

CLAIMS

What is claimed is:

1. A method for allocating control channel candidates, comprising:

determining K sets for transmitting a control channel, wherein each set in the K sets
5 comprises at least one physical resource block pair, and K is an integer greater than 0; and

allocating control channel candidates at each aggregation level to at least one set in the
 K sets according to the following factors: aggregation levels supported by the control channel,
the number of control channel candidates corresponding to each aggregation level, the K sets
for transmitting the control channel, and types of the sets, which comprises:

10 when K_L is a positive integer, allocating all control channel candidates at the
aggregation levels supported by the localised transmission mode to at least one of the K_L
sets; or

when K_D is a positive integer, allocating all control channel candidates at the
aggregation levels supported by the distributed transmission mode to at least one of the K_D
15 sets; or

when both K_L and K_D are positive integers, allocating all control channel candidates
at each aggregation level in the aggregation levels supported by both the localised
transmission mode and the distributed transmission mode to at least one of the K_L sets and
at least one of the K_D sets;

20 wherein: the K sets for transmitting the control channel comprise one or both of a set of
a localised transmission mode and a set of a distributed transmission mode, wherein the
number of sets of the localised transmission mode is K_L , and the number of sets of the
distributed transmission mode is K_D , $K_L + K_D = K$, and K_L and K_D are integers
greater than or equal to 0; and

25 the aggregation levels supported by the control channel comprise one or more of the

following levels:

aggregation levels supported by the localised transmission mode, aggregation levels supported by the distributed transmission mode, and common aggregation levels supported by both the localised transmission mode and the distributed transmission mode.

2. The method according to claim 1, wherein: the K sets for transmitting the control channel comprise one or both of a set of a localised transmission mode and a set of a distributed transmission mode, wherein the number of sets of the localised transmission mode is K_L , and the number of sets of the distributed transmission mode is K_D , $K_L + K_D = K$, and K_L and K_D are integers greater than or equal to 0; and

the aggregation levels supported by the control channel comprise one or more of the following levels:

aggregation levels supported by the localised transmission mode, aggregation levels supported by the distributed transmission mode, and common aggregation levels supported by both the localised transmission mode and the distributed transmission mode.

3. The method according to claim 2, wherein the allocating control channel candidates at each aggregation level to at least one set in the K sets comprises:

allocating the control channel candidates at each aggregation level to at least one set in the K sets according to the aggregation levels supported by the control channel, the number of control channel candidates corresponding to each aggregation level, the K sets for transmitting the control channel, and the types of the sets.

4. The method according to claim 3, wherein the allocating the control channel candidates at each aggregation level to at least one set in the K sets according to the aggregation levels supported by the control channel, the number of control channel candidates corresponding to each aggregation level, the K sets for transmitting the control channel, and the types of the sets, comprises:

when K_L is a positive integer, allocating all control channel candidates at the aggregation levels supported by the localised transmission mode to at least one of the K_L

sets; or

~~when K_D is a positive integer, allocating all control channel candidates at the aggregation levels supported by the distributed transmission mode to at least one of the K_D~~

~~sets; or~~

5 ~~when both K_L and K_D are positive integers, allocating all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets.~~

10 52. The method according to claim 41, wherein when both K_L and K_D are positive integers, the allocating all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets comprises:

15 allocating at least one half of all control channel candidates at each first aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets; and

allocating at least one half of all control channel candidates at each second aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_D sets.

20 63. The method according to claim 52, wherein:

when the aggregation levels supported by both the localised transmission mode and the distributed transmission mode are 1, 2, 4, and 8, the first aggregation levels are 1 and 2, and the second aggregation levels are 4 and 8; and

25 when the aggregation levels supported by both the localised transmission mode and the distributed transmission mode are 2, 4, 8, and 16, the first aggregation levels are 2 and 4, and the second aggregation levels are 8 and 16.

74. The method according to claim 52 or 63, wherein:

remaining control channel candidates at each aggregation level are allocated to different sets according to a predefined sequence of control channel sets and/or a position of a start set at the aggregation level.

