured as the spatialRelationInfo RS for SRS-2.

[0082] A second embodiment relates to determining other power control parameters except PL-RS, i.e. the other power control parameters including P0, alpha and ClosedLoopIndex for UL transmission.

[0083] It is agreed that the gNB shall configure one or more power control settings for PUSCH as follow:

```
PUSCH-PowerControl-Config::={
    PUSCH-PowerControl-Config-Id,
    P0,
    Alpha,
    ClosedLoopIndex
}
```

[0084] In addition, the gNB shall configure one or more power control settings for PUCCH as follow. Incidentally, for PUCCH, alpha is equal to 1.

```

PUCCH-PowerControl-Config::={
    PUCCH-PowerControl-Config-Id,
    P0,
    ClosedLoopIndex
5   }

```

[0085] Each activated joint DL/UL TCI state or activated UL TCI state may be associated with a PUSCH power control setting as well as a PUCCH power control setting. Therefore, the UE can obtain the power control parameters for PUSCH and PUCCH according to the indicated joint DL/UL TCI state or UL TCI state (i.e. the joint DL/UL TCI state or UL TCI state indicated from all activated joint DL/UL TCI states or UL TCI states).

[0086] For example, if the indicated TCI state is not associated with a PUSCH power control setting, the UE shall determine the first configured PUSCH power control setting, i.e., *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*, as the power control parameters for PUSCH.

[0087] If the indicated TCI state is not associated with a PUCCH power control setting, the UE shall determine the first configured PUCCH power control setting, i.e., *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*, as the power control parameters for PUCCH.

[0088] A third embodiment relates to applying the indicated TCI state to SRS.

[0089] In NR Release 15, only one SRS resource set used for either codebook or non-codebook can be configured in one BWP of a serving cell for a UE for UL scheduling. Each SRS resource in the one SRS resource set is configured with a spatialRelationInfo RS to determine the UL TX spatial filter in FR2. Besides, a set of power control parameters including P0, alpha, closedLoopIndex and PL-RS are configured for the one SRS resource set by RRC signaling. In NR Release 16, the PL-RS for aperiodic and semi-persistent SRS resource set can be updated by MAC CE.

[0090] In NR Release 15 and NR Release 16, the PUSCH shall be transmitted using the same antenna port(s) as the SRS port(s) in the SRS resource used for codebook or non-codebook indicated in the UL grant. Thus, the UL TX spatial filter for PUSCH is determined by the spatialRelationInfo RS configured for the SRS resource(s) indicated in the UL grant. However, in NR Release 17, a common UL TX spatial filter shall be determined for all PUSCH

transmissions in the BWPs of a serving cell. It means that the UL TX spatial filter shall not be changed according to the spatialRelationInfo RS configured for the SRS resource(s) used for codebook or non-codebook based PUSCH transmission.

[0091] The feature of default spatial relation (e.g. default spatialRelationInfo RS) and default PL-RS for SRS was introduced in NR Release 16. When the SRS resources do not have configured spatialRelationInfo RS or configured PL-RS, the UE determines a default spatialRelationInfo RS and a default PL-RS according to the QCL-TypeD RS configured in the TCI state or QCL assumption of the CORESET with the lowest index in the active DL BWP if CORESETs (each of which identifies a set of time-frequency resources used for PDCCH transmission, and is identified with an index) are provided in the active DL BWP of serving cell, or according to the QCL-TypeD RS configured in the active PDSCH TCI state with the lowest index in the active DL BWP, if CORESETs are not provided in the active DL BWP of the serving cell.

[0092] In the unified TCI framework introduced in NR Release 17, the default spatial relation (e.g. default spatialRelationInfo RS) and the default PL-RS can be determined differently.

[0093] According to the third embodiment, if the spatialRelationInfo RS is not provided to a SRS resource used for either codebook or non-codebook, the UE shall determine the UL TX spatial filter for the SRS resource according to the QCL-TypeD RS configured in the indicated joint DL/UL TCI state or the spatialRelationInfo RS configured in the UL TCI state. In addition, if the PL-RS is not provided for the SRS resource set, and a PL-RS is associated with the indicated joint DL/UL TCI state or UL TCI state, the associated PL-RS shall be determined as the PL-RS for the SRS resource set (i.e. determined as the default PL-RS).

