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(54) **TERMINAL, RADIO COMMUNICATION METHOD, AND BASE STATION**

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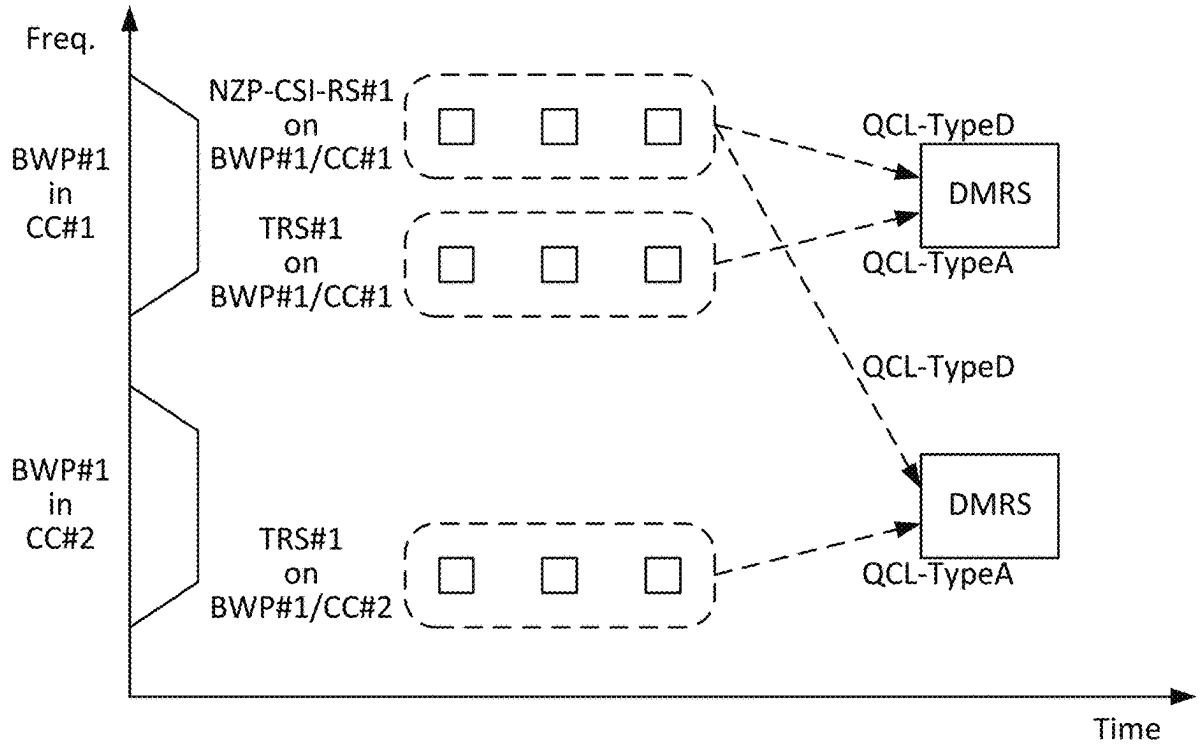
(57) **ABSTRACT**

A terminal according to one aspect of the present disclosure includes: a receiving section that receives a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and a control section that applies, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band. According to one aspect of the present disclosure, it is possible to appropriately determine a TCI state(s) for a plurality of cells/CCs.



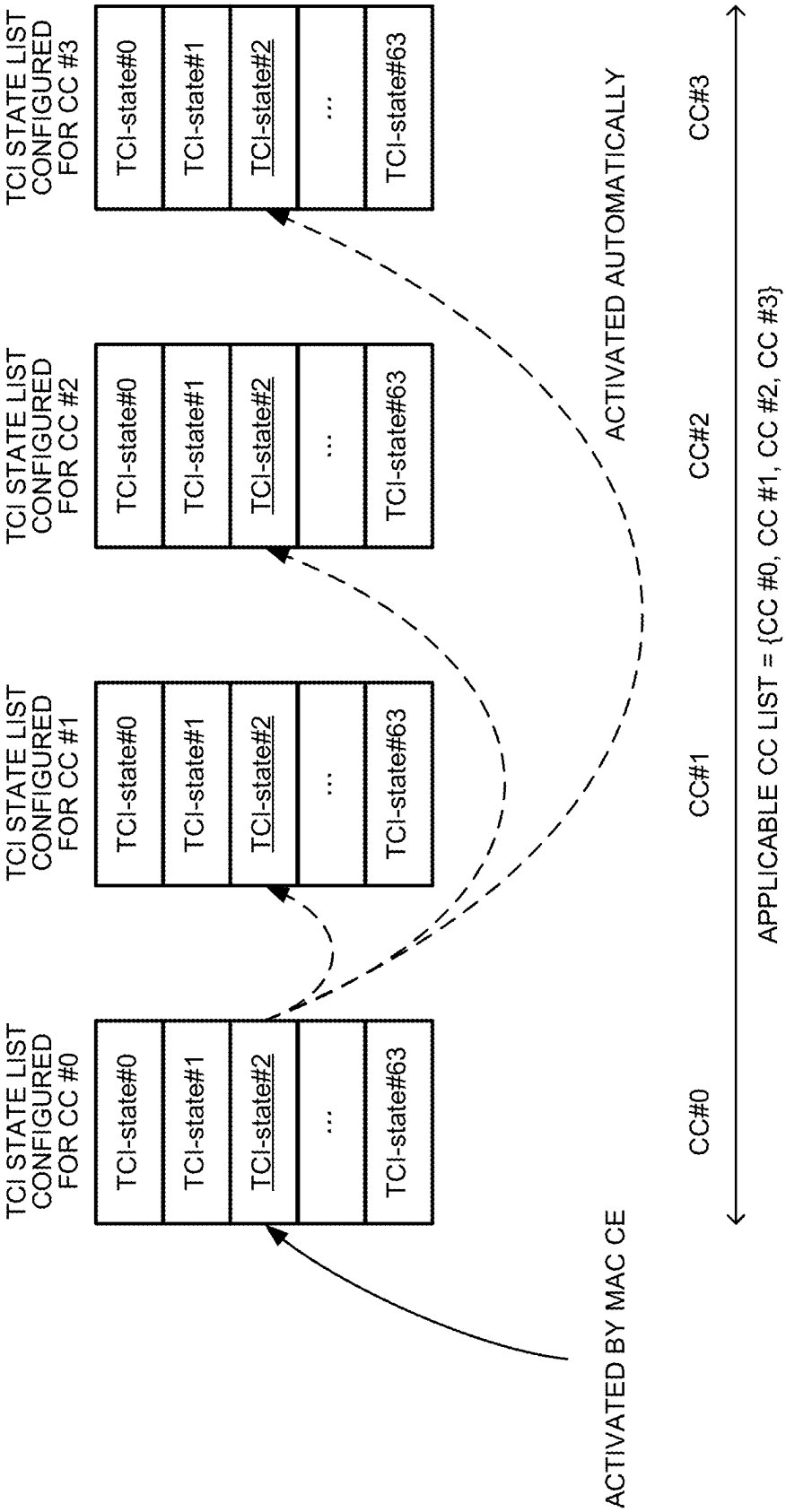

TCI STATE LIST CONFIGURED FOR CC #0
TCI STATE LIST CONFIGURED FOR CC #1
TCI STATE LIST CONFIGURED FOR CC #2
TCI STATE LIST CONFIGURED FOR CC #3
TCI-state#0
TCI-state#1
TCI-state#2
...
TCI-state#63
ACTIVATED BY MAC CE
ACTIVATED AUTOMATICALLY
CC#0
CC#1
CC#2
CC#3
APPLICABLE CC LIST = {CC #0, CC #1, CC #2, CC #3}

FIG. 1

FIG. 2A

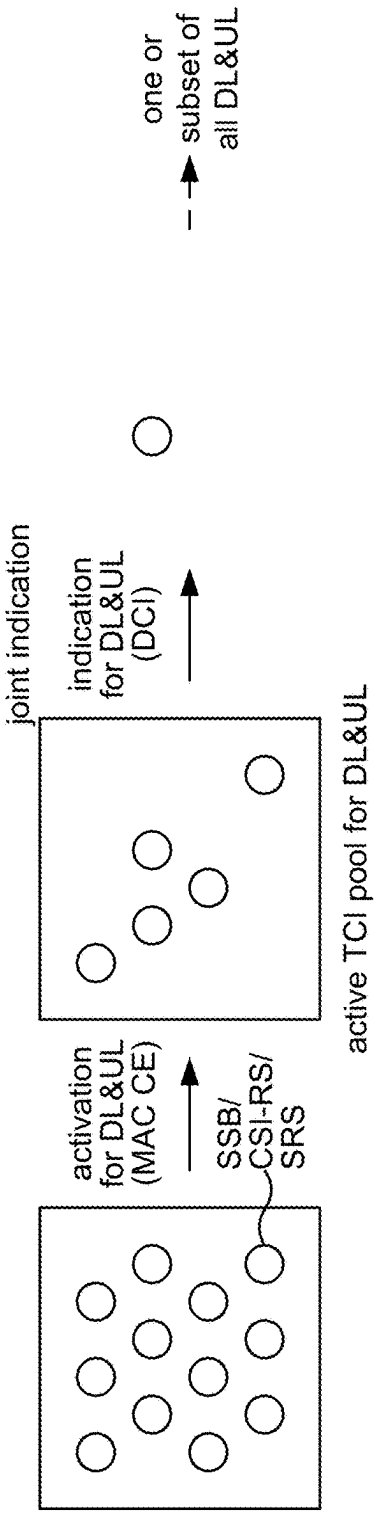

configuration for DL&UL (RRC)
activation for DL&UL (MAC CE)
SSB/ CSI-RS/ SRS
active TCI pool for DL&UL
joint indication
indication for DL&UL (DCI)
one or subset of all DL&UL

FIG. 2B

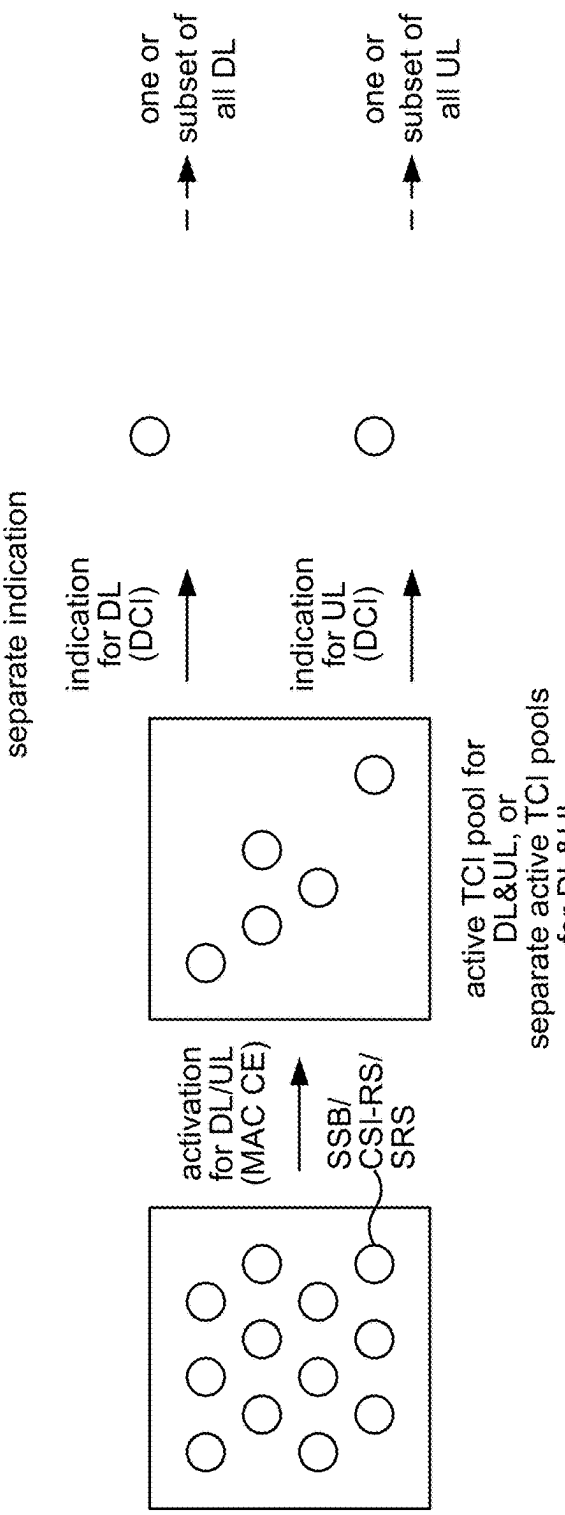

configuration for DL&UL (RRC)
activation for DL/UL (MAC CE)
SSB/ CSI-RS/ SRS
active TCI pool for DL&UL, or separate active TCI pools for DL&UL
separate indication
indication for DL (DCI)
indication for UL (DCI)
one or subset of all DL
one or subset of all UL

FIG. 3A

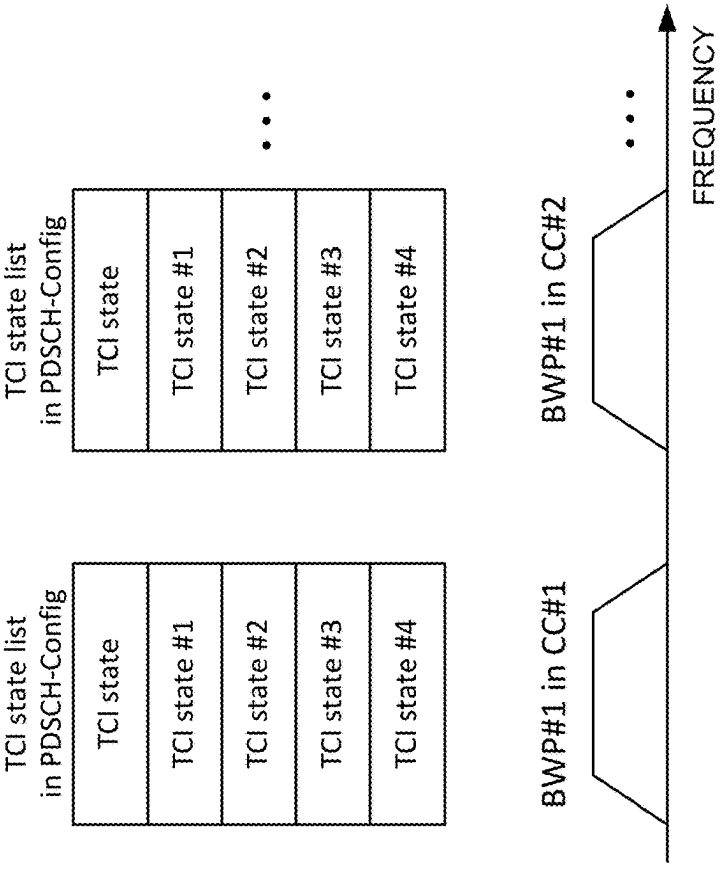
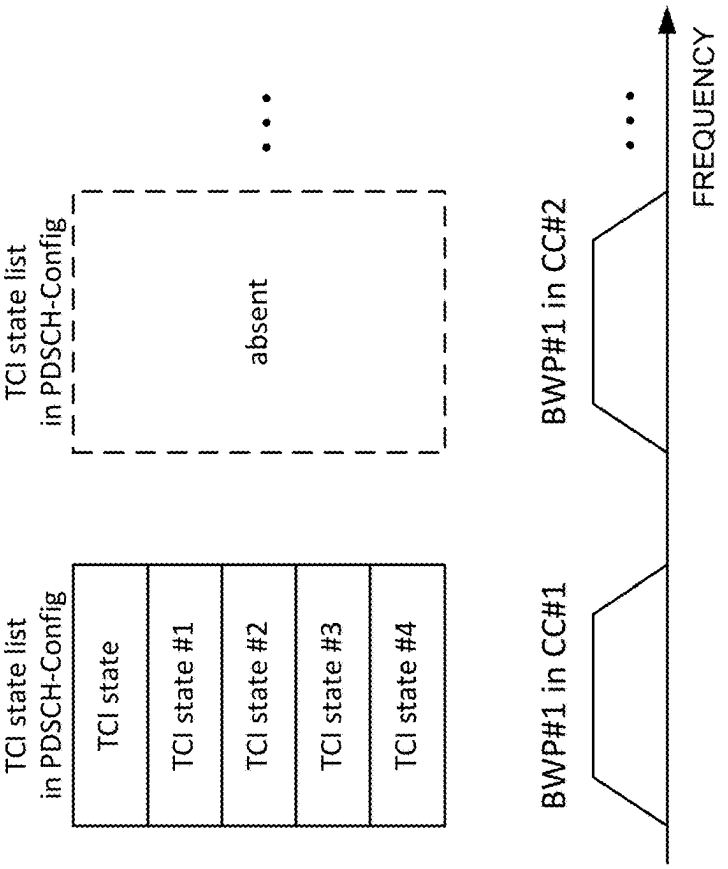

CC-specific TCI state pool
TCI state list in PDSCH-Config
TCI state
TCI state #1
TCI state #2
TCI state #3
TCI state #4
BWP#1 in CC#1
BWP#1 in CC#2
FREQUENCY