85. The method according to claim 41, wherein all control channel candidates at an aggregation level supported by only the distributed transmission mode or the localised transmission mode are allocated to at least one set in the K_D sets of the distributed transmission mode or in the K_L sets of the localised transmission mode.

96. The method according to claim 85, wherein allocating all control channel candidates at an aggregation level supported by only the distributed transmission mode or the localised transmission mode to at least one set in the K_D sets of the distributed transmission mode or in the K_L sets of the localised transmission mode comprises:

determining, according to the number of sets used for the aggregation level in K_D or K_L sets, the number of control channel candidates allocated to each set in the K_D or K_L sets, at the aggregation level; or

determining, according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D or K_L sets, the number of control channel candidates allocated to each set in the K_D or K_L sets, at the aggregation level.

107. The method according to claim 96, wherein the determining, according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D or K_L sets, the number of control channel candidates allocated to each set in the K_D or K_L sets, at the aggregation level comprises:

allocating c_i control channel candidates to set s_i supporting an aggregation level L ,

wherein the number c_i is indicated by $c_i = \left\lfloor \frac{C_L \times N_i}{\sum_{j=1}^T N_j} \right\rfloor$, L is the aggregation level supported by

only the distributed transmission mode or the localised transmission mode, C_L is the

number of control channel candidates at the aggregation level L ; s_i is a set supporting the aggregation level L , c_i is the number of control channel candidates allocated to the set s_i , $i \in [1, T]$, and T is a positive integer;

allocating remaining R control channel candidates to R sets according to a preset rule,

5 wherein the number R is indicated by $R = C_L - \sum_{j=1}^T c_j$,

and the preset rule comprises: allocating one control channel candidate to each set of the R sets according to a descending order of the number of physical resource block pairs included in each set.

10 418. The method according to claim 41, wherein when both K_L and K_D are positive integers, the allocating all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets, comprises:

15 determining, according to a ratio between the numbers of sets used for the aggregation level in K_D and K_L , the numbers of control channel candidates allocated to the K_L and K_D sets at each aggregation level; or

determining, according to a ratio between the total numbers of physical resource blocks in sets used for the aggregation levels in K_D and K_L , the numbers of control channel candidates allocated to the K_L and K_D sets at each aggregation level; or

20 determining, according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D and K_L , the number of control channel candidates allocated to each set in the K_L and K_D sets at each aggregation level.

419. The method according to claim 41, wherein:

25 at each aggregation level, when the number of control channel candidates configured for the K_L sets is greater than 1, the number of control channel candidates in each set is determined according to the number of physical resource blocks comprised in each set that

can support the aggregation level in the K_L sets or the number of sets that can support the aggregation level in the K_L sets, wherein K_L is greater than 1; or

when the number of control channel candidates configured for the K_D sets is greater than 1, the number of control channel candidates in each set is determined according to the number of physical resource blocks comprised in each set that can support the aggregation level in the K_D sets or the number of sets that can support the aggregation level in the K_D sets, wherein K_D is greater than 1.

1310. The method according to claim 129, wherein when the number of control channel candidates configured for the K_L or K_D sets is greater than 1, determining the number of control channel candidates in each set according to the number of physical resource blocks comprised in each set that can support the aggregation level in the K_L or K_D sets comprises:

allocating c_i control channel candidates to set s_i supporting an aggregation level L ,

wherein the number c_i is indicated by $c_i = \left\lfloor \frac{C_L \times N_i}{\sum_{j=1}^T N_j} \right\rfloor$, L is an aggregation level, C_L is the

number of control channel candidates at the aggregation level L ; s_i is a set supporting the aggregation level L , c_i is the number of control channel candidates allocated to the set s_i , $i \in [1, T]$, and T is a positive integer;

allocating remaining R control channel candidates to R sets according to a preset rule,

wherein the number R is indicated by $R = C_L - \sum_{j=1}^T c_j$,

and the preset rule comprises: allocating one control channel candidate to each set of the R sets according to a descending order of the number of physical resource block pairs included in each set.

