3GPP TSG-RAN WG3 Meeting #110-e R3-206884

E-meeting, 2 – 12 November, 2020

**Agenda item: 10.2.2**

**Source: Huawei (moderator)**

**Title: CB: # 1008\_SONMDT\_CCO - Summary of email discussion**

**Document for: Approval**

# 1 Introduction

This paper provides summary of discussions at RAN#110-e on:

**CB: # 1008\_SONMDT\_CCO**

**- Topics to discuss:**

 **- Beam related information**

 **- Cell shaping and beam shaping**

 **- gNB-DU is responsible to modify the coverage of an NR cell?**

 **- gNB-CU-CP is responsible for CCO issue detection?**

 **- Transfer of coverage measurements collected at the cell border**

 **- NR coverage modification triggered by LTE for improved EN-DC connectivity**

 **- Xn and F1 signaling details**

 **- May also discuss other topics based on contributions**

**- Propose to have the discussion in two phases; if there are agreements in the first phase, can proceed to discuss TPs in the second phase**

(HW - moderator)

Summary of offline disc [R3-206884](file:///D%3A%5C3gpp%E4%BC%9A%E8%AE%AE%5CRAN3%5CRAN3%23110%5Cdraft%5CCB%20%23%201008_SONMDT_CCO%5CInbox%5CR3-206884.zip)

Initial comments is received by Thursday, Nov. 5, 8:00 UTC. This will be presented as an intermediate summary, and will be submitted to the inbox for the online discussion starting at Thursday, Nov. 5, 13:00 UTC

# 2 For the Chairman’s Notes

These are the proposed agreements after 1st round

Moderator's note: In this proposal there is an attempt to clean up previous agreements while adding new to simplify future discussions. This leads to a slightly complicated summary part, but with the hope that this will help future work.

**Xn**

* First part is regarding the general functionality the signalling shall support. There seems to be agreement to support MRO, but not yet an agreement to support mutual coverage adjustments
	+ New: The CCO signalling over Xn supports MRO to adapt to changes resulting from CCO.
	+ New: Whether the CCO signalling over Xn should also support the mutual coverage adjustment in the receiving node is FFS
* Regarding supporting beam optimisation, there seems to be agreement to support this functionality, but the signalling is still FFS. This was previously captured in two places in agreements. One of the previous open issue is replaced with an agreement and an open issue, and one of the previous agreements are simplified (FFS removed):
	+ Old: *FFS (on impact/usefulness) whether to support SSB beam coverage optimizations in NR CCO for beam coverage switching, SSB beam shaping/splitting/merging scenarios*
	+ Remove: Whether to include SSB beam information for NR cell (on top of cell info) is FFS.
	+ New: The CCO signalling over Xn supports SSB beam coverage optimizations.
	+ New: *FFS whether CCO signalling over Xn is signalled as separate per cell state information and SSB state information or whether each cell state reflect a specific SSB configuration*
* Regarding forwarding of MDT information, there is no consensus, so this is added as an open issue.
	+ New: FFS whether forwarding of collected MDT information over Xn is supported

**F1**

* Regarding the roles, there is no agreement on who decides on the correction. To emphasize this, an agreement is added and an open issue is replaced
	+ New: Correction of CCO issues is performed by the gNB-DU
	+ The following open issue is replaced:
		- Old:  *FFS whether CCO Assistance Information is needed over F1AP for CU-CP to indicate gNB-DU with the type of CCO issue detected*
		- New: *FFS who decides on CCO changes: gNB-DU autonomously, gnB-DU assisted by gNB-CU, or gNB-CU.*

**X2**

It seems there is agreement to down-prioritize this. The previous open issue is replaced with an agreement:

* Old: *FFS whether EN-DC CCO Support over X2 is needed and should be deprioritized w.r.t CCO support in NR SA scenarios*
* New: *EN-DC CCO Support over X2 is should be deprioritized w.r.t CCO support in NR SA scenarios*

This would leave us with the following end result (changes above incorporated in the list of agreements so far (included to give the full picture):

E-UTRAN CCO function should be considered as baseline for NG-RAN CCO solution for dynamic coverage changes with an index-based solution for coverage switching among deployment options

In NG-RAN scenario, a NG-RAN node may send to a neighbor NG-RAN node a coverage modification list which includes deployment related information concerning the serving cells.

