3GPP TSG-RAN WG1 Meeting #109-e R1-22xxxxx

e-Meeting, 9th – 20th May 2022

**Agenda Item: 8.6.1**

**Title: FL summary for incoming LS (R1-2203046) on introduction of an offset to transmit CD-SSB and NCD-SSB at different times**

**Source: Moderator (Ericsson)**

**Document for: Discussion, Decision**

# 1 Introduction

This feature lead (FL) summary (FLS) concerns the Rel-17 work item (WI) for support of reduced capability (RedCap) NR devices [1]. Earlier RAN1 agreements for this WI are summarized in [2], which also includes links to earlier FLSs. The latest Rel-17 NR higher-layer parameter list sent from RAN1 to RAN2 can be found in [3].

This document captures the following email discussion for the incoming LS [4] and related contributions [5] – [14]:

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| [109-e-R17\_RedCap-02] Email discussion on incoming LS ([R1-2203046](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203046.zip)) on introduction of an offset to transmit CD-SSB and NCD-SSB at different times by May 12 – Johan (Ericsson)   * Relevant tdocs: R1-2203120, R1-2203495, R1-2203590, R1-2204271, R1-2204434, R1-2203053, R1-2203109, R1-2203517, R1-2204711, and R1-2204771 |

The issues in this document are tagged and color coded with High Priority or Medium Priority. The issues that are in the focus of this round of the discussion are furthermore tagged FL1.

**FL1 Question 1-1a: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Nordic | Karol Schober | karol.schober@nordicsemi.no |
| Qualcomm | Jing Lei | leijing@qti.qualcomm.com |
| Nokia | Rapeepat Ratasuk | rapeepat.ratasuk@nokia-bell-labs.com |
| CATT | Yongqiang FEI | feiyongqiang@catt.cn |

# 2 Discussion

RAN1 and RAN4 have received an LS [4] from RAN2 with the following content:

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| **1. Overall Description:**  In RAN2#117-e, it was concluded that, from RAN2 signalling standpoint, CD-SSB and NCD-SSB(s) may be transmitted at different times by configuring an offset. RAN2 would like to ask RAN4 and RAN1 whether such offset is feasible/needed.  **2. Actions:**  **To RAN4 and RAN1**  **ACTION:** RAN2 kindly asks RAN4 and RAN1 to take the information above into consideration and provide feedback. |

Contributions [5] – [14] express views on the topic raised in the LS. This topic has also been brought up in the previous RAN1 meeting in contribution [15] and discussed on pages 94-106 in the FLS in [16], where the discussion ended with an FL note that “RAN1 can come back to these topics if necessary once they have been treated in RAN2”.

Regarding the ***necessity*** of a configurable time offset between CD-SSB and NCD-SSB, some contributions [11, 12, 14] express that it is beneficial or even needed to have the possibility to transmit CD-SSB and NCD-SSB at different times to avoid power shortage at the gNB side, especially if/when power boosting is used for SSB the transmission.

Contribution [5] expresses that there is no strong need for a time offset and that in many cases it will be desired to have zero offset to minimize the ON time for power saving purposes, but that it would be OK if it is up to the gNB whether to configure a time offset and the UE cannot expect a time offset.

Contribution [7] expresses that there is no need for a time offset and points out that CD-SSB and NCD-SSB are configured without offset in legacy.

**FL1 High Priority Question 2-1a: Is a configurable time offset between CD-SSB and NCD-SSB *needed*? Please elaborate on your answer in the Comments field.**

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| **Company** | **Y/N** | **Comments** |
| Nordic | N | Assuming e.g. 60Mhz channel BW and 162RB of 30kHz SCS there  1 SSB can be boosted 8x while 2SSB only 4x. In our opinion boosting SSB 6dB is enough, or at least benefit to bootst 3dB more is not really clear to us.  Therefore we think offset is not essential. |
| Qualcomm | N | In NR R15/16, a CD-SSB can be FDMed with other DL channels/signals with power boosting on the same set of symbols. Therefore, we don’t think it is necessary to configure such a time offset between CD-SSB and NCD-SSB.  On the other hand, such time offset can only be configured with half-frame granularity, which does not provide much flexibility for scheduler but incurs DL resource fragmentation for legacy UEs. |
| Nokia, NSB | N | We don’t think time offset is necessary. First, SSB coverage is robust compared to other DL channels and generally power boosting is not necessary. Even if power boosting is used, it is our view that there is sufficient power for sharing between CD-SSB and NCD-SSB. Second, introducing an offset increases implementation complexity and introduces further scheduling restrictions due to e.g. QCL relationship between CD-SSB and NCD-SSB, resource fragmentation, different collision handling between BWPs, etc. |
| CATT |  | The question ‘*needed’* is a little ambiguous. In our view, without time offset the system may still work (although maybe reluctantly). But a configurable time offset is more flexible and can ease the deployment of NCD-SSB. |

Regarding the ***feasibility*** of a configurable time offset between CD-SSB and NCD-SSB, several contributions [6, 8, 11, 12, 14] express that it is feasible.