FIG. 3B


CC-common TCI state pool
TCI state list in PDSCH-Config
TCI state
TCI state #1
TCI state #2
TCI state #3
TCI state #4
absent
BWP#1 in CC#1
BWP#1 in CC#2
FREQUENCY

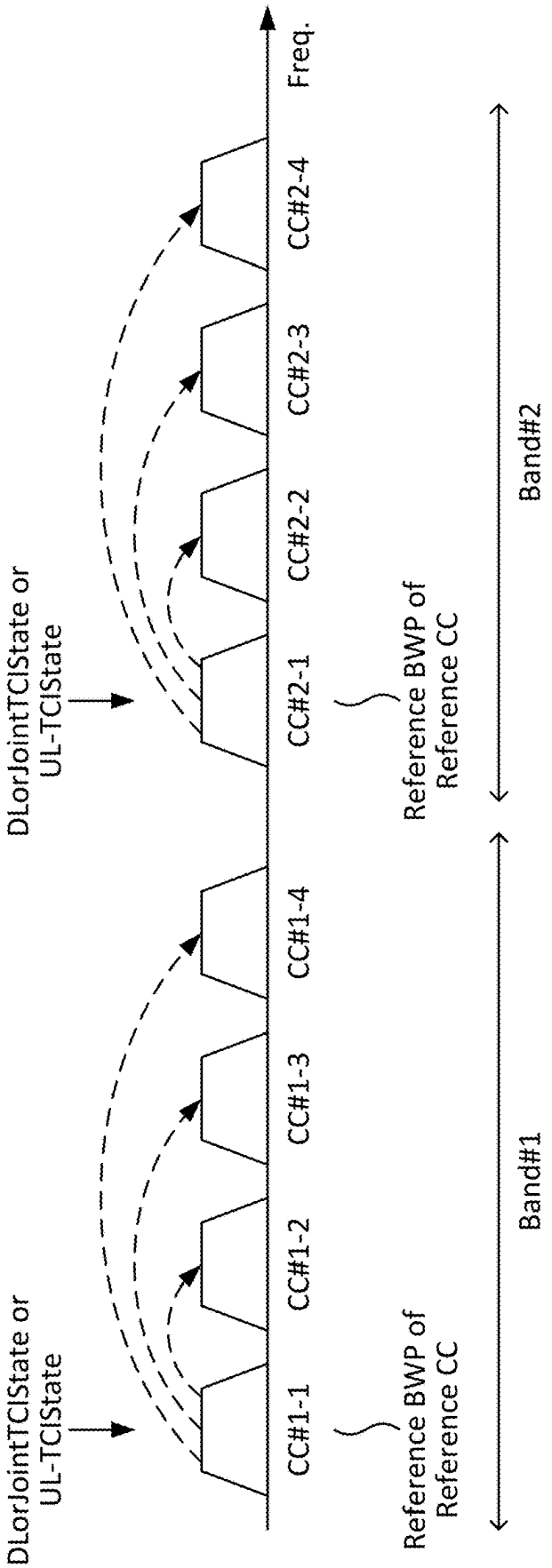

Freq.
CC#1-1
CC#1-2
CC#1-3
CC#1-4
CC#2-1
CC#2-2
CC#2-3
CC#2-4
DLorJointTCIState or UL-TCIState
DLorJointTCIState or UL-TCIState
Reference BWP of Reference CC
Reference BWP of Reference CC
Band#1
Band#2

FIG. 4

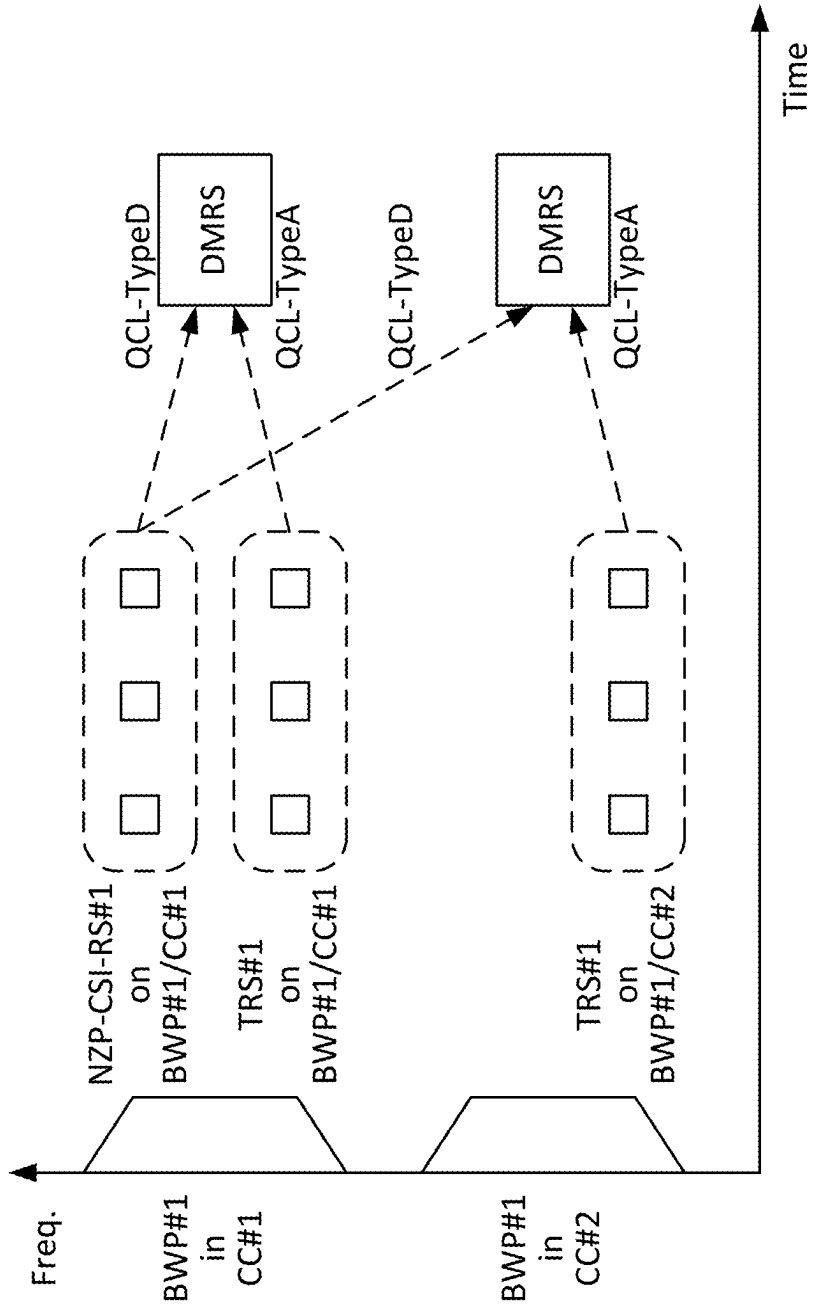

Freq.
Time
BWP#1 in CC#1
BWP#1 in CC#2
NZP-CSI-RS#1 on BWP#1/CC#1
TRS#1 on BWP#1/CC#1
TRS#1 on BWP#1/CC#2
QCL-TypeD
QCL-TypeA
QCL-TypeD
QCL-TypeA
DMRS
DMRS

FIG. 5

TCI-state

qcl-Type1

Field	value
cell	- (absent)
bwp-id	- (absent)
referenceSignal	TRS#1
qcl-Type	typeA

qcl-Type2

Field	value
cell	cell #1
bwp-id	bwp #1
referenceSignal	NZP-CSI-RS#1
qcl-Type	typeD

FIG. 6

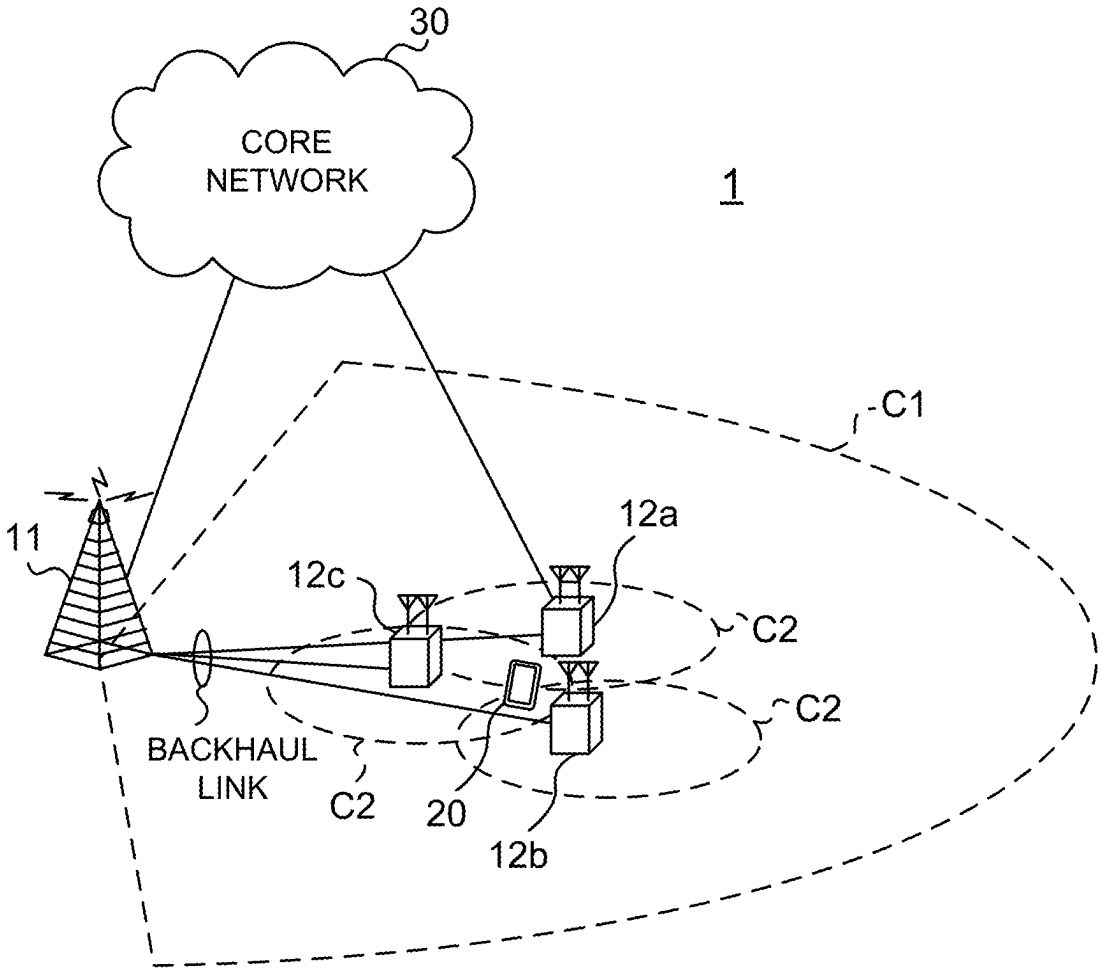


FIG. 7

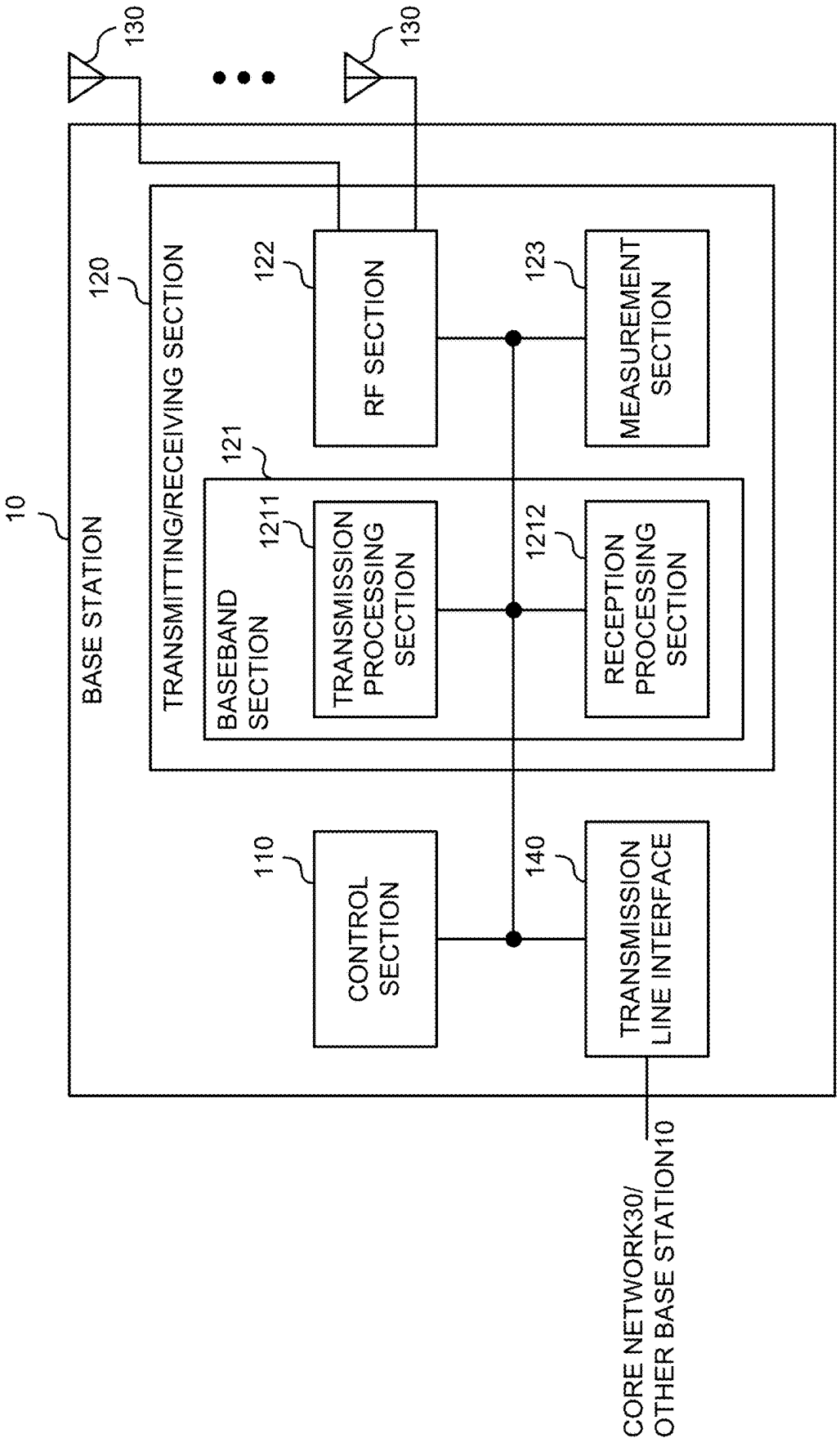

10
BASE STATION
120
TRANSMITTING/RECEIVING SECTION
121
BASEBAND SECTION
1211
TRANSMISSION PROCESSING SECTION
1212
RECEPTION PROCESSING SECTION
122
RF SECTION
123
MEASUREMENT SECTION
130
130
110
CONTROL SECTION
140
TRANSMISSION LINE INTERFACE
CORE NETWORK30/ OTHER BASE STATION10