[0094] Besides, an NZP CSI-RS resource is configured for the SRS resource set used for non-codebook by a RRC signaling *associatedCSI-RS* for the UE to calculate the precoder(s) applied to the transmission of the SRS resources within the SRS resource set. The UE shall receive the NZP CSI-RS resource using the RX beam that is the same as TX beam used for transmission of the SRS resources.

[0095] According to the third embodiment, when associatedCSI-RS is configured for the SRS resource set used for non-codebook, while the UE determines the UL TX spatial filter based on the indicated joint DL/UL TCI state or UL TCI state, the UE expects that the QCL-TypeD RS in the TCI state configured for the associatedCSI-RS should be QCLed with the RS used to

determine the UL TX spatial filter for PUSCH transmissions and PUCCH transmissions configured in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD.

[0096] In addition, the UE shall determine the DL RX spatial filter for the *associatedCSI-RS* based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state used to determine the UL TX spatial filter. Alternatively, the UE shall use the source QCL-TypeD RS configured in the joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state to calculate the precoder for SRS transmission used for non-codebook based PUSCH transmission.

[0097] The other power control parameter including P0, alpha and closedLoopIndex shall be configured by the gNB per SRS resource set with the same manner as in NR Release 15.

[0098] Figure 2 is a schematic flow chart diagram illustrating an embodiment of a method 200 according to the present application. In some embodiments, the method 200 is performed by an apparatus, such as a remote unit (UE). In certain embodiments, the method 200 may be performed by a processor executing program code, for example, a microcontroller, a microprocessor, a CPU, a GPU, an auxiliary processing unit, a FPGA, or the like.

[0099] The method 200 may comprise 202 transmitting a capability on whether “beam misalignment” is supported; and 204 determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[00100] In one embodiment, the method may further comprise determining power control parameters including P0, alpha and closedLoopIndex for the PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUSCH power control setting; and determining power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUCCH power control setting. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUCCH power control setting, P0 and closedLoopIndex for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.

[00101] In another embodiment, the method may further comprise determining a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured. A PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS resource set without configured PL-RS. When associatedCSI-RS is configured for the SRS resource set for non-codebook, the QCL-TypeD RS configured for the associatedCSI-RS is QCLed with the RS used to determine the UL TX spatial filter in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD, and the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state.

[00102] In some embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources, a capability to support “beam misalignment” is transmitted. In some other embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same source QCL-TypeD SSB resource, a capability not to support “beam misalignment” is transmitted.

[00103] When the capability to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS. When the capability not to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

[00104] When the capability not to support “beam misalignment” is transmitted, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a third condition that a CSI-RS resource for BM is

configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

[00105] When the capability not to support “beam misalignment” is transmitted, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS; in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS; in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS; in a fifth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS; and in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the

spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

[00106] Figure 3 is a schematic flow chart diagram illustrating a further embodiment of a method 300 according to the present application. In some embodiments, the method 300 is performed by an apparatus, such as a base unit. In certain embodiments, the method 300 may be performed by a processor executing program code, for example, a microcontroller, a microprocessor, a CPU, a GPU, an auxiliary processing unit, a FPGA, or the like.

[00107] The method 300 may comprise 302 receiving a capability on whether “beam misalignment” is supported; and 304 determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[00108] In one embodiment, the method may further comprise determining power control parameters including P0, alpha and closedLoopIndex for the PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUSCH power control setting; and determining power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUCCH power control setting. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUCCH power control setting, P0 and closedLoopIndex for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.

[00109] In another embodiment, the method may further comprise determining a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured. A PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS resource set without configured PL-RS. When associatedCSI-RS is configured for the SRS resource set for non-codebook, the QCL-TypeD RS configured for the associatedCSI-RS is QCLED with the RS used to determine the UL TX spatial filter in the indicated joint DL/UL TCI

state or UL TCI state with QCL-TypeD, and the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state.

[00110] In some embodiment, a capability to support “beam misalignment” is received, which means that the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources. In some embodiment, a capability not to support “beam misalignment” is received, which means that the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same source QCL-TypeD SSB resource.

