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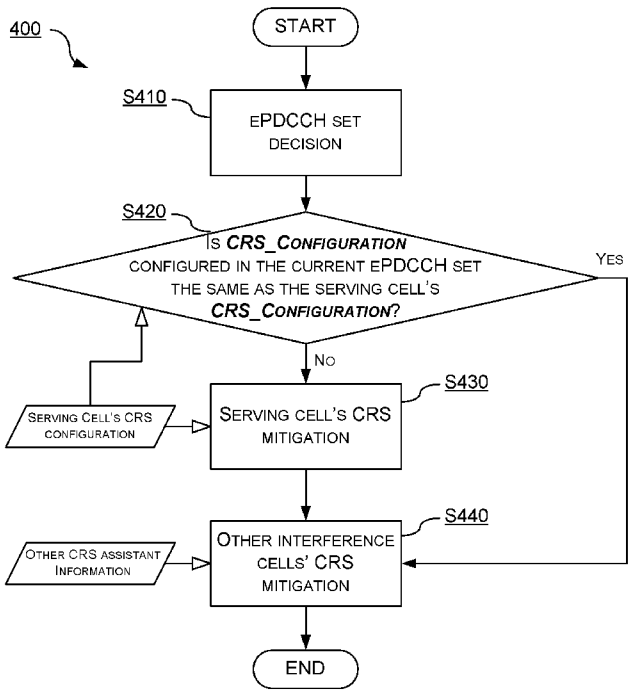
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[Continued on next page]

(54) Title: CRS INTERFERENCE MITIGATION FOR EPDCCH/PDSCH DEMODULATION UNDER COMP

Fig. 4



(57) Abstract: According to the disclosure, there is provided a method for the UE to mitigate Cell-specific Reference Signal (CRS) interference (not only the other interference cells' CRS interference but also the serving cell's CRS interference) during ePDCCH/PDSCH demodulation. In one non-limiting embodiment, a CRS interference mitigation method may include steps of: determining CRS having been configured is not serving cell's CRS; and mitigating interference originating from the serving cell's CRS by referring to serving cell's CRS configuration. The present disclosure also relates to a UE for implementing the above CRS interference mitigation method.

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CRS INTERFERENCE MITIGATION FOR EPDCCH/PDSCH DEMODULATION UNDER COMP

TECHNICAL FIELD

[0001] The disclosure relates to the field of wireless communications, and more particularly, to a scheme for CRS interference mitigation for ePDCCH/PDSCH demodulation under CoMP.

BACKGROUND

[0002] 3GPP has been continuously working on the further evolutions of Long Term Evolution (LTE) to meet the demands for even higher data rates and network capacity. A lot of advanced features have been introduced to enhance the peak data rate, such as Multi-Input Multi-Output (MIMO), Coordinated MultiPoint transmission/reception (CoMP), Carrier Aggregation (CA). However, these techniques mainly target to boost the data channel. With the exploding growth in the number of connections per cell, the control channel capacity becomes the bottleneck of the system performance. The design principles of control channel in early releases are not appropriate any more. Currently 3GPP is working on designing a new control channel, termed as “enhanced PDCCH (ePDCCH)” hereunder.

[0003] The discussions in RAN1 for ePDCCH is ongoing and a lot of details have not yet been decided, e.g. eREG/eCCE to RE mapping, DM-RS antenna port association and scrambling sequence initialization, search space design, PUCCH HARQ-ACK resource allocation for ePDCCH, etc.

[0004] In the ePDCCH discussion, whether to signal the CRS configuration for each ePDCCH set has not been decided in 3GPP. In each ePDCCH set, if the CRS configuration is different from serving cell CRS configuration, how to handle the serving cell CRS and ePDCCH RE mapping is still to be discussed.

SUMMARY

[0005] According to a first aspect of the present disclosure, there is provided a CRS interference mitigation method, including steps of: determining CRS having been configured (excluded in mapping) is not serving cell’s CRS; and mitigating interference originating from the serving cell’s CRS by referring to serving cell’s CRS configuration.

[0006] In one embodiment, the CRS interference mitigation method may further include a step of detecting a current ePDCCH set configuration to determine a CRS configuration (e.g., including cell ID (may be used to determine a scrambling sequence and a CRS shift) and the number of antenna ports) included in the current ePDCCH set configuration.

[0007] In another embodiment, the CRS interference mitigation method may further include a step of acquiring DCI to determine a CRS configuration signaled in the DCI.

[0008] If the determined CRS configuration is not identical to the serving cell's CRS configuration, it is determined that the CRS having been configured is not the serving cell's CRS. Otherwise, if the determined CRS configuration is identical to the serving cell's CRS configuration, it is determined that the CRS having been configured is the serving cell's CRS.

[0009] In still another embodiment, the CRS interference mitigation method may further include a step of mitigating other interference cell's CRS by referring to other CRS assistant information.

[0010] According to a second aspect of the present disclosure, there is provided a User Equipment (UE) including: a CRS mitigation determination unit configured to determine CRS having been configured (excluded in mapping) is not serving cell's CRS; and a CRS mitigation unit configured to mitigate interference originating from the serving cell's CRS by referring to serving cell's CRS configuration.

[0011] In one embodiment, the UE may further include an ePDCCH set detection unit configured to detect a current ePDCCH set configuration to determine a CRS configuration included in the current ePDCCH set configuration.

[0012] In another embodiment, the UE may further include a DCI acquisition unit configured to acquire DCI to determine a CRS configuration signaled in the DCI.

[0013] When the determined CRS configuration is not identical to the serving cell's CRS configuration, the CRS mitigation determination unit determines the CRS having been configured is not the serving cell's CRS. Otherwise, when the determined CRS configuration is identical to the serving cell's CRS configuration, the CRS mitigation determination unit determines the CRS having been

configured is the serving cell's CRS.

[0014] In still another embodiment, the CRS mitigation unit is further configured to mitigate other interference cell's CRS by referring to other CRS assistant information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The above and other objects, features and advantages of the present disclosure will be clearer from the following detailed description about the non-limited embodiments of the present disclosure taken in conjunction with the accompanied drawings, in which:

Figure 1A is a schematic diagram showing ePDCCH mapped around neighbor cell CRS;

Figure 1B is a schematic diagram showing serving cell's CRS mapping;

Figure 2 is a schematic diagram explaining the received data at the UE side with the ePDCCH shown in Figure 1A and the serving cell's CRS shown in Figure 1B;

Figure 3 shows a block diagram of UE 300 which has the capability of mitigating the serving cell CRS interference for ePDCCH demodulation;

Figure 4 shows a flowchart of the CRS interference mitigation method 400 for ePDCCH demodulation according to the present disclosure;

Figure 5 shows a block diagram of UE 500 which has the capability of mitigating the serving cell CRS interference for PDSCH demodulation; and

Figure 6 shows a flowchart of the CRS interference mitigation method 600 for PDSCH demodulation according to the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0016] Hereunder, the embodiments of the present disclosure will be described in accordance with the drawings. In the following description, some particular embodiments are used for the purpose of description only, which shall not be understood as any limitation to the present disclosure but the examples thereof. While it may blur the understanding of the present disclosure, the conventional structure or construction will be omitted.

