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TERMINAL, RADIO COMMUNICATION METHOD, AND BASE STATION

Abstract

A terminal according to an aspect of the present disclosure includes a receiving section that receives information regarding more than one power control parameter set for operation in a frequency range 1, and a control section that determines, in a case where an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, a value of a closed loop index for transmit power control for a Physical Uplink Control Channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets. According to an aspect of the present disclosure, parameters for transmit power control for PUCCH/PUSCH can be appropriately determined.

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Background/Summary

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] In NR, it has been studied that one or a plurality of transmission/reception points (TRPs) (multiple TRPs (MTRPs)) perform downlink (DL) transmission to a terminal (user terminal, User Equipment (UE)). It has also been studied that the UE performs uplink (UL) transmission to one or a plurality of TRPs.

[0006] It has been studied that a future radio system (for example, Rel-17 NR) supports, for an MTRP, UL (for example, Physical Uplink Shared Channel (PUSCH)) power control per TRP in a frequency range 1 (FR1). It has also been studied that a future radio system (for example, Rel-17 NR) supports, for an MTRP, an indication of two spatial relations for one Physical Uplink Control Channel (PUCCH) resource.

[0007] However, as to transmit power control for PUCCH/PUSCH in the cases described above, parameters for determination of transmit power cannot be determined using existing standards. Unless a method for determining such parameters is clearly defined, communication using PUCCH/PUSCH is not performed appropriately, so that the communication throughput, the communication quality, and so on possibly deteriorates.

[0008] Thus, one of the objects of the present disclosure is to provide a terminal, a radio communication method, and a base station that can appropriately determine parameters for transmit power control for PUCCH/PUSCH.

Solution to Problem

[0009] A terminal according to an aspect of the present disclosure includes a receiving section that receives information regarding more than one power control parameter set for operation in a frequency range 1, and a control section that determines, in a case where an activation command indicating one or two power control parameter sets of the more than one power control parameter

set is received, a value of a closed loop index for transmit power control for a Physical Uplink Control Channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.

Advantageous Effects of Invention

[0010] According to an aspect of the present disclosure, parameters for transmit power control for PUCCH/PUSCH can be appropriately determined.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0011] FIG. **1** is a diagram illustrating an example of PUCCH/PUSCH transmission for MTRP.

[0012] FIG. **2** is a diagram illustrating an example of a schematic configuration of a radio communication system according to an embodiment.

[0013] FIG. **3** is a diagram illustrating an example of a configuration of a base station according to an embodiment.

[0014] FIG. **4** is a diagram illustrating an example of a configuration of a user terminal according to an embodiment.

[0015] FIG. **5** is a diagram illustrating an example of a hardware configuration of a base station and a user terminal according to an embodiment.

[0016] FIG. **6** is a diagram illustrating an example of a vehicle according to an embodiment.

DESCRIPTION OF EMBODIMENTS

(Transmit Power Control)

[0017] A description is given of transmit power control for a Physical Uplink Shared Channel (PUSCH) and a Physical Uplink Control Channel (PUCCH) in Rel-16 NR.

<Transmit Power Control for PUSCH>

[0018] In Rel-16 NR, transmit power for a PUSCH is controlled based on a TPC command for the PUSCH (also referred to as a TPC command value, an increase/decrease value, a correction value, and so on) The TPC command for the PUSCH is indicated by a value of a transmit power control (TPC) command field in a downlink control information (DCI) format or DCI format 2_2 for scheduling PUSCH transmission.

[0019] For example, in a case where a UE transmits a PUSCH on an active uplink bandwidth part (UL BWP) b of a carrier f of a serving cell c by using a power control adjustment state having a parameter set with an index j (open-loop parameter set) and an index l, the UE determines transmit power for PUSCH P.sub.PUSCH,b,f,c(i,j,q.sub.d,l) in a PUSCH transmission occasion i by the following Expression (1).

[Math. 1]

[0020] Note that, in the present disclosure, the power control adjustment state may be referred to as a value based on a TPC command of the power control adjustment state index l, a cumulative value of the TPC command, a value corresponding to a closed loop, or the like. As to l, it may be referred to as a closed loop index.

[0021] The power control adjustment state may be configured to have a plurality of states (for example, two states) or a single state according to a higher layer parameter (twoPUSCH-PC-AdjustmentStates for PUSCH, and twoPUCCH-PC-AdjustmentStates for PUCCH). In a case where a plurality of power control adjustment states is configured, one of the plurality of power control adjustment states may be identified using the index l (for example, lϵ{0,1}).

[0022] The PUSCH transmission occasion i is a period of transmission of the PUSCH and may be configured using, for example, one or more symbols or one or more slots.