FIG. 8

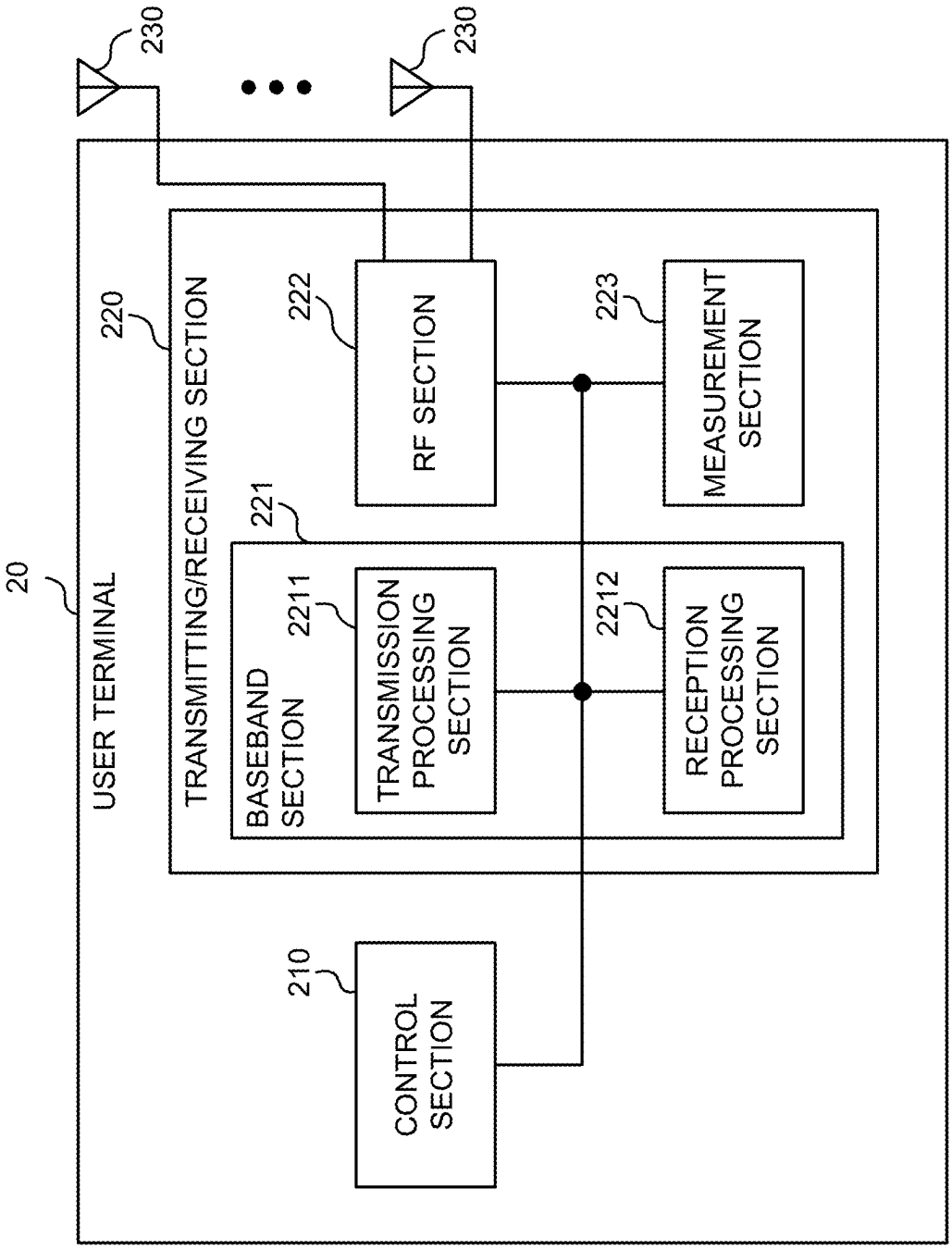

20
USER TERMINAL
230
230
220
TRANSMITTING/RECEIVING SECTION
222
RF SECTION
223
MEASUREMENT SECTION
221
BASEBAND SECTION
2211
TRANSMISSION PROCESSING SECTION
2212
RECEPTION PROCESSING SECTION
210
CONTROL SECTION

FIG. 9

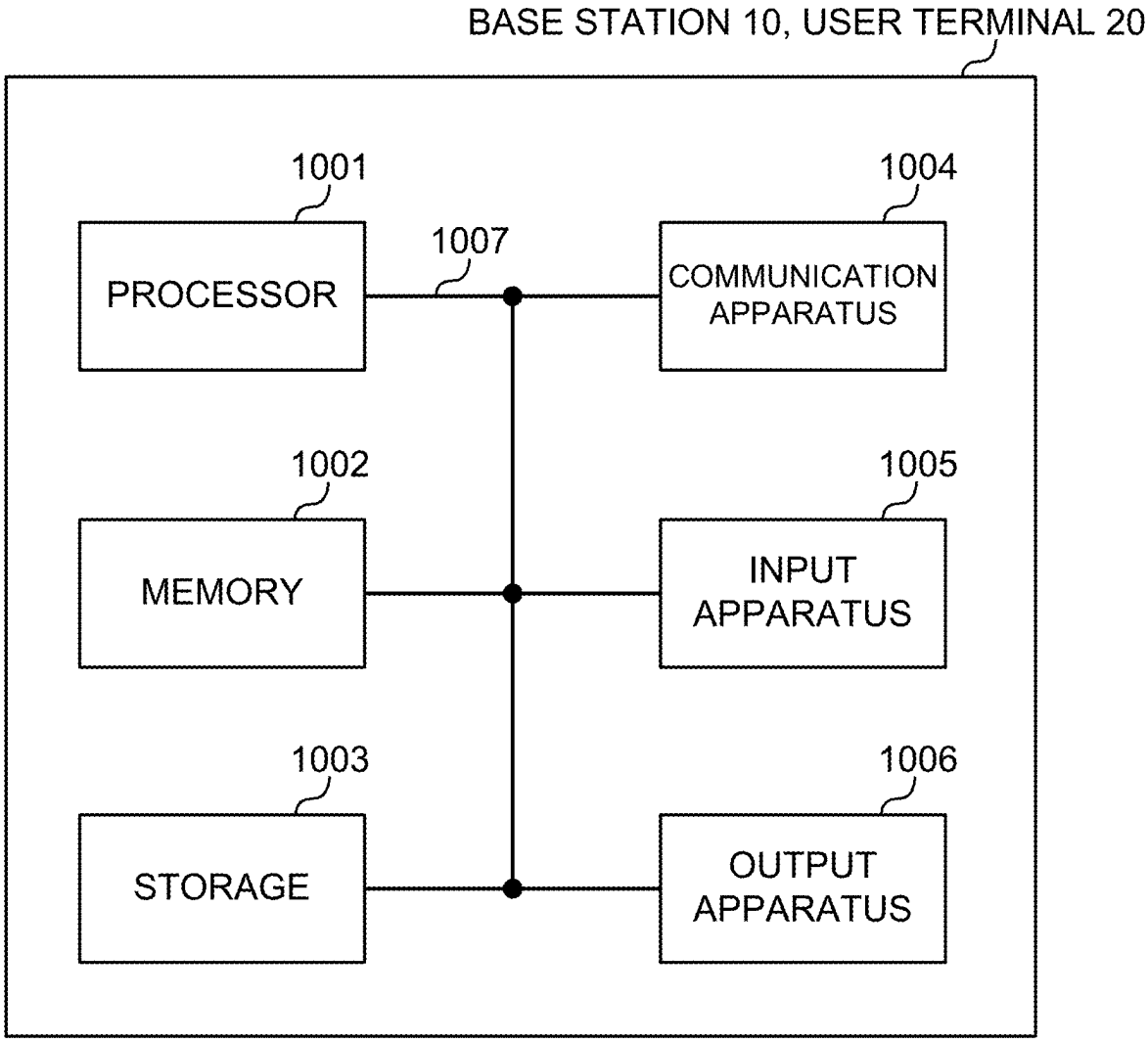
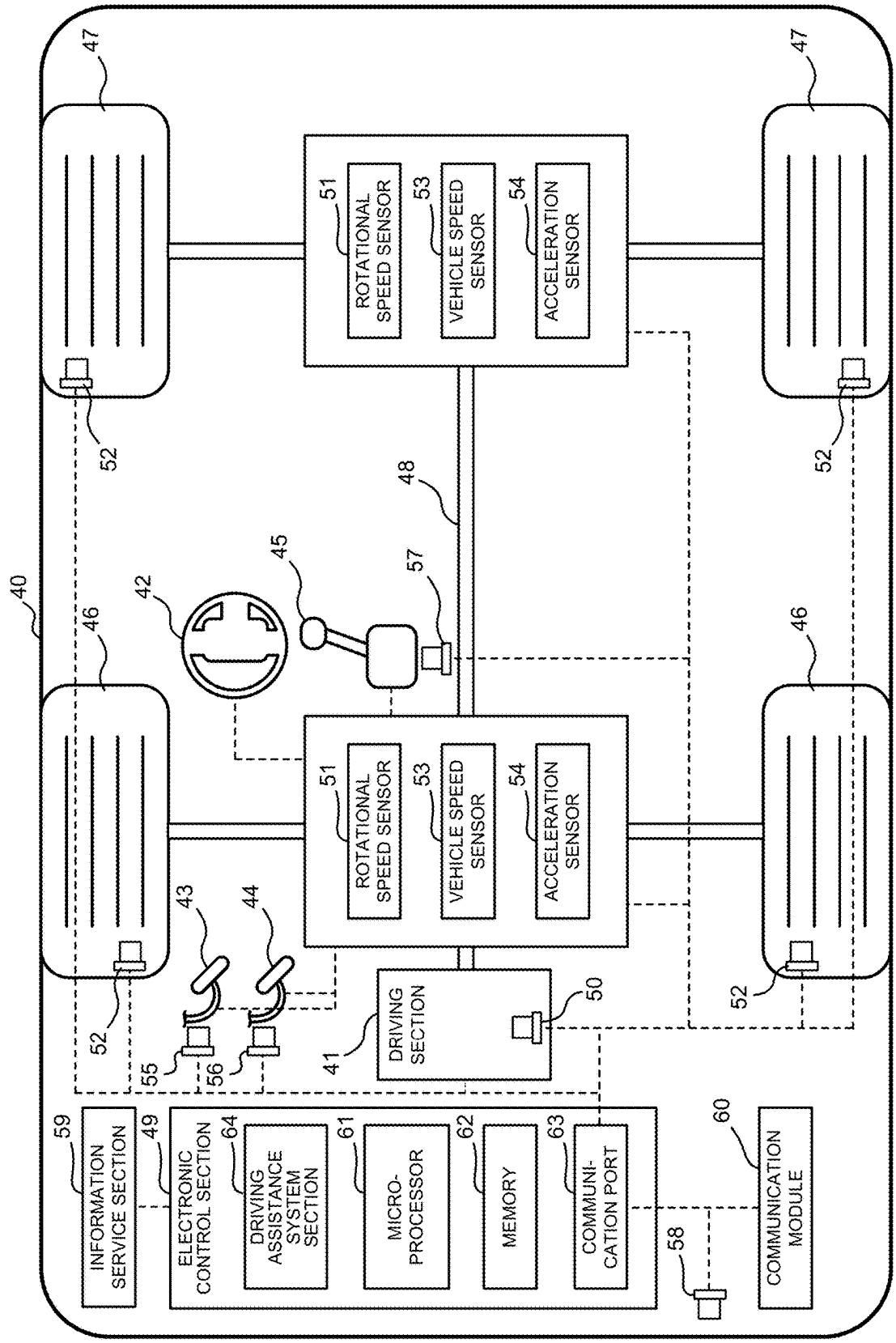

BASE STATION 10, USER TERMINAL 20
1001
PROCESSOR
1007
1004
COMMUNICATION APPARATUS
1002
MEMORY
1005
INPUT APPARATUS
1003
STORAGE
1006
OUTPUT APPARATUS

FIG. 10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ROTATIONAL SPEED SENSOR
VEHICLE SPEED SENSOR
ACCELERATION SENSOR
DRIVING SECTION
INFORMATION SERVICE SECTION
ELECTRONIC CONTROL SECTION
DRIVING ASSISTANCE SYSTEM SECTION
MICRO-PROCESSOR
MEMORY
COMMUNI-CATION PORT
COMMUNICATION MODULE

FIG. 11

TERMINAL, RADIO COMMUNICATION METHOD, AND BASE STATION

TECHNICAL FIELD

[0001] The present disclosure relates to a terminal, a radio communication method, and a base station in next-generation mobile communication systems.

BACKGROUND ART

[0002] In a Universal Mobile Telecommunications System (UMTS) network, the specifications of Long-Term Evolution (LTE) have been drafted for the purpose of further increasing high speed data rates, providing lower latency and so on (see Non-Patent Literature 1). In addition, for the purpose of further high capacity, advancement and the like of the LTE (Third Generation Partnership Project (3GPP) Release (Rel.) 8 and Rel. 9), the specifications of LTE-Advanced (3GPP Rel. 10 to Rel. 14) have been drafted.

[0003] Successor systems of LTE (for example, also referred to as "5th generation mobile communication system (5G)," "5G+ (plus)," "6th generation mobile communication system (6G)," "New Radio (NR)," "3GPP Rel. 15 (or later versions)," and so on) are also under study.

CITATION LIST

Non-Patent Literature

[0004] Non-Patent Literature 1: 3GPP TS 36.300 V8.12.0 "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2 (Release 8)," April, 2010

SUMMARY OF INVENTION

Technical Problem

[0005] For future radio communication systems (for example, NR), it is studied that a user terminal (terminal, User Equipment (UE)) controls transmission/reception processing, based on information related to quasi-co-location (QCL) (QCL assumption/Transmission Configuration Indication (TCI) state/spatial relation).

[0006] It is studied to apply a configured/activated/indicated TCI state(s) to a plurality of types of signals (channels/RSS). However, study about a method of applying/method of determining a TCI state(s) to a plurality of cells/component carriers (CCs) is not sufficient. Unless the methods are appropriate, degradation in communication quality, throughput reduction, and the like may occur.

[0007] Thus, an object of the present disclosure is to provide a terminal, a radio communication method, and a base station that can appropriately determine a TCI state(s) for a plurality of cells/CCs.

Solution to Problem

[0008] A terminal according to one aspect of the present disclosure includes: a receiving section that receives a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and a control section that applies, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band.

Advantageous Effects of Invention

[0009] According to one aspect of the present disclosure, it is possible to appropriately determine a TCI state(s) for a plurality of cells/CCs.

BRIEF DESCRIPTION OF DRAWINGS

[0010] FIG. **1** is a diagram to show an example of simultaneous beam update of a plurality of CCs.

[0011] FIGS. **2**A and **2**B are diagrams to show examples of a unified/common TCI framework.

[0012] FIGS. **3**A and **3**B are diagrams to show examples of a CC-specific TCI state pool and a CC-common TCI state pool.

[0013] FIG. **4** is a diagram to show an example of embodiment #1.

[0014] FIG. **5** is a diagram to show an example of a QCL type A/D source RS according to embodiment #2.

[0015] FIG. **6** is a diagram to show an example of a TCI state configuration according to embodiment #2.

[0016] FIG. **7** is a diagram to show an example of a schematic structure of a radio communication system according to one embodiment.

[0017] FIG. **8** is a diagram to show an example of a structure of a base station according to one embodiment.

[0018] FIG. **9** is a diagram to show an example of a structure of a user terminal according to one embodiment.

[0019] FIG. **10** is a diagram to show an example of a hardware structure of the base station and the user terminal according to one embodiment.

[0020] FIG. **11** is a diagram to show an example of a vehicle according to one embodiment.

DESCRIPTION OF EMBODIMENTS

(TCI, Spatial Relation, QCL)

[0021] For NR, control of reception processing (for example, at least one of reception, de-mapping, demodulation, and decoding) and transmission processing (for example, at least one of transmission, mapping, precoding, modulation, and coding) of at least one of a signal and a channel (expressed as a signal/channel) in a UE, based on a transmission configuration indication state (TCI state) is under study.

[0022] The TCI state may be a state applied to a downlink signal/channel. A state that corresponds to the TCI state applied to an uplink signal/channel may be expressed as spatial relation.

[0023] The TCI state is information related to quasi-co-location (QCL) of the signal/channel, and may be referred to as a spatial reception parameter, spatial relation information, or the like. The TCI state may be configured for the UE for each channel or for each signal.

[0024] QCL is an indicator indicating statistical properties of the signal/channel. For example, when a given signal/channel and another signal/channel are in a relationship of QCL, it may mean that it is assumable that at least one of Doppler shift, a Doppler spread, an average delay, a delay spread, and a spatial parameter (for example, a spatial reception parameter (spatial Rx parameter)) is the same (the

relationship of QCL is satisfied in at least one of these) between the plurality of different signals/channels.

[0025] Note that the spatial reception parameter may correspond to a receive beam of the UE (for example, a receive analog beam), and the beam may be identified based on spatial QCL. The QCL (or at least one element in the relationship of QCL) in the present disclosure may be interpreted as sQCL (spatial QCL).

[0026] For the QCL, a plurality of types (QCL types) may be defined. For example, four QCL types A to D may be provided, which have a different parameter(s) (or a parameter set(s)) that can be assumed to be the same, and such parameters (which may be referred to as QCL parameters) are described below:

[0027] QCL type A (QCL-A): Doppler shift, Doppler spread, average delay, and delay spread

[0028] QCL type B (QCL-B): Doppler shift and Doppler spread

[0029] QCL type C (QCL-C): Doppler shift and average delay

[0030] QCL type D (QCL-D): spatial reception parameter

[0031] A case that the UE assumes that a given control resource set (CORESET), channel, or reference signal is in a relationship of specific QCL (for example, QCL type D) with another CORESET, channel, or reference signal may be referred to as QCL assumption.

[0032] The UE may determine at least one of a transmit beam (Tx beam) and a receive beam (Rx beam) of the signal/channel, based on the TCI state or the QCL assumption of the signal/channel.

[0033] The TCI state may be, for example, information related to QCL between a channel as a target (in other words, a reference signal (RS) for the channel) and another signal (for example, another RS). The TCI state may be configured (indicated) by higher layer signaling or physical layer signaling, or a combination of these.

[0034] The physical layer signaling may be, for example, downlink control information (DCI).

[0035] A channel for which the TCI state or spatial relation is configured (specified) may be, for example, at least one of a downlink shared channel (Physical Downlink Shared Channel (PDSCH)), a downlink control channel (Physical Downlink Control Channel (PDCCH)), an uplink shared channel (Physical Uplink Shared Channel (PUSCH)), and an uplink control channel (Physical Uplink Control Channel (PUCCH)).

[0036] The RS to have a QCL relationship with the channel may be, for example, at least one of a synchronization signal block (SSB), a channel state information reference signal (CSI-RS), a reference signal for measurement (Sounding Reference Signal (SRS)), a CSI-RS for tracking (also referred to as a Tracking Reference Signal (TRS)), and a reference signal for QCL detection (also referred to as a QRS).