[0017] Different from PDCCH processing, ePDCCH processing needs to handle each ePDCCH set and their corresponding eCCEs individually. In PDCCH processing, the CCEs from each encoded PDCCH are concatenated and cell specific scrambling is applied before modulation, interleaving and a cell specific cyclic shift. The interleaving and cell specific cyclic shift of the interleaved sequence enables exploitation of frequency diversity and inter-cell interference randomization respectively.

[0018] For ePDCCH processing on the other hand, the eCCE to RE mapping is pre-determined within the set of ePDCCH resources as soon as the eCCE index is known. Hence, there is no need for interleaving multiple ePDCCH transmissions (*cf.* Reference [1]). It should be noted that scrambling can be UE specific (*cf.* Reference [2]).

[0019] The remaining issue is how to perform the mapping of the encoded bits to REs. As already being agreed, an RE that collides with any other signal is not used for ePDCCH, and code chain rate matching is used around CRS and the region up to the PDSCH starting position. Furthermore, one of the main applicable situations of ePDCCH is operation with large Cell Range Expansion (CRE) where received CRS power from neighboring cell could be significantly larger than CRS power received from serving cell. Therefore, the possibility to map ePDCCH around the CRS from a neighboring cell instead of the serving cell would provide a significant performance benefit for the ePDCCH for UE with large CRE. This principle has already been agreed for PDSCH in the CoMP WI and it can be envisioned that the same benefit can be given to the ePDCCH. A difference is that dynamic signaling is not possible; however, for ePDCCH we have the structure of ePDCCH sets where a set can be associated with ePDCCH transmissions from a certain transmission point. Therefore, it should be possible to configure, per set, which CRS that should be excluded in the ePDCCH mapping. Hence, in configuration of an ePDCCH set, one CRS configuration is possible signaled. UE may know that, the CRS RE to which the ePDCCH is not mapped is the CRS signaled by the configuration.

[0020] In order to support dynamic point selection or dynamic point blanking, the mapping of ePDCCH is proposed to be around the CRS from a neighbor cell instead of the serving cell (*cf.* Reference [1]). In large cell range extension scenarios, this provides significant performance benefit for ePDCCH.

[0021] Assume the serving cell CellId=1 and the neighbor cell CellId=0. If ePDCCH is mapped around neighbor cell CRS, the mapping is shown in Figure 1A. However, the serving cell's CRS shall be always transmitted in order to support legacy UE and other UEs using CRS, as shown in Figure 1B. In this case, the serving cell CRS would be the interference to the ePDCCH. In Figure 2, the received data at the UE side is shown. From Figure 2, the REs polluted by serving cell CRS (termed as "CRS-polluted REs" hereunder) are marked with bold-edged blocks. In the CRS-polluted REs, not only ePDCCH is received, but also the serving cell CRS is received.

[0022] The CRS-polluted REs have to cope with a new interference scenario: the interference comes from its own serving cell's CRS instead of other cells' CRS. In traditional CRS interference mitigation, such as CRS mitigation in FeICIC, the mitigated CRS is always coming from neighbor cells. The configuration is semi-static. But in this case, the CRS interference comes from its own serving cell, and it is dynamically changed from subframe to subframe. For these new interference scenarios, UE need new procedure to handle this kind of interference.

[0023] This disclosure provides a method for the UE to mitigate CRS interference (not only the other interference cells' CRS interference but also the serving cell's CRS interference) during ePDCCH/PDSCH demodulation. For ePDCCH set where the associated CRS configuration is different from serving cell, ePDCCH should be mapped around signaled CRS configuration instead of the serving cell's CRS. This results in that the serving cell CRS will interfere the ePDCCH transmitted from another transmission point. This is different from traditional scenarios and thus new UE behavior should be specified to handle the interference for ePDCCH reception. We propose that the UE should mitigate the interference from its own serving cell's CRS if the configured CRS configuration in the ePDCCH configuration is not the same as the serving cell. With the introduction of this interference mitigation, the ePDCCH demodulation performance can be improved. As found and proposed by the inventors, the similar cases are also true for PDSCH.

[0024] For identifying whether the serving cell's CRS is interfering the ePDCCH or PDSCH, the parameter CRS configuration (e.g., including cell ID (may be used to determine a scrambling sequence and a CRS shift) and the number of antenna ports), denoted as "***CRS_Configuration***" hereunder, may be used. Each

configuration of an ePDCCH set contains a ***CRS_Configuration*** to signal/identify a CRS configuration (which CRS that should be excluded in the ePDCCH mapping) as well as the number of antenna ports. Slightly different, for PDSCH, a ***CRS_Configuration*** is contained in DCI to signal/identify a CRS configuration (which CRS that should be excluded in the PDSCH mapping) as well as the number of antenna ports. Therefore, with a comparison of the ***CRS_Configuration*** of each ePDCCH set configuration (or the ***CRS_Configuration*** of DCI for each PDSCH configuration) and the ***CRS_Configuration*** of its own serving cell, a UE may identify whether the serving cell's CRS is interfering the ePDCCH or PDSCH.

[0025] In this case,

- ✧ UE shall assume CRS of serving cell is interference for ePDCCH decoding when the configured ***CRS_Configuration*** in this ePDCCH set is different from serving cell's ***CRS_Configuration***; or
- ✧ UE shall assume CRS of serving cell is interference for PDSCH decoding when the signaled ***CRS_Configuration*** in DCI is different from serving cell's ***CRS_Configuration***.

CRS mitigation for ePDCCH under CoMP

[0026] For ePDCCH, in order to support dynamic point selection and other CoMP schemes, it should be possible to configure, per set, which CRS that should be excluded in the ePDCCH mapping. In each configuration of an ePDCCH set, one CRS configuration (i.e., which CRS that should be excluded in the PDSCH mapping) is signaled (the CRS configuration can be identified/signaled by a parameter, ***CRS_Configuration***, of the cell transmitting the CRS to be excluded). When the CellId configured in some ePDCCH set is not the same as the serving cell's CellId, the serving cell's CRS will interfere some ePDCCH REs, as previously shown in Figure 2. In order to improve the CRS-polluted REs detection performance, the serving cell CRS interference can be mitigated.

[0027] Figure 3 shows a block diagram of UE 300 which has the capability of mitigating the serving cell CRS interference for ePDCCH demodulation.

[0028] As shown in Figure 3, the UE 300 may include an ePDCCH set detection unit 310, a CRS mitigation determination unit 320, and a CRS mitigation unit 330.

[0029] The ePDCCH set detection unit 310 detects a current ePDCCH set configuration, in particularly, a ***CRS_Configuration*** included in the current ePDCCH set configuration (in the corresponding CRS configuration information) can be determined.

