# DESCRIPTION

## User equipment and network node involved in the transmission of signals

### BACKGROUND

### 1. Technical Field

The present disclosure relates to transmission and reception of signals in a communication system. In particular, the present disclosure relates to methods and apparatuses for such transmission and reception.

### 2. Description of the Related Art

The 3rd Generation Partnership Project (3GPP) works at technical specifications for the next generation cellular technology, which is also called fifth generation (5G) including "New Radio" (NR) radio access technology (RAT), which operates in frequency ranges up to 100 GHz. The NR is a follower of the technology represented by Long Term Evolution (LTE) and LTE Advanced (LTE-A).

For systems like LTE and NR, further modifications and options may facilitate efficient operation of the communication system as well as particular devices pertaining to the system.

### SUMMARY

One non-limiting example~~and exemplary embodiment~~ facilitates physical downlink control channel (PDCCH) signaling for multi-TRP (transmission and reception point) communication.

In one general aspect, the techniques disclosed herein feature a user equipment (UE) comprising a transceiver which, in operation, receives, on a physical downlink control channel, PDCCH, downlink control information, DCI, for scheduling a plurality of transmissions or receptions between the UE and a plurality of transmission and reception points, TRPs, on a plurality of channels, the DCI including one or more indicators indicating one or more respective transmission parameters, and circuitry which, in operation, obtains, based on the

one or more indicators and on a configuration, a plurality of values respectively of the one or more transmission parameters, wherein the transceiver, in operation, performs the plurality of

transmissions or receptions using a respective one of the plurality of values of the one or more transmission parameters for each of the plurality of transmissions or receptions, characterized in that the plurality of values respectively of the one or more transmission parameters is obtained by using a first table in a case where the configuration indicated by the TCI field indicates a single TRP case, and the plurality of values respectively of the one or more transmission parameters is obtained by using a second table in a case where the configuration indicated by the TCI field indicates a multi-TRP case.

It should be noted that general or specific examplesembodiments may be implemented as a system, a method, an integrated circuit, a computer program, a storage medium, or any selective combination thereof.

Additional benefits and advantages of the disclosed examplesembodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various examplesembodiments and features of the specification and drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

## BRIEF DESCRIPTION OF DRAWINGS

In the following, exemplary embodiments are described in more detail with reference to the attached figures and drawings.

**Fig. 1** shows an exemplary architecture for a 3GPP NR system including exemplary user and control plane architecture for the LTE eNB, gNB, and UE;

**Fig. 2** shows an exemplary illustration of transmission of two PDSCHs to a single UE;

**Fig. 3** shows an exemplary illustration of a single PDCCH transmission from one TRP scheduling two PDSCH transmissions from two TRPs;

**Fig. 4** is a graph showing front-loaded demodulation reference symbol configurations for data channels;

**Fig. 5** is a block diagram showing the structure of UE and of a network node;

**Fig. 6** is a flow chart showing a method for a UE and a method for a network node;

**Fig. 7** is a block diagram showing an exemplary structure of UE parameter obtaining circuitry;

**Fig. 8** is a block diagram showing an exemplary structure of UE parameter obtaining circuitry;

**Fig. 9** is an example of RRC code including values of a multi-TRP combination table;

**Fig. 10** is an example of RRC code including values of a multi-TRP combination table for DMRS indication;

CLAIMS

1. A user equipment (510), UE, comprising:

a transceiver (520) which, in operation, receives, on a physical downlink control channel, PDCCH, downlink control information, DCI, for scheduling a plurality of transmissions or receptions between the UE and a plurality of transmission and reception points, TRPs, on a plurality of channels, the DCI including one or more indicators indicating one or more respective transmission parameters; and

circuitry (530) which, in operation, obtains, based on the one or more indicators and on a configuration indicated by a transmission configuration indication, TCI field of the DCI, a plurality of values respectively of the one or more transmission parameters; wherein

the transceiver (520), in operation, performs the plurality of transmissions or receptions using a respective one of the plurality of values of the one or more transmission parameters for each of the plurality of transmissions or receptions,

**characterized in that**

the plurality of values respectively of the one or more transmission parameters is obtained by using a first table in a case where the configuration indicated by the TCI field indicates a single TRP case, and

the plurality of values respectively of the one or more transmission parameters is obtained by using a second table in a case where the configuration indicated by the TCI field indicates a multi-TRP case.