[00111] When the capability to support “beam misalignment” is received, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS. When the capability not to support “beam misalignment” is received, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

[00112] When the capability not to support “beam misalignment” is received, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB

resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

[00113] When the capability not to support “beam misalignment” is received, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS; in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS; in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS; in a fifth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS; and in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

[00114] Figure 4 is a schematic block diagram illustrating apparatuses according to one embodiment.

[00115] Referring to Figure 4, the UE (i.e. the remote unit) includes a processor, a memory, and a transceiver. The processor implements a function, a process, and/or a method which are proposed in Figure 2.

[00116] The UE comprises a transmitter that transmits a capability on whether “beam misalignment” is supported; and a processor that determines a PL-RS for PUSCH

transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[00117] In one embodiment, the processor may further determine power control parameters including P0, alpha and closedLoopIndex for the PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUSCH power control setting; and determine power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUCCH power control setting. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUCCH power control setting, P0 and closedLoopIndex for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.

[00118] In another embodiment, the process may further determine a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured. A PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS resource set without configured PL-RS. When associatedCSI-RS is configured for the SRS resource set for non-codebook, the QCL-TypeD RS configured for the associatedCSI-RS is QCLed with the RS used to determine the UL TX spatial filter in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD, and the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state.

[00119] In some embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources, a capability to support “beam misalignment” is transmitted. In some other embodiment, if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same source QCL-TypeD SSB resource, a capability not to support “beam misalignment” is transmitted.

[00120] When the capability to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS. When the capability not to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

[00121] When the capability not to support “beam misalignment” is transmitted, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

[00122] When the capability not to support “beam misalignment” is transmitted, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured in the UL TCI state to

determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS; in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS; in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS; in a fifth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS; and in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

[00123] Referring to Figure 4, the gNB (i.e. base unit) includes a processor, a memory, and a transceiver. The processors implement a function, a process, and/or a method which are proposed in Figure 3.

[00124] The base unit comprises a receiver that receives a capability on whether “beam misalignment” is supported; and a processor that determines a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

[00125] In one embodiment, the processor may further determine power control parameters including P0, alpha and closedLoopIndex for the PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUSCH power control setting; and determine power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUCCH power control setting. If the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*. If the indicated joint DL/UL TCI state or UL TCI state is not

associated with the PUCCH power control setting, P_0 and closedLoopIndex for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.

[00126] In another embodiment, the processor may further determine a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured. A PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS resource set without configured PL-RS. When associatedCSI-RS is configured for the SRS resource set for non-codebook, the QCL-TypeD RS configured for the associatedCSI-RS is QCLeD with the RS used to determine the UL TX spatial filter in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD, and the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state.

[00127] In some embodiment, a capability to support “beam misalignment” is received, which means that the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources. In some embodiment, a capability not to support “beam misalignment” is received, which means that the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same source QCL-TypeD SSB resource.

[00128] When the capability to support “beam misalignment” is received, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS. When the capability not to support “beam misalignment” is received, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

[00129] When the capability not to support “beam misalignment” is received, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined in different conditions: in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI

state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS; in a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic
 5 NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is
 10 determined as the PL-RS; in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB resource is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the
 15 joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

[00130] When the capability not to support “beam misalignment” is received, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined in different
 20 conditions: in a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS; in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS; in a third
 25 condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS; in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS; in a fifth condition that an SRS resource for BM is
 30 configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS;

and in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

[00131] Layers of a radio interface protocol may be implemented by the processors.

5 The memories are connected with the processors to store various pieces of information for driving the processors. The transceivers are connected with the processors to transmit and/or receive a radio signal. Needless to say, the transceiver may be implemented as a transmitter to transmit the radio signal and a receiver to receive the radio signal.

10 [00132] The memories may be positioned inside or outside the processors and connected with the processors by various well-known means.

[00133] In the embodiments described above, the components and the features of the embodiments are combined in a predetermined form. Each component or feature should be considered as an option unless otherwise expressly stated. Each component or feature may be implemented not to be associated with other components or features. Further, the embodiment
15 may be configured by associating some components and/or features. The order of the operations described in the embodiments may be changed. Some components or features of any embodiment may be included in another embodiment or replaced with the component and the feature corresponding to another embodiment. It is apparent that the claims that are not expressly cited in the claims are combined to form an embodiment or be included in a new claim.