[0030] The CRS mitigation determination unit 320 can determine whether the CRS is to be mitigated or not. For the serving cell's CRS, the CRS mitigation determination unit 320 determines whether the ***CRS_Configuration*** detected by the ePDCCH set detection unit 310 is the same as the UE's serving cell's ***CRS_Configuration***. If the two ***CRS_Configurations*** are identical, it means that the ePDCCH is coming from the UE's serving cell and there is no need to mitigate the serving cell's CRS (because the ePDCCH is around the serving cell's CRS and the serving cell's CRS do not interfere the ePDCCH). On the other hand, if the two ***CRS_Configurations*** are not identical, it means the ePDCCH is coming from a neighbor cell but not the serving cell and there is a need to mitigate the serving cell's CRS (*cf.* Figure 2). In both cases, the CRS mitigation determination unit 320 may further determine whether some other interference cell CRS need to be mitigated, for example, by referring to other CRS assistant information (which can be obtained from ***NeighCellsCRSInfo-r11*** defined in 3GPP TS 36.331).

[0031] The CRS mitigation unit 330 is used for mitigating either or both of the serving cell's CRS and the other interference cell's CRS according to the determination results from the CRS mitigation determination unit 320. Any existing CRS interference mitigation techniques can be applicable to the serving cell's CRS and/or the other interference cell's CRS.

[0032] Thereafter, the CRS mitigation unit 330 can provide the data from which the CRS interference has been mitigated, for the subsequent ePDCCH demodulation.

[0033] Figure 4 shows a flowchart of the CRS interference mitigation method 400 for ePDCCH demodulation according to the present disclosure.

[0034] According to Figure 4, the following steps for CRS interference mitigation may be included.

- ✧ Step S410, "ePDCCH set decision", UE (e.g., UE 300 in Figure 3) can decide which ePDCCH set will be explored for ePDCCH according to pre-defined rule (monitoring the search space), and extract the corresponding CRS

configuration information (including the ***CRS_Configuration***).

- ✧ Step S420, "Is ***CRS_Configuration*** configured in the current ePDCCH set the same as the serving cell's ***CRS_Configuration***?", UE can decide whether the serving cell's CRS is interfering the ePDCCH or not.
  If the configured ***CRS_Configuration*** obtained in Step S410 is the same as the serving cell's ***CRS_Configuration***, it can predict ePDCCH is transmitted from the serving cell. Serving cell's CRS is not interference. Then, the procedure goes to Step S440.
  If the configured ***CRS_Configuration*** obtained in Step S410 is not the same as the serving cell's ***CRS_Configuration***, it can predict ePDCCH is transmitted from a neighbor cell, and the serving cell's CRS is interference. Serving cell's CRS interference needs to be mitigated. Then, the procedure goes to Step S430.

- ✧ Step S430, "Serving cell's CRS mitigation", with the information of its serving cell's CRS configuration, the UE can perform serving cell's CRS mitigation. In one non-limiting example, the UE can perform channel estimation, recover the CRS signal and subtract the CRS from the received data at the corresponding CRS REs before ePDCCH demodulation. Any existing CRS interference mitigation techniques can be applied in this step.

- ✧ Step S440, "Other interference cells' CRS mitigation", besides the possible serving cell's CRS interference, some other interference cells' CRS can also be mitigated, e.g. by any existing CRS interference mitigation techniques, same or different from that used in Step S430 for the serving cell's CRS mitigation. These CRS assistant information can be obtained from ***NeighCellsCRSInfo-r11*** defined in 3GPP TS 36.331.

[0035] After the CRS interference mitigation procedure 400 described above, the ePDCCH can be demodulated.

[0036] Based on the above procedure 400, the CRS to be mitigated can be dynamically changed from subframe to subframe. The change can be based on the ePDCCH transmission set, which is different from any traditional CRS mitigation method.

Signaling for ePDCCH Demodulation

[0037] With the CRS interference mitigation procedure 400 described above, the corresponding new signaling for ePDCCH demodulation may be provided as follows.

[0038] The IE ***ePDCCHCRSInfo-r11*** is used to provide CRS RE information for ePDCCH resource mapping.

```
ePDCCHCRSInfo-r11::=      CHOICE {
   release                          NULL,
   setup                            ePDCCHCRS-InfoList-r11
}

ePDCCHCRS-InfoList-r11::= SEQUENCE (SIZE (1.. maxCellReport)) OF
ePDCCHCRSInfo-r11

ePDCCHCRSInfo-r11::= SEQUENCE {
   physCellId-r11                PhysCellId,
   antennaPortsCount-r11         ENUMERATED {an1, an2, an4, spare1}
}
```

NeighCellsCRSInfo-r11 Field Descriptions

ePDCCHCRS-InfoList-r11 This field contains a list of CRS configurations, each CRS configuration corresponding to one ePDCCH set configuration. ***maxCellReport*** is the number of ePDCCH sets.
physCellId-r11 This field contains CRS RE information for ePDCCH resource mapping.
antennaPortsCount-r11 This field indicates the number of antenna ports of the given CRS configuration, ***an1***, ***an2*** and ***an4*** indicate 1, 2 and 4 antenna ports respectively.

[0039] When the ***physCellId-r11*** is not the same as serving cell's cell ID and/or the ***antennaPortsCount-r11*** is not the same as serving cell's number of antenna ports, the serving cell's CRS may be assumed as interference for ePDCCH demodulation.

CRS mitigation for PDSCH under CoMP

[0040] Similar to the CRS mitigation for ePDCCH under CoMP, the present disclosure also relates to the CRS mitigation for PDSCH demodulation. For PDSCH, the CRS configuration can be obtained from DCI.

[0041] Figure 5 shows a block diagram of UE 500 which has the capability of mitigating the serving cell CRS interference for PDSCH demodulation. Figure 5 is similar to Figure 3. Therefore, those elements with the same or similar functions are denoted with the same or similar reference signs, and the detailed descriptions are omitted when appropriate and for the purpose of simplification only.

[0042] As shown in Figure 5, the UE 500 may include a DCI acquisition unit 510, a CRS mitigation determination unit 520, and a CRS mitigation unit 530.

[0043] The DCI acquisition unit 510 acquires DCI, in particularly, a ***CRS_Configuration*** signaled in the DCI (e.g., in the corresponding CRS configuration information) can be determined.

[0044] The CRS mitigation determination unit 520 can determine whether the CRS is to be mitigated or not. For the serving cell's CRS, the CRS mitigation determination unit 520 determines whether the ***CRS_Configuration*** acquired by the DCI acquisition unit 510 is the same as the UE's serving cell's ***CRS_Configuration***. If the two ***CRS_Configurations*** are identical, it means that the PDSCH is coming from the UE's serving cell and there is no need to mitigate the serving cell's CRS (because the serving cell's CRS do not interfere the PDSCH). On the other hand, if the two ***CRS_Configurations*** are not identical, it means the PDSCH is coming from a neighbor cell but not the serving cell and there is a need to mitigate the serving cell's CRS. In both cases, the CRS mitigation determination unit 520 may further determine whether some other interference cell CRS need to be mitigated, for example, by referring to other CRS assistant information (which can be obtained from ***NeighCellsCRSInfo-r11*** defined in 3GPP TS 36.331).

[0045] The CRS mitigation unit 530 is used for mitigating either or both of the serving cell's CRS and the other interference cell's CRS according to the determination results from the CRS mitigation determination unit 520. Any existing CRS interference mitigation techniques can be applicable to the serving cell's CRS and/or the other interference cell's CRS.

[0046] Thereafter, the CRS mitigation unit 530 can provide the data from which the CRS interference has been mitigated, for the subsequent PDSCH demodulation.

