3GPP TSG-RAN WG2 #113b-e R2-210xxxx

Electronic Meeting, 12th Apr – 20th Apr 2021

**Agenda item: 5.4.2**

**Source: Nokia**

**Title: Summary of [Post113-e][008][NR15] 4-layer MIMO in EN-DC for Cat5 UEs (Nokia)**

**WID/SID: NR\_newRAT-Core**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion:

5.4.2 LTE changes related to NR

* [Post113-e][008][NR15] 4-layer MIMO in EN-DC for Cat5 UEs (Nokia)

 Scope: Handling of 4-layer MIMO in EN-DC for Cat5 UEs, baseline is [AT113-e][008] [R2-2100946](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100946.zip), collect opinions to decide way forward. Can also discuss

 Intended outcome: Report

 Deadline: Long

During the RAN2#113-e meeting, the following was input contribution for this IoDT issue

[R2-2100946](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2100946.zip) Handling of 4-layer MIMO in EN-DC for Cat5 UEs Nokia, Nokia Shanghai Bell discussion Rel-15 NR\_newRAT-Core

An email discussion was held with the summary in [R2-2102444](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2102444.zip) for the discussion

* [Offline-008][NR15] LTE changes (Nokia)

# 2 **Discussion**

Based on the discussion during RAN2#113-e, the following proposal requires further discussion:

**Proposal 1**: RAN2 to clarify what is the correct interpretation on LTE RI bit width for Cat5 UEs in EN-DC out of the following options:

* Option 1) The UE always used 2-bit RI bit width (even if it only supports 2-layer MIMO in EN-DC mode)
* Option 2) The used RI bit width depend on the maximum support MIMO layers, i.e. if UE only supports 2 layers in EN-DC, it will use 1-bit RI bit width in EN-DC mode (and it uses 2-bit RI in LTE-only mode).

**Question 1**: Do companies agree to the Proposal 1? Please explain your reasoning as well.

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| Answers to Question 1 |
| Company | Yes/No | Comments |
| Samsung | - | From our understanding, something similar to Option 1–but not exactly same as in Option 1–is the correct interpretation.According to TS 36.212 v15.4.0,

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| 5.2.2.6 Channel coding of control information…For rank indication (RI) (RI only, joint report of RI and i1, joint report of CRI and RI, joint report of CRI, RI and i1, joint report of CRI, RI, and PTI, joint report of RI and i1,p-2, and joint report of RI and PTI) or CRI - …- The corresponding bit widths for RI feedback for PDSCH transmissions are given by Tables 5.2.2.6.1-2, 5.2.2.6.1-2B, 5.2.2.6.1-2D, 5.2.2.6.1-2E, 5.2.2.6.1-2F, 5.2.2.6.2-3, 5.2.2.6.2-3B, 5.2.2.6.2-3D, 5.2.2.6.2-3E, 5.2.2.6.2-3F, 5.2.2.6.3-3, 5.2.2.6.3-3B, 5.2.2.6.3-3D, 5.2.2.6.3-3E, 5.2.2.6.3-3F, 5.2.3.3.1-3, 5.2.3.3.1-3A, 5.2.3.3.1-3B, 5.2.3.3.1-3B-1, 5.2.3.3.1-3C, 5.2.3.3.1-3D, 5.2.3.3.1-3F, 5.2.3.3.1-3G, 5.2.3.3.1-3I, 5.2.3.3.1-3J, 5.2.3.3.1-5, 5.2.3.3.2-4, 5.2.3.3.2-4A, 5.2.3.3.2-4B, 5.2.3.3.2-4C, 5.2.3.3.2-4D, 5.2.3.3.2-4F, 5.2.3.3.2-4G and 5.2.3.3.2-4I which are determined assuming the maximum number of layers as follows: - If the *maxLayersMIMO-r10* is configured for the DL cell, the maximum number of layers for subframe operation is determined according to *maxLayersMIMO-r10* for the DL cell.- …- Else,- …- Otherwise the maximum number of layers is determined according to the minimum of the number of PBCH antenna ports and *ue-Category* (without suffix).… |

From our understanding, RI bit width is not dependent on the *fourLayerTM3-TM4*, but is only based on the text above, as in legacy LTE. Hence, for determination of the RI bit width, UE follows *maxLayersMIMO-r10* if configured, but otherwise it depends on the number of PBCH antenna ports and *ue-Category*. That is, if the number of CRS port is four, then two bits (as in Option 1), but if not, it is one bit.Hence, we can simply confirm that RI bit width for EN-DC is determined according to TS 36.212 subclause 5.2.2.6 as in legacy LTE only mode, and no specification changes are needed.  |
| MediaTek | - | We believe that rank indication is designed by RAN1 and also the quoted text by Samsung is from RAN1 SPEC. Therefore, we would suggest to discuss this in RAN1 instead of RAN2. At least request RAN1 to confirm our assumption. |
| CATT |  | We agree that this is mainly R1 topic to clarify. So we’d prefer that any potential conclusion in R2 should base on R1 input. So it is better that this discussion is initiated in R1. |
| Nokia, Nokia Shanghai Bell | Yes (P1 with the Samsung clarification) | We agree with Samsung that the number of PBCH antenna ports does influence the RI bith width, thanks for clarifying that: Our initial thinking was aimed for the case where PBCH antenna ports = 4 (since that's the case when 2-bit RI bit width makes any difference to system performance). But better be clear in this.**[Rapporteur]**The rapporteur proposes sending a LS to RAN1 on this but would explain to RAN1 that this has an interpretation in RAN2 which stems from the RAN2 decision to not mandate 4-layer MIMO in EN-DC as the UE capability may be limited compared to LTE SA. We agree with others that since the cited part from RAN1 specification needs to be discussed in RAN1 for full interpretation, it is relevant to check with them that the RAN2 interpretation is consistent and correct and an LS asking this (i.e. asking for a "yes/no"-answer to the interpretation) would be sensible. We provided an example of such a draft LS in Annex B based on the option1 and Samsung corrections to that. |
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# 3 Conclusion

