

Citation List

Non-Patent Literature

[0007]

NPL 1

3GPP TR 36.888 V12.0.0, and "Machine-Type Communications (MTC) User Equipments (UEs) based on LTE (Release 12), "June 2013.

Summary of Invention

Technical Problem

[0008] As with the traditional terminals, an MTC terminal receives MPDCCH, which is a downlink (DL) control signal, receives the downlink data (PDSCH) indicated by MPDCCH, and transmits an ACK/NACK signal of the received result via PUCCH, which is an uplink (UL) control signal. In order for each MTC terminal to identify a PUCCH resource for an MTC terminal in this case, use of an offset (called "N_{pucch}") configured for each PRB set, as in the case of EPDCCH, has been discussed.

[0009] However, no studies have been conducted on how to define the offset (N_{pucch}) for "24 ECCEs" for mapping one MPDCCH to all 6 PRB pairs in Narrowband.

[0010] Thus, embodiments of the present disclosure provide a base station, a terminal, and a communication method each making it possible to efficiently identify a PUCCH resource of a case where one MPDCCH is mapped to all 6 PRB pairs in Narrowband.

Solution to Problem

[0011] Disclosed herein is a base station including: a signal assignment section that assigns a downlink control signal to a downlink resource, the downlink control signal including resource allocation information on Physical Downlink Shared Channel (PDSCH); an identifying section that identifies a Physical Uplink Control Channel (PUCCH) resource based on the downlink resource to which the downlink control signal has been assigned, the PUCCH resource being a resource to which an ACK/NACK signal for the PDSCH is assigned; and a signal separating section that separates the ACK/NACK signal included in the identified PUCCH resource from a received signal from a terminal to which the downlink control signal has been transmitted, in which the downlink resource is composed of a plurality of PRB pairs, and any of a first PRB set and a second PRB set is assigned to each of the plurality of PRB pairs, and in a case where the downlink control signal is mapped over the first PRB set and the second PRB set, the identifying section identifies the PUCCH resource, using an offset value configured for any of the first PRB set and the second PRB set.

[0012] Disclosed herein is a terminal including: a receiving section that receives a downlink control signal including resource allocation information on Physical Downlink Shared Channel (PDSCH); and an identifying section that identifies a Physical Uplink Control Channel (PUCCH) resource based on a downlink resource to which the downlink control signal has been assigned, the PUCCH resource being a resource to which an ACK/NACK signal for the PDSCH is assigned; and a signal assignment section that assigns the ACK/NACK signal to the identified PUCCH resource, in which the downlink resource is composed of a plurality of PRB pairs, and any of a first PRB set and a second PRB set is assigned to each of the plurality of PRB pairs, and in a case where the downlink control signal is mapped over the first PRB set and the second PRB set, the identifying section identifies the PUCCH resource, using an offset value configured for any of the first PRB set and the second PRB set.

[0012a] According to a first aspect of the present disclosure, there is provided a communication apparatus including: a receiver that receives downlink control information (DCI) mapped to one or more Physical Resource Block (PRB) set(s) among a plurality of PRB sets; a mapper that maps an ACK/NACK signal to Physical Uplink Control Channel (PUCCH) resource, the ACK/NACK signal being generated based on a detection result of data signal indicated by the DCI; and a transmitter that transmits the ACK/NACK signal, wherein: the plurality of PRB sets includes a first PRB set and a second PRB set; an index to the PUCCH resource is determined based on an offset which is common to the first PRB set and the second PRB set and a variable to be added the offset; for the first PRB set, the variable is zero; and for the second PRB sets, the variable is a value which is not zero.