Exchange at least NG-RAN CGI, Cell Coverage State, Cell Deployment Status Indicator, Cell Replacing Info in NG-RAN NODE CONFIGURATION UPDATE message over Xn for coverage modification

DU signals to CU coverage related configuration information. Whether to include SSB beam information (on top of cell info) is FFS.

CSI-RS based beam coverage tuning is an optimization and is not covered as part of NR CCO for Rel-17

The CCO signalling over Xn supports MRO to adapt to changes resulting from CCO.
The CCO signalling over Xn supports SSB beam coverage optimizations.

Correction of CCO issues is performed by the gNB-DU

EN-DC CCO Support over X2 is should be deprioritized w.r.t CCO support in NR SA scenarios

*Open issues:*

*FFS Whether the CCO signalling over Xn should also support the mutual coverage adjustment in the receiving node*

*FFS whether CCO signalling over Xn is signalled as separate per cell state information and SSB state information or whether each cell state reflect a specific SSB configuration*

*FFS who decides on CCO changes: gNB-DU autonomously, gnB-DU assisted by gNB-CU, or gNB-CU.*

*FFS whether forwarding of collected MDT information over Xn is supported*

# 3 Discussion

## 3.1 Xn functionality and related signalling

Applicable agreements and open issues listed below

**Agreements:**

E-UTRAN CCO function should be considered as baseline for NG-RAN CCO solution for dynamic coverage changes with an index-based solution for coverage switching among deployment options

In NG-RAN scenario, a NG-RAN node may send to a neighbor NG-RAN node a coverage modification list which includes deployment related information concerning the serving cells. Whether to include SSB beam information for NR cell (on top of cell info) is FFS.

Exchange at least NG-RAN CGI, Cell Coverage State, Cell Deployment Status Indicator, Cell Replacing Info in NG-RAN NODE CONFIGURATION UPDATE message over Xn for coverage modification

***Open issues:***

*FFS (on impact/usefulness) whether to support SSB beam coverage optimizations in NR CCO for beam coverage switching, SSB beam shaping/splitting/merging scenarios*

### 3.1.1 General

The agreement so far is to include E-UTRAN CCO function should be considered as baseline. This baseline functionality entails informing neighbour nodes about coverage changes to improve the MRO performance. This is expressed as signalling different states so that MRO can retrieve a previously stored states (e.g. including statistics).

Another possibility would be to use this information for other purposes, e.g. to trigger matching coverage modifications in the receiving node as discussed in R3-206514.

**Question: Is this baseline functionality enough over Xn? Any other functionality to be discussed?**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei | This baseline functionality is enough. If we exchange coverage to have matching coverage actions in another node we have to express this in a way that conveys the coverage impact at the receiving side or use some form of cross node coordination of OAM. This is not described in the proposed solution. This was discussed for LTE but not pursued. |
| CATT | Prefer to support basic function for CCO which is similar with LTE and then discuss other aspects later |
| CMCC | Similar view as CATT. |
| Ericsson | The LTE functionality is based on the aspects described in R3-206514. Namely, if a RAN node receives a new cell coverage state indication from a neighbour node, the receiving node may use it to adjust its cell coverage state accordingly. This was discussed during CCO for LTE discussions. We therefore do not see why the possibility of coverage coordination between nodes, based on a coverage state indication should be excluded. Namely, if a node decides to extend coverage of its cell in a way that this coverage overlaps that of a neighbour cell in a neighbour RAN node, why should we exclude that the neighbour RAN node can modify the coverage of its cells to match the new neighbour cell shape?Besides, we should not limit possible enhancements for NG RAN, only because we need to mirror at all costs LTE.  |
| Deutsche Telekom | Similar view as Ericsson. We support to discuss also the features listed under Open Issues w.r.t. SSB beam coverage optimizations (as also addressed in R3-206514). |
| BT | Possibility of coverage coordination should be included. |
| Nokia | Apart from agreeing that DU is responsible for beam management (Proposal 1 in 6514), since it is obvious as BM is carried out on MAC layer, Nokia does not support proposals in 6514, First of all, it should be mentioned that the topic is not about CCO per se, but about method to guarantee a proper MRO functionality after coverage adaptations resulting from CCO. The considered baseline functionality on sharing coverage changes (splitting/merging/shaping) with neighbouring nodes as defined for LTE to allow MRO instances to adapt to deployment changes of surrounding cells might be sufficient if handover would only be triggered by cell-specific RSRP measurements as it is true for LTE. But NR is using SS-RS and even allows CSI-RS measurements for mobility. Even though currently a quasi cell-specific measurement is derived from SSB beam measurements, it is not forbidden to use pure SS-RSRP or even CSI-RSRP measurements for mobility, i.e. also MRO instances have to adapt to these measurement types. For future-proof MRO concepts within NR, Nokia thinks that SSB beam information will be needed. |
| Qualcomm | We also support introducing beam related coverage coordination in addition to the baseline LTE CCO functionality. |
| ZTE | Same view with CATT and CMCC, the basic CCO function should be supported, and then we can consider the further step. |
| Samsung | Same view with CATT, CMCC and ZTE, the basic CCO function should be supported, and then we can consider the further step. |