The following issues (concerns or other aspects to consider) are brought up in the contributions [5, 7, 9, 12, 13]:

1. Impacts on mapping pattern for SSB in slots within a half-frame [5]
2. Impacts on the QCL relationship [7]
3. RAN1 specification impacts on SSB starting symbols [7]
4. No support for offset resulting in collision between CD-SSB and NCD-SSB with different TCI states [9]
5. Collision handling between SSB and UL transmissions for HD-FDD [12]
6. Available slot determination for PUCCH/PUSCH repetitions for HD-FDD [12]
7. RACH occasion validation and SSB-RO association [13]
8. PDSCH rate matching around SSB [13]

**FL1 High Priority Question 2-2a: Is a configurable time offset between CD-SSB and NCD-SSB *feasible*? Please elaborate on the issues listed above in the Comments field.**

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| **Company** | **Y/N** | **Comments** |
| Nordic | Y |  |
| Qualcomm |  | To solve the issues listed above, such time offset can only be configured with half-frame granularity by RRC. The half-frame granularity does not provide much flexibility for the scheduling of NCD-SSB, but incurs additional issues for NW and UE, such as:   1. DL resource fragmentation 2. complicating the rate matching/collision handling procedures 3. imposing additional constraints on the configuration of TDD slot format 4. potential degradation of UL throughput in TDD |
| vivo | Y | It is feasible to configure time offset of NCD-SSB relative to CD-SSB, and the offset is half-frame level. |
| Nokia, NSB | Y | While we think it’s feasible to configure a time offset, our preference is not to support time offset. |
| CATT | Y | We do not see serious issues if (1) Time offset is in half-frame level (2) RedCap UE is required to deal with only one SSB (either CD- or NCD- one) within the active BWP. |

Regarding the ***impacts*** on RAN1 specifications and the RRC parameter list [3] from a configurable time offset between CD-SSB and NCD-SSB, the submitted contributions do not contain any detailed text proposals. Companies are invited to describe the expected impacts in detail, were such a configurable time offset to be introduced.

**FL1 High Priority Question 2-3a: If a configurable time offset between CD-SSB and NCD-SSB is introduced, what are the *impacts* on the RAN1 specifications and the RRC parameter list [3]? Please be as detailed as possible.**

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| **Company** | **Comments** |
| Nordic | With assumption that there is only one SSB within UEs BWP, NCD or CD, the spec should just work fine, given that UE assumes that only SSB within BWP matters, for collisions for RO handling, etc.. But of course, having offset between CD and NCD would mean that UE must treat collisions differently depending on BWP, which is clearly not desirable. |
| Qualcomm | Please see our comments on Question 2-2a. |
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# References

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| [1] | [RP-220966](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_95e/Docs/RP-220966.zip) | Revised WID on support of reduced capability NR devices | Ericsson |
| [2] | [R1-2202535](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202535.zip) | RAN1 agreements for Rel-17 NR RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2202759](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202759.zip) | Consolidated higher layers parameter list for Rel-17 NR | Moderator (Ericsson) |
| [4] | [R1-2203046](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203046.zip) | LS on introduction of an offset to transmit CD-SSB and NCD-SSB at different times | RAN2, Ericsson |
| [5] | [R1-2203120](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203120.zip) | On introduction of an offset to transmit CD-SSB and NCD-SSB at different times | Ericsson |
| [6] | [R1-2203495](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203495.zip) | Draft Reply LS on introduction of an offset to transmit CD-SSB and NCD-SSB at different times | Vivo |
| [7] | [R1-2203590](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203590.zip) | Discussion on NCD-SSB offset | ZTE, Sanechips |
| [8] | [R1-2204271](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204271.zip) | Discussion on RAN2 LS on introduction of an offset to transmit CD-SSB and NCD-SSB at different times | CMCC |
| [9] | [R1-2204434](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204434.zip) | Discussion on LS on introduction of an offset to transmit CD-SSB and NCD-SSB at different times | NEC |
| [10] | [R1-2203053](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203053.zip) | Remaining aspects of Bandwidth Reduction for RedCap UEs | Futurewei |
| [11] | [R1-2203109](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203109.zip) | Remaining issues on UE complexity reduction | Huawei, HiSilicon |
| [12] | [R1-2203517](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203517.zip) | Remaining issues on reduced maximum UE bandwidth | Vivo, Guangdong Genius |
| [13] | [R1-2204711](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204711.zip) | On RedCap UE complexity reduction | MediaTek Inc. |
| [14] | [R1-2204771](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204771.zip) | Remaining details on UE complexity reduction for Rel-17 RedCap | Intel Corporation |
| [15] | [R1-2200918](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200918.zip) | On RAN1 aspects of RAN2 led issues for RedCap | Huawei, HiSilicon |
| [16] | [R1-2202532](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202532.zip) | FL summary #5 on reduced maximum UE bandwidth for RedCap | Moderator (Ericsson) |