[0047] Figure 6 shows a flowchart of the CRS interference mitigation method 600 for ePDCCH demodulation according to the present disclosure. Figure 6 is similar to Figure 4. Therefore, those elements with the same or similar functions are denoted with the same or similar reference signs, and the detailed descriptions are omitted when appropriate and for the purpose of simplification only.

[0048] According to Figure 6, the following steps CRS interference mitigation may be included.

- Step S610, "DCI acquisition", UE (e.g., UE 500 in Figure 5) can acquire DCI by monitoring its search space and get the corresponding CRS configuration information (including the ***CRS_Configuration***) from its DCI.

- Step S620, "Is ***CRS_Configuration*** signaled in the DCI the same as the serving cell's ***CRS_Configuration***?", UE can decide whether the serving cell's CRS is interfering the PDSCH or not.
  If the signaled ***CRS_Configuration*** obtained in Step S610 is the same as the serving cell's ***CRS_Configuration***, it can predict PDSCH is transmitted from the serving cell. Serving cell's CRS is not interference. Then, the procedure goes to Step S640.
  If the signaled ***CRS_Configuration*** obtained in Step S610 is not the same as the serving cell's ***CRS_Configuration***, it can predict PDSCH is transmitted from a neighbor cell, and the serving cell's CRS is interference. Serving cell's CRS interference needs to be mitigated. Then, the procedure goes to Step S630.

- Step S630, "Serving cell's CRS mitigation", with the information of its serving cell's CRS configuration, the UE can perform serving cell's CRS mitigation. In

one non-limiting example, the UE can perform channel estimation, recover the CRS signal and subtract the CRS from the received data at the CRS-polluted REs before PDSCH demodulation. Any existing CRS interference mitigation techniques can be applied in this step.

- ✧ Step S640, "Other interference cells' CRS mitigation", besides the possible serving cell's CRS interference, some other interference cells' CRS can also be mitigated, e.g. by any existing CRS interference mitigation techniques, same or different from that used in Step S430 for the serving cell's CRS mitigation. These CRS assistant information can be obtained from ***NeighCellsCRSInfo-r11*** defined in 3GPP TS 36.331.

[0049] After the CRS interference mitigation procedure 600 described above, the PDSCH can be demodulated.

[0050] Based on the above procedure 600, the CRS to be mitigated can be dynamically changed from subframe to subframe. The change can be based on the CRS configuration signaled in the DCI, which is different from any traditional CRS mitigation method.

[0051] With the present disclosure, for ePDCCH/PDSCH, when the configured/signaled CRS configuration is not the same as serving cell's CRS configuration, significant performance improvement can be achieved.

[0052] The foregoing description gives only the preferred embodiments of the present disclosure and is not intended to limit the present disclosure in any way. Thus, any modification, substitution, improvement or like made within the spirit and principle of the present disclosure should be encompassed by the scope of the present disclosure.

ABBREVIATIONS

3GPP	3rd Generation Partnership Project
CA	Carrier Aggregation
CoMP	Coordinated MultiPoint transmission/reception
CRE	Cell Range Expansion
CRS	Cell-specific Reference Signal
DM-RS	DeModulation Reference Signal
eCCE	enhanced Control Channel Element
ePDCCH	enhanced Physical Downlink Control CHannel
eREG	enhanced Resource Element Group
FeICIC	Further enhanced Inter Cell Interference Coordination
HARQ	Hybrid Automatic Repeat reQuest
IE	Information Element
LTE	Long Term Evolution
MIMO	Multi-Input Multi-Output
PDSCH	Physical Downlink Shared CHannel
PUCCH	Physical Uplink Control CHannel
RE	Resource Element
WI	Work Item

REFERENCES

[1] 3GPP TSG-RAN WG1 #70bis, R1-124149, “Mapping of ePDCCH to RE”, Ericsson, ST-Ericsson; and

[2] 3GPP TSG-RAN WG1 #70bis, R1-124159, “On resolving ePDCCH aggregation level ambiguity.”, Ericsson, ST-Ericsson.

What is claimed is:

1. A Cell-specific Reference Signal (CRS) interference mitigation method, comprising steps of:

determining CRS having been configured is not serving cell's CRS; and

mitigating interference originating from the serving cell's CRS by referring to serving cell's CRS configuration.

2. The CRS interference mitigation method according to claim 1, further comprising a step of detecting a current enhanced Physical Downlink Control CHannel (ePDCCH) set configuration to determine a CRS configuration included in the current ePDCCH set configuration.

3. The CRS interference mitigation method according to claim 1, further comprising a step of acquiring Downlink Control Information (DCI) to determine a CRS configuration signaled in the DCI.

4. The CRS interference mitigation method according to claim 2 or 3, wherein if the determined CRS configuration is not identical to the serving cell's CRS configuration, it is determined that the CRS having been configured is not the serving cell's CRS.

5. The CRS interference mitigation method according to claim 2 or 3, wherein if the determined CRS configuration is identical to the serving cell's CRS configuration, it is determined that the CRS having been configured is the serving cell's CRS.

6. The CRS interference mitigation method according to any of claims 1-5, further comprising a step of mitigating other interference cell's CRS by referring to other CRS assistant information.

7. A User Equipment (UE), comprising:

a Cell-specific Reference Signal (CRS) mitigation determination unit configured to determine CRS having been configured is not serving cell's CRS; and

a CRS mitigation unit configured to mitigate interference originating from the serving cell's CRS by referring to serving cell's CRS configuration.

8. The UE according to claim 7, further comprising:

an enhanced Physical Downlink Control CHannel (ePDCCH) set detection unit configured to detect a current ePDCCH set configuration to determine a CRS configuration included in the current ePDCCH set configuration.

9. The UE according to claim 7, further comprising:

a Downlink Control Information (DCI) acquisition unit configured to acquire DCI to determine a CRS configuration signaled in the DCI.

10. The UE according to claim 8 or 9, wherein when the determined CRS configuration is not identical to the serving cell's CRS configuration, the CRS mitigation determination unit determines the CRS having been configured is not the serving cell's CRS.

11. The UE according to claim 8 or 9, wherein when the determined CRS configuration is identical to the serving cell's CRS configuration, the CRS mitigation determination unit determines the CRS having been configured is the serving cell's CRS.

12. The UE according to any of claims 7-11, wherein the CRS mitigation unit is further configured to mitigate other interference cell's CRS by referring to other CRS assistant information.