[0023] P.sub.CMAX,f,c(i) is, for example, transmit power for a UE (also referred to as maximum transmit power, UE maximum output power, or the like) configured for the carrier f of the serving

cell c in the transmission occasion i. Note that min(. . .) represents the minimum value of the values in the parentheses.
[0024] P.sub.O_PUSCH,b,f,c(j) is, for example, a parameter (also referred to as, for example, a parameter related to transmit power offset, transmit power offset P0, a target reception power parameter, or the like) related to target reception power configured for the active UL BWP b of the carrier f of the serving cell c in the transmission occasion i.
[0025] M.sup.PUSCH.sub.RB,b,f,c(i) is the number of resource blocks (bandwidths) allocated to the PUSCH for the transmission occasion i in the active UL BWP b of the carrier f of the serving cell c and a subcarrier spacing μ, for example, α.sub.b,f,c(j) is a value provided from the higher layer parameter (also referred to as msg3-Alpha, p0-PUSCH-Alpha, a fractional factor, or the like, for example).
[0026] PL.sub.b,f,c(q.sub.d) is pathloss (downlink pathloss estimate [dB], pathloss compensation) calculated by a user terminal using an index q.sub.d to a reference signal (RS), a pathloss reference RS, an RS for pathloss reference, a DL-RS for pathloss measurement, PUSCH-PathlossReferenceRS) for downlink BWP associated with the active UL BWP b of the carrier f of the serving cell c, for example.
[0027] In a case where the UE is not given a pathloss reference RS (for example, PUSCH-PathlossReferenceRS), or, alternatively, in a case where the UE is not given a dedicated higher layer parameter, the UE calculates PL.sub.b,f,c(q.sub.d) using an RS resource from a synchronization signal (SS)/physical broadcast channel (PBCH) block (SS block (SSB)) used for acquiring a Master Information Block (MIB).
[0028] In a case where the UE is configured with RS resource indices of a number corresponding to a value up to a maximum number of pathloss reference RSs (for example, maxNrofPUSCH-PathlossReferenceRSs) and each set of RS configurations for the RS resource indices using the pathloss reference RSs, the set of the RS resource indices includes one or both of an SS/PBCH block index set and a channel state information (CSI)-reference signal (RS) resource index set. The UE identifies an RS resource index q.sub.d in the RS resource index set.
[0029] In a case where PUSCH transmission is scheduled by Random Access Response (PAR) UL grant, the UE uses the RS resource index q.sub.d that is the same as that for corresponding PRACH transmission.
[0030] In a case where the UE is given a configuration of power control over the PUSCH using a sounding reference signal (SRS) resource indicator (SRI) (for example, SRI-PUSCH-PowerControl), and is also given a value of an ID of the pathloss reference RS that is equal to or greater than 1, the UE acquires mapping between a set of values for an SRI field in DCI format 0_1 and a set of ID values of the pathloss reference RS from higher layer signaling (for example, sri-PUSCH-PowerControl-Id in SRI-PUSCH-PowerControl). The UE determines the RS resource index q.sub.d using an ID of the pathloss reference RS mapped on an SRI field value in DCI format 0_1 for scheduling the PUSCH.
[0031] In a case where PUSCH transmission is scheduled using DCI format 0_0, and further, in a case where the UE is given a spatial setting using PUCCH spatial relation information (PUCCH-SpatialRelationInfo) for one PUCCH resource having the lowest index for active UL BWP b of each carrier f and serving cell c, the UE uses the same RS resource index q.sub.d as that for PUCCH transmission in that PUCCH resource.
[0032] In a case where PUSCH transmission is scheduled using DCI format 0_0, and further, in a case where the UE is not given a spatial setting for PUCCH transmission, or, alternatively, in a case where PUSCH transmission is scheduled using DCI format 0_1 having no SRI field, or, yet alternatively, in a case where the UE is not given a configuration of power control over the PUSCH using an SRI, the UE uses the RS resource index q.sub.d having an ID of the pathloss reference RS equal to zero.
[0033] In a case where a configured grant configuration (for example, ConfiguredGrantConfig)

includes a specific parameter (for example, rrc-ConfiguredUplinkGrant) in response to PUSCH transmission configured using the configured grant configuration, the UE is given the RS resource index q.sub.d from a pathloss reference index (for example, pathlossReferenceIndex) in the specific parameter.

[0034] In a case where the configured grant configuration does not include a specific parameter in response to PUSCH transmission configured using the configured grant configuration, the UE determines the RS resource index q.sub.d from an ID value of the pathloss reference RS mapped on an SRI field in a DCI format for activating the PUSCH transmission. In a case where the DCI format does not include an SRI field, the UE determines the RS resource index q.sub.d having an ID of the pathloss reference RS equal to zero.

[0035] As to Δ.sub.TF,b,f,c(i), it is a transmission power adjustment component (offset, transmission format compensation) for the UL BWP b of the carrier f of the serving cell c.

[0036] f.sub.b,f,c(i,l) is a PUSCH power control adjustment state with respect to the active UL BWP b of the carrier f of the serving cell c in the transmission occasion i. f.sub.b,f,c(i,l) is based on δ.sub.PUSCH,b,f,c(i,l).