20 [00134] The embodiments may be implemented by hardware, firmware, software, or combinations thereof. In the case of implementation by hardware, according to hardware implementation, the exemplary embodiment described herein may be implemented by using one or more application-specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable
25 gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, and the like.

[00135] Embodiments may be practiced in other specific forms. The described embodiments are to be considered in all respects to be only illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of
30 the claims are to be embraced within their scope.

CLAIMS

1. A method of an UE, comprising:
transmitting a capability on whether “beam misalignment” is supported; and
5 determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.
2. The method of claim 1, further comprising:
determining power control parameters including P0, alpha and closedLoopIndex for the
PUSCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is
10 not associated with a PUSCH power control setting; and
determining power control parameters including P0 and closedLoopIndex for the PUCCH transmissions if the indicated joint DL/UL TCI state or UL TCI state is not associated with a PUCCH power control setting.
3. The method of claim 1, further comprising:
15 determining a UL TX spatial filter for SRS resources according to QCL-TypeD RS contained in the indicated joint DL/UL TCI state and/or spatialRelationInfo RS contained in the indicated UL TCI state when spatialRelationInfo RS for SRS resource is not configured.
4. The method of claim 1, wherein,
20 if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter can have different source QCL-TypeD SSB resources, transmitting a capability to support “beam misalignment”, and
if the DL RS used as PL-RS and the DL RS used to determine the UL TX spatial filter should have a same source QCL-TypeD SSB resource, transmitting a capability
25 not to support “beam misalignment”.

5. The method of claim 4, wherein, when the capability to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS.

6. The method of claim 4, wherein, when the capability not to support “beam misalignment” is transmitted, a periodic DL RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as the PL-RS, and the periodic DL RS and a DL RS to determine the UL TX spatial filter have the same source QCL-TypeD SSB resource.

7. The method of claim 4, wherein, when the capability not to support “beam misalignment” is transmitted, and the indicated joint DL/UL TCI state is not associated with PL-RS, the PL-RS is determined as follows:

in a first condition that a periodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS;

in a second condition that an aperiodic TRS is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the aperiodic TRS, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS;

in a third condition that a CSI-RS resource for BM is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS;

in a fourth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a periodic TRS is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured periodic TRS is determined as the PL-RS;

in a fifth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and an SSB resource is

configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, the SSB resource is determined as the PL-RS; and
in a sixth condition that a CSI-RS resource for CSI acquisition is configured as the source QCL-TypeD RS contained in the joint DL/UL TCI state, and a CSI-RS for BM is configured in the TCI state as the source QCL-TypeD RS for the CSI-RS resource for CSI acquisition, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS.

8. The method of claim 4, wherein, when the capability not to support “beam misalignment” is transmitted, and the indicated UL TCI state is not associated with a PL-RS, the PL-RS is determined as follows:

in a first condition that a periodic TRS is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the periodic TRS is determined as the PL-RS;

in a second condition that a CSI-RS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, a periodic NZP CSI-RS resource with the same ID as the configured CSI-RS resource for BM is determined as the PL-RS;

in a third condition that an SSB resource is configured in the UL TCI state to determine the UL TX spatial filter, the configured SSB resource is determined as the PL-RS;

in a fourth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and an SSB resource is configured as the spatialRelationInfo RS for the SRS resource for BM, the SSB resource is determined as the PL-RS;

in a fifth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a CSI-RS resource for BM is configured as the spatialRelationInfo RS for the SRS resource for BM, a periodic NZP CSI-RS resource with the same ID as the CSI-RS resource for BM is determined as the PL-RS; and

in a sixth condition that an SRS resource for BM is configured in the UL TCI state to determine the UL TX spatial filter, and a periodic TRS is configured as the spatialRelationInfo RS for the SRS resource for BM, the periodic TRS is determined as the PL-RS.