1411. An apparatus for allocating control channel candidates, comprising:

a determining unit, configured to determine K sets for transmitting a control channel,

wherein each set in the K sets comprises at least one physical resource block pair, and K is an integer greater than 0; and

an allocating unit, configured to allocate, according to the following factors: aggregation levels supported by the control channel, the number of control channel candidates corresponding to each aggregation level, the K sets for transmitting the control channel, and types of the sets, control channel candidates at each aggregation level to at least one set in the K sets determined by the determining unit, wherein the allocating unit is configured to:

allocate, when K_L is a positive integer, all control channel candidates at the aggregation levels supported by the localised transmission mode to at least one of the K_L sets; or

allocate, when K_D is a positive integer, all control channel candidates at the aggregation levels supported by the distributed transmission mode to at least one of the K_D sets; or

allocate, when both K_L and K_D are positive integers, all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets;

wherein: the K sets for transmitting the control channel comprise one or both of a set of a localised transmission mode and a set of a distributed transmission mode, wherein the number of sets of the localised transmission mode is K_L , and the number of sets of the distributed transmission mode is K_D , $K_L + K_D = K$, and K_L and K_D are integers greater than or equal to 0; and

the aggregation levels supported by the control channel comprise one or more of the following levels:

aggregation levels supported by the localised transmission mode, aggregation levels supported by the distributed transmission mode, and common aggregation levels supported by both the localised transmission mode and the distributed transmission mode.

15. The apparatus according to claim 14, wherein: the K sets for transmitting the control channel comprise one or both of a set of a localised transmission mode and a set of a distributed transmission mode, wherein the number of sets of the localised transmission mode is K_L , and the number of sets of the distributed transmission mode is K_D , $K_L + K_D = K$, and K_L and K_D are integers greater than or equal to 0; and

the aggregation levels supported by the control channel comprise one or more of the following levels:

aggregation levels supported by the localised transmission mode, aggregation levels supported by the distributed transmission mode, and common aggregation levels supported by both the localised transmission mode and the distributed transmission mode.

16. The apparatus according to claim 15, wherein the allocating unit is configured to allocate the control channel candidates at each aggregation level to at least one set in the K sets according to the aggregation levels supported by the control channel, the number of control channel candidates corresponding to each aggregation level, the K sets for transmitting the control channel, and the types of the sets.

17. The apparatus according to claim 16, wherein the allocating unit is configured to: allocate, when K_L is a positive integer, all control channel candidates at the aggregation levels supported by the localised transmission mode to at least one of the K_L sets; or

allocate, when K_D is a positive integer, all control channel candidates at the aggregation levels supported by the distributed transmission mode to at least one of the K_D sets; or

allocate, when both K_L and K_D are positive integers, all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets.

~~18~~12. The apparatus according to claim ~~17~~11, wherein the allocating unit being configured to allocate all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets when both

5 K_L and K_D are positive integers, comprises:

allocating at least one half of all control channel candidates at each first aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets; and

10 allocating at least one half of all control channel candidates at each second aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_D sets.

~~19~~13. The apparatus according to claim ~~18~~12, wherein:

when the aggregation levels supported by both the localised transmission mode and the distributed transmission mode are 1, 2, 4, and 8, the first aggregation levels are 1 and 2, and
15 the second aggregation levels are 4 and 8; and

when the aggregation levels supported by both the localised transmission mode and the distributed transmission mode are 2, 4, 8, and 16, the first aggregation levels are 2 and 4, and the second aggregation levels are 8 and 16.

~~20~~14. The apparatus according to claim ~~18-12~~ or ~~19~~13, wherein:

20 remaining control channel candidates at each aggregation level are allocated to different sets according to a predefined sequence of control channel sets and/or a position of a start set at the aggregation level.

~~21~~15. The apparatus according to claim ~~17~~11, wherein the allocating unit is configured to allocate all control channel candidates at an aggregation level supported by only the
25 distributed transmission mode or the localised transmission mode to at least one set in the K_D sets of the distributed transmission mode or the K_L sets of the localised transmission mode.