[0037] The SSB is a signal block including at least one of a primary synchronization signal (PSS), a secondary synchronization signal (SSS), and a broadcast channel (Physical Broadcast Channel (PBCH)). The SSB may be referred to as an SS/PBCH block.

[0038] An RS of QCL type X in a TCI state may mean an RS in a relationship of QCL type X with (a DMRS of) a given channel/signal, and this RS may be referred to as a QCL source of QCL type X in the TCI state.

(Simultaneous Beam Update of Plurality of CCs)

[0039] In Rel. 16, one MAC CE can update beam indices (TCI states) of a plurality of CCs.

[0040] The UE can be configured with up to two applicable CC lists (for example, applicable-CC-list) by RRC. When two applicable CC lists are configured, the two applicable CC lists may correspond to inter-band CA in FR1 and inter-band CA in FR2.

[0041] A network may transmit a TCI states activation/deactivation for UE-specific PDSCH MAC CE to thereby activate and deactivate configured TCI states of a serving cell or a set of serving cells configured in simultaneous TCI update list 1 (simultaneousTCI-UpdateList1) or simultaneous TCI update list 2 (simultaneousTCI-UpdateList2). If an indicated serving cell is configured as part of simultaneous TCI update list 1 or simultaneous TCI update list 2, the MAC CE is applied to all the serving cells configured in the set of simultaneous TCI update list 1 or simultaneous TCI update list 2.

[0042] The network may transmit a TCI states indication for UE-specific PDCCH MAC CE to thereby indicate configured TCI states of a serving cell or a set of serving cells configured in simultaneous TCI update list 1 (simultaneousTCI-UpdateList1) or simultaneous TCI update list 2 (simultaneousTCI-UpdateList2). If an indicated serving cell is configured as part of simultaneous TCI update list 1 or simultaneous TCI update list 2, the MAC CE is applied to all the serving cells configured in the set of simultaneous TCI update list 1 or simultaneous TCI update list 2.

[0043] An activation MAC CE for a TCI state of a PDCCH activates TCI states associated with the same CORESET ID in all the BWPs/CCs in an applicable CC list.

[0044] An activation MAC CE for a TCI state of a PDSCH activates TCI states in all the BWPs/CCs in the applicable CC list.

[0045] An activation MAC CE for a spatial relation of an A-SRS/SP-SRS activates spatial relations associated with the same SRS resource ID in all the BWPs/CCs in the applicable CC list.

[0046] In the example in FIG. **1**, the UE is configured with an applicable CC list indicating CCs #0, #1, #2, and #3 and a list indicating 64 TCI states for a CORESET or a PDSCH in each of the CCs. When one TCI state in CC #0 is activated by a MAC CE, corresponding TCI states are activated in CCs #1, #2, and #3.

[0047] It is studied that such simultaneous beam update is applicable only to a single-TRP case.

[0048] For a PDSCH, the UE may be based on Procedure A below.

{Procedure A}

[0049] The UE receives an activation command for mapping up to eight TCI states to a codepoint in a DCI field (TCI field) in one CC/DL BWP or in one set of CCs/BWPs. When one set of TCI state IDs is activated for one set of CCs/DL BWPs, an applicable CC list is determined by a CC(s) indicated in an activation command, and a set of TCI states being the same is applied to all the DL BWPs in the indicated CC. Only if the UE is not provided with a plurality of different values of CORESET pool indices (CORESET-PoolIndex) in a CORESET information element (ControlResourceSet) and is not provided with at least one TCI

codepoint mapped to two TCI states, the one set of TCI state IDs can be activated for one set of CCs/DL BWPs.

[0050] For a PDCCH, the UE may be based on Procedure B below.

{Procedure B}

[0051] If the UE is provided with up to two lists of cells for simultaneous TCI state activation by a simultaneous TCI update list (at least one of simultaneousTCI-UpdateList-r16 and simultaneousTCI-UpdateListSecond-r16), by a simultaneous TCI cell list (simultaneousTCI-CellList), the UE applies, to CORESETs with an index p in all the configured DL BWPs in all the configured cells in one list determined based on a serving cell index provided by a MAC CE command, an antenna port quasi co-location (QCL) provided by TCI states with the same activated TCI state ID value. Only if the UE is not provided with a plurality of different values of CORESET pool indices (CORESETPoolIndex) in a CORESET information element (ControlResourceSet) and is not provided with at least one TCI codepoint mapped to two TCI states, the UE can be provided with a simultaneous TCI cell list for simultaneous TCI state activation.

[0052] For a semi-persistent (SP)/aperiodic (AP)-SRS, the UE may be based on Procedure C below.

{Procedure C}

[0053] When an SP configured by an SRS resource information element (higher layer parameter SRS-Resource) or spatial relation information (spatialRelationInfo) for an AP-SRS resource is activated/updated by a MAC CE for one set of CCs/BWPs, an applicable CC list is indicated by a simultaneous spatial update list (higher layer parameter simultaneousSpatial-UpdateList-r16 or simultaneousSpatial-UpdateListSecond-r16), and the spatial relation information is applied to SPs or AP-SRS resources with the same SRS resource ID in all the BWPs in the indicated CC. Only if the UE is not provided with a plurality of different values of CORESET pool indices (CORESETPoolIndex) in a CORESET information element (ControlResourceSet) and is not provided with at least one TCI codepoint mapped to two TCI states, the SP configured by the SRS resource information element (higher layer parameter SRS-Resource) or spatial relation information (spatialRelationInfo) for the AP-SRS resource is activated/updated by an MAC CE for the one set of CCs/BWPs.

[0054] The simultaneous TCI cell list (simultaneousTCI-CellList) and simultaneous TCI update lists (at least one of simultaneousTCI-UpdateList1-r16 and simultaneousTCI-UpdateList2-r16) are lists of serving cells for which a TCI relationship can be updated simultaneously by using a MAC CE. simultaneousTCI-UpdateList1-r16 and simultaneousTCI-UpdateList2-r16 do not include the same serving cell.

[0055] The simultaneous spatial update list (at least one of higher layer parameters simultaneousSpatial-UpdatedList1-r16 and simultaneousSpatial-UpdatedList2-r16) is a list of serving cells for which a spatial relationship can be updated simultaneously by using a MAC CE. simultaneousSpatial-UpdatedList1-r16 and simultaneousSpatial-UpdatedList2-r16 do not include the same serving cell.

[0056] Here, the simultaneous TCI update lists and the simultaneous spatial update lists are configured by RRC, a CORESET pool index of a CORESET is configured by RRC, and a TCI codepoint mapped to TCI state(s) is indicated by a MAC CE.

[0057] In the present disclosure, a CC list, a new CC list, a simultaneous TCI cell list, simultaneousTCI-CellList, a simultaneous TCI update list, simultaneousTCI-UpdateList1-r16, simultaneousTCI-UpdateList2-r16, a simultaneous spatial update list, simultaneousSpatial-UpdatedList1-r16, and simultaneousSpatial-UpdatedList2-r16 may be interchangeably interpreted.

[0058] In the present disclosure, simultaneousTCI-UpdateList1, simultaneousTCI-UpdateList1-r16, and simultaneousTCI-UpdateList-r16 may be interchangeably interpreted. In the present disclosure, simultaneousTCI-UpdateList2, simultaneousTCI-UpdateList2-r16, and simultaneousTCI-UpdateListSecond-r16 may be interchangeably interpreted.

[0059] In the present disclosure, simultaneousSpatial-UpdatedList1, simultaneousSpatial-UpdatedList1-r16, and simultaneousSpatial-UpdateList-r16 may be interchangeably interpreted. In the present disclosure, simultaneousSpatial-UpdatedList2, simultaneousSpatial-UpdatedList2-r16, and simultaneousSpatial-UpdateListSecond-r16 may be interchangeably interpreted.

(Unified/Common TCI Framework)

[0060] With a unified TCI framework, UL and DL channels can be controlled by a common framework. A unified TCI framework may indicate a common beam (common TCI state) and apply the common beam to all the UL and DL channels instead of defining a TCI state or a spatial relation for each channel as in Rel. 15, or apply a common beam for UL to all the UL channels while applying a common beam for DL to all the DL channels.

[0061] One common beam for both DL and UL or a common beam for DL and a common beam for UL (two common beams in total) are studied.

[0062] The UE may assume the same TCI state (joint TCI state, joint TCI pool, joint common TCI pool, joint TCI state set) for UL and DL. The UE may assume respective different TCI states (separate TCI states, separate TCI pools, UL separate TCI pool and DL separate TCI pool, separate common TCI pools, UL common TCI pool and DL common TCI pool) for UL and DL.

[0063] By beam management based on a MAC CE (MAC CE level beam indication), default UL and DL beams may be aligned. A default TCI state of a PDSCH may be updated to match to a default UL beam (spatial relation).

[0064] By beam management based on DCI (DCI level beam indication), a common beam/unified TCI state may be indicated from the same TCI pool (joint common TCI pool, joint TCI pool, set) for both UL and DL. X (>1) TCI states may be activated by a MAC CE. UL/DL DCI may select one from the X active TCI states. The selected TCI state may be applied to channels/RSs of both UL and DL.

[0065] The TCI pool (set) may be a plurality of TCI states configured by an RRC parameter or a plurality of TCI states (active TCI states, active TCI pool, set) activated by a MAC CE among the plurality of TCI states configured by the RRC parameter. Each TCI state may be a QCL type A/D RS. As the QCL type A/D RS, an SSB, a CSI-RS, or an SRS may be configured.

[0066] The number of TCI states corresponding to each of one or more TRPs may be defined. For example, the number N (≥1) of TCI states to be applied to a UL channel/RS (UL

TCI states) and the number M (≥1) of TCI states to be applied to a DL channel/RS (DL TCI states) may be defined. At least one of N and M may be notified/configured/indicated to a UE by higher layer signaling/physical layer signaling.

[0067] In the present disclosure, when it is described as N=M=X (where X is any integer), this may mean that X TCI states (corresponding to X TRPs) common to UL and DL (joint TCI states) are notified/configured/indicated to a UE. When it is described as N=X (where X is any integer) and M=Y (where Y is any integer, Y may be equal to X (Y=X)), this may mean that X UL TCI states (corresponding to X TRP(s)) and Y DL TCI states (corresponding to Y TRP(s)) (in other words, separate TCI states) are notified/configured/indicated to a UE.

[0068] For example, when it is described as N=M=1, this may mean that one TCI state common to DL and UL for a single TRP is notified/configured/indicated to a UE (joint TCI state for a single TRP).

[0069] For example, when it is described as N=1 and M=1, this may mean that one UL TCI state and one DL TCI state for a single TRP are separately notified/configured/indicated to a UE (separate TCI states for a single TRP).

[0070] For example, when it is described as N=M=2, this may mean that a plurality of (two) TCI states common to UL and DL for a plurality of (two) TRPs are notified/configured/indicated to a UE (joint TCI states for a plurality of TRPs).

[0071] For example, when it is described as N=2 and M=2, this may mean that a plurality of (two) UL TCI states and a plurality of (two) DL TCI states for a plurality of (two) TRPs are notified/configured/indicated to a UE (separate TCI states for a plurality of TRPs).

[0072] Note that, in the above examples, cases where the values of N and M are each one or two have been described, but the values of N and M may each be three or more, and N and M may be different from each other.

[0073] In the example in FIG. **2**A, an RRC parameter (information element) configures a plurality of TCI states for both DL and UL. The MAC CE may activate a plurality of TCI states among the plurality of configured TCI states. DCI may indicate one of the plurality of activated TCI states. The DCI may be UL/DL DCI. The indicated TCI state may be applied to at least one (or all) of UL/DL channels/RSs. One piece of DCI may indicate both a UL TCI and a DL TCI.

[0074] In the example in FIG. **2**A, one dot may correspond to one TCI state applied to both UL and DL or may correspond to two respective TCI states applied to UL and DL.

[0075] At least one of the plurality of TCI states configured by the RRC parameter and the plurality of TCI states activated by the MAC CE may be referred to as a TCI pool (common TCI pool, joint TCI pool, TCI state pool). The plurality of TCI states activated by the MAC CE may be referred to as an active TCI pool (active common TCI pool).

[0076] Note that, in the present disclosure, a higher layer parameter (RRC parameter) that configures a plurality of TCI states may be referred to as configuration information that configures a plurality of TCI states or simply as "configuration information." In the present disclosure, one of a plurality of TCI states being indicated by using DCI may be receiving indication information indicating one of a plurality of TCI states included in DCI or may simply be receiving "indication information."

[0077] In the example in FIG. **2**B, an RRC parameter configures a plurality of TCI states for both DL and UL (joint common TCI pool). A MAC CE may activate a plurality of TCI states (active TCI pool) among the plurality of configured TCI states. Respective (different, separate) active TCI pools for UL and DL may be configured/activated.

[0078] DL DCI or a new DCI format may select (indicate) one or more (for example, one) TCI states. The selected TCI state(s) may be applied to one or more (or all) DL channels/RSs. The DL channel(s) may be a PDCCH/PDSCH/CSI-RS (s). The UE may determine the TCI state of each of the DL channels/RSs by using operation of a TCI state (TCI framework) of Rel. 16. UL DCI or a new DCI format may select (indicate) one or more (for example, one) TCI states. The selected TCI state(s) may be applied to one or more (or all) UL channels/RSs. The UL channel(s) may be a PUSCH/SRS/PUCCH(s). Thus, different pieces of DCI may indicate a UL TCI and a DL DCI separately.

[0079] Existing DCI format 1_1/1_2 may be used for indication of a common TCI state.

[0080] A common TCI framework may include separate TCI states for DL and UL.

[0081] In the present disclosure, a TCI state pool, a TCI state list, a unified TCI state pool, a joint TCI state pool, a separate TCI state pool, a separate DL/UL TCI state pool, a DL TCI state pool, a UL TCI state pool, separate DL TCI state pool, and a separate UL TCI state pool may be interchangeably interpreted.

[0082] A UE can be configured by using a list of up to 128 DL or joint-TCI state (DLorJointTCIState) configurations in a PDSCH configuration (higher layer parameter PDSCH-Config). The list is used for provision of a reference signal for quasi co-location (QCL) for a DMRS of a PDSCH and a DMRS of a PDCCH in a CC and for a CSI-RS. When reference for determination of a UL TX spatial filter for dynamic-grant and configured-grant based PUSCH and PUCCH resources in a CC and an SRS is available, the list is used for provision of the reference.

(Unified TCI Framework in Carrier Aggregation (CA))

[0083] It is studied to support a CC-specific TCI state pool/list/configuration (case 1) and a CC-common TCI state pool/list/configuration (case 2) in CA in a Rel-17 unified TCI framework.

{Case 1}

[0084] In a CC-specific TCI state configuration, a TCI state pool/list is configured in each BWP/CC.

[0085] FIG. **3**A is a diagram to show an example of a CC-specific TCI state pool. In this example, a TCI state list in a PDSCH configuration is configured for BWP 1 in CC 1, and a TCI state list in a PDSCH configuration is configured for BWP 1 in CC 2.

{Case 2}

[0086] In a CC-common TCI state configuration, a TCI state pool/list is configured in a reference BWP/CC, and no TCI state pool/list may be configured in another BWP/CC. TCI state information (QCL type A/D RS) indicating which TCI state is to be applied to a target BWP/CC can be derived from TCI states in the reference BWP/CC.

[0087] FIG. **3**B shows an example of a CC-common TCI state pool. In this example, a TCI state list in a PDSCH

configuration is configured for BWP 1 in CC 1, and a TCI state list in a PDSCH configuration is not configured (is absent) for BWP 1 in CC 2.

[0088] It is studied that a maximum number of configurable CC lists for CC lists for update and activation of a common TCI state ID(s) in MAC CE based beam indication (MAC CE based TCI state ID update) and DCI based beam indication (MAC CE based TCI state ID update) of Rel. 17 is four per cell group and the maximum number of CC lists for a given UE depends on UE capability.

[0089] It is studied to support MAC CE/DCI based TCI state ID update on multiple CCs. One MAC CE or one DCI format 1_1/1_2 (with/without DL assignment) can indicate a TCI state ID to be applied to a plurality of BWPs/CCs in a configured CC list.

PROBLEMS

[0090] Problems 1 to 3 below are conceivable.

Problem 1

[0091] For a CC-common TCI state pool/configuration, the following is studied.

[0092] When a DL or joint-TCI state configuration (DLorJointTCIState configuration) or a UL-TCI state configuration (UL-TCIState configuration) is absent in a BWP in a CC, a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP in a reference CC.

[0093] However, a "reference BWP in a reference CC" is not clear in an RRC based CC-common TCI state pool/list/configuration.

[0094] For example, if band #1 includes CC #1-1, CC #1-2, CC #1-3, and CC #1-4 and band #2 includes CC #2-1, CC #2-2, CC #2-3, and CC #2-4, and DLorJointTCIState or UL-TCIState is configured in both BWP #1 in CC #1-1 and BWP #1 in CC #2-1, a "reference BWP in a reference CC" for each of CC #1-2, CC #1-3, CC #1-4, CC #2-2, CC #2-3, and CC #2-4 is not clear. Unless this is clear, different UEs assume different BWPs/CCs as reference BWPs/CCs, which may prevent a CC-common TCI state pool configuration from operating. It is studied to introduce a new CC list for MAC CE/DCI based TCI state ID indication. However, whether this CC list is applied to indication of a BWP/CC list for an RRC based CC-common TCI state pool configuration is not clear. At the present time, introduction of another CC list for a CC-common TCI state pool is not realistic.