2. The UE (510) according to claim 1, wherein the one or more transmission parameters include at least one of a DMRS, demodulation reference signal, port indication and a transmission configuration indication, TCI, state.

3. The UE (510) according to claim 2, wherein

the configuration includes a first DMRS port indication table and a second DMRS port indication table,

the circuitry (530), in operation, descrambles a cyclic redundancy check, CRC, appended to the DCI using a radio network temporary identifier, RNTI, included in or derivable from the configuration, wherein the RNTI indicates that the second DMRS port indication table is to be used for at least one of the plurality of transmissions or receptions, and

the transceiver (520), in operation, performs, in accordance with a result of successfully performing the descrambling of the CRC using the RNTI, the at least one of the plurality of transmissions or receptions using the second DMRS port indication table, wherein the one or more indicators indicates the DMRS port indication from the second DMRS port indication table.

4. The UE (510) according to claim 3, wherein

the one or more indicators indicates a first value from among the plurality of values of the TCI state,

the RNTI is one of K RNTI candidates, wherein a first of the K RNTI candidates is included in the configuration and the RNTI candidates are K subsequent integers respectively indicating K configured TCI states signaled by Radio Resource Control, RRC, and

the circuitry (530), in operation, determines the first value of the TCI state based on the one or more indicators and obtains a second value from among the plurality of values of the TCI state based on a result of successfully descrambling the CRC appended to the DCI using, as the RNTI, the RNTI candidate indicating the TCI state to be used as the second value from among the K TCI states.

5. The UE according to claim 2, wherein

the one or more indicators indicates a first value from among the plurality of values of the TCI state,

the circuitry (530), in operation, descrambles a cyclic redundancy check, CRC, appended to the DCI using a radio network temporary identifier, RNTI, included in or derivable from the configuration,

the RNTI is one of K RNTI candidates, wherein a first of the K RNTI candidates is included in the configuration and the RNTI candidates are K subsequent integers respectively indicating K configured TCI states signaled by RRC, and

the circuitry (530), in operation, determines the first value of the TCI state based on the one or more indicators and obtains a second value from among the plurality of values of the TCI state based on a result of successfully descrambling the CRC appended to the DCI using, as the RNTI, the RNTI candidate indicating the TCI state to be used as the second value from among the K TCI states.

6. The UE (510) according to claim 4 or 5, wherein

at least one of the one or more indicators and the RNTI indicates a multi-TRP TCI state, a multi-TRP TCI state comprising more than one TCI states for transmission or reception respectively to or from more than one TRP.

7. The UE according to claim 2, wherein

the configuration includes a set of mappings between TRP sets and value candidate sets of value candidates of the one or more transmission parameters, and

at least one of the one or more indicators indicates, from among the set of mappings, the mapping between one among the TRP sets to be used as the plurality of TRPs and one among the value candidate sets to be used as the plurality of values of the one or more transmission parameters to be used for the plurality of transmissions or receptions.

8. The UE (510) according to claim 7, wherein

the set of mappings comprises M mappings from among N statically configured mappings, M being equal to or smaller than N, and

the transceiver (520), in operation, receives M indices indicating respectively the M mappings which are signaled by RRC, and

the at least one indicator indicates the index which indicates the mapping between the plurality of TRPs and the plurality of values of the one or more transmission parameters to be used for the plurality of transmissions or receptions.

9. The UE (510) according to claim 7, wherein

the transceiver (520), in operation, receives content of a mapping table which defines the set of mappings, the content of the mapping table being signaled by RRC.