### 3.1.2 Beam information

With NR, the concept of beams are introduced.

**Question: Do we need to include signalling of beam information over Xn to cover the basic functionality described in 3.1.1?**

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| --- | --- |
| Company | Comment |
| Huawei | Different beam configurations can be expressed as different cell states. It is very important to keep the number of states in a controllable low level since it directly relates to different MRO states. It is however important to discuss the range of states. In LTE it is 16 per cell. We may want to extend to e.g. 32, but the number should be kept low.The reason is that it is impossible for the receiving node to know how to group these states. The receiver cannot know how large modification is done for each state. Hence, the receiver cannot make any assumptions like, state X is similar to state X+1 and the statistics can therefore be re-used for both. |
| CATT | Not quite sure.We have sympathy with Huawei that we should consider the complexity of introducing beam level configuration. Different cell state could already represent different beam configurations. |
| CMCC | See benefits to include beam information, and agree to FFS on the range of states. |
| Ericsson | We see benefits in per beam granularity. The discussion on the number of states is independent on the one for per SSB area configuration states. One of the differences between E-UTRAN and NG-RAN is the fact that cells are structured according to beam areas in NG-RAN. In order to make the CCO function fit for NR, we need to account for beam level granularity. It is much simpler to indicate that e.g. a cell shape change regarded only one beam in a cell rather than the whole cell. This more granular per beam indication helps to better understand how mobility policies should be adapted and how coverage coordination should be achieved between nodes.  |
| Deutsche Telekom | Similar view as Ericsson and CMCC w.r.t. benefits of beam information. Nevertheless, more clarification seems to be needed w.r.t. cell states and SSB area configuration states to keep the state numbers manageable. |
| BT |  Same view as CMCC/ Deutsche Telekom & Ericsson, we see benefits in per beam granularity and to further study the range of states. |
| Nokia | As mentioned above, we believe that a future-proof NR MRO might need the information on changes related to SSB beams in cells served by neighbouring nodes. |
| Qualcomm | Yes, we see benefits in including beam level information in NG-RAN CCO. |
| ZTE | Beam information could be considered for CCO, but the detail should be further studied. |
| Samsung | Same view as Huawei and CATT. Cell coverage state already considered the beam coverage. Beam coverage information is not helpful for MRO state retrieve. |

**Question: Do we need to include signalling of beam information over Xn to cover any new functionality described in 3.1.1**

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| --- | --- |
| Company | Comment |
| Ericsson | We believe that per beam granularity information over Xn is beneficial. Mobility in NG-RAN is based on a per beam granularity. To understand how to adapt mobility policies due to a coverage state change, we need to know how coverage changes per beam. |
| Deutsche Telekom | Same view as Ericsson. |
| BT | Yes, where beam granularity is introduced |
| Nokia | As mentioned above, we believe that a future-proof NR MRO might need the information on changes related to SSB beams in cells served by neighbouring nodes. |
| Qualcomm | Yes |

### 3.1.2 Forwarding of collected MDT information

R3-206514 propose to introduce a mechanism to exchange collected MDT information between nodes over Xn.