[0037] δ.sub.PUSCH,b,f,c(i,l) is a TPC command value included in a DCI format (for example, DCI format 0_0/0_1/0_2) for scheduling the PUSCH transmission occasion i on the active UL BWP b of the carrier f of the serving cell c, or, alternatively, δ.sub.PUSCH,b,f,c(i,l) is a TPC command value coded after being coupled with a different TPC command in DCI format 2_2 having cyclic redundancy check (CRC) scrambled using a specific radio network temporary identifier (RNTI) (for example, TPC-PUSCH-RNTI).

[0038] The index l may be given from a higher layer parameter powerControlLoopToUse, may be determined based on an SRI field in the DCI format for scheduling the PUSCH, or may be given from a closed loop indicator field in DCI format 2_2.

[0039] In RRC information element (IE), PUSCH configuration (PUSCH-Config) includes a PUSCH power control information element (PUSCH-PowerControl) and a PUSCH power control information element for Rel. 16 (PUSCH-PowerControl-v1610). The PUSCH power control information element includes a list (p0-AlphaSets) of P0-Alpha set for PUSCH (P0-PUSCH-AlphaSet) and a list of a PUSCH pathloss reference RS (PUSCH-PathlossReferenceRS). The P0-Alpha set for PUSCH includes a P0-Alpha set ID for PUSCH (P0-PUSCH-AlphaSetId), P0, and Alpha. The PUSCH pathloss reference RS includes a PUSCH pathloss reference RS-ID (PUSCH-PathlossReferenceRS-Id) and a reference signal (referenceSignal, SSB index, or non-zero-power (NZP)-CSI-RS resource ID).

[0040] The PUSCH power control information element for Rel. 16 includes a list (P0-PUSCH-SetList-r16) of a P0 set for Rel-16 PUSCH (P0-PUSCH-Set-r16). The P0 set for Rel-16 PUSCH includes a P0 set ID for Rel-16 PUSCH (P0-PUSCH-SetId-r16) and a list of P0 for Rel-16 PUSCH (P0-PUSCH-r16).

<Transmit Power Control for PUCCH>

[0041] According to Rel-16 NR, transmit power for a PUCCH is controlled based on a TPC command for the PUCCH. The TPC command for the PUCCH is indicated by a value of a TPC command field in a DCI format or DCI format 2_2 for scheduling downlink shared channel (Physical Downlink Shared Channel (PDSCH)) transmission.

[0042] For example, in a case where a UE transmits a PUCCH on an active UL BWP b of a carrier f of a primary cell c by using a PUCCH power control adjustment state having an index l, the UE determines transmit power for PUCCH P.sub.PUCCH,b,f,c(i,q.sub.u,q.sub.d,l) in a PUCCH transmission occasion i by the following Expression (2).

[Math. 2]

[0043] The PUCCH transmission occasion i is a period of transmission of the PUCCH and may be configured using, for example, one or more symbols or one or more slots.

[0044] P.sub.CMAX,f,c(i) is, for example, transmit power for a UE (also referred to as maximum

transmit power, UE maximum output power, or the like) configured for the carrier f of the primary cell c in the transmission occasion i.
[0045] P.sub.O_PUCCH,b,f,c(q.sub.u) is, for example, a parameter (also referred to as, for example, a parameter related to transmit power offset, transmit power offset P0, or a target reception power parameter) related to target reception power configured for the active UL BWP b of the carrier f of the primary cell c in the transmission occasion i. q.sub.u may be a P0 ID for PUCCH (p0-PUCCH-Id) showing P0 for PUCCH (P0-PUCCH) in a P0 set for PUCCH (p0-Set).
[0046] M.sup.PUCCH.sub.RB,b,f,c(i) is the number of resource blocks (bandwidths) allocated to the PUCCH for the transmission occasion i in the active UL BWP b of the carrier f of the primary cell c and a subcarrier spacing μ, for example.
[0047] PL.sub.b,f,c(q.sub.d) is pathloss (downlink pathloss estimate [dB], pathloss compensation) calculated by a UE using an index q.sub.d to a reference signal (a pathloss reference RS, an RS for pathloss reference, a DL-RS for pathloss measurement, PUCCH-PathlossReferenceRS) for downlink BWP associated with the active UL BWP b of the carrier f of the primary cell c, for example.
[0048] If the UE is not given a pathloss reference RS (pathlossReferenceRSs), or, alternatively, before the UE is given a dedicated higher layer parameter, the UE calculates pathloss PL.sub.b,f,c(q.sub.d) using an RS resource acquired from an SS/PBCH block used for the UE to acquire an MIB.
[0049] If the UE is given pathloss reference RS information (pathlossReferenceRSs in PUCCH power control information (PUCCH-PowerControl)), and further, if the UE is not given PUCCH spatial relation information (PUCCH-SpatialRelationInfo), then the UE acquires a value of a reference signal (referencesignal) in the pathloss reference RS for PUCCH from a pathloss reference RS-ID for PUCCH (PUCCH-PathlossReferenceRS-Id) having an index 0 in the pathloss reference RS information for PUCCH (PUCCH-PathlossReferenceRS). A resource for this reference signal is either on the identical primary cell, or, alternatively on a serving cell indicated in a value of pathloss reference linking information (pathlossReferenceLinking) if such information is given.
[0050] As to Δ.sub.F_PUCCH(F), it is a higher layer parameter given per PUCCH format. As to Δ.sub.TF,b,f,c(i), it is a transmission power adjustment component (offset) for the UL BWP b of the carrier f of the primary cell c.
[0051] g.sub.b,f,c(i,l) is a value based on a TPC command of the power control adjustment state index l on the active UL BWP of the carrier f of the primary cell c and the transmission occasion i (PUCCH power adjustment state). For example, g.sub.b,f,c(i,l) is based on δ.sub.PUCCH,b,f,c(i,l).
[0052] Here, δ.sub.PUCCH,b,f,c(i,l) is a TPC command value and is included in a DCI format (for example, DCI format 1_0/1_1/1_2) for scheduling PDSCH reception detected by the UE for the PUCCH transmission occasion i on the active UL BWP b of the carrier f of the primary cell c, or, alternatively, is coded after being coupled with a different TPC command in DCI format 2_2 having CRC scrambled using a specific RNTI (for example, TPC-PUSCH-RNTI).
[0053] If the UE is given information showing the use of two PUCCH power control adjustment states (twoPUCCH-PC-AdjustmentStates) and PUCCH spatial relation information (PUCCH-SpatialRelationInfo), then 1 is equal to {0,1}. If the UE is not given the information showing the use of the two PUCCH power control adjustment states or the PUCCH spatial relation information, then l is equal to 0.
[0054] In a case where the UE acquires a TPC command value from a DCI format for scheduling the PDSCH reception, and further, in a case where the UE is given the PUCCH spatial relation information (PUCCH-SpatialRelationInfo), the UE may acquire mapping between a set of a PUCCH spatial relation information ID (pucch-SpatialRelationInfoId) value and a closed loop index (closedLoopIndex, power adjustment state index l) using an index given from a P0 ID for PUCCH (p0-PUCCH-Id in p0-Set in PUCCH-PowerControl in PUCCH-Config). In a case where