[0012b] According to a second aspect of the present disclosure, there is provided a communication method including: receiving downlink control information (DCI) mapped to one or more Physical Resource Block (PRB) set(s) among a plurality of PRB sets; mapping an ACK/NACK signal to Physical Uplink Control Channel (PUCCH) resource, the ACK/NACK signal being generated based on a detection result of data signal indicated by the DCI; and transmitting the ACK/NACK signal, wherein: the plurality of PRB sets includes a first PRB set and a second PRB set; an index to the PUCCH resource is determined based on an offset which is common to the first PRB set and the second PRB set and a variable to be added to the offset; for the first PRB set, the variable is zero; and for the second PRB sets, the variable is a value which is not zero.

[0012c] According to a third aspect of the present disclosure, there is provided an integrated circuit including: circuitry, which, in operation, controls receiving downlink control information (DCI) mapped to one or more Physical Resource Block (PRB) set(s) among a plurality of PRB sets; mapping an ACK/NACK signal to Physical Uplink Control

Channel (PUCCH) resource, the ACK/NACK signal being generated based on a detection result of data signal indicated by the DCI; and transmitting the ACK/NACK signal, wherein: the plurality of PRB sets includes a first PRB set and a second PRB set; an index to the PUCCH resource is determined based on an offset which is common to the first PRB set and the second PRB set and a variable to be added to the offset; for the first PRB set, the variable is zero; and for the second PRB sets, the variable is a value which is not zero.

[0013] It should be noted that general or specific embodiments may be implemented as a system, an apparatus, a method, an integrated circuit, a computer program or a storage medium, or any selective combination of the system, the apparatus, the method, the integrated circuit, the computer program, and the storage medium.

[0014] According to an embodiments of the present disclosure, it is made possible to efficiently identify a PUCCH resource of a case where one MPDCCH is mapped to all 6 PRB pairs in Narrowband.

[0015] Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various embodiments 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

[0016]

FIG. 1 is a conceptual diagram of a PUCCH resource;

FIG. 2A is a diagram illustrating an example of an MPDCCH mapping method (Option 1);

FIG. 2B is another diagram illustrating another example of the MPDCCH mapping method (Option 1);

FIG. 3A is a diagram illustrating an example of an MPDCCH mapping method (Option 2);

FIG. 3B is another diagram illustrating the example of the MPDCCH mapping method (Option 2)

FIG. 4 is a block diagram illustrating a main configuration of a base station;

FIG. 5 is a block diagram illustrating a main configuration of a terminal;

FIG. 6 is a block diagram illustrating a configuration of the base station;

FIG. 7 is a block diagram illustrating a configuration of the terminal;

Claims

1. A communication apparatus comprising:
 - a receiver that receives downlink control information (DCI) mapped to one or more Physical Resource Block (PRB) set(s) among a plurality of PRB sets;
 - a mapper that maps an ACK/NACK signal to Physical Uplink Control Channel (PUCCH) resource, the ACK/NACK signal being generated based on a detection result of data signal indicated by the DCI; and
 - a transmitter that transmits the ACK/NACK signal, wherein:
 - the plurality of PRB sets includes a first PRB set and a second PRB set;
 - an index to the PUCCH resource is determined based on an offset which is common to the first PRB set and the second PRB set and a variable to be added the offset;
 - for the first PRB set, the variable is zero; and
 - for the second PRB sets, the variable is a value which is not zero.
2. The communication apparatus according to claim 1, wherein a value of the variable to be used for the second PRB set is determined based on a number of PRBs in the first PRB set.
3. The communication apparatus according to claim 1, wherein a value of the variable to be used for the second PRB set is same as a number of ECCEs included in the first PRB set.
4. The communication apparatus according to claim 1, wherein the index to the PUCCH resource is determined further based on a repetition level offset which is common for a same repetition level, the repetition level offset being indicated by a higher layer.

5. The communication apparatus according to claim 1, wherein the downlink control information is mapped in the one or more PRB set(s) by prioritizing a frequency direction compared to a time direction.