Fig. 1A

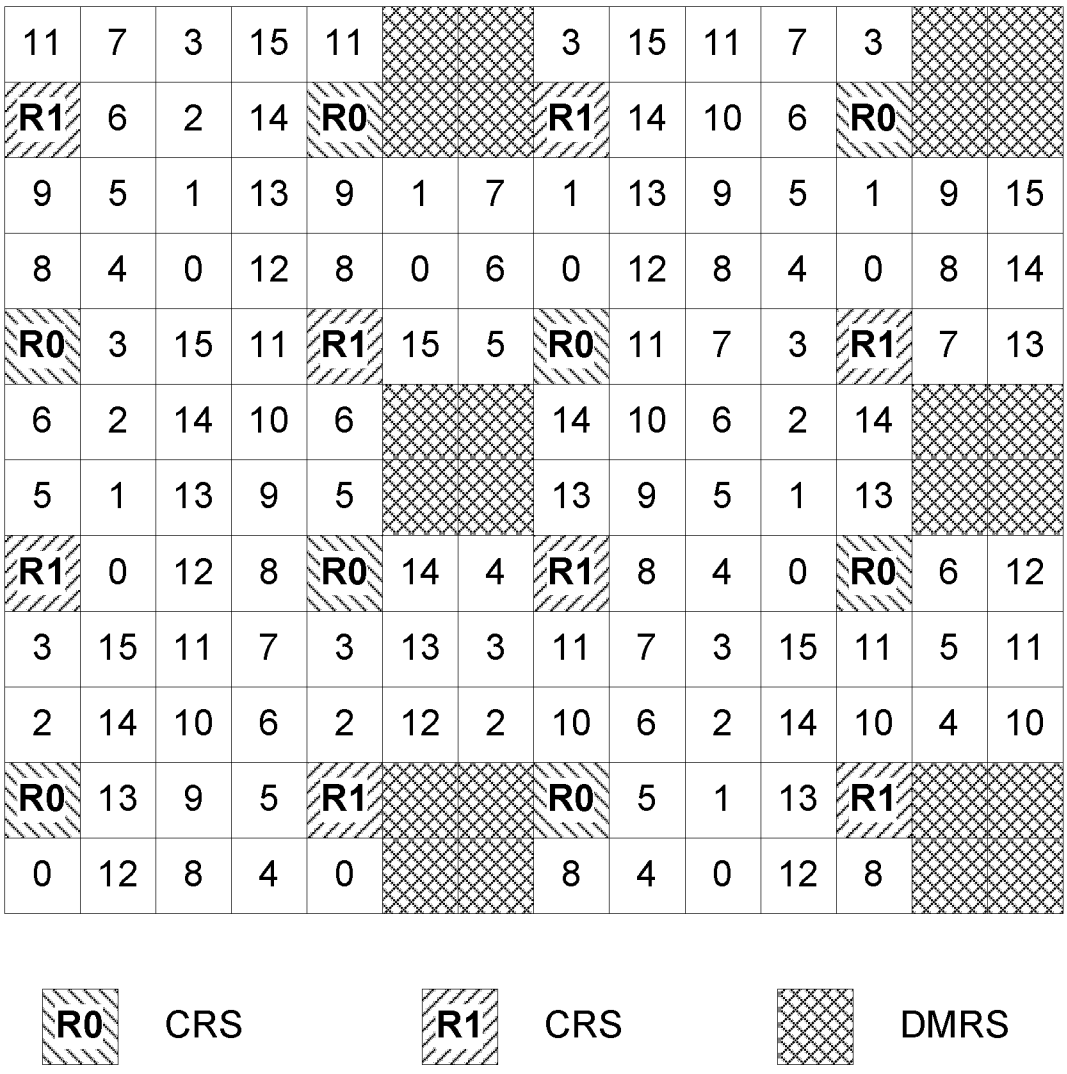

11 7 3 15 11 3 15 11 7 3
R1 6 2 14 R0 R1 14 10 6 R0
9 5 1 13 9 1 7 1 13 9 5 1 9 15
8 4 0 12 8 0 6 0 12 8 4 0 8 14
R0 3 15 11 R1 15 5 R0 11 7 3 R1 7 13
6 2 14 10 6 14 10 6 2 14
5 1 13 9 5 13 9 5 1 13
R1 0 12 8 R0 14 4 R1 8 4 0 R0 6 12
3 15 11 7 3 13 3 11 7 3 15 11 5 11
2 14 10 6 2 12 2 10 6 2 14 10 4 10
R0 13 9 5 R1 R0 5 1 13 R1
0 12 8 4 0 8 4 0 12 8
R0 CRS
R1 CRS
DMRS