9. The method of claim 2, wherein, if the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUSCH power control setting, P0, alpha and closedLoopIndex for PUSCH are determined according to a configured *PUSCH-PowerControl-Config* with *PUSCH-PowerControl-Config-Id=0*.
- 5 10. The method of claim 2, wherein, if the indicated joint DL/UL TCI state or UL TCI state is not associated with the PUCCH power control setting, P0 and closedLoopIndex for PUCCH are determined according to a configured *PUCCH-PowerControl-Config* with *PUCCH-PowerControl-Config-Id=0*.
- 10 11. The method of claim 3, wherein, a PL-RS associated with the indicated joint DL/UL TCI state or UL TCI state is determined as a default PL-RS for a SRS resource set without configured PL-RS.
12. The method of claim 3, wherein, when associatedCSI-RS is configured for the SRS resource set for non-codebook,
the QCL-TypeD RS configured for the associatedCSI-RS is QCLed with the RS used to
15 determine the UL TX spatial filter in the indicated joint DL/UL TCI state or UL TCI state with QCL-TypeD, and
the DL RX spatial filter for the *associatedCSI-RS* is determined based on the source QCL-TypeD RS in the indicated joint DL/UL TCI state or the source spatialRelationInfo RS in the indicated UL TCI state.
- 20 13. An UE, comprising:
a transmitter that transmits a capability on whether “beam misalignment” is supported;
and
a processor that determines a PL-RS for PUSCH transmissions and PUCCH
transmissions from an indicated joint DL/UL TCI state or UL TCI state according
25 to the capability.
14. A method at an base unit, comprising:
receiving a capability on whether “beam misalignment” is supported; and

determining a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

15. A base unit, comprising:

a receiver that receives a capability on whether “beam misalignment” is supported; and

5 a processor that determines a PL-RS for PUSCH transmissions and PUCCH transmissions from an indicated joint DL/UL TCI state or UL TCI state according to the capability.