6. The communication apparatus according to claim 1, wherein the index to the PUCCH resource is determined based on an equation 1 and the variable,
(Equation 1)

distributed assignment: $n_{\text{PUCCH}}^{(1, \tilde{p}_0)} = n_{\text{ECCE}, q} + \Delta_{\text{ARO}} + N_{\text{PUCCH}, q}^{(\text{el})}$

localized assignment: $n_{\text{PUCCH}}^{(1, \tilde{p}_0)} = \left\lfloor \frac{n_{\text{ECCE}, q}}{N_{\text{RB}}^{\text{ECCE}, q}} \right\rfloor \cdot N_{\text{RB}}^{\text{ECCE}, q} + n' + \Delta_{\text{ARO}} + N_{\text{PUCCH}, q}^{(\text{el})}$

7. The communication apparatus according to claim 1, wherein the index to the PUCCH resource is determined by assuming the first ECCE index as 0 when the DCI mapped on the plurality of PRB sets is received.

8. The communication apparatus according to claim 1, wherein a value of the variable is selected from multiple values including zero.

9. A communication method comprising:

receiving downlink control information (DCI) mapped to one or more Physical Resource Block (PRB) set(s) among a plurality of PRB sets;

mapping an ACK/NACK signal to Physical Uplink Control Channel (PUCCH) resource, the ACK/NACK signal being generated based on a detection result of data signal indicated by the DCI; and

transmitting the ACK/NACK signal, wherein:

the plurality of PRB sets includes a first PRB set and a second PRB set;

an index to the PUCCH resource is determined based on an offset which is common to the first PRB set and the second PRB set and a variable to be added to the offset;

for the first PRB set, the variable is zero; and

for the second PRB sets, the variable is a value which is not zero.

10. The communication method according to claim 9, wherein a value of the variable to be used for the second PRB set is determined based on a number of PRBs in the first PRB set.

11. The communication apparatus according to claim 9, wherein a value of the variable to be used for the second PRB set is same as a number of ECCEs included in the first PRB set.

12. The communication method according to claim 9, wherein the index to the PUCCH resource is determined further based on a repetition level offset which is common for a same repetition level, the repetition level offset being indicated by a higher layer.

13. The communication method according to claim 9, wherein the downlink control information is mapped in the one or more PRB set(s) by prioritizing a frequency direction compared to a time direction.

14. The communication method according to claim 9, wherein the index to the PUCCH resource is determined based on an equation 1 and the variable,
(Equation 1)

distributed assignment: $n_{\text{PUCCH}}^{(1, \bar{P}_0)} = n_{\text{ECCE}, q} + \Delta_{\text{ARO}} + N_{\text{PUCCH}, q}^{(\text{e1})}$

localized assignment: $n_{\text{PUCCH}}^{(1, \bar{P}_0)} = \left\lfloor \frac{n_{\text{ECCE}, q}}{N_{\text{RB}}^{\text{ECCE}, q}} \right\rfloor \cdot N_{\text{RB}}^{\text{ECCE}, q} + n' + \Delta_{\text{ARO}} + N_{\text{PUCCH}, q}^{(\text{e1})}$

15. The communication method according to claim 9, wherein the index to the PUCCH resource is determined by assuming the first ECCE index as 0 when the DCI mapped on the plurality of PRB sets is received.

16. The communication method according to claim 9, wherein a value of the variable is selected from multiple values including zero.
17. An integrated circuit comprising:
circuitry, which, in operation, controls
receiving downlink control information (DCI) mapped to one or more
Physical Resource Block (PRB) set(s) among a plurality of PRB sets;
mapping an ACK/NACK signal to Physical Uplink Control Channel
(PUCCH) resource, the ACK/NACK signal being generated based on a detection result of
data signal indicated by the DCI; and
transmitting the ACK/NACK signal, wherein:
the plurality of PRB sets includes a first PRB set and a second PRB set;
an index to the PUCCH resource is determined based on an offset which is common
to the first PRB set and the second PRB set and a variable to be added to the offset;
for the first PRB set, the variable is zero; and
for the second PRB sets, the variable is a value which is not zero.