the UE receives an activation command including a value of the PUCCH spatial relation information ID, the UE determines a value of the closed loop index providing a value of l through a link to the corresponding P0 ID for PUCCH.

[0055] In the RRC information element (IE), a PUCCH power control information element (PUCCH-PowerControl) includes a P0 set (p0-Set) that is a set of P0 for PUCCH (P0-PUCCH) and the pathloss reference RS (pathlossReferenceRSs) that is a set of a PUCCH pathloss reference RS (PUCCH-PathlossReferenceRS). The P0 for PUCCH includes a P0 ID for PUCCH (P0-PUCCH-Id) and a P0 value for PUCCH (p0-PUCCH-Value). The PUCCH pathloss reference RS includes a PUCCH pathloss reference RS-ID (PUCCH-PathlossReferenceRS-Id) and a reference signal (referenceSignal, SSB index, or NZP-CSI-RS resource ID).

(Multiple TRPs)

[0056] In NR, it has been studied that one or a plurality of transmission/reception points (TRPs) (multiple TRPs (MTRPs)) perform DL transmission to a UE by using one or a plurality of panels (multiple panels). It has also been studied that a UE performs UL transmission to one or a plurality of TRPs.

[0057] Note that the plurality of TRPs may correspond to the same cell identifier (ID), or may correspond to different cell IDs. The cell ID may be a physical cell ID (for example, PCI), or may be a virtual cell ID.

[0058] FIG. **1** is a diagram illustrating an example of PUCCH/PUSCH transmission for MTRP. A UE can perform the PUCCH/PUSCH transmission to two base stations (BSs) (TRPs). Note that the transmission to the two TRPs may be performed based on one or two DCIs.

[0059] In the meantime, it has been studied that a future radio communication system (for example, Rel-17 NR) supports, for an MTRP, UL power control per TRP in a frequency range 1 (FR1). The power control per TRP may be achieved by configuring, in the UE, more than one power control parameter set for operation in the FR1, and linking the power control parameter sets to the PUCCH resource.

[0060] Note that, in the present disclosure, the power control parameter may be at least one of P.sub.CMAX,f,c, Maximum Power Reduction (MPR), P-MPR, additional maximum power reduction (Additional MPR (A-MPR)), ΔTc, P.sub.0, alpha, a pathloss reference signal (PL-RS) ID, and a closed loop index (l). The power control parameter set may mean a set including one or more power control parameters. In the present disclosure, the power control parameter set, the power control set, and the power control set information may be interchangeably interpreted.

[0061] For example, it has been studied that one or two power control parameter set IDs corresponding to a certain PUCCH resource ID are indicated (updated) based on an MAC CE (for example, may be referred to as PUCCH power control set update for multiple TRP PUCCH repetition MAC CE).

[0062] However, studies have not yet advanced concerning the method for determining a value of l for a case where more than one power control parameter set for operation in the FR1 is configured.