Fig. 1B

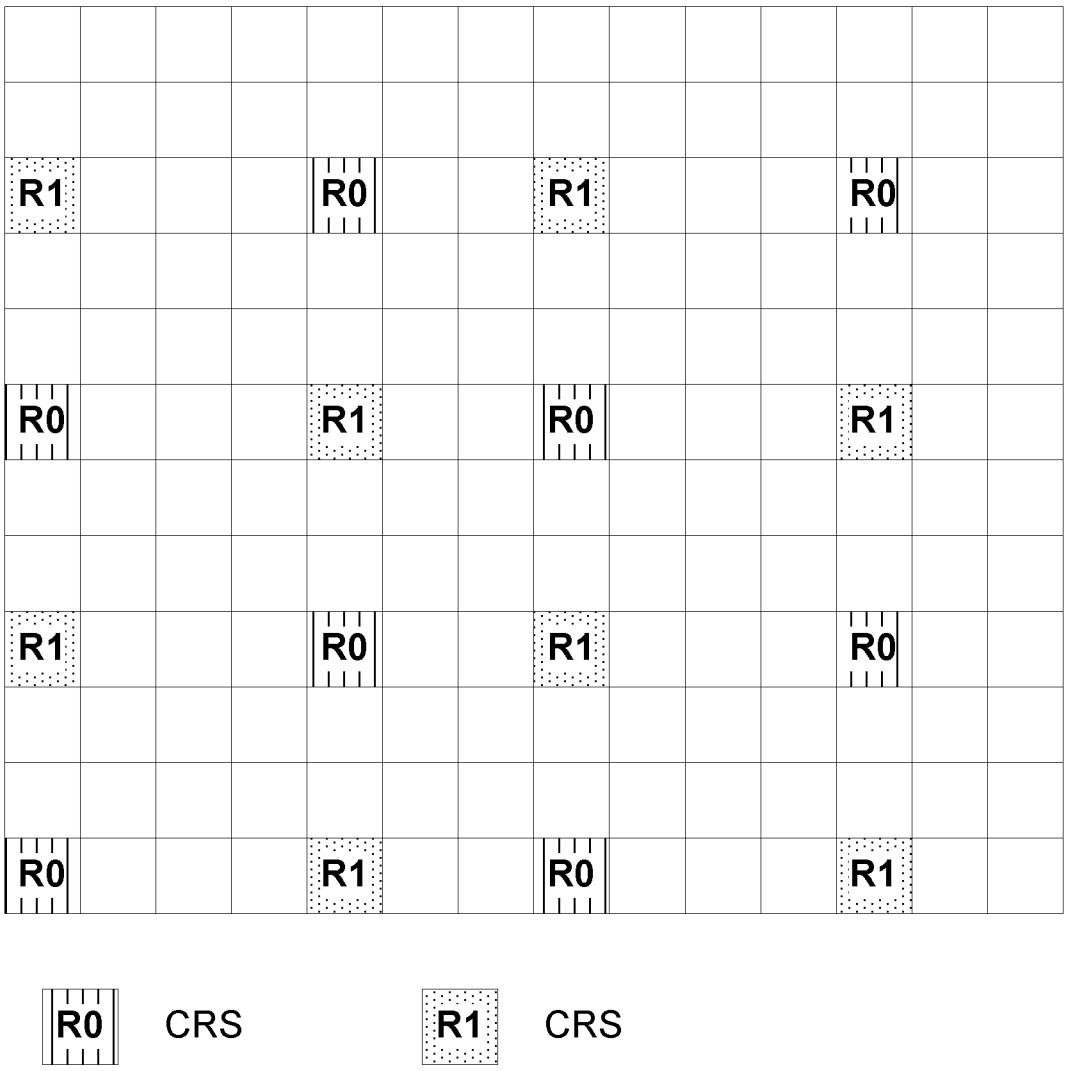


Fig. 2

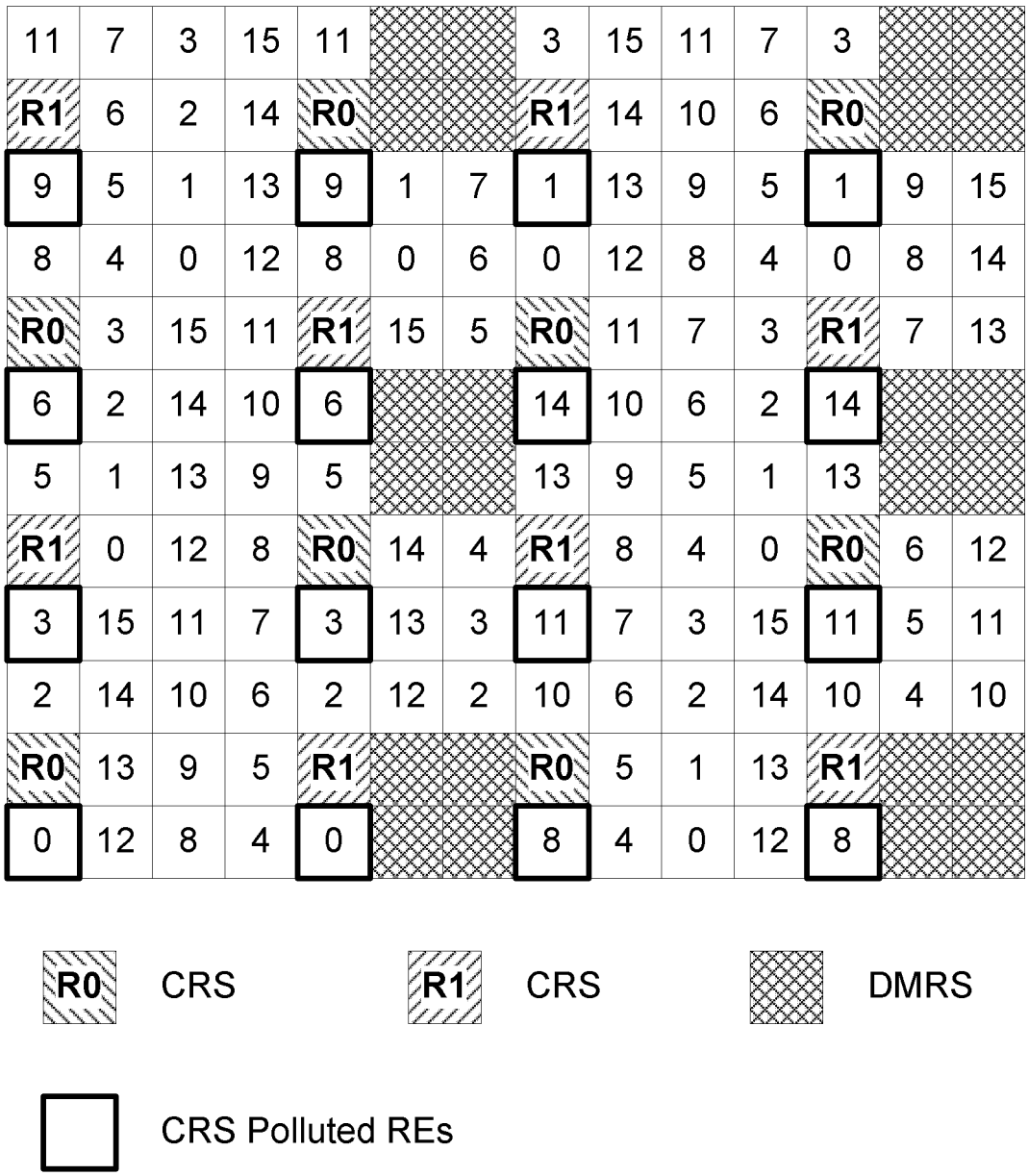

11 7 3 15 11 3 15 11 7 3
R1 6 2 14 R0 R1 14 10 6 R0
9 5 1 13 9 1 7 1 13 9 5 1 9 15
8 4 0 12 8 0 6 0 12 8 4 0 8 14
R0 3 15 11 R1 15 5 R0 11 7 3 R1 7 13
6 2 14 10 6 14 10 6 2 14
5 1 13 9 5 13 9 5 1 13
R1 0 12 8 R0 14 4 R1 8 4 0 R0 6 12
3 15 11 7 3 13 3 11 7 3 15 11 5 11
2 14 10 6 2 12 2 10 6 2 14 10 4 10
R0 13 9 5 R1 R0 5 1 13 R1
0 12 8 4 0 8 4 0 12 8
R0 CRS
R1 CRS
DMRS
CRS Polluted REs

