

[6] There is thus a need for communication apparatuses and methods that can solve the above mentioned issue. Furthermore, other desirable features and characteristics will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background of the disclosure.

SUMMARY

[7] This disclosure presents a non-limiting example which facilitates implementation of CORESET#0 for RedCap devices in 5G NR based communications.

[8] In one aspect, the techniques disclosed herein provide a communication apparatus. The communication apparatus comprises a receiver, which in operation, receives a physical downlink control channel (PDCCH) on a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a bandwidth configuration of reduced capability user equipments (RedCap UEs), and receives a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) which is scheduled based on the CORESET#0; and circuitry, which in operation, determines control information and parameters from the PDCCH on CORESET#0 to read SIB1, for initial access, handover, or beam failure recovery, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

[9] In another aspect, the techniques disclosed herein provide a communication apparatus. The communication apparatus includes a base station which comprises circuitry, which in operation, configures a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) based on the CORESET#0; and a transmitter, which in operation, transmits the PDCCH

on CORESET#0 and the SIB1 PDSCH to a communication apparatus, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

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[10] In another aspect, the techniques disclosed herein provide a communication method. The communication method comprises receiving a CORESET#0 of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and RedCap UEs, receiving a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) which is scheduled based on the CORESET#0; and determining control information and parameters from the PDCCH on CORESET#0 to read the SIB1, for initial access, handover, or beam failure recovery, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

[10a] In another aspect, the techniques disclosed herein provide an integrated circuit for controlling a process of a communication apparatus. The process comprises receiving a CORESET#0 of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and RedCap UEs, receiving a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) which is scheduled based on the CORESET#0; and determining control information and parameters from the PDCCH on CORESET#0 to read the SIB1 for initial access, handover, or beam failure recovery, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

[10b] In another aspect, the techniques disclosed herein provide a communication method. The communication method comprises configuring a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1)

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physical downlink shared channel (PDSCH) based on the CORESET#0; and transmitting the PDCCH on CORESET#0 and the SIB1 PDSCH to a communication apparatus, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the
5 CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

[10c] In another aspect, the techniques disclosed herein provide an integrated circuit for controlling a process of a base station. The process comprises configuring a control resource set zero (CORESET#0) of which time and frequency resources are defined
10 based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) based on the CORESET#0; and transmitting the PDCCH on CORESET#0 and the SIB1 PDSCH to
15 a communication apparatus, wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

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

[12] Additional benefits and advantages of the examples in this disclosure will become apparent from the specification and drawings. The benefits and/or advantages
25 may be individually obtained by the various examples 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 THE DRAWINGS

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[13] Embodiments of the disclosure will be better understood and readily apparent to one of ordinary skilled in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

35 [14] Fig. 1 shows an exemplary architecture for a 3GPP NR system.

[15] Fig. 2 is a schematic drawing which shows functional split between NG-RAN and 5GC.

CLAIMS

1. A communication apparatus, comprising:

a receiver, which in operation, receives a physical downlink control
 5 channel (PDCCH) on a control resource set zero (CORESET#0) of which time
 and frequency resources are defined based on a bandwidth configuration of
 reduced capacity user equipments (RedCap UEs), and receives a system
 information block type 1 (SIB1) physical downlink shared channel (PDSCH) which
 is scheduled based on the CORESET#0; and

10 circuitry, which in operation, determines control information and
 parameters from the PDCCH on CORESET#0 to read SIB1 for initial access,
 handover, or beam failure recovery, wherein the RedCap UEs support a
 bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined
 in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of
 15 non-RedCap and RedCap UEs.

2. The communication apparatus according to claim 1, wherein the circuitry is
 configured to discard or ignore control information on the CORESET#0 if the
 CORESET#0 has a larger bandwidth than that of the communication apparatus.

20 3. The communication apparatus according to claim 1, wherein CORESET#0 for
 the RedCap UEs can be a subset of entries of Tables 13.1-13.10 in TS 38.213 or a
 subset of physical resources such as control channel elements (CCEs) or physical
 resource blocks (PRBs) of Rel-15 CORESET#0.

4. The communication apparatus according to claim 1, wherein the CORESET#0 is a subset of a Rel-15 CORESET#0, such that only the subset is available to configure for all types of UEs including normal (non-RedCap) UEs and RedCap UEs in an associated network.

5. The communication apparatus according to claim 1, wherein the CORESET#0 is a Rel-15 CORESET#0 that is partitioned into m equal or unequal subsets such that $m \geq 1$, each subset having a bandwidth that is lesser than that of the RedCap UE.

6. The communication apparatus according to claim 5, wherein each subset is mapped to each of m consecutive slots.

7. The communication apparatus of claim 5, wherein the subsets are mapped to m consecutive slots such that an i th subset of the subsets is mapped in a corresponding slot $n - i$, where $0 \leq i < m$, wherein slot n can be a PDCCH monitoring occasion (slot or symbol) for Rel.15 CORESET#0 or a PDCCH monitoring occasion configured for RedCap UE.