[0063] It has also been studied that a future radio communication system (for example, Rel-17 NR) supports, for an MTRP, the indication of two spatial relations for one PUCCH resource. For example, it has been studied that a plurality of spatial relation information IDs (for example, PUCCH-SpatialRelationInfoId (or PUCCH-SpatialRelationInfoId-r16)) corresponding to a certain PUCCH resource ID is indicated based on an MAC CE (for example, may be referred to as PUCCH spatial relation activation/deactivation for multiple TRP PUCCH repetition MAC CE).

[0064] Here, as described above, the specifications of Rel. 16 defines the following: in a case where PUSCH transmission is scheduled using DCI format 0_0, and further, in a case where the UE is given a spatial setting using PUCCH spatial relation information (PUCCH-SpatialRelationInfo) for one PUCCH resource having the lowest index for active UL BWP b of each carrier f and serving cell c, the UE uses the same RS resource index q.sub.d as that for PUCCH transmission in that PUCCH resource (in other words, as that for PUCCH transmission in

that PUCCH resource). However, in a case where two spatial relations are indicated for one PUCCH resource, it is impossible to determine q.sub.d for PUSCH transmission in accordance with the specifications.

[0065] Unless the method for determining the value of l for transmit power control for PUCCH and the method for determining q.sub.d for transmit power control for PUSCH are clearly specified, communication using PUCCH/PUSCH is not performed appropriately, so that the communication throughput, the communication quality, and so on possibly deteriorates.

[0066] In light of the above, the inventors of the present invention came up with the idea of a method for appropriately determining parameters for transmit power control for PUCCH/PUSCH.

[0067] Hereinafter, embodiments according to the present disclosure are detailed with reference to the drawings. The radio communication methods according to the embodiments may be applied alone or in combination.

[0068] 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".

[0069] In the present disclosure, terms such as activate, deactivate, specify (or indicate), select, configure, update, determine, and so on may be interchangeably interpreted. In the present disclosure, terms such as support, control, controllable, operate, operable, and so on may be interchangeably interpreted.

[0070] 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 so on 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 so on may be interchangeably interpreted.

[0071] In the present disclosure, the higher layer signaling may be, for example, any one of Radio Resource Control (RRC) signaling, Medium Access Control (MAC) signaling, broadcast information, and so on, or a combination thereof.

[0072] 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.

[0073] In the present disclosure, physical layer signaling may be, for example, downlink control information (DCI), uplink control information (UCI), or the like.

[0074] In the present disclosure, an index, an identifier (ID), an indicator, and a resource ID may be interchangeably interpreted. In the present disclosure, a sequence, a list, a set, a group, a category, a cluster, a subset, or the like may be interchangeably interpreted.

[0075] 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 (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 (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 Transmission Configuration Indication state (TCI state) of a downlink (DL TCI state), a TCI state of an uplink (UL TCI state), a unified TCI state, a common TCI state, a quasi-colocation (Quasi-Co-Location (QCL)), a QCL assumption, and the like may be interchangeably interpreted.

[0076] Further, 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 “spatial relation”, “spatial setting”, a “set of spatial relation information”, “one piece or a plurality of pieces of spatial relation information”, and so on. The TCI state and the TCI may be interchangeably interpreted.

(Radio Communication Method)

First Embodiment

[0077] The first embodiment relates to a method for determining “l” for power control for PUCCH.

[0078] In the first embodiment, if a UE is given information showing the use of two PUCCH power control adjustment states (twoPUCCH-PC-AdjustmentStates) and PUCCH spatial relation information (PUCCH-SpatialRelationInfo), or, alternatively, in a case where more than one power control parameter set for operation in an FR1 is configured, then l may be equal to {0, 1}. If the UE is not given the information showing the use of the two PUCCH power control adjustment states, the PUCCH spatial relation information, or more than one power control parameter set, then l may be equal to 0.

[0079] In the first embodiment, in a case where the UE acquires a TPC command value from a DCI format associated with PUCCH transmission, and further, in a case where the UE is given the PUCCH spatial relation information (PUCCH-SpatialRelationInfo), the UE may acquire mapping between a set of a value of a PUCCH spatial relation information ID (pucch-SpatialRelationInfoId) and a closed loop index (closedLoopIndex, power adjustment state index l) using an index given from a P0 ID for PUCCH (p0-PUCCH-Id in p0-Set in PUCCH-PowerControl in PUCCH-Config). In a case where the UE receives an activation command including a value of the PUCCH spatial relation information ID, the UE may determine a value of the closed loop index providing a value of l through a link to the corresponding P0 ID for PUCCH.

[0080] In the first embodiment, in a case where the UE acquires a TPC command value from a DCI format associated with PUCCH transmission, and further, in a case where the UE is given more than one power control parameter set for operation in the FR1, and yet further, in a case where the UE receives an activation command indicating one or two power control parameter sets of the more than one power control parameter set (for a PUCCH resource used for the PUCCH transmission), the UE determines a value of l based on a value of a closed loop index in that one or two power control parameter sets (in other words, determines a value of the closed loop index providing the value of l in that one or two power control parameter sets.