Fig. 3

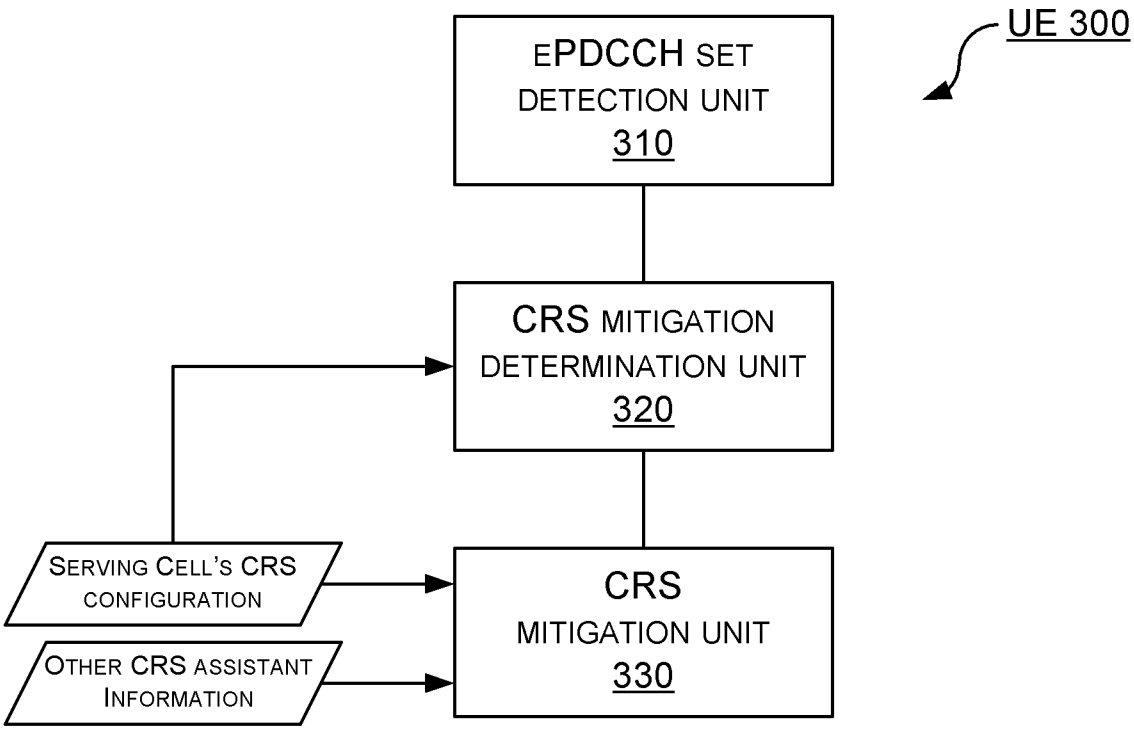

UE 300
EPDCCH SET DETECTION UNIT 310
CRS MITIGATION DETERMINATION UNIT 320
CRS MITIGATION UNIT 330
SERVING CELL'S CRS CONFIGURATION
OTHER CRS ASSISTANT INFORMATION

Fig. 4

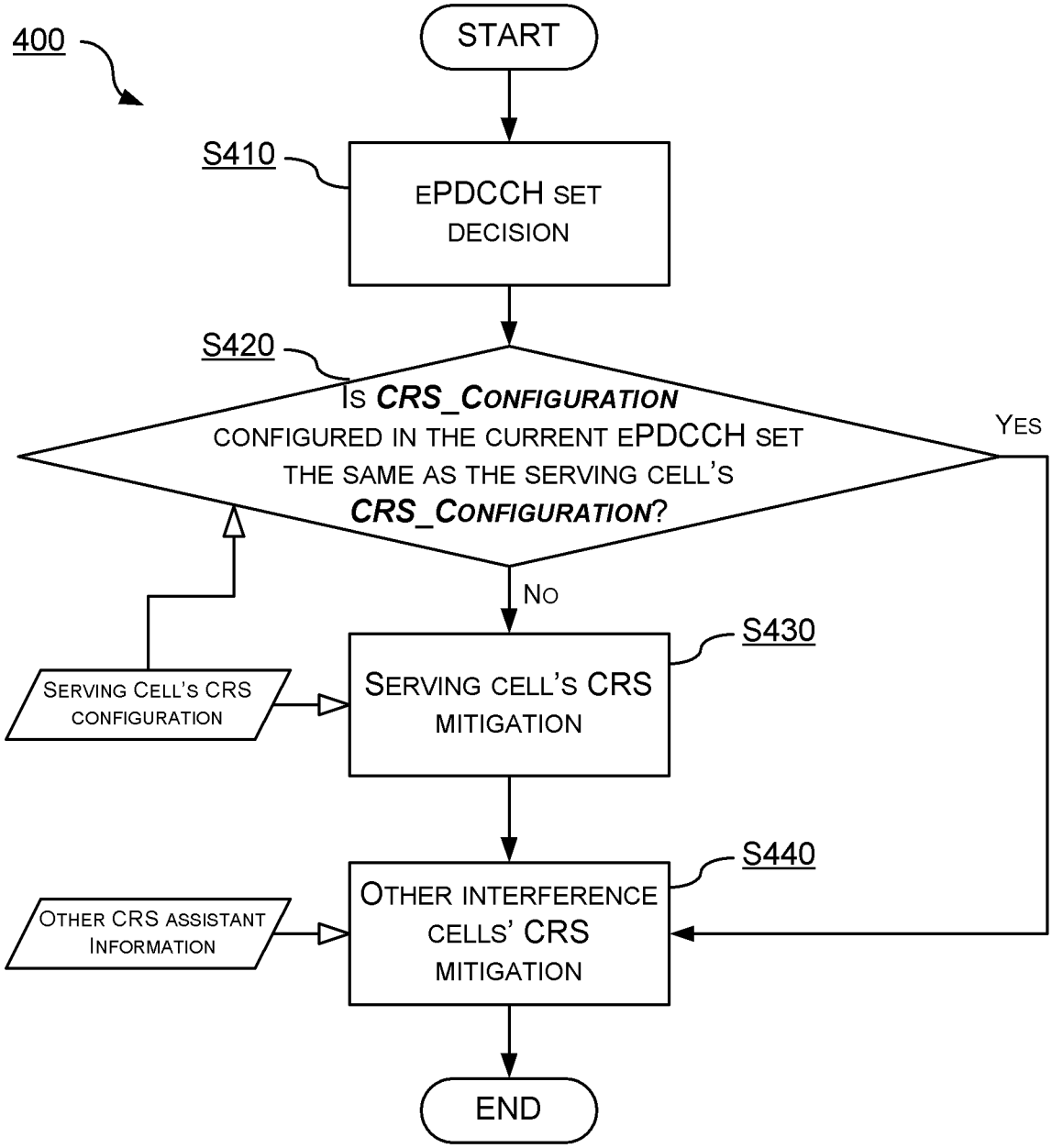

400
START
S410
EPDCCH SET DECISION
S420
IS CRS_CONFIGURATION CONFIGURED IN THE CURRENT EPDCCH SET THE SAME AS THE SERVING CELL'S CRS_CONFIGURATION?
YES
NO
S430
SERVING CELL'S CRS MITIGATION
SERVING CELL'S CRS CONFIGURATION
S440
OTHER INTERFERENCE CELLS' CRS MITIGATION
OTHER CRS ASSISTANT INFORMATION
END