Problem 2

[0095] For a CC-common TCI state pool/configuration, the following is studied.

[0096] When a BWP-ID (bwp-id) or a cell ID (cell) for a QCL type A/D source RS in QCL information (QCL-Info) of a TCI state configured with DLorJointTCIState is not configured, a UE assumes that a QCL type A/D source RS is configured in a CC/DL BWP to which the TCI state is to be applied.

[0097] However, which RS is used as the QCL type A/D source RS in the CC/DL BWP to which the TCI state is not clear.

Problem 3

[0098] The following is studied for MAC CE/DCI based TCI state ID update on multiple CCs.

[0099] When presence of TCI in DCI is configured (tci-PresentInDCI is set at 'enabled' or tci-PresentInDCI-1-2 is configured) for a CORESET, a UE with an activated DL-or-joint-TCI state configuration (DLorJointTCIState configuration) or an activated UL-TCI state configuration (UL-TCIState configuration) receives specific DCI format 1_1/1_2. Specific DCI format 1_1/1_2 provides indicated DLorJointTCIState or indicated UL-TCIState for one CC or all the CCs in the same CC list. The CC list is configured by simultaneousTCI-UpdateList1-r17, simultaneousTCI-UpdateList2-r17, simultaneousTCI-UpdateList3-r17, or simultaneousTCI-UpdateList4-r17. Specific DCI format 1_1/1_2 above may be with DL assignment but may be without DL assignment. If specific DCI format 1_1/1_2 above is without DL assignment, a UE can assume (verify) the following.

[0100] A CS-RNTI is used for CRC-scrambling for DCI.

[0101] Values of the following DCI fields (specific fields) are set as follows:

[0102] a redundancy version (RV) field is set at all '1's

[0103] a modulation and coding scheme (MCS) field is set at all '1's

[0104] a new data indicator (NDI) field is set at 0

[0105] a frequency domain resource assignment (FDRA) field is set at all '0's for FDRA type 0, all '1's for FDRA type 1, or all '0's for dynamic switch (DynamicSwitch).

[0106] However, a case where a MAC CE indicates one activated DLorJointTCIState or one activated UL-TCIState as indicated DLorJointTCIState or indicated UL-TCIState without DCI format 1_1/1_2 (beam indication only with a MAC CE) is not clear.

[0107] Unless such problems are clear, communication throughput reduction and the like may occur.

[0108] Thus, the inventors of the present invention came up with the idea of a method of determining a TCI state(s) for a TCI state pool.

[0109] Embodiments according to the present disclosure will be described in detail with reference to the drawings as follows. The radio communication methods according to respective embodiments may each be employed individually, or may be employed in combination.

[0110] In the present disclosure, "A/B" and "at least one of A and B" may be interchangeably interpreted. In the present disclosure, "A/B/C" may mean "at least one of A, B, and C."

[0111] In the present disclosure, "activate," "deactivate," "indicate," "select," "configure," "update," "determine," and the like may be interchangeably interpreted. In the present disclosure, "support," "control," "controllable," "operate," "operable," and the like may be interchangeably interpreted.

[0112] In the present disclosure, radio resource control (RRC), an RRC parameter, an RRC message, a higher layer parameter, a field, an information element (IE), a configuration, and the like may be interchangeably interpreted. In the present disclosure, a Medium Access Control control

element (MAC Control Element (CE)), an update command, an activation/deactivation command, and the like may be interchangeably interpreted.

[0113] In the present disclosure, the higher layer signaling may be, for example, any one or combinations of Radio Resource Control (RRC) signaling, Medium Access Control (MAC) signaling, broadcast information, and the like.

[0114] In the present disclosure, the MAC signaling may use, for example, a MAC control element (MAC CE), a MAC Protocol Data Unit (PDU), or the like. The broadcast information may be, for example, a master information block (MIB), a system information block (SIB), minimum system information (Remaining Minimum System Information (RMSI)), other system information (OSI), or the like.

[0115] In the present disclosure, the physical layer signaling may be, for example, downlink control information (DCI), uplink control information (UCI), or the like.

[0116] In the present disclosure, an index, an identifier (ID), an indicator, a resource ID, and the like may be interchangeably interpreted. In the present disclosure, a sequence, a list, a set, a group, a cluster, a subset, and the like may be interchangeably interpreted.

[0117] In the present disclosure, a panel, a UE panel, a panel group, a beam, a beam group, a precoder, an Uplink (UL) transmission entity, a transmission/reception point (TRP), a base station, spatial relation information (SRI), a spatial relation, an SRS resource indicator (SRI), a control resource set (CORESET), a Physical Downlink Shared Channel (PDSCH), a codeword (CW), a transport block (TB), a reference signal (RS), an antenna port (for example, a demodulation reference signal (DMRS) port), an antenna port group (for example, a DMRS port group), a group (for example, a spatial relation group, a code division multiplexing (CDM) group, a reference signal group, a CORESET group, a Physical Uplink Control Channel (PUCCH) group, a PUCCH resource group), a resource (for example, a reference signal resource, an SRS resource), a resource set (for example, a reference signal resource set), a CORESET pool, a downlink Transmission Configuration Indication state (TCI state) (DL TCI state), an uplink TCI state (UL TCI state), a unified TCI state, a common TCI state, quasi-co-location (QCL), QCL assumption, a reference signal for QCL, a UL transmission (TX) spatial filter, and the like may be interchangeably interpreted.

[0118] A spatial relation information Identifier (ID) (TCI state ID) and spatial relation information (TCI state) may be interchangeably interpreted. "Spatial relation information" may be interchangeably interpreted as "a set of spatial relation information", "one or a plurality of pieces of spatial relation information", and the like. The TCI state and the TCI may be interchangeably interpreted.

[0119] In the present disclosure, the phrase "Rel. XX" indicates a release of 3GPP. However, a release number "XX" is an example and may be replaced with another number.

(Radio Communication Method)

Embodiment #1

[0120] This embodiment relates to problem 1 for a CC-common TCI state pool/list/configuration.

[0121] It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState in the same band (specific band) as the band including the target BWP/CC is configured.

[0122] In the example in FIG. **4**, band #1 includes CC #1-1, CC #1-2, CC #1-3, and CC #1-4, band #2 includes CC #2-1, CC #2-2, CC #2-3, and CC #2-4, and DLorJointTCIState or UL-TCIState is configured in both BWP #1 in CC #1-1 and BWP #1 in CC #2-1. For CC #1-2, CC #1-3, and CC #1-4, the "reference BWP in the reference CC" may be CC #1-1 (BWP #1 in CC #1-1). For CC #2-2, CC #2-3, and CC #2-4, the "reference BWP in the reference CC" may be CC #2-1 (BWP #1 in CC #2-1).

[0123] It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState in a band (specific band) included in the same Frequency Range (FR) as the FR including the target BWP/CC is configured. For example, the FR may be any one of FR1, FR2, ...

[0124] It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState of the same UE is configured.

[0125] It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be any one BWP/CC/band (specific BWP/CC/band) of a plurality of BWPs/plurality of CCs/plurality of bands including the target BWP/CC and a BWP/CC/band for which DLorJointTCIState or UL-TCIState is configured.

[0126] A list of reference BWPs/CCs may be configured in a higher layer. It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState in the list of reference BWPs/CCs including the target BWP/CC is configured. Note that the list of reference BWPs/CCs may be the same as or different from a list of BWPs/CCs configured for a function of updating TCI state IDs of a plurality of BWPs/CCs all together by a MAC CE/DCI.

[0127] A list of reference BWPs/CCs may be configured in a higher layer. It may be defined that, when a DLorJointTCIState configuration or a UL-TCIState configuration is

absent in a BWP (second BWP) (target BWP/CC) in a CC (second CC) (condition), a UE can apply a DLorJointTCIState configuration or a UL-TCIState configuration from a reference BWP (first BWP) in a reference CC (first CC). The reference BWP in the reference CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState in the list of reference BWPs/CCs is configured. Note that the list of reference BWPs/CCs may be the same as or different from a list of BWPs/CCs configured for a function of updating TCI state IDs of a plurality of BWPs/CCs all together by a MAC CE/DCI.

[0128] According to this embodiment, a UE can appropriately determine a TCI state in a CC-common TCI state pool/list/configuration.

<Embodiment #2>

[0129] This embodiment relates to problem 2 for a CC-common TCI state pool/list/configuration.

[0130] It may be defined that, when a BWP-ID (bwp-id) or a cell ID (cell) for a QCL type A/D source RS in QCL information (QCL-Info) of a TCI state configured with DLorJointTCIState is not configured (condition), a UE assumes that a QCL type A/D source RS is configured in a CC/DL BWP (second CC/second BWP) to which the TCI state is to be applied.

[0131] If no BWP-ID or cell ID for a QCL type A/D RS is configured, the QCL type A/D RS may be a CSI-RS or an SS/PBCH block with a resource ID in QCL information configured in a CC/DL BWP (target BWP/CC) to which a TCI state is to be applied. It may be defined that, if no BWP-ID or cell ID for a QCL type A/D RS is configured, the UE assumes that the QCL type A/D resource RS is a CSI-RS or an SS/PBCH block with a resource ID in QCL information and is configured in a CC/DL BWP to which a TCI state is to be applied. It may be defined that, if no BWP-ID or cell ID for a QCL type A/D RS is configured, the UE assumes that a CSI-RS or an SS/PBCH block with a resource ID in QCL information is configured as the QCL type A/D source RS in the CC/DL BWP to which a TCI state is to be applied.

[0132] The resource of the CSI-RS may be a non-zero power (NZP)-CSI-RS resource. "With a resource ID in QCL information" may be interpreted as "with the same resource ID as a resource ID in QCL information." "QCL information" may be interpreted as "QCL information configured for a reference BWP/CC."

[0133] As in the example in FIG. **5**, NZP CSI-RS #1 and TRS #1 are transmitted in BWP #1 in CC #1, and TRS #1 is transmitted in BWP #1 in CC #2. Here, when a reference BWP/CC is BWP #1 in CC #1, a QCL type A RS is TRS #1 in a target BWP/CC (BWP #1 in CC #1 or BWP #1 in CC #2), and a QCL type D RS is CSI-RS #1 in the reference BWP/CC (BWP #1 in CC #1), a base station may configure a TCI state (QCL type A/D RS) as in the example in FIG. **6**. The TCI state includes qcl-Type1 and qcl-Type2. The qcl-Type1 (QCL-Info) does not include a cell ID (cell) and a BWP-ID (bwp-id) but includes a source RS (referenceSignal)=TRS #1 and QCL type (qcl-Type)=type A. The qcl-Type2 (QCL-Info) includes cell=CC #1, bwp-id=BWP #1, referenceSignal=NZP-CSI-RS #1, and qcl-Type=type D.

[0134] The reference BWP/CC (first CC/first BWP) may be a BWP/CC indicated by a BWP-ID or a cell ID for a QCL type A/D RS. The reference BWP/CC may be a BWP/CC for which DLorJointTCIState or UL-TCIState in the same band as that of the target BWP/CC and a BWP/CC for which a BWP-ID or a cell ID for a QCL type A/D RS is configured. The BWP CC indicated by the BWP-ID or the cell ID may be in the same band as that of the target BWP/CC.

[0135] If no BWP-ID or cell ID for a QCL type A/D RS in QCL information of a TCI state configured with DLorJointTCIState or UL-TCIState is configured, a QCL type A/D source RS in a BWP/CC to which the TCI state is to be actually applied may be a CSI-RS or an SS/PBCH block in the BWP/CC to which the TCI state is to be actually applied and a CSI-RS or an SS/PBCH block with a resource ID included in the QCL information configured for the reference BWP/CC. The RS with the resource ID may be configured for each BWP/CC.

[0136] According to this embodiment, a UE can appropriately determine a QCL type A/D source RS in a CC-common TCI state pool/list/configuration.

Embodiment #3

[0137] This embodiment relates to problem 3 for MAC CE/DCI based TCI state ID update on multiple CCs.

[0138] For MAC CE/DCI based TCI state ID update on multiple CCs, a MAC CE may be able to indicate one DL/joint TCI state ID or one UL TCI state ID on the multiple BWPs/CCs irrespective of DCI format 1_1/1_2. The multiple BWPs/CCs may include a first CC/first BWP and a second CC/second BWP.

[0139] The following operation may be defined.

[0140] When presence of TCI in DCI is configured (tci-PresentInDCI is set at 'enabled' (condition) or tci-PresentInDCI-1-2 is configured) for a CORESET, a UE with an activated DL-or-joint-TCI state configuration (DLorJointTCIState configuration) or an activated UL-TCI state configuration (UL-TCIState configuration) receives DCI format 1_1/1_2 or an activation command (MAC CE). Specific DCI format 1_1/1_2 or the activation command thus received provides one indicated DLorJointTCIState or indicated UL-TCIState for one CC or all the CCs in the same CC list. The CC list is configured by simultaneousTCI-UpdateList1-r17, simultaneousTCI-UpdateList2-r17, simultaneousTCI-UpdateList3-r17, or simultaneousTCI-UpdateList4-r17.

[0141] The following operation may be defined.

[0142] When presence of TCI in DCI is not configured (tci-PresentInDCI is not set at 'enabled' (condition) and tci-PresentInDCI-1-2 is not configured) for a CORESET, a UE with an activated DL-or-joint-TCI state configuration (DLorJointTCIState configuration) or an activated UL-TCI state configuration (UL-TCIState configuration) may receive an activation command (MAC CE). The activation command thus received provides one indicated DLorJointTCIState or indicated UL-TCIState for one CC or all the CCs in the same CC list. The CC list is configured by simultaneousTCI-UpdateList1-r17, simultaneousTCI-UpdateList2-r17, simultaneousTCI-UpdateList3-r17, or simultaneousTCI-UpdateList4-r17.

[0143] The "activation command" may be a MAC CE indicating a DL/joint TCI state or a UL TCI state.

[0144] According to this embodiment, a UE can appropriately update a TCI state ID according to a MAC CE or DCI.

<Supplements>

<<UE Capability Information/Higher Layer Parameter>>

[0145] At least one of the embodiments described above may be applied only to a UE that has reported a specific UE capability or that supports the specific UE capability.

[0146] The specific UE capability may indicate at least one of the following:

[0147] supporting of processing/operation/control/information about at least one of the embodiments above.

[0148] The specific UE capability may be a capability applied over all the frequencies (in common irrespective of frequency), a capability for each frequency (for example, cell, band, BWP), a capability for each frequency range (for example, Frequency Range 1 (FR1), FR2, FR3, FR4, FR5, FR2-1, and FR2-2), or a capability for each subcarrier spacing (SCS).

[0149] The specific UE capability may be a capability applied for all duplex schemes (in common irrespective of duplex scheme) or a capability for each duplex scheme (for example, time division duplex (TDD), frequency division duplex (FDD)).

[0150] At least one of the embodiments above may be applied to a case where the UE is configured with specific information related to the embodiment above by higher layer signaling. For example, the specific information may be information indicating enabling of at least one of functions in the embodiments above, any RRC parameter for a specific release (for example, Rel. 18), or the like. "_r18" may be attached to the name of the RRC parameter.

[0151] When the UE does not support at least one of the specific UE capabilities above or is not configured with the specific information, operation of Rel. 15/16 may be applied, for example.

[0152] According to the UE capability/higher layer parameter above, a UE can implement the above functions while maintaining compatibility with an existing specification.

SUPPLEMENTARY NOTE

[0153] Regarding one embodiment of the present disclosure, the following supplementary notes of the invention will be given.

Supplementary Note 1

[0154] A terminal including:

[0155] a receiving section that receives a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and

[0156] a control section that applies, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band.

Supplementary Note 2

[0157] The terminal according to supplementary note 1, wherein, when a second configuration of one or more TCI states to be applied to the plurality of types of signals is absent for the second BWP in the second CC, the control section applies the one or more TCI states to the second BWP.

Supplementary Note 3

[0158] The terminal according to supplementary note 1 or 2, wherein, when a BWP-ID or a cell ID is not configured in quasi co-location (QCL) information in a second configuration of one or more TCI states to be applied to the plurality of types of signals, for the second BWP in the second CC, the second configuration includes a resource ID of a channel state information reference signal or a synchronization signal block.

Supplementary Note 4

[0159] The terminal according to any one of supplementary notes 1 to 3, wherein the receiving section receives a list of CCs for simultaneous TCI state update and receives a medium access control (MAC) control element (CE) indicating one TCI state of the one or more TCI states.

(Radio Communication System)

[0160] Hereinafter, a structure of a radio communication system according to one embodiment of the present disclosure will be described. In this radio communication system, the radio communication method according to each embodiment of the present disclosure described above may be used alone or may be used in combination for communication.