[0081] Here, the activation command indicating the power control parameter set (for example, PUCCH power control set update for MTRP PUCCH repetition MAC CE) may indicate the correspondence relation between one PUCCH resource ID and one or two power control parameter set IDs in a certain BWP of a certain serving cell.

[0082] The power control parameter set may be configured in the UE by the higher layer parameter PUCCH-PowerControlSetInfo-r17 indicating PUCCH power control set information. One or a plurality of power control parameter sets may be configured in the UE by a list (powerControlSetInfoToAddModList-r17) including one or more PUCCH-PowerControlSetInfo-r17.

[0083] The PUCCH-PowerControlSetInfo-r17 may include a power control set information ID (PUCCH-PowerControlSetInfoId-r17), a P0 ID for PUCCH (P0-PUCCH-Id), a PUCCH closed loop index (pucch-ClosedLoopIndex-r17, and the value is i0 (corresponding to l=0) or i1 (corresponding to l=1), and a PUCCH PL-RS ID (PUCCH-PathlossReferenceRS-Id). Parameters included in the same PUCCH power control set information are associated with one another.

[0084] The UE may determine the value of l corresponding to the power control parameter set based on the PUCCH closed loop index related to the power control set information ID indicating that power control parameter set.

[0085] Note that, in the first embodiment, transmit power for PUCCH

P.sub.PUCCH,b,f,c(i,q.sub.u,q.sub.d,l) in the PUCCH transmission occasion i may be determined by using the Expression (2) above.

[0086] According to the first embodiment described above, the UE can appropriately determine parameters for transmit power control for PUCCH.

Second Embodiment

[0087] The second embodiment relates to a method for determining q.sub.d for power control for PUSCH.

[0088] In the second embodiment, in a case where PUSCH transmission is scheduled using DCI format 0_0, a UE may perform the following control:

In a case where two spatial settings are activated based on PUCCH spatial relation information (PUCCH-SpatialRelationInfo) for one PUCCH resource having the lowest index for active UL BWP b of each carrier f and serving cell c, the UE uses the RS resource index q.sub.d that is the same as that for PUCCH transmission (in other words, the same as that for that PUCCH transmission) using a spatial setting from the two spatial settings with the lowest index in that PUCCH resource having the lowest index; and

Otherwise, in a case where the UE is given a spatial setting using PUCCH spatial relation information (PUCCH-SpatialRelationInfo) for one PUCCH resource having the lowest index for active UL BWP b of each carrier f and serving cell c, the UE uses the same RS resource index q.sub.d as that for PUCCH transmission in that PUCCH resource (in other words, the same as that for that PUCCH transmission).

[0089] For example, in the second embodiment, a case is considered in which two spatial settings of a spatial relation ID (PUCCH-SpatialRelationInfoId)=1 and a spatial relation ID=2 are activated for the UE, for one PUCCH resource (for example, a PUCCH resource corresponding to PUCCH-ResourceId=0) having the lowest index for active UL BWP b of each carrier f and serving cell c. In this case, in a case where PUSCH transmission is scheduled using DCI format 0_0, the UE uses the same RS resource index q.sub.d in the PUCCH resource corresponding to PUCCH resource ID=0 as that for PUCCH transmission using a spatial relation ID=1 for power control for the PUSCH transmission. Note that the RS resource index q.sub.d may correspond to the SSB index/NZP-CSI-RS resource ID/SRS resource ID indicated in the referenceSignal parameter included in the PUCCH spatial relation information (RRC information element PUCCH-SpatialRelationInfo) corresponding to the spatial relation ID=1.

[0090] Note that, in the second embodiment, the transmit power for PUSCH P.sub.PUSCH,b,f,c(i,j,q.sub.d,l) in the PUSCH transmission occasion i may be determined by the above Expression (1).

[0091] According to the second embodiment described above, the UE can appropriately determine parameters for transmit power control for PUSCH.

<Supplementary Information>

[0092] At least one of the embodiments described above may be applied only to a UE that has reported or supports a specific UE capability.

[0093] The specific UE capability may indicate at least one of the following: [0094] Supporting specific processing/operation/control/information for at least one of the above embodiments; [0095] Supporting MTRP operations (for example, multiDCI-MultiTRP-r16); [0096] Supporting the indication (update) of one or two power control parameter sets for one PUCCH resource; and [0097] Supporting the indication of two spatial relations for one PUCCH resource.

[0098] The specific UE capability may be a capability that is applied across all frequencies (commonly applied independent 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, FR2-2), or a capability for each subcarrier spacing (SubCarrier Spacing (SCS)).

