

CLAIMS

1. A method of transmitting machine type communication, MTC, downlink control information, DCI, being applicable to a base station, comprising:

determining a DCI transmission region configured for an MTC device;

generating and sending control resource configuration information to the MTC device;

determining an information detection capability of the MTC device in the DCI transmission region, wherein the information detection capability indicates whether the MTC device supports searching for DCI from a target resource region, and the target resource region is a control region of an original LTE system;

mapping a target physical resource in the DCI transmission region according to the information detection capability and a preset resource mapping mode, wherein the target physical resource carries the DCI of the MTC device; and

transmitting the DCI to the MTC device through the target physical resource mapped in the DCI transmission region.

2. The method according to claim 1, wherein the control region comprises:

a time/frequency region corresponding to first 3 OFDM symbols of a subframe.

3. The method according to claim 1, wherein the preset resource mapping mode comprises:

a first mapping mode configured to map the target physical resource in a data region of the original LTE system; and/or,

a second mapping mode configured to map the target physical resource in a valid region of a subframe, wherein the valid region of the subframe is a time/frequency region excluding a cell reference signal resource in the subframe.

4. The method according to claim 3, wherein the data region comprises:

a time/frequency region corresponding to last 11 OFDM symbols of a subframe.

5. The method according to claim 1, wherein determining the information detection capability of the MTC device in the DCI transmission region comprises:

obtaining device capability information reported by each MTC device; and

determining the information detection capability of the MTC device according to the device capability information.

6. The method according to claim 5,
wherein the device capability information comprises:
 a preset indication value for indicating the information detection capability; and
 wherein determining the information detection capability of the MTC device according to the device capability information comprises:
 if the preset indication value is a first indication value, determining that the MTC device supports searching for the DCI from the target resource region; and
 if the preset indication value is a second indication value, determining that the MTC device does not support searching for the DCI from the target resource region.
7. The method according to claim 3, wherein mapping the target physical resource in the DCI transmission region according to the information detection capability and the preset resource mapping mode comprises:
 if the MTC device does not support searching for the DCI from the target resource region, mapping the target physical resource in the DCI transmission region according to the first mapping mode.
8. The method according to claim 3, wherein mapping the target physical resource in the DCI transmission region according to the information detection capability and the preset resource mapping mode comprises:
 determining a target resource mapping mode of the target physical resource, and performing resource mapping, wherein the target resource mapping mode is the first mapping mode or the second mapping mode;
 generating physical resource configuration information according to the target resource mapping mode, wherein the physical resource configuration information informs the MTC device about a mapping range of the target physical resource; and
 sending the physical resource configuration information to the MTC device through high-layer signaling.
9. The method according to claim 3, wherein mapping the target physical resource in the DCI transmission region according to the information detection capability and the preset resource mapping mode comprises:

if the MTC device supports searching for the DCI from the target resource region, mapping the target physical resource in the DCI transmission region according to a control channel element, CCE, aggregation level.

10. The method according to claim 9, wherein mapping the target physical resource in the DCI transmission region according to the CCE aggregation level comprises:

determining a CCE aggregation level of the DCI transmission region;

if the CCE aggregation level is less than a maximum value of CCEs supported by the DCI transmission region, mapping the target physical resource in the DCI transmission region according to the first mapping mode; and

if the CCE aggregation level is equal to the maximum value of CCEs supported by the DCI transmission region, mapping the target physical resource in the DCI transmission region according to the second mapping mode.

11. The method according to claim 9,

wherein the DCI transmission region comprises:

mapping regions of different sizes; and

wherein mapping the target physical resource in the DCI transmission region according to the CCE aggregation level comprises:

determining a CCE aggregation level of a current mapping region;

if the CCE aggregation level of the current mapping region is less than a maximum value of CCEs supported by the current mapping region, mapping the target physical resource in the current mapping region according to the first mapping mode; and

if the CCE aggregation level of the current mapping region is equal to the maximum value of CCEs supported by the current mapping region, mapping the target physical resource in the current mapping region according to the second mapping mode.

12. A method of transmitting MTC DCI, being applicable to an MTC device, the MTC device supporting searching for DCI from a target resource region, the target resource region being a control region of an original LTE system, the method comprising:

obtaining control resource configuration information from a base station;

determining a DCI transmission region;

determining a target search region according to preset reference information and the DCI transmission region, wherein the preset reference information comprises a blind detection CCE aggregation level or physical resource configuration information sent by the base station; and
detecting target DCI from the target search region according to a preset blind detection CCE aggregation level.

13. The method according to claim 12, wherein if the preset reference information comprises the blind detection CCE aggregation level, determining the target search region according to the preset reference information and the DCI transmission region comprises:

determining a blind detection CCE aggregation level of a region to be detected, wherein the region to be detected comprises the DCI transmission region or a mapping region of the DCI transmission region;

if the blind detection CCE aggregation level is equal to a maximum value of CCEs supported by the region to be detected, determining a valid region of the entire region to be detected as the target search region, wherein the valid region is a region of the entire region to be detected excluding a cell reference signal, CRS, resource; and

if the blind detection CCE aggregation level is less than the maximum value of CCEs supported by the region to be detected, determining the region to be detected excluding the target resource region as the target search region.