[0161] FIG. **7** is a diagram to show an example of a schematic structure of the radio communication system according to one embodiment. The radio communication system **1** may be a system implementing a communication using Long Term Evolution (LTE), 5th generation mobile communication system New Radio (5G NR) and so on the specifications of which have been drafted by Third Generation Partnership Project (3GPP).

[0162] The radio communication system **1** may support dual connectivity (multi-RAT dual connectivity (MR-DC)) between a plurality of Radio Access Technologies (RATs). The MR-DC may include dual connectivity (E-UTRA-NR Dual Connectivity (EN-DC)) between LTE (Evolved Universal Terrestrial Radio Access (E-UTRA)) and NR, dual connectivity (NR-E-UTRA Dual Connectivity (NE-DC)) between NR and LTE, and so on.

[0163] In EN-DC, a base station (eNB) of LTE (E-UTRA) is a master node (MN), and a base station (gNB) of NR is a secondary node (SN). In NE-DC, a base station (gNB) of NR is an MN, and a base station (eNB) of LTE (E-UTRA) is an SN.

[0164] The radio communication system **1** may support dual connectivity between a plurality of base stations in the same RAT (for example, dual connectivity (NR-NR Dual Connectivity (NN-DC)) where both of an MN and an SN are base stations (gNB) of NR).

[0165] The radio communication system **1** may include a base station **11** that forms a macro cell C1 of a relatively wide coverage, and base stations **12** (**12***a* to **12***c*) that form small cells C2, which are placed within the macro cell C1 and which are narrower than the macro cell C1. The user terminal **20** may be located in at least one cell. The arrangement, the number, and the like of each cell and user terminal **20** are by no means limited to the aspect shown in the diagram. Hereinafter, the base stations **11** and **12** will be collectively referred to as "base stations **10**," unless specified otherwise.

[0166] The user terminal **20** may be connected to at least one of the plurality of base stations **10**. The user terminal **20**

may use at least one of carrier aggregation (CA) and dual connectivity (DC) using a plurality of component carriers (CCs).

[0167] Each CC may be included in at least one of a first frequency band (Frequency Range 1 (FR1)) and a second frequency band (Frequency Range 2 (FR2)). The macro cell C1 may be included in FR1, and the small cells C2 may be included in FR2. For example, FR1 may be a frequency band of 6 GHz or less (sub-6 GHZ), and FR2 may be a frequency band which is higher than 24 GHZ (above-24 GHz). Note that frequency bands, definitions and so on of FR1 and FR2 are by no means limited to these, and for example, FR1 may correspond to a frequency band which is higher than FR2.

[0168] The user terminal **20** may communicate using at least one of time division duplex (TDD) and frequency division duplex (FDD) in each CC.

[0169] The plurality of base stations **10** may be connected by a wired connection (for example, optical fiber in compliance with the Common Public Radio Interface (CPRI), the X2 interface and so on) or a wireless connection (for example, an NR communication). For example, if an NR communication is used as a backhaul between the base stations **11** and **12**, the base station **11** corresponding to a higher station may be referred to as an "Integrated Access Backhaul (IAB) donor," and the base station **12** corresponding to a relay station (relay) may be referred to as an "IAB node."

[0170] The base station **10** may be connected to a core network **30** through another base station **10** or directly. For example, the core network **30** may include at least one of Evolved Packet Core (EPC), 5G Core Network (5GCN), Next Generation Core (NGC), and so on.

[0171] The user terminal **20** may be a terminal supporting at least one of communication schemes such as LTE, LTE-A, 5G, and so on.

[0172] In the radio communication system **1**, an orthogonal frequency division multiplexing (OFDM)-based wireless access scheme may be used. For example, in at least one of the downlink (DL) and the uplink (UL), Cyclic Prefix OFDM (CP-OFDM), Discrete Fourier Transform Spread OFDM (DFT-S-OFDM), Orthogonal Frequency Division Multiple Access (OFDMA), Single Carrier Frequency Division Multiple Access (SC-FDMA), and so on may be used.

[0173] The wireless access scheme may be referred to as a "waveform." Note that, in the radio communication system **1**, another wireless access scheme (for example, another single carrier transmission scheme, another multi-carrier transmission scheme) may be used for a wireless access scheme in the UL and the DL.

[0174] In the radio communication system **1**, a downlink shared channel (Physical Downlink Shared Channel (PDSCH)), which is used by each user terminal **20** on a shared basis, a broadcast channel (Physical Broadcast Channel (PBCH)), a downlink control channel (Physical Downlink Control Channel (PDCCH)) and so on, may be used as downlink channels.

[0175] In the radio communication system **1**, an uplink shared channel (Physical Uplink Shared Channel (PUSCH)), which is used by each user terminal **20** on a shared basis, an uplink control channel (Physical Uplink Control Channel (PUCCH)), a random access channel (Physical Random Access Channel (PRACH)) and so on may be used as uplink channels.

[0176] User data, higher layer control information, System Information Blocks (SIBs) and so on are communicated on the PDSCH. User data, higher layer control information and so on may be communicated on the PUSCH. The Master Information Blocks (MIBs) may be communicated on the PBCH.

[0177] Lower layer control information may be communicated on the PDCCH. For example, the lower layer control information may include downlink control information (DCI) including scheduling information of at least one of the PDSCH and the PUSCH.

[0178] Note that DCI for scheduling the PDSCH may be referred to as "DL assignment," "DL DCI," and so on, and DCI for scheduling the PUSCH may be referred to as "UL grant," "UL DCI," and so on. Note that the PDSCH may be interpreted as "DL data", and the PUSCH may be interpreted as "UL data".

[0179] For detection of the PDCCH, a control resource set (CORESET) and a search space may be used. The CORESET corresponds to a resource to search DCI. The search space corresponds to a search area and a search method of PDCCH candidates. One CORESET may be associated with one or more search spaces. The UE may monitor a CORESET associated with a given search space, based on search space configuration.

[0180] One search space may correspond to a PDCCH candidate corresponding to one or more aggregation levels. One or more search spaces may be referred to as a "search space set." Note that a "search space," a "search space set," a "search space configuration," a "search space set configuration," a "CORESET," a "CORESET configuration" and so on of the present disclosure may be interchangeably interpreted.

[0181] Uplink control information (UCI) including at least one of channel state information (CSI), transmission confirmation information (for example, which may be referred to as Hybrid Automatic Repeat reQuest ACKnowledgement (HARQ-ACK), ACK/NACK, and so on), and scheduling request (SR) may be communicated by means of the PUCCH. By means of the PRACH, random access preambles for establishing connections with cells may be communicated.

[0182] Note that the downlink, the uplink, and so on in the present disclosure may be expressed without a term of "link." In addition, various channels may be expressed without adding "Physical" to the head.

[0183] In the radio communication system **1**, a synchronization signal (SS), a downlink reference signal (DL-RS), and so on may be communicated. In the radio communication system **1**, a cell-specific reference signal (CRS), a channel state information-reference signal (CSI-RS), a demodulation reference signal (DMRS), a positioning reference signal (PRS), a phase tracking reference signal (PTRS), and so on may be communicated as the DL-RS.

[0184] For example, the synchronization signal may be at least one of a primary synchronization signal (PSS) and a secondary synchronization signal (SSS). A signal block including an SS (PSS, SSS) and a PBCH (and a DMRS for a PBCH) may be referred to as an "SS/PBCH block," an "SS Block (SSB)," and so on. Note that an SS, an SSB, and so on may be also referred to as a "reference signal."

[0185] In the radio communication system **1**, a reference signal for measurement (Sounding Reference Signal (SRS)), a demodulation reference signal (DMRS), and so on may be

communicated as an uplink reference signal (UL-RS). Note that DMRS may be referred to as a "user terminal specific reference signal (UE-specific Reference Signal)."

(Base Station)

[0186] FIG. **8** is a diagram to show an example of a structure of the base station according to one embodiment. The base station **10** includes a control section **110**, a transmitting/receiving section **120**, transmitting/receiving antennas **130** and a communication path interface (transmission line interface) **140**. Note that the base station **10** may include one or more control sections **110**, one or more transmitting/receiving sections **120**, one or more transmitting/receiving antennas **130**, and one or more communication path interfaces **140**.

[0187] Note that, the present example primarily shows functional blocks that pertain to characteristic parts of the present embodiment, and it is assumed that the base station **10** may include other functional blocks that are necessary for radio communication as well. Part of the processes of each section described below may be omitted.

[0188] The control section **110** controls the whole of the base station **10**. The control section **110** can be constituted with a controller, a control circuit, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0189] The control section **110** may control generation of signals, scheduling (for example, resource allocation, mapping), and so on. The control section **110** may control transmission and reception, measurement and so on using the transmitting/receiving section **120**, the transmitting/receiving antennas **130**, and the communication path interface **140**. The control section **110** may generate data, control information, a sequence and so on to transmit as a signal, and forward the generated items to the transmitting/receiving section **120**. The control section **110** may perform call processing (setting up, releasing) for communication channels, manage the state of the base station **10**, and manage the radio resources.

[0190] The transmitting/receiving section **120** may include a baseband section **121**, a Radio Frequency (RF) section **122**, and a measurement section **123**. The baseband section **121** may include a transmission processing section **1211** and a reception processing section **1212**. The transmitting/receiving section **120** can be constituted with a transmitter/receiver, an RF circuit, a baseband circuit, a filter, a phase shifter, a measurement circuit, a transmitting/receiving circuit, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0191] The transmitting/receiving section **120** may be structured as a transmitting/receiving section in one entity, or may be constituted with a transmitting section and a receiving section. The transmitting section may be constituted with the transmission processing section **1211**, and the RF section **122**. The receiving section may be constituted with the reception processing section **1212**, the RF section **122**, and the measurement section **123**.

[0192] The transmitting/receiving antennas **130** can be constituted with antennas, for example, an array antenna, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0193] The transmitting/receiving section **120** may transmit the above-described downlink channel, synchronization signal, downlink reference signal, and so on. The transmitting/receiving section **120** may receive the above-described uplink channel, uplink reference signal, and so on.

[0194] The transmitting/receiving section **120** may form at least one of a transmit beam and a receive beam by using digital beam forming (for example, precoding), analog beam forming (for example, phase rotation), and so on.

[0195] The transmitting/receiving section **120** (transmission processing section **1211**) may perform the processing of the Packet Data Convergence Protocol (PDCP) layer, the processing of the Radio Link Control (RLC) layer (for example, RLC retransmission control), the processing of the Medium Access Control (MAC) layer (for example, HARQ retransmission control), and so on, for example, on data and control information and so on acquired from the control section **110**, and may generate bit string to transmit.

[0196] The transmitting/receiving section **120** (transmission processing section **1211**) may perform transmission processing such as channel coding (which may include error correction coding), modulation, mapping, filtering, discrete Fourier transform (DFT) processing (as necessary), inverse fast Fourier transform (IFFT) processing, precoding, digital-to-analog conversion, and so on, on the bit string to transmit, and output a baseband signal.

[0197] The transmitting/receiving section **120** (RF section **122**) may perform modulation to a radio frequency band, filtering, amplification, and so on, on the baseband signal, and transmit the signal of the radio frequency band through the transmitting/receiving antennas **130**.

[0198] On the other hand, the transmitting/receiving section **120** (RF section **122**) may perform amplification, filtering, demodulation to a baseband signal, and so on, on the signal of the radio frequency band received by the transmitting/receiving antennas **130**.

[0199] The transmitting/receiving section **120** (reception processing section **1212**) may apply reception processing such as analog-digital conversion, fast Fourier transform (FFT) processing, inverse discrete Fourier transform (IDFT) processing (as necessary), filtering, de-mapping, demodulation, decoding (which may include error correction decoding), MAC layer processing, the processing of the RLC layer and the processing of the PDCP layer, and so on, on the acquired baseband signal, and acquire user data, and so on.

[0200] The transmitting/receiving section **120** (measurement section **123**) may perform the measurement related to the received signal. For example, the measurement section **123** may perform Radio Resource Management (RRM) measurement, Channel State Information (CSI) measurement, and so on, based on the received signal. The measurement section **123** may measure a received power (for example, Reference Signal Received Power (RSRP)), a received quality (for example, Reference Signal Received Quality (RSRQ), a Signal to Interference plus Noise Ratio (SINR), a Signal to Noise Ratio (SNR)), a signal strength (for example, Received Signal Strength Indicator (RSSI)), channel information (for example, CSI), and so on. The measurement results may be output to the control section **110**.

[0201] The communication path interface **140** may perform transmission/reception (backhaul signaling) of a signal with an apparatus included in the core network **30** or other base stations **10**, and so on, and acquire or transmit user data (user plane data), control plane data, and so on for the user terminal **20**.

[0202] Note that the transmitting section and the receiving section of the base station **10** in the present disclosure may be constituted with at least one of the transmitting/receiving section **120**, the transmitting/receiving antennas **130**, and the communication path interface **140**.

[0203] The transmitting/receiving section **120** may transmit a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band. When a condition is satisfied, the control section **110** may apply the one or more TCI states to a second BWP in a second CC in the specific band.

(User Terminal)

[0204] FIG. **9** is a diagram to show an example of a structure of the user terminal according to one embodiment. The user terminal **20** includes a control section **210**, a transmitting/receiving section **220**, and transmitting/receiving antennas **230**. Note that the user terminal **20** may include one or more control sections **210**, one or more transmitting/receiving sections **220**, and one or more transmitting/receiving antennas **230**.

[0205] Note that, the present example primarily shows functional blocks that pertain to characteristic parts of the present embodiment, and it is assumed that the user terminal **20** may include other functional blocks that are necessary for radio communication as well. Part of the processes of each section described below may be omitted.

[0206] The control section **210** controls the whole of the user terminal **20**. The control section **210** can be constituted with a controller, a control circuit, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0207] The control section **210** may control generation of signals, mapping, and so on. The control section **210** may control transmission/reception, measurement and so on using the transmitting/receiving section **220**, and the transmitting/receiving antennas **230**. The control section **210** generates data, control information, a sequence and so on to transmit as a signal, and may forward the generated items to the transmitting/receiving section **220**.

[0208] The transmitting/receiving section **220** may include a baseband section **221**, an RF section **222**, and a measurement section **223**. The baseband section **221** may include a transmission processing section **2211** and a reception processing section **2212**. The transmitting/receiving section **220** can be constituted with a transmitter/receiver, an RF circuit, a baseband circuit, a filter, a phase shifter, a measurement circuit, a transmitting/receiving circuit, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0209] The transmitting/receiving section **220** may be structured as a transmitting/receiving section in one entity, or may be constituted with a transmitting section and a receiving section. The transmitting section may be constituted with the transmission processing section **2211**, and the RF section **222**. The receiving section may be constituted with the reception processing section **2212**, the RF section **222**, and the measurement section **223**.

[0210] The transmitting/receiving antennas **230** can be constituted with antennas, for example, an array antenna, or the like described based on general understanding of the technical field to which the present disclosure pertains.

[0211] The transmitting/receiving section **220** may receive the above-described downlink channel, synchronization signal, downlink reference signal, and so on. The transmitting/receiving section **220** may transmit the above-described uplink channel, uplink reference signal, and so on.

[0212] The transmitting/receiving section **220** may form at least one of a transmit beam and a receive beam by using digital beam forming (for example, precoding), analog beam forming (for example, phase rotation), and so on.

[0213] The transmitting/receiving section **220** (transmission processing section **2211**) may perform the processing of the PDCP layer, the processing of the RLC layer (for example, RLC retransmission control), the processing of the MAC layer (for example, HARQ retransmission control), and so on, for example, on data and control information and so on acquired from the control section **210**, and may generate bit string to transmit.

[0214] The transmitting/receiving section **220** (transmission processing section **2211**) may perform transmission processing such as channel coding (which may include error correction coding), modulation, mapping, filtering, DFT processing (as necessary), IFFT processing, precoding, digital-to-analog conversion, and so on, on the bit string to transmit, and output a baseband signal.

[0215] Note that, whether to apply DFT processing or not may be based on the configuration of the transform precoding. The transmitting/receiving section **220** (transmission processing section **2211**) may perform, for a given channel (for example, PUSCH), the DFT processing as the above-described transmission processing to transmit the channel by using a DFT-s-OFDM waveform if transform precoding is enabled, and otherwise, does not need to perform the DFT processing as the above-described transmission process.

[0216] The transmitting/receiving section **220** (RF section **222**) may perform modulation to a radio frequency band, filtering, amplification, and so on, on the baseband signal, and transmit the signal of the radio frequency band through the transmitting/receiving antennas **230**.

[0217] On the other hand, the transmitting/receiving section **220** (RF section **222**) may perform amplification, filtering, demodulation to a baseband signal, and so on, on the signal of the radio frequency band received by the transmitting/receiving antennas **230**.

[0218] The transmitting/receiving section **220** (reception processing section **2212**) may apply reception processing such as analog-digital conversion, FFT processing, IDFT processing (as necessary), filtering, de-mapping, demodulation, decoding (which may include error correction decoding), MAC layer processing, the processing of the RLC layer and the processing of the PDCP layer, and so on, on the acquired baseband signal, and acquire user data and so on.