**Question: Can we agree to exchange collected MDT information between nodes over Xn**

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| --- | --- |
| Company | Comment |
| HW | We think this is not needed. The benefit is unclear. The current available measurments should be enough |
| Ericsson | We think this is needed. A cell in a RAN node does not have visibility over the UE measurements taken by UEs served by a neighbour cell and at the neighbour cell’s edge. In the figure above, gNB1 can deduce from the measurements received by UE2 that there is a coverage hole between Cell A and Cell B. This information is otherwise not derivable by gNB1 and for that a CCO action cannot be taken before failures are experienced and before an analysis of failure information is carried out. |
| Deutsche Telekom | We support the approach introduced in R3-206514. |
| BT  | We support the inclusion of MDT data as additional information to detect CCO issues. |
| Nokia | Such information exchange is not needed. The information is already available in the OAM (via the TCE), which defines the coverage states. |
| Qualcomm | We agree with Nokia as well. A centralized approach to handle CCO function is a preferable approach rather than just communicating locally between the NG-RAN nodes. Also will have Xn signalling impact with the introduction of new messages. |
| ZTE | Share the view with Nokia and Qualcomm. |
| Samsung | Share the view with Nokia, Qualcomm and ZTE. |

## 3.2 F1 functionality and related signalling

Applicable agreements and open issues listed below

**Agreements:**

DU signals to CU coverage related configuration information. Whether to include SSB beam information (on top of cell info) is FFS.

***Open issues:***

*FFS (on impact/usefulness) whether to support SSB beam coverage optimizations in NR CCO for beam coverage switching, SSB beam shaping/splitting/merging scenarios*

*FFS whether CCO Assistance Information is needed over F1AP for CU-CP to indicate gNB-DU with the type of CCO issue detected*

### 3.2.1 General

We have the agreement that DU informs the CU about coverage related information. A minimal subset of information would be to provide the same information as is exchanged with neighbour nodes over Xn. This is needed since the CU needs to send this information to neighbour nodes.

**Question: Can we agree that the DU (at least) sends the same information to CU as agreed to be exchanged over Xn.**

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| --- | --- |
| Company | Comment |
| HW | Yes |
| CATT | Yes |
| CMCC | Yes |
| Ericsson | We agree with the principle, but we need to reformulate the sentence to make it clear. We understand that the intention is to confirm the following:*The gNB-DU will signal to the gNB-CU information concerning coverage states that need to be propagated over the Xn to neighbour nodes* |
| Deutsche Telekom | Yes.  |
| BT  | Yes |
| Nokia | No, we believe that F1 and Xn signalling will serve different purposes. As already mentioned, the information sharing over Xn helps other SON functions like MRO to adapt on coverage deployment changes carried out under responsibility of CCO.Furthermore, the CCO functionality which is finally responsible for cell deployment changes would be typically placed more centrally, for instance in CU or even in NM domain. DU would execute the parameter configuration setting resulting in beam / cell coverage change. Running many distributed CCO instances on each DU is unrealistic and hardly efficient. Therefore, we believe that the DU should be instructed in terms of cell / beam adaptations by the CU and not vice versa. |
| Qualcomm | We share similar concerns as Nokia. Although DU is the node responsible which runs the beam management functionalities and has control on the cell coverage, CU is the node which is aware of UE reported serving cell/beam and neighbour cell/beam measurements and also gets the RLF/RACH reports from UE. Hence CU can decide what cell/beam level coverage adaptations can be done by selecting an appropriate cell/beam coverage state and then inform the DU to do the actual coverage changes. |
| ZTE | Yes |
| Samsung | Yes. Beam information are not needed. |

### 3.2.2 Detection of coverage issues

As mentioned in the open issues, it is to be discussed whether CCO assistance information is needed from CU to DU. But one first step is probably to further clarify the roles. Although not explicitly mentioned, it is assumed (by the moderator) that we can agree that the decision on corrections is performed in the DU. But it is probably good to also explicitly agree on this.