14. The method according to claim 12, wherein if the preset reference information comprises the physical resource configuration information sent by the base station, determining the target search region according to the preset reference information and the DCI transmission region comprises:

determining a preset resource mapping mode of a region to be detected according to the physical resource configuration information, wherein the region to be detected comprises the DCI transmission region or a mapping region of the DCI transmission region;

if the preset resource mapping mode is a first mapping mode, determining the region to be detected excluding the target resource region as the target search region; and

if the preset resource mapping mode is a second mapping mode, determining a valid region of the entire region to be detected as the target search region, wherein the valid region is a region of the region to be detected excluding a CRS resource;

wherein the first mapping mode is configured to map a target physical resource in a data region of the original LTE system, and the target physical resource carries the DCI of the MTC device; and

the second mapping mode is configured to map the target physical resource in a valid region of a subframe, and the valid region of the subframe is a time/frequency region excluding a CRS resource in the subframe.

15. The method according to claim 12, further comprising:

reporting device capability information to the base station, wherein the device capability information indicates whether the MTC device has an ability to search for the DCI from the target resource region, such that the base station maps a target physical resource for carrying the MTC DCI in a preset DCI transmission region according to the device capability information.

~~16. An apparatus for transmitting MTC DCI, setting in a base station, comprising:~~

~~a transmission region determining module configured to determine a DCI transmission region configured for an MTC device, generate and send control resource configuration information to the MTC device;~~

~~a capability determining module configured to determine an information detection capability of the MTC device in the DCI transmission region, wherein the information detection capability indicates whether the MTC device supports searching for DCI from a target resource region, and the target resource region is a control region of an original LTE system;~~

~~a resource mapping module configured to map a target physical resource in the DCI transmission region according to the information detection capability and a preset resource mapping mode, wherein the target physical resource carries the DCI of the MTC device; and~~

~~an information transmitting module configured to transmit the DCI to the MTC device through the target physical resource mapped in the DCI transmission region.~~

~~17. The apparatus according to claim 16, wherein the control region comprises:~~

~~a time/frequency region corresponding to first 3 OFDM symbols of a subframe.~~

~~18. The apparatus according to claim 16, wherein the preset resource mapping mode comprises:~~

a first mapping mode configured to map the target physical resource in a data region of the original LTE system; and/or,

a second mapping mode configured to map the target physical resource in a valid region of a subframe, wherein the valid region of the subframe is a time/frequency region excluding a cell reference signal resource in the subframe.

19. The apparatus according to claim 18, wherein the data region comprises:

a time/frequency region corresponding to last 11 OFDM symbols of a subframe.

20. The apparatus according to claim 16, wherein the capability determining module comprises:

a capability information obtaining submodule configured to obtain device capability information reported by each MTC device; and

a capability determining submodule configured to determine the information detection capability of the MTC device according to the device capability information.

21. The apparatus according to claim 20,

wherein the device capability information comprises:

a preset indication value for indicating the information detection capability; and

wherein the capability determining submodule comprises:

a first capability determining unit configured to determine that the MTC device supports searching for the DCI from the target resource region in a case where the preset indication value is a first indication value; and

a second capability determining unit configured to determine that the MTC device does not support searching for the DCI from the target resource region in a case where the preset indication value is a second indication value.

22. The apparatus according to claim 18, wherein the resource mapping module is configured to:

in a case where the MTC device does not support searching for the DCI from the target resource region, map the target physical resource in the DCI transmission region according to the first mapping mode.

~~23. The apparatus according to claim 18, wherein the resource mapping module comprises:
a mapping mode determining submodule configured to determine a target resource mapping mode of the target physical resource, and perform resource mapping, wherein the target resource mapping mode is the first mapping mode or the second mapping mode;~~

~~a configuration information generating submodule configured to generate physical resource configuration information according to the target resource mapping mode, wherein the physical resource configuration information informs the MTC device about a mapping range of the target physical resource; and~~

~~a configuration information sending submodule configured to send the physical resource configuration information to the MTC device through high-layer signaling.~~

~~24. The apparatus according to claim 18, wherein the resource mapping module is configured to:~~

~~map the target physical resource in the DCI transmission region according to a CCE aggregation level in a case where the MTC device supports searching for the DCI from the target resource region.~~

~~25. The apparatus according to claim 24, wherein the resource mapping module comprises:
a first CCE aggregation level determining submodule configured to determine a CCE aggregation level of the DCI transmission region;~~

~~a first resource mapping submodule configured to map the target physical resource in the DCI transmission region according to the first mapping mode in a case where the CCE aggregation level is less than a maximum value of CCEs supported by the DCI transmission region; and~~

~~a second resource mapping submodule configured to map the target physical resource in the DCI transmission region according to the second mapping mode in a case where the CCE aggregation level is equal to the maximum value of CCEs supported by the DCI transmission region.~~