10. The UE (510) according to any of claims 7 to 9, wherein

the transceiver (520), in operation, receives an enabling parameter which indicates that the plurality of transmissions or receptions are to be performed based on the set of mappings and which is signaled by RRC, and

the circuitry (530), in operation, determines, based on the enabling parameter, that the plurality of transmissions or receptions are to be performed based on the set of mappings.

11. The UE (510) according to any of claims 7 to 9, wherein,

the circuitry (530), in operation, descrambles a cyclic redundancy check, CRC, appended to the DCI using a radio network temporary identifier, RNTI, included in or derivable from the configuration, wherein the RNTI indicates that the plurality of transmissions or receptions are to be performed based on the set of mappings, and

determines, based on a result of successfully descrambling the CRC appended to the DCI using the RNTI, that the plurality of transmissions or receptions are to be performed based on the set of mappings.

12. A network node (560) comprising:

circuitry (580) which, in operation, determines a plurality of values respectively of one or more transmission parameters for a plurality of transmissions and receptions

between a plurality of transmission and reception points, TRPs, and a user equipment, UE, on a plurality of channels, and generates downlink control information, DCI, for scheduling the plurality of transmissions or receptions, the DCI including one or more indicators indicating the one or more respective transmission parameters, wherein the one or more indicators, in combination with a configuration, indicate the plurality of values respectively of the one or more transmission parameters;

and a transceiver (570) which, in operation, transmits the DCI on a physical downlink control channel, PDCCH,

**characterized in that**

the plurality of values respectively of the one or more transmission parameters is obtained by using a first table in a case where the configuration indicated by the TCI field indicates a single TRP case,

the plurality of values respectively of the one or more transmission parameters is obtained by using a second table in a case where the configuration indicated by the TCI field indicates a multi-TRP case.

13. The network node (560) according to claim 12, wherein the transceiver (570), in operation, performs at least one of the plurality of transmissions or receptions using a respective one of the plurality of values of the one or more transmission parameters for each of the plurality of transmissions or receptions.

14. The UE according to claim 1, wherein one or more additional pointers or parameters are added in the second table.

15. The UE according to claim 1, wherein one or more additional entries to be used is added in the second table.

16. The UE according to claim 1, wherein some values of the TCI field indicate a single TRP case, and the other value of the TCI field indicate a multi-TRP case.

~~14~~17. A communication method for a user equipment, comprising:

receiving (S635), on a physical downlink control channel, PDCCH, downlink control information, DCI, for scheduling a plurality of transmissions or receptions between the UE and a plurality of transmission and reception points, TRPs, on a plurality of channels, the DCI including one or more indicators indicating one or more respective transmission parameters;

obtaining (S645), based on the one or more indicators and on a configuration, a plurality of values respectively of the one or more transmission parameters; and

performing(S655) the plurality of transmissions or receptions using a respective one of the plurality of values of the one or more transmission parameters for each of the plurality of transmissions or receptions,

**characterized in that**

the plurality of values respectively of the one or more transmission parameters is obtained by using a first table in a case where the configuration indicated by the TCI field indicates a single TRP case,

the plurality of values respectively of the one or more transmission parameters is obtained by using a second table in a case where the configuration indicated by the TCI field indicates a multi-TRP case.

~~15~~18. A communication method for a network node, comprising:

determining (S610) a plurality of values respectively of one or more transmission parameters for a plurality of transmissions and receptions between a plurality of transmission and reception points, TRPs, and a user equipment, UE, on a plurality of channels;

generating (S620) downlink control information, DCI, for scheduling the plurality of transmissions or receptions, the DCI including one or more indicators indicating the one or more respective transmission parameters, wherein the one or more indicators, in combination with a configuration, indicate the plurality of values respectively of the one or more transmission parameters; and

transmitting (S630) the DCI on a physical downlink control channel, PDCCH,

**characterized in that**

the plurality of values respectively of the one or more transmission parameters is obtained by using a first table in a case where the configuration indicated by the TCI field indicates a single TRP case,

the plurality of values respectively of the one or more transmission parameters is obtained by using a second table in a case where the configuration indicated by the TCI field indicates a multi-TRP case.