[0219] The transmitting/receiving section **220** (measurement section **223**) may perform the measurement related to the received signal. For example, the measurement section **223** may perform RRM measurement, CSI measurement, and so on, based on the received signal. The measurement section **223** may measure a received power (for example, RSRP), a received quality (for example, RSRQ, SINR, SNR), a signal strength (for example, RSSI), channel information (for example, CSI), and so on. The measurement results may be output to the control section **210**.

[0220] Note that the transmitting section and the receiving section of the user terminal **20** in the present disclosure may

be constituted with at least one of the transmitting/receiving section **220** and the transmitting/receiving antennas **230**.

[0221] The transmitting/receiving section **220** may receive a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band. When a condition is satisfied, the control section **210** may apply the one or more TCI states to a second BWP in a second CC in the specific band.

[0222] When a second configuration of one or more TCI states to be applied to the plurality of types of signals is absent for the second BWP in the second CC, the control section **210** may apply the one or more TCI states to the second BWP.

[0223] When a BWP-ID or a cell ID is not configured in quasi co-location (QCL) information in a second configuration of one or more TCI states to be applied to the plurality of types of signals, for the second BWP in the second CC, the second configuration may include a resource ID of a channel state information reference signal or a synchronization signal block.

[0224] The transmitting/receiving section **220** may receive a list of CCs for simultaneous TCI state update and receive a medium access control (MAC) control element (CE) indicating one TCI state of the one or more TCI states.

(Hardware Structure)

[0225] Note that the block diagrams that have been used to describe the above embodiments show blocks in functional units. These functional blocks (components) may be implemented in arbitrary combinations of at least one of hardware and software. Also, the method for implementing each functional block is not particularly limited. That is, each functional block may be realized by one piece of apparatus that is physically or logically coupled, or may be realized by directly or indirectly connecting two or more physically or logically separate pieces of apparatus (for example, via wire, wireless, or the like) and using these plurality of pieces of apparatus. The functional blocks may be implemented by combining softwares into the apparatus described above or the plurality of apparatuses described above.

[0226] Here, functions include judgment, determination, decision, calculation, computation, processing, derivation, investigation, search, confirmation, reception, transmission, output, access, resolution, selection, designation, establishment, comparison, assumption, expectation, considering, broadcasting, notifying, communicating, forwarding, configuring, reconfiguring, allocating (mapping), assigning, and the like, but function are by no means limited to these. For example, functional block (components) to implement a function of transmission may be referred to as a "transmitting section (transmitting unit)," a "transmitter," and the like. The method for implementing each component is not particularly limited as described above.

[0227] For example, a base station, a user terminal, and so on according to one embodiment of the present disclosure may function as a computer that executes the processes of the radio communication method of the present disclosure. FIG. **10** is a diagram to show an example of a hardware structure of the base station and the user terminal according to one embodiment. Physically, the above-described base station **10** and user terminal **20** may each be formed as a computer apparatus that includes a processor **1001**, a memory **1002**, a storage **1003**, a communication apparatus **1004**, an input apparatus **1005**, an output apparatus **1006**, a bus **1007**, and so on.

[0228] Note that in the present disclosure, the words such as an apparatus, a circuit, a device, a section, a unit, and so on can be interchangeably interpreted. The hardware structure of the base station **10** and the user terminal **20** may be configured to include one or more of apparatuses shown in the drawings, or may be configured not to include part of apparatuses.

[0229] For example, although only one processor **1001** is shown, a plurality of processors may be provided. Furthermore, processes may be implemented with one processor or may be implemented at the same time, in sequence, or in different manners with two or more processors. Note that the processor **1001** may be implemented with one or more chips.

[0230] Each function of the base station **10** and the user terminals **20** is implemented, for example, by allowing given software (programs) to be read on hardware such as the processor **1001** and the memory **1002**, and by allowing the processor **1001** to perform calculations to control communication via the communication apparatus **1004** and control at least one of reading and writing of data in the memory **1002** and the storage **1003**.

[0231] The processor **1001** controls the whole computer by, for example, running an operating system. The processor **1001** may be configured with a central processing unit (CPU), which includes interfaces with peripheral apparatus, control apparatus, computing apparatus, a register, and so on. For example, at least part of the above-described control section **110** (**210**), the transmitting/receiving section **120** (**220**), and so on may be implemented by the processor **1001**.

[0232] Furthermore, the processor **1001** reads programs (program codes), software modules, data, and so on from at least one of the storage **1003** and the communication apparatus **1004**, into the memory **1002**, and executes various processes according to these. As for the programs, programs to allow computers to execute at least part of the operations of the above-described embodiments are used. For example, the control section **110** (**210**) may be implemented by control programs that are stored in the memory **1002** and that operate on the processor **1001**, and other functional blocks may be implemented likewise.

[0233] The memory **1002** is a computer-readable recording medium, and may be constituted with, for example, at least one of a Read Only Memory (ROM), an Erasable Programmable ROM (EPROM), an Electrically EPROM (EEPROM), a Random Access Memory (RAM), and other appropriate storage media. The memory **1002** may be referred to as a "register," a "cache," a "main memory (primary storage apparatus)" and so on. The memory **1002** can store executable programs (program codes), software modules, and the like for implementing the radio communication method according to one embodiment of the present disclosure.

[0234] The storage **1003** is a computer-readable recording medium, and may be constituted with, for example, at least one of a flexible disk, a floppy (registered trademark) disk, a magneto-optical disk (for example, a compact disc (Compact Disc ROM (CD-ROM) and so on), a digital versatile disc, a Blu-ray (registered trademark) disk), a removable disk, a hard disk drive, a smart card, a flash memory device (for example, a card, a stick, and a key drive), a magnetic

stripe, a database, a server, and other appropriate storage media. The storage **1003** may be referred to as "secondary storage apparatus."

[0235] The communication apparatus **1004** is hardware (transmitting/receiving device) for allowing inter-computer communication via at least one of wired and wireless networks, and may be referred to as, for example, a "network device," a "network controller," a "network card," a "communication module," and so on. The communication apparatus **1004** may be configured to include a high frequency switch, a duplexer, a filter, a frequency synthesizer, and so on in order to realize, for example, at least one of frequency division duplex (FDD) and time division duplex (TDD). For example, the above-described transmitting/receiving section **120** (**220**), the transmitting/receiving antennas **130** (**230**), and so on may be implemented by the communication apparatus **1004**. In the transmitting/receiving section **120** (**220**), the transmitting section **120***a* (**220***a*) and the receiving section **120***b* (**220***b*) can be implemented while being separated physically or logically.

[0236] The input apparatus **1005** is an input device that receives input from the outside (for example, a keyboard, a mouse, a microphone, a switch, a button, a sensor, and so on). The output apparatus **1006** is an output device that allows sending output to the outside (for example, a display, a speaker, a Light Emitting Diode (LED) lamp, and so on). Note that the input apparatus **1005** and the output apparatus **1006** may be provided in an integrated structure (for example, a touch panel).

[0237] Furthermore, these types of apparatus, including the processor **1001**, the memory **1002**, and others, are connected by a bus **1007** for communicating information. The bus **1007** may be formed with a single bus, or may be formed with buses that vary between pieces of apparatus.

[0238] Also, the base station **10** and the user terminals **20** may be structured to include hardware such as a microprocessor, a digital signal processor (DSP), an Application Specific Integrated Circuit (ASIC), a Programmable Logic Device (PLD), a Field Programmable Gate Array (FPGA), and so on, and part or all of the functional blocks may be implemented by the hardware. For example, the processor **1001** may be implemented with at least one of these pieces of hardware.

(Variations)

[0239] Note that the terminology described in the present disclosure and the terminology that is needed to understand the present disclosure may be replaced by other terms that convey the same or similar meanings. For example, a "channel," a "symbol," and a "signal" (or signaling) may be interchangeably interpreted. Also, "signals" may be "messages." A reference signal may be abbreviated as an "RS," and may be referred to as a "pilot," a "pilot signal," and so on, depending on which standard applies. Furthermore, a "component carrier (CC)" may be referred to as a "cell," a "frequency carrier," a "carrier frequency" and so on.

[0240] A radio frame may be constituted of one or a plurality of periods (frames) in the time domain. Each of one or a plurality of periods (frames) constituting a radio frame may be referred to as a "subframe." Furthermore, a subframe may be constituted of one or a plurality of slots in the time domain. A subframe may be a fixed time length (for example, 1 ms) independent of numerology.

[0241] Here, numerology may be a communication parameter applied to at least one of transmission and reception of a given signal or channel. For example, numerology may indicate at least one of a subcarrier spacing (SCS), a bandwidth, a symbol length, a cyclic prefix length, a transmission time interval (TTI), the number of symbols per TTI, a radio frame structure, a specific filter processing performed by a transceiver in the frequency domain, a specific windowing processing performed by a transceiver in the time domain, and so on.

[0242] A slot may be constituted of one or a plurality of symbols in the time domain (Orthogonal Frequency Division Multiplexing (OFDM) symbols, Single Carrier Frequency Division Multiple Access (SC-FDMA) symbols, and so on). Furthermore, a slot may be a time unit based on numerology.

[0243] A slot may include a plurality of mini-slots. Each mini-slot may be constituted of one or a plurality of symbols in the time domain. A mini-slot may be referred to as a "sub-slot." A mini-slot may be constituted of symbols less than the number of slots. A PDSCH (or PUSCH) transmitted in a time unit larger than a mini-slot may be referred to as "PDSCH (PUSCH) mapping type A." A PDSCH (or PUSCH) transmitted using a mini-slot may be referred to as "PDSCH (PUSCH) mapping type B."

[0244] A radio frame, a subframe, a slot, a mini-slot, and a symbol all express time units in signal communication. A radio frame, a subframe, a slot, a mini-slot, and a symbol may each be called by other applicable terms. Note that time units such as a frame, a subframe, a slot, mini-slot, and a symbol in the present disclosure may be interchangeably interpreted.

[0245] For example, one subframe may be referred to as a "TTI," a plurality of consecutive subframes may be referred to as a "TTI," or one slot or one mini-slot may be referred to as a "TTI." That is, at least one of a subframe and a TTI may be a subframe (1 ms) in existing LTE, may be a shorter period than 1 ms (for example, 1 to 13 symbols), or may be a longer period than 1 ms. Note that a unit expressing TTI may be referred to as a "slot," a "mini-slot," and so on instead of a "subframe."

[0246] Here, a TTI refers to the minimum time unit of scheduling in radio communication, for example. For example, in LTE systems, a base station schedules the allocation of radio resources (such as a frequency bandwidth and transmit power that are available for each user terminal) for the user terminal in TTI units. Note that the definition of TTIs is not limited to this.

[0247] TTIs may be transmission time units for channel-encoded data packets (transport blocks), code blocks, or codewords, or may be the unit of processing in scheduling, link adaptation, and so on. Note that, when TTIs are given, the time interval (for example, the number of symbols) to which transport blocks, code blocks, codewords, or the like are actually mapped may be shorter than the TTIS.

[0248] Note that, in the case where one slot or one mini-slot is referred to as a TTI, one or more TTIs (that is, one or more slots or one or more mini-slots) may be the minimum time unit of scheduling. Furthermore, the number of slots (the number of mini-slots) constituting the minimum time unit of the scheduling may be controlled.

[0249] A TTI having a time length of 1 ms may be referred to as a "normal TTI" (TTI in 3GPP Rel. 8 to Rel. 12), a "long TTI," a "normal subframe," a "long subframe," a "slot" and

so on. A TTI that is shorter than a normal TTI may be referred to as a "shortened TTI," a "short TTI," a "partial or fractional TTI," a "shortened subframe," a "short subframe," a "mini-slot," a "sub-slot," a "slot" and so on.

[0250] Note that a long TTI (for example, a normal TTI, a subframe, and so on) may be interpreted as a TTI having a time length exceeding 1 ms, and a short TTI (for example, a shortened TTI and so on) may be interpreted as a TTI having a TTI length shorter than the TTI length of a long TTI and equal to or longer than 1 ms.

[0251] A resource block (RB) is the unit of resource allocation in the time domain and the frequency domain, and may include one or a plurality of consecutive subcarriers in the frequency domain. The number of subcarriers included in an RB may be the same regardless of numerology, and, for example, may be 12. The number of subcarriers included in an RB may be determined based on numerology.

[0252] Also, an RB may include one or a plurality of symbols in the time domain, and may be one slot, one mini-slot, one subframe, or one TTI in length. One TTI, one subframe, and so on each may be constituted of one or a plurality of resource blocks.

[0253] Note that one or a plurality of RBs may be referred to as a "physical resource block (Physical RB (PRB))," a "sub-carrier group (SCG)," a "resource element group (REG)," a "PRB pair," an "RB pair" and so on.

[0254] Furthermore, a resource block may be constituted of one or a plurality of resource elements (REs). For example, one RE may correspond to a radio resource field of one subcarrier and one symbol.

[0255] A bandwidth part (BWP) (which may be referred to as a "fractional bandwidth," and so on) may represent a subset of contiguous common resource blocks (common RBs) for given numerology in a given carrier. Here, a common RB may be specified by an index of the RB based on the common reference point of the carrier. A PRB may be defined by a given BWP and may be numbered in the BWP.

[0256] The BWP may include a UL BWP (BWP for the UL) and a DL BWP (BWP for the DL). One or a plurality of BWPs may be configured in one carrier for a UE.

[0257] At least one of configured BWPs may be active, and a UE does not need to assume to transmit/receive a given signal/channel outside active BWPs. Note that a "cell," a "carrier," and so on in the present disclosure may be interpreted as a "BWP".

[0258] Note that the above-described structures of radio frames, subframes, slots, mini-slots, symbols, and so on are merely examples. For example, structures such as the number of subframes included in a radio frame, the number of slots per subframe or radio frame, the number of mini-slots included in a slot, the numbers of symbols and RBs included in a slot or a mini-slot, the number of subcarriers included in an RB, the number of symbols in a TTI, the symbol length, the cyclic prefix (CP) length, and so on can be variously changed.

[0259] Also, the information, parameters, and so on described in the present disclosure may be represented in absolute values or in relative values with respect to given values, or may be represented in another corresponding information. For example, radio resources may be specified by given indices.

[0260] The names used for parameters and so on in the present disclosure are in no respect limiting. Furthermore, mathematical expressions that use these parameters, and so on may be different from those expressly disclosed in the present disclosure. For example, since various channels (PUCCH, PDCCH, and so on) and information elements can be identified by any suitable names, the various names allocated to these various channels and information elements are in no respect limiting.

[0261] The information, signals, and so on described in the present disclosure may be represented by using any of a variety of different technologies. For example, data, instructions, commands, information, signals, bits, symbols, chips, and so on, all of which may be referenced throughout the herein-contained description, may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or photons, or any combination of these.

[0262] Also, information, signals, and so on can be output in at least one of from higher layers to lower layers and from lower layers to higher layers. Information, signals, and so on may be input and/or output via a plurality of network nodes.

[0263] The information, signals, and so on that are input and/or output may be stored in a specific location (for example, a memory) or may be managed by using a management table. The information, signals, and so on to be input and/or output can be overwritten, updated, or appended. The information, signals, and so on that are output may be deleted. The information, signals, and so on that are input may be transmitted to another apparatus.

[0264] Notification of information is by no means limited to the aspects/embodiments described in the present disclosure, and other methods may be used as well. For example, notification of information in the present disclosure may be implemented by using physical layer signaling (for example, downlink control information (DCI), uplink control information (UCI)), higher layer signaling (for example, Radio Resource Control (RRC) signaling, broadcast information (master information block (MIB), system information blocks (SIBs), and so on), Medium Access Control (MAC) signaling and so on), and other signals or combinations of these.

[0265] Note that physical layer signaling may be referred to as "Layer 1/Layer 2 (L1/L2) control information (L1/L2 control signals)," "L1 control information (L1 control signal)," and so on. Also, RRC signaling may be referred to as an "RRC message," and can be, for example, an RRC connection setup message, an RRC connection reconfiguration message, and so on. Also, MAC signaling may be notified using, for example, MAC control elements (MAC CEs).

[0266] Also, notification of given information (for example, notification of "X holds") does not necessarily have to be notified explicitly, and can be notified implicitly (by, for example, not notifying this given information or notifying another piece of information).

[0267] Determinations may be made in values represented by one bit (0 or 1), may be made in Boolean values that represent true or false, or may be made by comparing numerical values (for example, comparison against a given value).

[0268] Software, whether referred to as "software," "firmware," "middleware," "microcode," or "hardware description language," or called by other terms, should be interpreted broadly to mean instructions, instruction sets, code, code segments, program codes, programs, subprograms, software modules, applications, software applications, soft-

ware packages, routines, subroutines, objects, executable files, execution threads, procedures, functions, and so on.

[0269] Also, software, commands, information, and so on may be transmitted and received via communication media. For example, when software is transmitted from a website, a server, or other remote sources by using at least one of wired technologies (coaxial cables, optical fiber cables, twisted-pair cables, digital subscriber lines (DSL), and so on) and wireless technologies (infrared radiation, microwaves, and so on), at least one of these wired technologies and wireless technologies are also included in the definition of communication media.

[0270] The terms "system" and "network" used in the present disclosure can be used interchangeably. The "network" may mean an apparatus (for example, a base station) included in the network.