[0099] Further, the specific UE capability may be a capability that is applied across all duplex

schemes (commonly applied independent of duplex scheme), or a capability for each duplex scheme (for example, time division duplex (TDD) or frequency division duplex (FDD)).
[0100] At least one of the embodiments may be applied in a case where the UE is configured with specific information related to the embodiments described above by higher layer signaling. For example, the specific information may be configuration information on a power control parameter set, any RRC parameter for a specific release (for example, Rel. 17), or the like.
[0101] In a case where the UE does not support at least one of the specific UE capabilities or is not configured with the specific information, for example, operations in Rel. 15/16 may be applied.
[0102] Note that "FR1" in the embodiments may be interchangeably interpreted as another FR. An embodiment in which "in FR1" is deleted from the description above may be used.
SUPPLEMENTARY NOTE
[0103] Regarding one embodiment of the present disclosure, the following supplementary notes of the invention will be given.
Supplementary Note 1
[0104] A terminal including: [0105] a receiving section that receives information regarding more than one power control parameter set for operation in a frequency range 1; and [0106] a control section that determines, in a case where an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, a value of a closed loop index for transmit power control for a Physical Uplink Control Channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.
Supplementary Note 2
[0107] The terminal according to supplementary note 1, wherein [0108] the receiving section receives downlink control information (DCI) format 0_0 for scheduling a Physical Uplink Shared Channel (PUSCH), and [0109] in a case where two spatial settings are activated based on PUCCH spatial relation information for one PUCCH resource having a lowest index for an active uplink bandwidth part of each carrier and serving cell, the control section controls transmit power for the PUSCH by using a reference signal resource index that is a same as a reference signal resource index for PUCCH transmission using a spatial setting from the two spatial settings with the lowest index in the PUCCH resource having the lowest index.
(Radio Communication System)
[0110] 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.
[0111] FIG. **2** 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).
[0112] 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.
[0113] 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.
[0114] 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).

[0115] The radio communication system **1** may include a base station **11** that forms a macro cell C**1** of a relatively wide coverage, and base stations **12** (**12***a* to **12***c*) that form small cells C**2**, which are placed within the macro cell C**1** and which are narrower than the macro cell C**1**. 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.
[0116] 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).
[0117] 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 C**1** may be included in FR1, and the small cells C**2** 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.
[0118] The user terminal **20** may communicate using at least one of time division duplex (TDD) and frequency division duplex (FDD) in each CC.
[0119] 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."
[0120] 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.
[0121] The user terminal **20** may be a terminal supporting at least one of communication schemes such as LTE, LTE-A, 5G, and so on.
[0122] 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.
[0123] 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.
[0124] 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.
[0125] 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.
[0126] 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.
[0127] 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.
[0128] 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".
[0129] 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 certain search space, based on search space configuration.
[0130] 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.
[0131] 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.
[0132] 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.
[0133] 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.
[0134] 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 referred to as a "reference signal."
[0135] In the radio communication system **1**, a 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)
[0136] FIG. **3** 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**.
[0137] 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.
[0138] 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.
[0139] 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.
[0140] 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.
[0141] 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**.
[0142] 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.
[0143] 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.
[0144] 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.
[0145] 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.
[0146] 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.
[0147] 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**.
[0148] 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**.

[0149] 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.
[0150] 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**.
[0151] 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**.
[0152] 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**.
[0153] Note that the transmitting/receiving section **120** may transmit, to the user terminal **20**, information regarding more than one power control parameter set for operation in a frequency range 1 (FR1), and transmit, to the user terminal **20**, an activation command indicating one or two power control parameter sets of the more than one power control parameter set.
[0154] The transmitting/receiving section **120** may receive, from the user terminal **20**, a Physical Uplink Control Channel (PUCCH) in which transmit power is controlled using a value of a closed loop index determined by the user terminal **20** based on a value of a closed loop index configured for the one or two power control parameter sets.
(User Terminal)
[0155] FIG. **4** 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**.
[0156] 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.
[0157] 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.
[0158] 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**.
[0159] 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.

[0160] 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**.

[0161] 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.

[0162] 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.

[0163] 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.

[0164] 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.

[0165] 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.

[0166] 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 certain 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 processing.

[0167] 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**.

[0168] 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**.

[0169] 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.

[0170] 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**.

[0171] 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**.
[0172] Note that the transmitting/receiving section **220** may receive information regarding more than one power control parameter set for operation in a frequency range 1 (FR1). The control section **210** may determine, in a case where an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, a value of a closed loop index for transmit power control for a Physical Uplink Control Channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.
[0173] The transmitting/receiving section **220** may receive downlink control information (DCI) format 0_0 for scheduling a Physical Uplink Shared Channel (PUSCH). In a case where two spatial settings are activated based on PUCCH spatial relation information for one PUCCH resource having a lowest index for an active uplink bandwidth part of each carrier and serving cell, the control section **210** may control transmit power for the PUSCH by using a reference signal resource index that is a same as a reference signal resource index for PUCCH transmission using a spatial setting from the two spatial settings with the lowest index in the PUCCH resource having the lowest index.
(Hardware Structure)
[0174] 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.
[0175] 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.
[0176] 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. **5** 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.
[0177] 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.
[0178] 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.
[0179] Each function of the base station **10** and the user terminals **20** is implemented, for example, by allowing certain 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**.
[0180] 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**.
[0181] 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.
[0182] 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.
[0183] 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."
[0184] 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.
[0185] 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).
[0186] 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.