Fig. 5

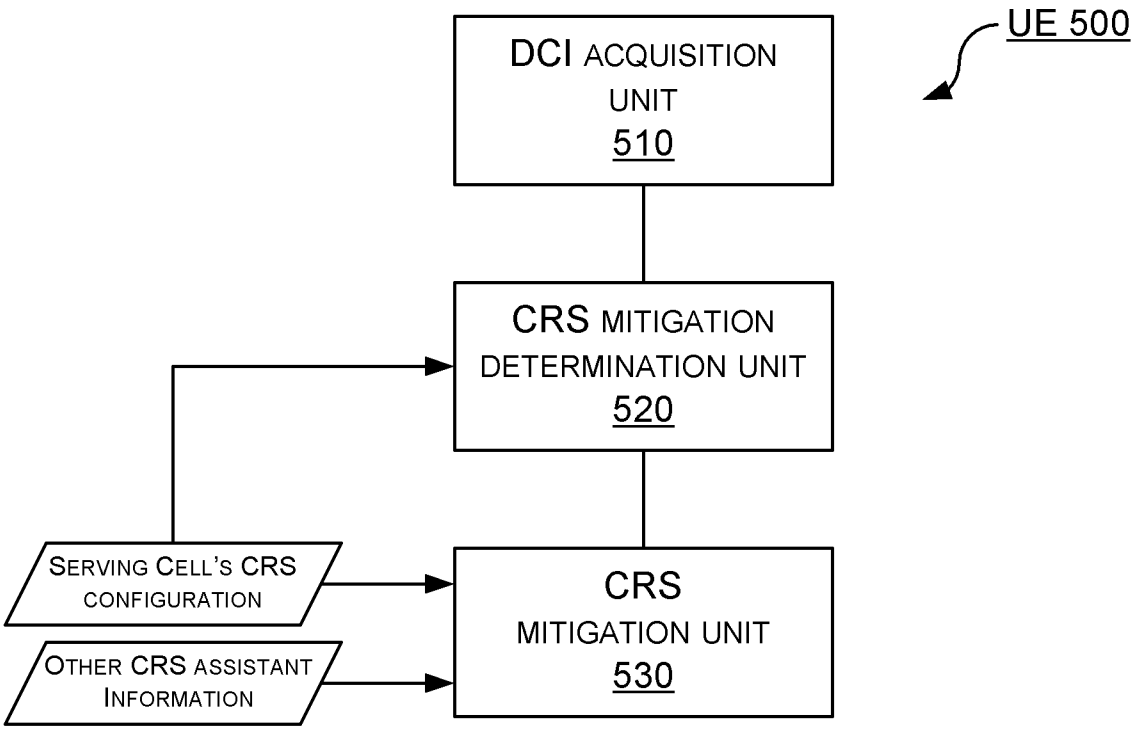
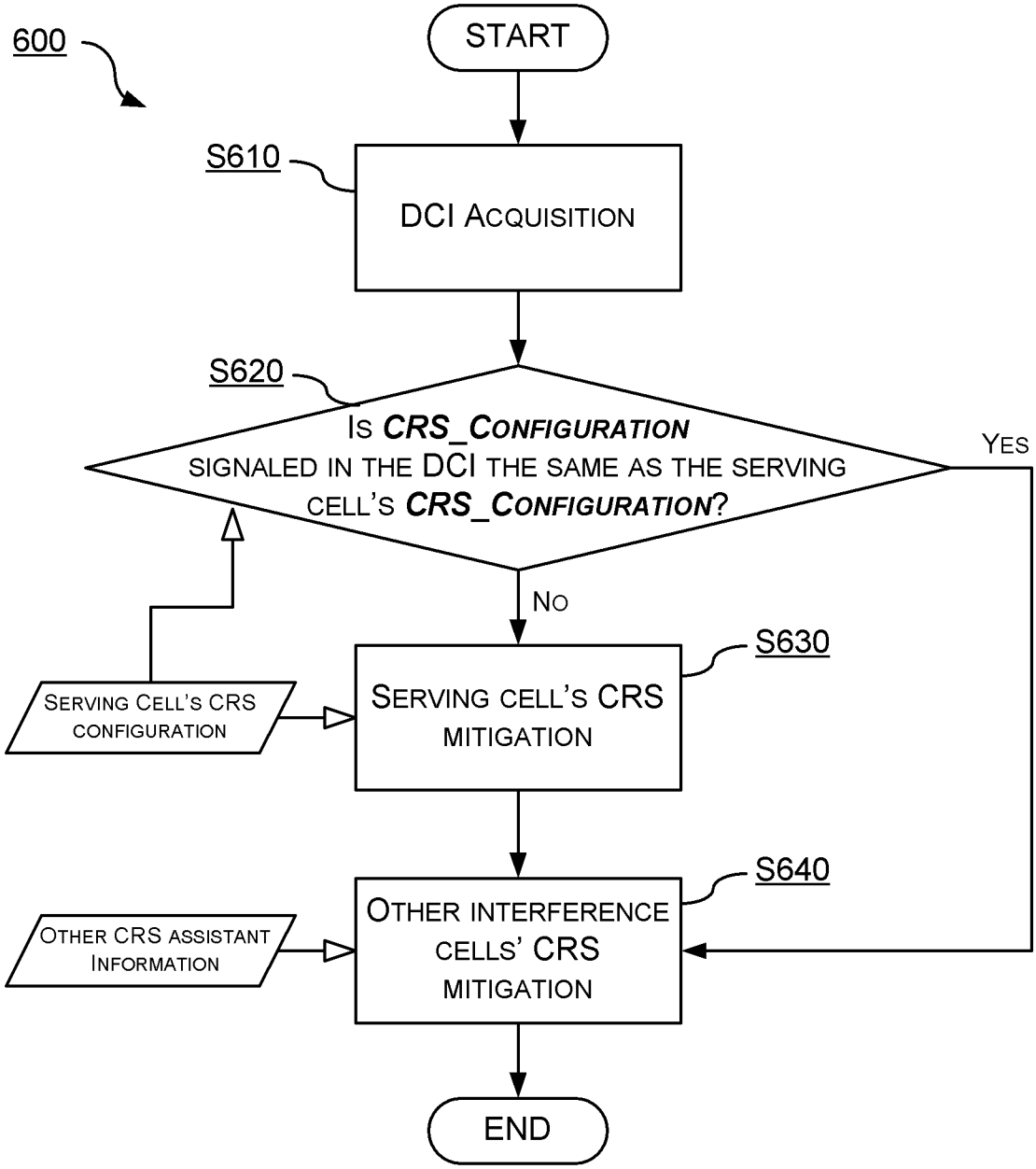

UE 500
DCI ACQUISITION UNIT 510
CRS MITIGATION DETERMINATION UNIT 520
CRS MITIGATION UNIT 530
SERVING CELL'S CRS CONFIGURATION
OTHER CRS ASSISTANT INFORMATION

Fig. 6


600
START
S610
DCI ACQUISITION
S620
IS CRS_CONFIGURATION SIGNALED IN THE DCI THE SAME AS THE SERVING CELL'S CRS_CONFIGURATION?
YES
NO
SERVING CELL'S CRS CONFIGURATION
S630
SERVING CELL'S CRS MITIGATION
S640
OTHER CRS ASSISTANT INFORMATION
OTHER INTERFERENCE CELLS' CRS MITIGATION
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/082529

A. CLASSIFICATION OF SUBJECT MATTER

H04W 36/16(2009.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04L, H04Q, H04W, H04M, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, CNPAT, CNKI: CRS, cell w reference w signal, interference

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO2011130451A1 (QUALCOMM INCORPORATED) 20 Oct. 2011(20.10.2011) description paragraph [0062], claim 1, figure 8	1-12
A	CN102300244A (ZTE CORPORATION) 28 Dec. 2011(28.12.2011) the whole document	1-12
A	WO2011137314A1 (QUALCOMM INCORPORATED) 03 Nov. 2011(03.11.2011) the whole document	1-12

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 May 2013(30.05.2013)	**27 Jun. 2013 (27.06.2013)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer CHEN, Yao Telephone No. (86-10)62413512

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/082529

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2011130451 A1	20.10.2011	US 2012082022 A1	05.04.2012
		CA 2794304 A1	20.10.2011
		KR 20120139847 A	27.12.2012
		EP 2559310 A1	20.02.2013
		SG 184170 A	30.10.2012
		CN 102907157 A	30.01.2013
CN 102300244 A	28.12.2011	WO 2012155520 A1	22.11.2012
WO 2011137314 A1	03.11.2011	US 2011267937 A1	03.11.2011
		KR 20130009860 A	23.01.2013
		EP 2564546 A1	06.03.2013
		CN 102959894 A	06.03.2013