8. The communication apparatus according to claim 1, wherein the CORESET#0 is a Rel-15 CORESET#0 that is partitioned into m equal or unequal subsets such that $m \geq 1$, each subset having a bandwidth that is lesser than that of the RedCap UE;

wherein the Rel-15 CORESET#0 is mapped in a first slot;

wherein each subset is mapped to each slot of $m-1$ consecutive slots different from the first slot.

- 5 9. The communication apparatus according to claim 1, wherein the CORESET#0 is a Rel-15 CORESET#0 that is partitioned into m equal or unequal subsets such that $m \geq 1$, each subset having a bandwidth that is lesser than that of the RedCap UE;

wherein the Rel-15 CORESET#0 is mapped in a slot n ;

- 10 wherein an i th subset is mapped to a corresponding slot $k - i$ such that k is a predefined value and $0 \leq i < m$.

10. The communication apparatus according to claim 1, wherein the CORESET#0 is a Rel-15 CORESET#0, wherein part of the Rel-15 CORESET#0 that is outside
15 of the RedCap UE bandwidth is partitioned into q equal or unequal subset(s) such that $q \geq 1$, each subset having a bandwidth that is lesser than that of the RedCap UE;

wherein the Rel-15 CORESET#0 is mapped in a first slot;

- 20 wherein each subset of the q equal or unequal subset(s) is copied and mapped within the RedCap UE bandwidth in each slot of q consecutive slots different from the first slot.

11. The communication apparatus according to claim 1, wherein the CORESET#0 is a Rel-15 CORESET#0, wherein part of the Rel-15 CORESET#0 that is outside

of the RedCap UE bandwidth is partitioned into q equal or unequal subset(s) such that $q \geq 1$, each subset having a bandwidth that is lesser than that of the RedCap UE;

wherein the Rel-15 CORESET#0 is mapped in a first slot;

5 wherein at each slot of q consecutive slots different from the first slot, only the part of CORESET#0 mapping inside of the BW, where the RedCap UE can monitor, is replaced by an subset of the q equal or unequal subset(s) of the CORESET#0.

10 12. The communication apparatus according to claim 1, wherein information indicating Rel-15 CORESET#0 and PDCCH monitoring occasions for normal UEs is used to present the CORESET#0 for RedCap UEs, the information comprising existing entries in *ControlResourceSetZero* and *SearchSpaceZero* IEs in MIB.

15 13. The communication apparatus according to claim 1, wherein information indicating Rel-15 CORESET#0 and PDCCH monitoring occasions for normal (non-RedCap) UEs, and information indicating CORESET#0 and PDCCH monitoring occasions for RedCap UEs, are configured to be independent from each other, wherein the receiver is configured to receive both information, and
20 wherein the circuitry is configured to determine control information and parameters to read the SIB1 based on the indicated information for normal UEs if the communication apparatus is the normal UE, or based on the indicated information for Redcap UEs if the communication apparatus is the RedCap UE.

14. The communication apparatus according to claim 1, wherein physical resources of CORESET#0 are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and RedCap UEs in a serving cell, wherein the UEs are configured to perform
 5 blind decoding on PDCCH candidates in a search space carried by the CORESET#0 to achieve all control information over one or more consecutive slots depending on the CORESET#0 bandwidth, physical resource mapping schemes, or monitoring occasions.

10 15. A base station, comprising:

circuitry, which in operation, configures a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink
 15 control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) based on the CORESET#0; and

a transmitter, which in operation, transmits the PDCCH on CORESET#0 and the SIB1 PDSCH to a communication apparatus,

20 wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

16. A communication method, comprising:

receiving a CORESET#0 of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and RedCap UEs,

5 receiving a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) which is scheduled based on the CORESET#0; and

determining control information and parameters from the PDCCH on CORESET#0 to read the SIB1 for initial access, handover, or beam failure recovery,

10 wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

17. An integrated circuit for controlling a process of a communication apparatus,

15 the process comprising:

receiving a CORESET#0 of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and RedCap UEs,

20 receiving a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) which is scheduled based on the CORESET#0; and

determining control information and parameters from the PDCCH on CORESET#0 to read the SIB1 for initial access, handover, or beam failure recovery,

wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

- 5 18. A communication method, comprising:

configuring a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) based on the CORESET#0; and

transmitting the PDCCH on CORESET#0 and the SIB1 PDSCH to a communication apparatus,

wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.

19. An integrated circuit for controlling a process of a base station, the process comprising:

configuring a control resource set zero (CORESET#0) of which time and frequency resources are defined based on a minimum bandwidth configuration associated with one or more UEs in a set of normal (non-RedCap) UEs and the RedCap UEs, generates a physical downlink control channel (PDCCH) on the CORESET#0, and schedules a system information block type 1 (SIB1) physical downlink shared channel (PDSCH) based on the CORESET#0; and

transmitting the PDCCH on CORESET#0 and the SIB1 PDSCH to a communication apparatus,

wherein the RedCap UEs support a bandwidth that is at least equal to a maximum bandwidth of CORESET#0 defined in Rel-15/16, and wherein the CORESET#0 is used to configure for all types of non-RedCap and RedCap UEs.