[0187] 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)

[0188] 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.

[0189] 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.

[0190] Here, numerology may be a communication parameter applied to at least one of transmission and reception of a certain 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.

[0191] 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.

[0192] 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."

[0193] 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.

[0194] 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."

[0195] 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.

[0196] 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.

[0197] 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.

[0198] 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.

[0199] 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.

[0200] 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.

[0201] 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.

[0202] 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.

[0203] 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.

[0204] 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 certain numerology in a certain 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 certain BWP and may be numbered in the BWP.

[0205] 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.

[0206] At least one of configured BWPs may be active, and a UE does not need to assume to transmit/receive a certain signal/channel outside active BWPs. Note that a "cell," a "carrier," and so on in the present disclosure may be interpreted as a "BWP".

[0207] 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.

[0208] 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 certain values, or may be represented in another corresponding information. For example, radio resources may be specified

by certain indices.
[0209] 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.
[0210] 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.
[0211] 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.
[0212] 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.
[0213] Reporting 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, reporting 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.
[0214] 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 reported using, for example, MAC control elements (MAC CEs).
[0215] Also, reporting of certain information (for example, reporting of “X holds”) does not necessarily have to be reported explicitly, and can be reported implicitly (by, for example, not reporting this certain information or reporting another piece of information).
[0216] 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 certain value).
[0217] 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, software packages, routines, subroutines, objects, executable files, execution threads, procedures, functions, and so on.
[0218] 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.
[0219] 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.
[0220] 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.
[0221] 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.
[0222] 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.
[0223] In the present disclosure, the base station transmitting information to the terminal may be interchangeably interpreted as the base station indicating control/operation based on the information to the terminal.
[0224] In the present disclosure, the terms "mobile station (MS)," "user terminal," "user equipment (UE)," and "terminal" may be used interchangeably.
[0225] 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.
[0226] 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.
[0227] 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.
[0228] 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, and the like.
[0229] FIG. **6** 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**.

[0230] 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.

[0231] 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).

[0232] 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**.

[0233] 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.

[0234] 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.

[0235] 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.

[0236] 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**.

[0237] 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**).

[0238] 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.

[0239] 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)).

[0240] 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**.

[0241] 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 such as “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.

[0242] 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.

[0243] 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.

[0244] The aspects/embodiments illustrated in the present disclosure may be used individually or in combinations, which may be switched depending on the mode of implementation. 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.

[0245] 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.

[0246] 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").

[0247] 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.

[0248] 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.

[0249] 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.

[0250] 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.

[0251] In addition, "judging (determining)" may be interpreted as "assuming," "expecting," "considering," and the like.

[0252] "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).

[0253] 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."

[0254] 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.
[0255] 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.”
[0256] 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.
[0257] 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.
[0258] 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).
[0259] In the present disclosure, “of,” “for,” “regarding,” “related to,” “associated with,” and the like may be interchangeably interpreted.
[0260] 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.

Claims

1.-**4**. (canceled)
5. A terminal comprising: a receiver that receives information regarding more than one power control parameter set for operation in a certain frequency range; and a processor that, when an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, determines a value of a closed loop index for transmit power control for a physical uplink control channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.
6. The terminal according to claim 5, wherein the receiver receives a downlink control information (DCI) format scheduling a physical uplink shared channel (PUSCH), and when two spatial settings are activated based on PUCCH spatial relation information for one PUCCH resource having a lowest index for an active uplink bandwidth part of each carrier and serving cell, the processor controls transmit power for the PUSCH by using a same reference signal resource index as a reference signal resource index for PUCCH transmission using one spatial setting with a lower

index of the two spatial settings in the PUCCH resource having the lowest index.

7. The terminal according to claim 5, wherein the activation command is a PUCCH power control set update for multiple transmission/reception point (MTRP) PUCCH repetition MAC control element (CE), and indicates a correspondence relation between one PUCCH resource ID and one or two power control parameter set IDs in a certain BWP of a certain serving cell.

8. A radio communication method for a terminal, comprising: receiving information regarding more than one power control parameter set for operation in a certain frequency range; and when an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, determining a value of a closed loop index for transmit power control for a physical uplink control channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.

9. A base station comprising: a transmitter that transmits, to a terminal, information regarding more than one power control parameter set for operation in a certain frequency range, and transmits, to the terminal, an activation command indicating one or two power control parameter sets of the more than one power control parameter set; and a processor that controls transmit power for a physical uplink control channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets.

10. A system comprising a terminal and a base station, wherein the terminal comprises: a receiver that receives information regarding more than one power control parameter set for operation in a certain frequency range; and a processor that, when an activation command indicating one or two power control parameter sets of the more than one power control parameter set is received, determines a value of a closed loop index for transmit power control for a physical uplink control channel (PUCCH), based on a value of a closed loop index configured for the one or two power control parameter sets, and the base station comprises: a transmitter that transmits the information regarding the more than one power control parameter set.