Thanks to all the companies for their valuable inputs. It seems the common consensus is to query RAN1 about the behavior. The rapporteur proposes sending a LS to RAN1 on this but would explain to RAN1 that this has an interpretation in RAN2 which stems from the RAN2 decision to not mandate 4-layer MIMO in EN-DC as the UE capability may be limited compared to LTE SA. We agree with others that since the cited part from RAN1 specification needs to be discussed in RAN1 for full interpretation, it is relevant to check with them that the RAN2 interpretation is consistent and correct and an LS asking this (i.e. asking for a "yes/no"-answer to the interpretation) would be sensible.

**Proposal: Send a LS to RAN1 based on the draft in Annex B with the RAN2 understanding that UE always uses 2-bit RI bit width (even if it only supports 2-layer MIMO in EN-DC mode).**

# Annex A – Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
| Company | Name | Email Address |
| Nokia | Amaanat | amaanat.ali@nokia.com |
| Samsung | Jaehyuk JANG | jack.jang@samsung.com |
| MediaTek | Felix Tsai | Chun-fan.tsai@mediatek.com |
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# Annex B – Draft LS to RAN1

The below shows a draft LS to RAN1 asking them to verify the RAN2 interpretation.

**3GPP TSG-RAN WG2 Meeting #113 Electronic DRAFT R2-210xxxx**

**Elbonia, April 12 – April 20, 2021**

**Title: [DRAFT]** LS on RI bit width for Cat5 UE in EN-DC mode

**Response to:** -

**Release:** Release 15

**Work Item:** NR\_NewRAT-Core

**Source:** Nokia [TSG RAN WG2]

**To:** TSG RAN WG1

**Cc:**

**Contact Person:**

**Name:** Amaanat Ali

**E-mail Address:** amaanat.ali@nokia.com

**Send any reply LS to: 3GPP Liaisons Coordinator, mailto:3GPPLiaison@etsi.org**

**Attachments:** -

**1. Overall Description:**

Cat5 UE was defined in LTE Rel-8 to reach the peak data rates allowed at that time. To that end, it was defined as being mandated to suppport 4-layer MIMO operation for TM3/4. However, when EN-DC was defined during Rel-15, RAN2 decided to allow Cat5 UEs to only support 2-layer MIMO while EN-DC mode. Due to this, the Cat5 UE shall support 4-layer MIMO in LTE-only mode but may only support 2-layer MIMO while operating under EN-DC.

This now causes a potential interpretation issues with RI bit width: The RAN1 specification [TS36.212](https://www.3gpp.org/DynaReport/36212.htm), subclause 5.2.2.6, only considers the *maxLayersMIMO-r10*, UE category and PBCH antenna ports, and doesn't mention anything about EN-DC or UE capabilities:

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| --- |
| - The corresponding bit widths for RI feedback for PDSCH transmissions are given by Tables 5.2.2.6.1-2, 5.2.2.6.1-2B, 5.2.2.6.1-2D, 5.2.2.6.1-2E, 5.2.2.6.1-2F, 5.2.2.6.2-3, 5.2.2.6.2-3B, 5.2.2.6.2-3D, 5.2.2.6.2-3E, 5.2.2.6.2-3F, 5.2.2.6.3-3, 5.2.2.6.3-3B, 5.2.2.6.3-3D, 5.2.2.6.3-3E, 5.2.2.6.3-3F, 5.2.3.3.1-3, 5.2.3.3.1-3A, 5.2.3.3.1-3B, 5.2.3.3.1-3B-1, 5.2.3.3.1-3C, 5.2.3.3.1-3D, 5.2.3.3.1-3F, 5.2.3.3.1-3G, 5.2.3.3.1-3I, 5.2.3.3.1-3J, 5.2.3.3.1-5, 5.2.3.3.2-4, 5.2.3.3.2-4A, 5.2.3.3.2-4B, 5.2.3.3.2-4C, 5.2.3.3.2-4D, 5.2.3.3.2-4F, 5.2.3.3.2-4G and 5.2.3.3.2-4I which are determined assuming the maximum number of layers as follows: - If the *maxLayersMIMO-r10* is configured for the DL cell, the maximum number of layers for subframe operation is determined according to *maxLayersMIMO-r10* for the DL cell.- ...- Else,- ...- Otherwise the maximum number of layers is determined according to the minimum of the number of PBCH antenna ports and *ue-Category* (without suffix). |

Hence, RAN2 interpretation is that the RI bit width for a Cat5 UE is NOT affected by the number of MIMO layers it supports in EN-DC mode but only by the network configuration parameter *maxLayersMIMO-r10*, PBCH antenna ports and the UE category (without suffix). Since this is specified in RAN1 specifications, RAN2 would like to confirm whether this is correct interpretation to determine whether any clarifications on this are needed in specifications.

**2. Actions:**

**To RAN1 group.**

**ACTION:** RAN2 respectfully asks RAN1 to indicate whether the RAN2 assumption on RI bit width for Cat5 UEs in EN-DC mode is correct.

**3. Date of Next TSG-RAN WG2 Meetings:**

3GPP RAN2#113bis-e from 2021-04-12 to 2021-04-20 Electronic Meeting

3GPP RAN2#114-e from 2021-05-19 to 2021-05-27 Electronic Meeting