[0271] In the present disclosure, the terms such as "precoding," a "precoder," a "weight (precoding weight)," "quasi-co-location (QCL)," a "Transmission Configuration Indication state (TCI state)," a "spatial relation," a "spatial domain filter," a "transmit power," "phase rotation," an "antenna port," an "antenna port group," a "layer," "the number of layers," a "rank," a "resource," a "resource set," a "resource group," a "beam," a "beam width," a "beam angular degree," an "antenna," an "antenna element," a "panel," and so on can be used interchangeably.

[0272] In the present disclosure, the terms such as a "base station (BS)," a "radio base station," a "fixed station," a "NodeB," an "eNB (eNodeB)," a "gNB (gNodeB)," an "access point," a "transmission point (TP)," a "reception point (RP)," a "transmission/reception point (TRP)," a "panel," a "cell," a "sector," a "cell group," a "carrier," a "component carrier," and so on can be used interchangeably. The base station may be referred to as the terms such as a "macro cell," a "small cell," a "femto cell," a "pico cell," and so on.

[0273] A base station can accommodate one or a plurality of (for example, three) cells. When a base station accommodates a plurality of cells, the entire coverage area of the base station can be partitioned into multiple smaller areas, and each smaller area can provide communication services through base station subsystems (for example, indoor small base stations (Remote Radio Heads (RRHs))). The term "cell" or "sector" refers to part of or the entire coverage area of at least one of a base station and a base station subsystem that provides communication services within this coverage.

[0274] In the present disclosure, a base station transmitting information to a terminal and the base station indicates control/operation based on the information to the terminal may be interchangeably interpreted.

[0275] In the present disclosure, the terms "mobile station (MS)," "user terminal," "user equipment (UE)," and "terminal" may be used interchangeably.

[0276] A mobile station may be referred to as a "subscriber station," "mobile unit," "subscriber unit," "wireless unit," "remote unit," "mobile device," "wireless device," "wireless communication device," "remote device," "mobile subscriber station," "access terminal," "mobile terminal," "wireless terminal," "remote terminal," "handset," "user agent," "mobile client," "client," or some other appropriate terms in some cases.

[0277] At least one of a base station and a mobile station may be referred to as a "transmitting apparatus," a "receiving apparatus," a "radio communication apparatus," and so on. Note that at least one of a base station and a mobile station may be a device mounted on a moving object or a moving object itself, and so on.

[0278] The moving object is a movable object with any moving speed, and naturally a case where the moving object is stopped is also included. Examples of the moving object include a vehicle, a transport vehicle, an automobile, a motorcycle, a bicycle, a connected car, a loading shovel, a bulldozer, a wheel loader, a dump truck, a fork lift, a train, a bus, a trolley, a rickshaw, a ship and other watercraft, an airplane, a rocket, a satellite, a drone, a multicopter, a quadcopter, a balloon, and an object mounted on any of these, but these are not restrictive. The moving object may be a moving object that autonomously travels based on a direction for moving.

[0279] The moving object may be a vehicle (for example, a car, an airplane, and the like), may be a moving object which moves unmanned (for example, a drone, an automatic operation car, and the like), or may be a robot (a manned type or unmanned type). Note that at least one of a base station and a mobile station also includes an apparatus which does not necessarily move during communication operation. For example, at least one of a base station and a mobile station may be an Internet of Things (IoT) device such as a sensor.

[0280] FIG. **11** is a diagram to show an example of a vehicle according to one embodiment. A vehicle **40** includes a driving section **41**, a steering section **42**, an accelerator pedal **43**, a brake pedal **44**, a shift lever **45**, right and left front wheels **46**, right and left rear wheels **47**, an axle **48**, an electronic control section **49**, various sensors (including a current sensor **50**, a rotational speed sensor **51**, a pneumatic sensor **52**, a vehicle speed sensor **53**, an acceleration sensor **54**, an accelerator pedal sensor **55**, a brake pedal sensor **56**, a shift lever sensor **57**, and an object detection sensor **58**), an information service section **59**, and a communication module **60**.

[0281] The driving section **41** includes, for example, at least one of an engine, a motor, and a hybrid of an engine and a motor. The steering section **42** at least includes a steering wheel, and is configured to steer at least one of the front wheels **46** and the rear wheels **47**, based on operation of the steering wheel operated by a user.

[0282] The electronic control section **49** includes a microprocessor **61**, a memory (ROM, RAM) **62**, and a communication port (for example, an input/output (IO) port) **63**. The electronic control section **49** receives, as input, signals from the various sensors **50** to **58** included in the vehicle. The electronic control section **49** may be referred to as an Electronic Control Unit (ECU).

[0283] Examples of the signals from the various sensors **50** to **58** include a current signal from the current sensor **50** for sensing current of a motor, a rotational speed signal of the front wheels **46**/rear wheels **47** acquired by the rotational speed sensor **51**, a pneumatic signal of the front wheels **46**/rear wheels **47** acquired by the pneumatic sensor **52**, a vehicle speed signal acquired by the vehicle speed sensor **53**, an acceleration signal acquired by the acceleration sensor **54**, a depressing amount signal of the accelerator pedal **43** acquired by the accelerator pedal sensor **55**, a depressing amount signal of the brake pedal **44** acquired by the brake pedal sensor **56**, an operation signal of the shift lever **45** acquired by the shift lever sensor **57**, and a detection signal

for detecting an obstruction, a vehicle, a pedestrian, and the like acquired by the object detection sensor **58**.

[0284] The information service section **59** includes various devices for providing (outputting) various pieces of information such as drive information, traffic information, and entertainment information, such as a car navigation system, an audio system, a speaker, a display, a television, and a radio, and one or more ECUs that control these devices. The information service section **59** provides various pieces of information/services (for example, multimedia information/multimedia service) for an occupant of the vehicle **40**, using information acquired from an external apparatus via the communication module **60** and the like.

[0285] The information service section **59** may include an input device (for example, a keyboard, a mouse, a microphone, a switch, a button, a sensor, a touch panel, and the like) for receiving input from the outside, or may include an output device (for example, a display, a speaker, an LED lamp, a touch panel, and the like) for implementing output to the outside.

[0286] A driving assistance system section **64** includes various devices for providing functions for preventing an accident and reducing a driver's driving load, such as a millimeter wave radar, Light Detection and Ranging (LiDAR), a camera, a positioning locator (for example, a Global Navigation Satellite System (GNSS) and the like), map information (for example, a high definition (HD) map, an autonomous vehicle (AV) map, and the like), a gyro system (for example, an inertial measurement apparatus (inertial measurement unit (IMU)), an inertial navigation apparatus (inertial navigation system (INS)), and the like), an artificial intelligence (AI) chip, and an AI processor, and one or more ECUs that control these devices. The driving assistance system section **64** transmits and receives various pieces of information via the communication module **60**, and implements a driving assistance function or an autonomous driving function.

[0287] The communication module **60** can communicate with the microprocessor **61** and the constituent elements of the vehicle **40** via the communication port **63**. For example, via the communication port **63**, the communication module **60** transmits and receives data (information) to and from the driving section **41**, the steering section **42**, the accelerator pedal **43**, the brake pedal **44**, the shift lever **45**, the right and left front wheels **46**, the right and left rear wheels **47**, the axle **48**, the microprocessor **61** and the memory (ROM, RAM) **62** in the electronic control section **49**, and the various sensors **50** to **58**, which are included in the vehicle **40**.

[0288] The communication module **60** can be controlled by the microprocessor **61** of the electronic control section **49**, and is a communication device that can perform communication with an external apparatus. For example, the communication module **60** performs transmission and reception of various pieces of information to and from the external apparatus via radio communication. The communication module **60** may be either inside or outside the electronic control section **49**. The external apparatus may be, for example, the base station **10**, the user terminal **20**, or the like described above. The communication module **60** may be, for example, at least one of the base station **10** and the user terminal **20** described above (may function as at least one of the base station **10** and the user terminal **20**).

[0289] The communication module **60** may transmit at least one of signals from the various sensors **50** to **58** described above input to the electronic control section **49**, information obtained based on the signals, and information based on an input from the outside (a user) obtained via the information service section **59**, to the external apparatus via radio communication. The electronic control section **49**, the various sensors **50** to **58**, the information service section **59**, and the like may be referred to as input sections that receive input. For example, the PUSCH transmitted by the communication module **60** may include information based on the input.

[0290] The communication module **60** receives various pieces of information (traffic information, signal information, inter-vehicle distance information, and the like) transmitted from the external apparatus, and displays the various pieces of information on the information service section **59** included in the vehicle. The information service section **59** may be referred to as an output section that outputs information (for example, outputs information to devices, such as a display and a speaker, based on the PDSCH received by the communication module **60** (or data/information decoded from the PDSCH)).

[0291] The communication module **60** stores the various pieces of information received from the external apparatus in the memory **62** that can be used by the microprocessor **61**. Based on the pieces of information stored in the memory **62**, the microprocessor **61** may perform control of the driving section **41**, the steering section **42**, the accelerator pedal **43**, the brake pedal **44**, the shift lever **45**, the right and left front wheels **46**, the right and left rear wheels **47**, the axle **48**, the various sensors **50** to **58**, and the like included in the vehicle **40**.

[0292] Furthermore, the base station in the present disclosure may be interpreted as a user terminal. For example, each aspect/embodiment of the present disclosure may be applied to the structure that replaces a communication between a base station and a user terminal with a communication between a plurality of user terminals (for example, which may be referred to as "Device-to-Device (D2D)," "Vehicle-to-Everything (V2X)," and the like). In this case, user terminals **20** may have the functions of the base stations **10** described above. The words "uplink" and "downlink" may be interpreted as the words corresponding to the terminal-to-terminal communication (for example, "sidelink"). For example, an uplink channel, a downlink channel, and so on may be interpreted as a sidelink channel.

[0293] Likewise, the user terminal in the present disclosure may be interpreted as base station. In this case, the base station **10** may have the functions of the user terminal **20** described above.

[0294] Actions which have been described in the present disclosure to be performed by a base station may, in some cases, be performed by upper nodes of the base station. In a network including one or a plurality of network nodes with base stations, it is clear that various operations that are performed to communicate with terminals can be performed by base stations, one or more network nodes (for example, Mobility Management Entities (MMEs), Serving-Gateways (S-GWs), and so on may be possible, but these are not limiting) other than base stations, or combinations of these.

[0295] The aspects/embodiments illustrated in the present disclosure may be used individually or in combinations, which may be switched depending on the mode of imple-

mentation. The order of processes, sequences, flowcharts, and so on that have been used to describe the aspects/embodiments in the present disclosure may be re-ordered as long as inconsistencies do not arise. For example, although various methods have been illustrated in the present disclosure with various components of steps in exemplary orders, the specific orders that are illustrated herein are by no means limiting.

[0296] The aspects/embodiments illustrated in the present disclosure may be applied to Long Term Evolution (LTE), LTE-Advanced (LTE-A), LTE-Beyond (LTE-B), SUPER 3G, IMT-Advanced, 4th generation mobile communication system (4G), 5th generation mobile communication system (5G), 6th generation mobile communication system (6G), xth generation mobile communication system (xG (where x is, for example, an integer or a decimal)), Future Radio Access (FRA), New-Radio Access Technology (RAT), New Radio (NR), New radio access (NX), Future generation radio access (FX), Global System for Mobile communications (GSM (registered trademark)), CDMA 2000, Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi (registered trademark)), IEEE 802.16 (WiMAX (registered trademark)), IEEE 802.20, Ultra-WideBand (UWB), Bluetooth (registered trademark), systems that use other adequate radio communication methods and next-generation systems that are enhanced, modified, created, or defined based on these. A plurality of systems may be combined (for example, a combination of LTE or LTE-A and 5G, and the like) and applied.

[0297] The phrase "based on" (or "on the basis of") as used in the present disclosure does not mean "based only on" (or "only on the basis of"), unless otherwise specified. In other words, the phrase "based on" (or "on the basis of") means both "based only on" and "based at least on" ("only on the basis of" and "at least on the basis of").

[0298] Reference to elements with designations such as "first," "second," and so on as used in the present disclosure does not generally limit the quantity or order of these elements. These designations may be used in the present disclosure only for convenience, as a method for distinguishing between two or more elements. Thus, reference to the first and second elements does not imply that only two elements may be employed, or that the first element must precede the second element in some way.

[0299] The term "judging (determining)" as in the present disclosure herein may encompass a wide variety of actions. For example, "judging (determining)" may be interpreted to mean making "judgments (determinations)" about judging, calculating, computing, processing, deriving, investigating, looking up, search and inquiry (for example, searching a table, a database, or some other data structures), ascertaining, and so on.

[0300] Furthermore, "judging (determining)" may be interpreted to mean making "judgments (determinations)" about receiving (for example, receiving information), transmitting (for example, transmitting information), input, output, accessing (for example, accessing data in a memory), and so on.

[0301] In addition, "judging (determining)" as used herein may be interpreted to mean making "judgments (determinations)" about resolving, selecting, choosing, establishing, comparing, and so on. In other words, "judging (determining)" may be interpreted to mean making "judgments (determinations)" about some action.

[0302] In addition, "judging (determining)" may be interpreted as "assuming," "expecting," "considering," and the like.

[0303] "The maximum transmit power" according to the present disclosure may mean a maximum value of the transmit power, may mean the nominal maximum transmit power (the nominal UE maximum transmit power), or may mean the rated maximum transmit power (the rated UE maximum transmit power).

[0304] The terms "connected" and "coupled," or any variation of these terms as used in the present disclosure mean all direct or indirect connections or coupling between two or more elements, and may include the presence of one or more intermediate elements between two elements that are "connected" or "coupled" to each other. The coupling or connection between the elements may be physical, logical, or a combination thereof. For example, "connection" may be interpreted as "access."

[0305] In the present disclosure, when two elements are connected, the two elements may be considered "connected" or "coupled" to each other by using one or more electrical wires, cables and printed electrical connections, and, as some non-limiting and non-inclusive examples, by using electromagnetic energy having wavelengths in radio frequency regions, microwave regions, (both visible and invisible) optical regions, or the like.

[0306] In the present disclosure, the phrase "A and B are different" may mean that "A and B are different from each other." Note that the phrase may mean that "A and B are each different from C." The terms "separate," "be coupled," and so on may be interpreted similarly to "different."

[0307] When terms such as "include," "including," and variations of these are used in the present disclosure, these terms are intended to be inclusive, in a manner similar to the way the term "comprising" is used. Furthermore, the term "or" as used in the present disclosure is intended to be not an exclusive disjunction.

[0308] For example, in the present disclosure, when an article such as "a," "an," and "the" in the English language is added by translation, the present disclosure may include that a noun after these articles is in a plural form.

[0309] In the present disclosure, "equal to or smaller than," "smaller than," "equal to or larger than," "larger than," "equal to," and the like may be interchangeably interpreted. In the present disclosure, words such as "good," "poor," "large," "small," "high," "low," "early," "late," "wide," "narrow," and the like may be interchangeably interpreted irrespective of positive degree, comparative degree, and superlative degree. In the present disclosure, expressions obtained by adding "i-th" (i is any integer) to words such as "good," "poor," "large," "small," "high," "low," "early," "late," "wide," "narrow," and the like may be interchangeably interpreted irrespective of positive degree, comparative degree, and superlative degree (for example, "highest" may be interpreted as "i-th highest," and vice versa).

[0310] In the present disclosure, "of," "for," "regarding," "related to," "associated with," and the like may be interchangeably interpreted.

[0311] Now, although the invention according to the present disclosure has been described in detail above, it should be obvious to a person skilled in the art that the invention according to the present disclosure is by no means limited to the embodiments described in the present disclosure. The

invention according to the present disclosure can be implemented with various corrections and in various modifications, without departing from the spirit and scope of the invention defined by the recitations of claims. Consequently, the description of the present disclosure is provided only for the purpose of explaining examples, and should by no means be construed to limit the invention according to the present disclosure in any way.

1. A terminal comprising:

a receiving section that receives a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and

a control section that applies, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band.

2. The terminal according to claim **1**, wherein

when a second configuration of one or more TCI states to be applied to the plurality of types of signals is absent for the second BWP in the second CC, the control section applies the one or more TCI states to the second BWP.

3. The terminal according to claim **1**, wherein

when a BWP-ID or a cell ID is not configured in quasi co-location (QCL) information in a second configuration of one or more TCI states to be applied to the plurality of types of signals, for the second BWP in the second CC, the second configuration includes a resource ID of a channel state information reference signal or a synchronization signal block.

4. The terminal according to claim **1**, wherein

the receiving section receives a list of CCs for simultaneous TCI state update and receives a medium access control (MAC) control element (CE) indicating one TCI state of the one or more TCI states.

5. A radio communication method for a terminal, the radio communication method comprising:

receiving a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and

applying, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band.

6. A base station comprising:

a transmitting section that transmits a first configuration of one or more transmission configuration indication (TCI) states to be applied to a plurality of types of signals for a first bandwidth part (BWP) in a first component carrier (CC) in a specific band; and

a control section that applies, when a condition is satisfied, the one or more TCI states to a second BWP in a second CC in the specific band.

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