~~22~~16. The apparatus according to claim ~~21~~15, wherein the allocating unit being

configured to allocate all control channel candidates at an aggregation level supported by only the distributed transmission mode or the localised transmission mode to at least one set in the K_D sets of the distributed transmission mode or the K_L sets of the localised transmission mode, comprises:

5 determine, according to the number of sets used for the aggregation level in K_D or K_L sets, the number of control channel candidates allocated to each set in the K_D or K_L sets, at the aggregation level; or

10 determine, according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D or K_L sets, the number of control channel candidates allocated to each set in the K_D or K_L sets, at the aggregation level.

2317. The apparatus according to claim 2216, wherein when the the number of control channel candidates allocated to each set in the K_D or K_L sets is determined according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D or K_L sets, the allocating unit is configured to:

15 allocate c_i control channel candidates to set s_i supporting an aggregation level L ,

wherein the number c_i is indicated by
$$c_i = \left\lfloor \frac{C_L \times N_i}{\sum_{j=1}^T N_j} \right\rfloor$$
, L is the aggregation level supported by

only the distributed transmission mode or the localised transmission mode, C_L is the number of control channel candidates at the aggregation level L ; s_i is a set supporting the aggregation level L , c_i is the number of control channel candidates allocated to the set s_i , $i \in$

20 【1, T】, and T is a positive integer;

allocate remaining R control channel candidates to R sets according to a preset rule,

wherein the number R is indicated by
$$R = C_L - \sum_{j=1}^T c_j,$$

and the preset rule comprises: allocating one control channel candidate to each set of the R sets according to a descending order of the number of physical resource block pairs

included in each set.

2418. The apparatus according to claim 1711, wherein the allocating unit being configured to allocate all control channel candidates at each aggregation level in the aggregation levels supported by both the localised transmission mode and the distributed transmission mode to at least one of the K_L sets and at least one of the K_D sets when both K_L and K_D are positive integers, comprises:

determining, according to a ratio between the numbers of sets used for the aggregation level in K_D and K_L , the numbers of control channel candidates allocated to the K_L and K_D sets, at each aggregation level; or

determining, according to a ratio between the total numbers of physical resource blocks in sets used for the aggregation level in K_D and K_L , the numbers of control channel candidates allocated to the K_L and K_D sets, at each aggregation level; or

determining, according to a ratio of the number of physical resource blocks of each set in sets used for the aggregation level in K_D and K_L , the number of control channel candidates allocated to each set in the K_L and K_D sets, at each aggregation level.

2519. The apparatus according to claim 1711, wherein:

at each aggregation level, when the number of control channel candidates configured for the K_L sets is greater than 1, the allocating unit is configured to determine the number of control channel candidates in each set according to the number of physical resource blocks comprised in each set that can support the aggregation level in the K_L sets or the number of sets that can support the aggregation level in the K_L sets, wherein K_L is greater than 1; or

when the number of control channel candidates configured for the K_D sets is greater than 1, the allocating unit is configured to determine the number of control channel candidates in each set according to the number of physical resource blocks comprised in each set that can support the aggregation level in the K_D sets or the number of sets that can

support the aggregation level in the K_D sets, wherein K_D is greater than 1.

2620. The apparatus according to claim 2519, wherein when the number of control channel candidates configured for the K_L or K_D sets is greater than 1, and the number of control channel candidates in each set is determined according to the number of physical resource blocks comprised in each set that can support the aggregation level in the K_L or K_D sets, the allocating unit is configured to:

allocate c_i control channel candidates to set s_i supporting an aggregation level L ,

wherein the number c_i is indicated by $c_i = \left\lfloor \frac{C_L \times N_i}{\sum_{j=1}^T N_j} \right\rfloor$, L is an aggregation level, C_L is the

number of control channel candidates at the aggregation level L ; s_i is a set supporting the aggregation level L , c_i is the number of control channel candidates allocated to the set s_i , $i \in [1, T]$, and T is a positive integer;

allocate remaining R control channel candidates to R sets according to a preset rule,

wherein the number R is indicated by $R = C_L - \sum_{j=1}^T c_j$,

and the preset rule comprises: allocating one control channel candidate to each set of the R sets according to a descending order of the number of physical resource block pairs included in each set.