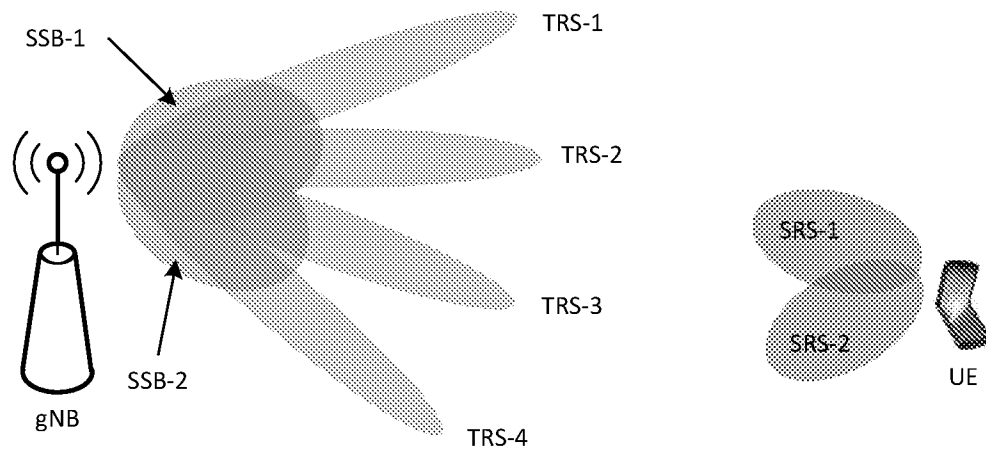


Figure 1

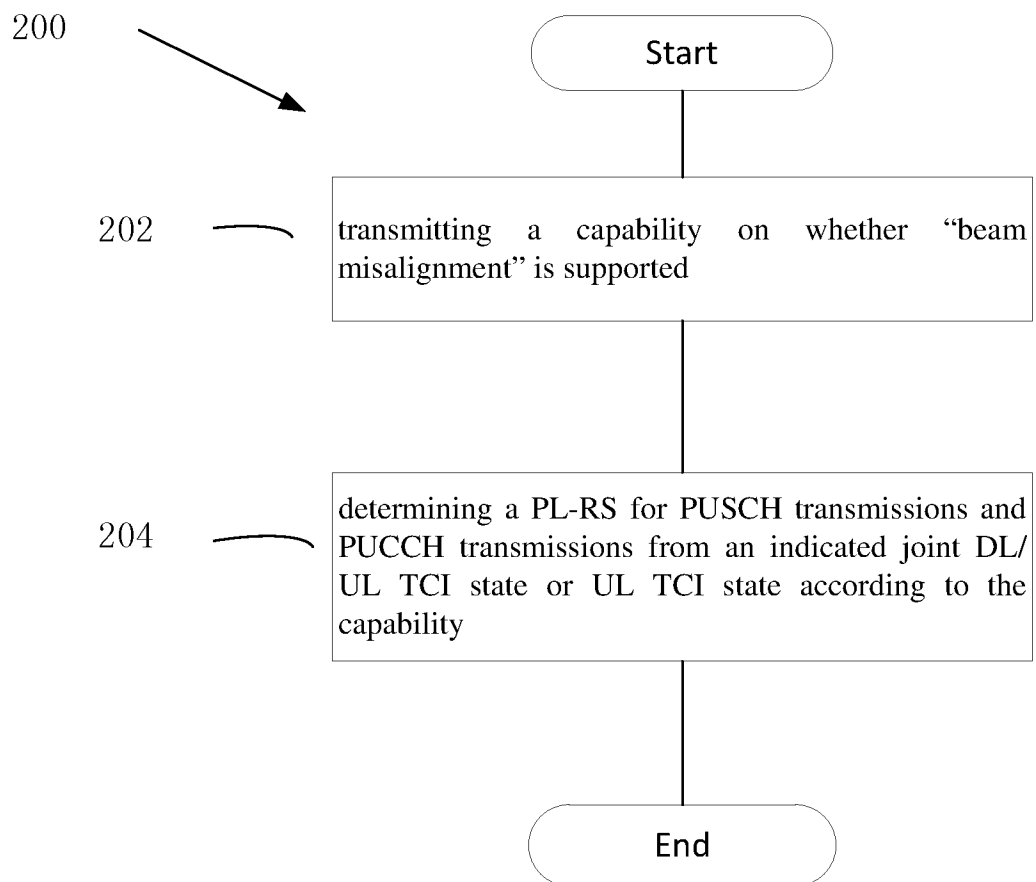


Figure 2

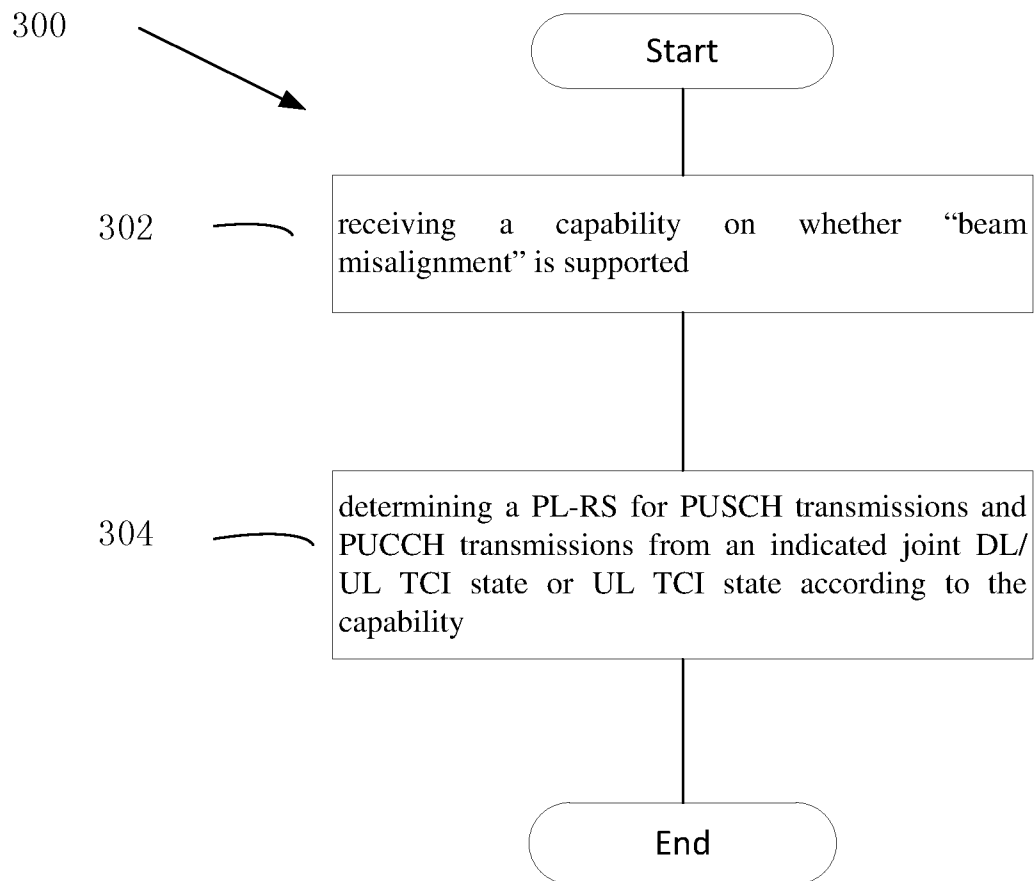


Figure 3

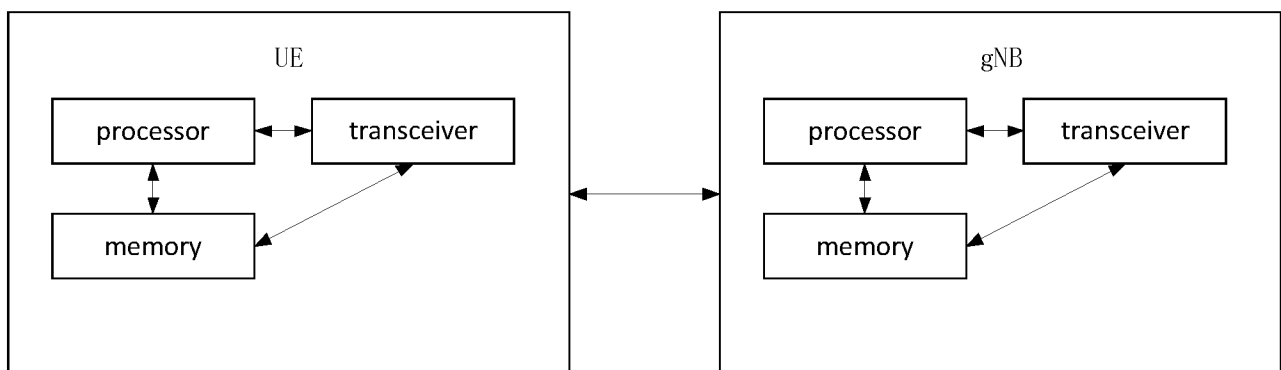


Figure 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2021/111928

A. CLASSIFICATION OF SUBJECT MATTER

H04W 52/18(2009.01)i; H04B 7/06(2006.01)i; H04B 17/309(2015.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W; H04B

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)

CNPAT, WPI, EPODOC, 3GPP: beam, misalignment, alignment, correspondence, reciprocity, calibration, calibrated, support, provide, capability, unified, joint, TCI, PL, pathloss, periodic, CSI, SSB, TRS, QCL, SRS, spatial, filter, codebook

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MODERATOR SAMSUNG. "Moderator summary for multi-beam enhancement" 3GPP TSG RAN WG1 #105-e R1-2105290, 24 May 2021 (2021-05-24), section 3	1-2, 4-10, 13-15
Y	MODERATOR SAMSUNG. "Moderator summary for multi-beam enhancement" 3GPP TSG RAN WG1 #105-e R1-2105290, 24 May 2021 (2021-05-24), section 3	3, 11-12
Y	CN 110535617 A (ZTE CORP.) 03 December 2019 (2019-12-03) description, paragraphs [0028]-[0170]	3, 11-12
X	WO 2021100531 A1 (NTT DOCOMO, INC.) 27 May 2021 (2021-05-27) description, paragraphs [0134]-[0240]	1-2, 4-10, 13-15
Y	WO 2021100531 A1 (NTT DOCOMO, INC.) 27 May 2021 (2021-05-27) description, paragraphs [0134]-[0240]	3, 11-12
A	WO 2021028059 A1 (FRAUNHOFER-GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG E.V.) 18 February 2021 (2021-02-18) the whole document	1-15

☐ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 April 2022

Date of mailing of the international search report

07 May 2022

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Telephone No. 86-(10)-53961584

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2021/111928

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	110535617	A	03 December 2019	TW	202114453	A	01 April 2021
				WO	2021063125	A1	08 April 2021
WO	2021100531	A1	27 May 2021	None			
WO	2021028059	A1	18 February 2021	None			