~~26. The apparatus according to claim 24,
wherein the DCI transmission region comprises:~~

~~mapping regions of different sizes; and~~

~~wherein the resource mapping module comprises:~~

~~a second CCE aggregation level determining submodule configured to determine a CCE aggregation level of a current mapping region;~~

~~a third resource mapping submodule configured to map the target physical resource in the current mapping region according to the first mapping mode in a case where the CCE aggregation level of the current mapping region is less than a maximum value of CCEs supported by the current mapping region; and~~

~~a fourth resource mapping submodule configured to map the target physical resource in the current mapping region according to the second mapping mode in a case where the CCE aggregation level of the current mapping region is equal to the maximum value of CCEs supported by the current mapping region.~~

~~27. An apparatus for transmitting MTC DCI, setting in an MTC device, the MTC device supporting searching for DCI from a target resource region, the target resource region being a control region of an original LTE system, the apparatus comprising:~~

~~a transmission region determining module configured to obtain control resource configuration information from a base station, and determine a DCI transmission region;~~

~~a search region determining module configured to determine a target search region according to preset reference information and the DCI transmission region, wherein the preset reference information comprises a blind detection CCE aggregation level or physical resource configuration information sent by the base station; and~~

~~a DCI detecting module is configured to detect target DCI from the target search region according to a preset blind detection CCE aggregation level.~~

~~28. The apparatus according to claim 27, wherein if the preset reference information comprises the blind detection CCE aggregation level, the search region determining module comprises:~~

~~a CCE aggregation level determining submodule configured to determine a blind detection CCE aggregation level of a region to be detected, wherein the region to be detected comprises the DCI transmission region or a mapping region of the DCI transmission region;~~

~~a first search region determining submodule configured to determine a valid region of the entire region to be detected as the target search region in a case where the blind detection CCE aggregation level is equal to a maximum value of CCEs supported by the region to be detected,~~

wherein the valid region is a region of the entire region to be detected excluding a CRS resource;
and

~~a second search region determining submodule configured to determine the region to be detected excluding the target resource region as the target search region in a case where the blind detection CCE aggregation level is less than the maximum value of CCEs supported by the region to be detected.~~

29. The apparatus according to claim 27, wherein if the preset reference information comprises the physical resource configuration information sent by the base station, the search region determining module comprises:

~~a resource mapping mode determining submodule configured to determine a preset resource mapping mode of a region to be detected according to the physical resource configuration information, wherein the region to be detected comprises the DCI transmission region or a mapping region of the DCI transmission region;~~

~~a third search region determining submodule configured to determine the region to be detected excluding the target resource region as the target search region in a case where the preset resource mapping mode is a first mapping mode; and~~

~~a fourth search region determining submodule configured to determine a valid region of the entire region to be detected as the target search region in a case where the preset resource mapping mode is a second mapping mode, wherein the valid region is a region of the region to be detected excluding a CRS resource;~~

~~wherein, the first mapping mode is configured to map a target physical resource in a data region of the original LTE system, and the target physical resource carries the DCI of the MTC device; and~~

~~the second mapping mode is configured to map the target physical resource in a valid region of a subframe, and the valid region of the subframe is a time/frequency region excluding a CRS resource in the subframe.~~

30. The apparatus according to claim 27, further comprising:

~~a device capability reporting module configured to report device capability information to the base station, wherein the device capability information indicates whether the MTC device has an ability to search for the DCI from the target resource region, such that the base station~~

~~maps a target physical resource for carrying the MTC DCI in a preset DCI transmission region according to the device capability information.~~

~~3416.~~ A non-transitory computer-readable storage medium storing computer instructions, when executed by a processor, the instructions implement the method according to any one of claims 1 to 11.

~~3217.~~ A non-transitory computer-readable storage medium storing computer instructions, when executed by a processor, the instructions implement the method according to any one of claims 12 to 15.

~~3318.~~ A base station, comprising:
a processor, and
a memory for storing instructions executable by the processor,
wherein the processor is configured to:
determine a DCI transmission region configured for an MTC device;
generate and send control resource configuration information to the MTC device;
determine an information detection capability of the MTC device in the DCI transmission region, wherein the information detection capability indicates whether the MTC device supports searching for DCI from a target resource region, and the target resource region is a control region of an original LTE system;
map a target physical resource in the DCI transmission region according to the information detection capability and a preset resource mapping mode, wherein the target physical resource carries the DCI of the MTC device; and
transmit the DCI to the MTC device through the target physical resource mapped in the DCI transmission region.

~~3419.~~ User equipment, comprising:
a processor, and
a memory for storing instructions executable by the processor,
wherein the processor is configured to:
obtain control resource configuration information from a base station;
determine a DCI transmission region;

determine a target search region according to preset reference information and the DCI transmission region, wherein the preset reference information comprises a blind detection CCE aggregation level or physical resource configuration information sent by the base station; and

detect target DCI from the target search region according to a preset blind detection CCE aggregation level.