

As mentioned above, the implicit ACK/NACK resource allocation in LTE Release 8 is based on the CCE indexing. However, such indexing scheme does not exist currently for ePDCCH.

In LTE Rel-8, the PDCCH resources are divided into CCEs which are then simply numbered. However, such an approach is not an attractive one in the case of ePDCCH as due to the nature of ePDCCH the number of resources and hence also the UL overhead would easily become excessive. This is shown in Figure 2 which illustrates a straightforward extension of Rel-8 approach to support ePDCCH.

Summary of the Invention

According to the present invention, there are provided a method, apparatus and a program for a control channel element indexing scheme.

According to an aspect of the present invention, there is provided a method comprising:

- obtaining information regarding first partition elements related to a first partitioning of channel resource elements carrying in downlink a configurable first control channel associated with a data channel,

- determining a number of second partition elements related to a second partitioning of channel resource elements per first partition element,

- determining for at least one second partition element a second-partition element index based on information regarding the first partition elements and the determined number,

- determining for at least one third partition element related to a third partitioning of channel resource elements, a third-partition element index,

- wherein the second partitioning is related to the allocation of channel resources of the first control channel, and

- wherein the third partitioning is related to allocating channel resources of a second control channel, and wherein the first partitioning is related to a partitioning used for allocating channel resources to the data channel.

determining for at least one second partition element a second-partition element index based on information regarding the first partition elements and the determined number,

determining for at least one third partition element related to a third partitioning of channel resource elements, a third-partition element index,

wherein the second partitioning is related to the allocation of channel resources of the first control channel, and

wherein the third partitioning is related to allocating channel resources of a second control channel, and wherein the first partitioning is related to a partitioning used for allocating channel resources to the data channel.

According to further refinements of the present invention as defined under the above aspects,

- the processor is further configured to cause the apparatus to perform receiving a data packet transmitted on the data channel, and providing feedback information in uplink direction on the second control channel about successful or unsuccessful reception of the data packet;
- the first partitioning is related to allocating channel resources of the data channel;
- at least one of the second-partition element index and information regarding first partition elements is unique in a cell;
- at least one of the second-partition element index and information regarding first partition elements is unique per user equipment;
- each second-partition element index is mapped to one or more third-partition element indexes;
- determining the number of second-partition elements comprises deriving the number from a subframe type;
- the second-partition element indices are determined so as to form a continuous set of indices;
- the second-partition element indices are determined starting from the second-partition element on the first partition element with the lowest index;
- the second-partition element indices are determined starting from the second-partition element on the first partition element with the highest index;

CLAIMS

1. A method, comprising:

obtaining information regarding first partition elements related to a first partitioning of channel resource elements carrying in downlink a configurable first control channel ~~associated with for allocating channel resources to~~ a data channel,

determining a number of second partition elements related to a second partitioning of channel resource elements per first partition element,

determining for at least one second partition element a second-partition element index based on information regarding the first partition elements and the determined number,

determining at least one third partition element related to a third partitioning of channel resource elements, associated with a third-partition element index,

wherein the second partitioning is related to the allocation of channel resources of the first control channel, ~~and~~

wherein the third partitioning is related to allocating channel resources of a second control channel, ~~and~~

~~wherein the first partitioning is related to a partitioning used for allocating channel resources to the data channel.~~

2. The method according to claim 1, further comprising

receiving on the first control channel control information for allocating channel resources to the data channel,

receiving a data packet transmitted on the data channel, and

providing feedback information in uplink direction on the second control channel about successful or unsuccessful reception of the data packet,

wherein the feedback information is provided on the at least one third partition element, and

wherein the second partition element index is used in determining the third-partition element index.

~~3. The method according to claim 1 or 2,~~

~~wherein the first partitioning is related to allocating channel resources of the data channel.~~

34. The method according to any one of claims 1 to 2,
 wherein ~~at least one of the~~ second-partition element indexing scheme is
~~specified per transmission point and information regarding first partition elements is~~
~~unique in a cell.~~

45. The method according to any one of according to claims 1 to 2,
 wherein at least one of the second-partition element index and information
 regarding first partition elements is unique per user equipment.

56. The method according to any one of claims 1 to 4,
 wherein each second-partition element index is mapped to one or more third-
 partition element indexes.

67. The method according to any one of claims 1 to 5, wherein
 determining the number of second-partition elements comprises deriving the
 number from a subframe type.

78. The method according to any one of claims 1 to 6, wherein
 the second-partition element indices are determined so as to form a
 continuous set of indices.

89. The method according to any one of claims 1 to 7, wherein
 the second-partition element indices are determined starting from the second-
 partition element on the first partition element with the lowest index.

910. The method according to any one of claims 1 to 7, wherein
 the second-partition element indices are determined starting from the second-
 partition element on the first partition element with the highest index.

1011. The method according to any one of claims 1 to 9, wherein
 determining at least one third-partition element index comprises one-to-one
 mapping between the second-partition element index and the third-partition element
 index starting from the lowest second-partition element index.

1112. The method according to any one of claims 1 to 9, wherein

determining at least one third-partition element index comprises many-to-one mapping between the second-partition element index and the third-partition element index.

~~1213~~. The method according to claim ~~111~~, further comprising a collision avoidance mechanism,

13. The method according to claim 12, wherein

the collision avoidance mechanism comprises including a specific field modifying the implicit uplink channel resource allocation.

14. The method according to claim ~~121~~, further comprising a collision avoidance mechanism, wherein

the collision avoidance mechanism comprises first control channel scheduling including selecting at least one second-partition element used for the first control channel.

15. The method according to claim ~~1112~~, wherein

the many-to-one mapping comprises one-to-one mapping between the second-partition element index and the third-partition element index for the second-partition elements contained on one first-partition element.

16. The method according to any one of claims 1 to 151, wherein

the method is executed by a user equipment, wherein obtaining information regarding first partition elements includes receiving the information from a base station.

17. The method according to claim 16, further comprising

receiving an offset parameter indicating the first second-partition element index from a base station.

18. An apparatus comprising

a receiver/transmitter configured to communicate with at least another apparatus,

a memory configured to store computer program code, and

a processor configured to cause the apparatus to perform:

obtaining information regarding first partition elements related to a first partitioning of channel resource elements carrying in downlink a configurable first control channel associated with a data channel,

determining a number of second partition elements related to a second partitioning of channel resource elements per first partition element,

determining for at least one second partition element a second-partition element index based on information regarding the first partition elements and the determined number,

determining at least one third partition element related to a third partitioning of channel resource elements, associated with a third-partition element index,

wherein the second partitioning is related to the allocation of channel resources of the first control channel, and

wherein the third partitioning is related to allocating channel resources of a second control channel, and

wherein the first partitioning is related to a partitioning used for allocating channel resources to the data channel.

19. A computer program product including a program for a processing device, comprising software code portions for performing the steps of any one of claims 1 to 17 when the program is run on the processing device.