**Question: who is responsible for correcting the CCO issues, CU or DU**

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| --- | --- |
| Company | Comment |
| HW | The DU owns the radio resources and is responsible for correcting any CCO issue |
| CATT | Agree with Huawei |
| CMCC | Agree with HW and CATT. |
| Ericsson | The header of this section is entitled “detection of coverage issue” but the question is “**who is responsible for correcting the CCO issues, CU or DU**”We therefore propose to add the following question “**who is responsible for detecting the CCO issues, CU or DU**”If we add this question, then we can give the following answers:- Detection of a CCO issue can only be performed by a node that has visibility over L3 measurements, e.g. neighbour cell measurements. That node is the gNB-CU, hence**Detection of CCO issues is performed by the gNB-CU**Correction of CCO issues can only be performed by the node that owns the management of cell coverage and shaping functions. That node is the gNB-DU, hence **Correction of CCO issues is performed by the gNB-DU**We propose to agree to the above statements. |
| Deutsche Telekom | Same view as Ericsson. Responsibility for correction of CCO issues is at DU, but a trigger for any action may come by the CU-CP. Differentiation required if a CCO issue addresses just an intra-DU aspect or inter-DU/intra-gNB and inter-gNB.  |
| BT | Preference for Ericsson proposal where the gNB-CU is performs the detection of CCO issue & correction is performed by DU |
| Nokia | The CCO instance is responsible of coverage adaptation resulting from cell / beam changes, and this CCO instance should be hosted in CU or even on NM layer. |
| Qualcomm | Although we agree DU is the node that owns the management of cell coverage and shaping functions, what happens in case two different DUs indicate coverage state modifications to CU which will worsen the coverage (i.e. no coordination among DUs exist).We think the entire CCO function (detection and correction) can be performed by the centralized entity CU alone which can then inform DU to effect the actual coverage changes. |
| ZTE | Share the view with Huawei. |
| Samsung | Share the view with Huawei CATT CMCC and ZTE. |

Next step is to discuss whether the DU has enough information to do this analysis, and whether he would benefit from additional information from the CU. This may e.g. include assistance information where the CU performs an analysis and sends the result to the DU. Note that in this case it may also be necessary to provide additional information from the DU to the CU to let the CU perform such analysis, i.e. the question below relates to information in both directions to/from the DU.

Note: In this question the moderator have assumed the agreement is that the DU is responsible for correcting CCO issues. If this is not agreeable, please outline the alternative preferred solution in the comments below.

**Question: Is additional information exchange Over F1 needed?**

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| --- | --- |
| Company | Comment |
| HW | We think the DU can do the analysis. The DU will e.g. receive RLF reports related to mobility problems |
| Ericsson | The gNB-DU has no visibility over L3 measurements, i.e. neighbour cell measurements. For that gNB-DU is not aware of whether e.g. a coverage hole exists between neighbour cells, or if a hotspot of UEs at cell border is creating excessive interference on a neighbour cell. Instead, the gNB-CU is aware about L3 measurements.It is true that in case of RLF, the gNB-DU may be forwarded an RLF Report. However, relying only on RLF reports would reduce the CCO function to a reactive function, where issues due to coverage and capacity can never be resolved before failures occur. Therefore, we support that the gNB-CU detect CCO issues and indicates to the gNB-DU the occurrence of the issue and the cells involved in it. |
| Deutsche Telekom | We have a preference for the solution described in R3-206514, that CU-CP is responsible for CCO issue detection (consideration of CCO issues for both intra-gNB and inter-gNB) and initiation of CCO issue resolution towards the DU. |
| BT | Agree with Ericsson and Deutsche Telekom |
| Nokia | As mentioned above, the CCO instance should run more centralized (e.g. in CU) and not distributed over multiple DUs which leads to explosion of signalling. |
| Qualcomm | CU can inform the DU the coverage state which it should change for CCO purposes using F1AP signalling. No other assistance information is needed as CU takes all the decisions |

## 3.3 X2 functionality and related signalling

Applicable agreements and open issues listed below

*FFS whether EN-DC CCO Support over X2 is needed and should be deprioritized w.r.t CCO support in NR SA scenarios*

Here the question is whether there is any need for supporting CCO over X2. Regarding the basic functionality related to MRO, there is no direct impact. Hence the question is if there is any interest in additional functionality. One example is described in R3-206520.

**Question: Is there any interest in additional X2 functionality and in that case what?**

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| --- | --- |
| Company | Comment |
| HW | We prefer to downprioritize this |
| Ericsson | Agree with Huawei |
| Deutsche Telekom | Primary focus should be on NG-RAN with Xn interface, but this may also cover other architecture options as Opt 2 (e.g. Opt 4 with different RATs). |
| Nokia | CCO functionality is not needed for EN-DC in Rel-17. |
| Qualcomm | Yes not needed in Rel-17 |
| ZTE | Low priority |
| Samsung | Low priority |