**3GPP TSG RAN WG1 Meeting #108-e R1-22xxxxx**

**e-Meeting, February 21st – March 3rd, 2022**

**Source: Moderator (vivo)**

**Title: Discussion summary #1 of [108-e-NR-52-71GHz-05]**

**Agenda item: 8.2.5**

**Document for: Discussion and decision**

# Introduction

In this contribution, we summarize issues regarding PDSCH/PUSCH enhancements for new SCSs on supporting NR from 52.6 GHz to 71 GHz for the following email discussion in RAN1 #108-e.

[108-e-NR-52-71GHz-05] Email discussion for maintenance on timeline related aspects adapted to each of the new numerologies 480kHz and 960kHz – Huaming (vivo)

* 1st check point: February 25
* Final check point: March 3

Note that the scope of agenda 8.2.5 including defining maximum bandwidth for new SCSs, time line related aspects adapted to each of the new numerologies 480kHz and 960kHz, reference signals, scheduling particularly w.r.t. multi-PDSCH/PUSCH with a single DCI, HARQ, etc. In this summary, only issues related to bandwidth for new SCSs, time line related aspects adapted to each of the new numerologies 480kHz and 960kHz and reference signals are summarized. Issues related to scheduling particularly w.r.t. multi-PDSCH/PUSCH with a single DCI, HARQ are not in the scope of this summary.

# PDSCH/PUSCH enhancements for new SCSs

In this section, we provide a summary of issues, observations and proposals related to PDSCH/PUSCH enhancements for new SCSs discussed in the submitted contributions.

As in WID, the related objectives for this summary of agenda 8.2.5 are the following.

* Physical layer aspects including [RAN1]:
  + In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.

Note: Except for timing line related aspects, a common design framework shall be adopted for 480kHz to 960kHz

* + Time line related aspects adapted to 480kHz and 960kHz, e.g., BWP and beam switching timing, HARQ timing, UE processing, preparation and computation timelines for PDSCH, PUSCH/SRS and CSI, respectively.
  + Evaluate, and if needed, specify the PTRS enhancement for 120kHz SCS, 480kHz SCS and/or 960kHz SCS, as well as DMRS enhancement for 480kHz SCS and/or 960kHz SCS.

## 2.1. Timeline

### Individual observations/proposals

The following are individual observations and proposals from the contributions.

|  |  |
| --- | --- |
| Sources | Observations/proposals |
| [12, Intel] | **Proposal 1**   * Agree on the following values for *cg-minDFI-Delay*   + SCS 120 kHz: 7, m\*14,   + SCS 480 kHz: 7\*4, m\*14\*4,   + SCS 960 kHz: 7\*8, m\*14\*8,   where m = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32} |

### *cg-minDFI-Delay*

It is identified in [12, Intel] that there’s a configured parameter *cg-minDFI-Delay* in *ConfiguredGrantConfig* indicates the minimum duration (in unit of symbols) from the last symbol of a PUSCH or PUSCH repetition of the HARQ process and the first symbol of the CG-DFI PDCCH.According to TS 38.331, *cg-minDFI-Delay* is currently only defined for SCS 15/30/60kHz. The upper bound of *cg-minDFI-Delay* for SCS 15/30/60 kHz is 4ms.

|  |
| --- |
| TS 38.311, clause 6.3.2  ***cg-minDFI-Delay***  Indicates the minimum duration (in unit of symbols) from the ending symbol of the PUSCH to the starting symbol of the PDCCH containing the downlink feedback indication (DFI) carrying HARQ-ACK for this PUSCH. The HARQ-ACK received before this minimum duration is not considered as valid for this PUSCH (see TS 38.213 [13], clause 10.5). The following minimum duration values are supported, depending on the configured subcarrier spacing [symbols]:  15 kHz:  7, m\*14, where m = {1, 2, 3, 4}  30 kHz:  7, m\*14, where m = {1, 2, 3, 4, 5, 6, 7, 8}  60 kHz:  7, m\*14, where m = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16} |

In is argued in [12, Intel] to allow the same upper bound of 4ms for SCS 120 kHz, the maximum value of *cg-minDFI-Delay* could be extended to 32 and proposed to allow all integer values from 1 to 32 for SCS 120 kHz. Furthermore, [12, Intel] proposed to keep the minimum value of *cg-minDFI-Delay* as 7 for 120 kHz SCS. For SCS 480kHz or 960kHz, it proposed to scale the values for SCS 120 kHz by 4 or 8 respectively.

Moderator’s comment:

The extension of this timeline parameter for FR2-2 seems straightforward. The following proposal is formulated for discussion.

##### Proposal 1-1 (high priority)

Support the following values for cg-minDFI-Delay

SCS 120 kHz: 7, m\*14,

SCS 480 kHz: 7\*4, m\*14\*4,

SCS 960 kHz: 7\*8, m\*14\*8,

where m = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32}

Companies are encouraged to provide comments.

|  |  |
| --- | --- |
| Company Name | Comments/Views |
| Intel | As original proponent, we support the proposal. |
| Huawei,HiSilicon | Support the proposal |
| ZTE, Sanechips | We are fine with Proposal 1-1. |
| Xiaomi | We are fine that the maximum values for 480/960khz are scaled up by 4/8. but we would also prefer to keep the same bit length as 60khz.  But if it is majority view to support the proposal, we can also support it |

## 2.2. Issue(s) related to reference signal

### Individual observations/proposals

The following are individual observations/proposals from the contributions.

|  |  |
| --- | --- |
| Sources | Observations/proposals |
| [1, Huawei] | Proposal 1: Support DMRS bundling FG developed in CovEnh WI for the same TB to FR2-2 with 120 kHz SCS. |
| [3, InterDigital] | Proposal 4: The use of DMRS bundling FG developed in CovEnh WI for the same TB should not be prohibited in FR2-2 with 120 kHz SCS. |
| [4, vivo] | Proposal 1: For the case where the predefined requirements specified in Rel-17 CovEnh WI are met, i.e. the phase coherency and power consistency are guaranteed across repetitions of a PUSCH, DMRS bundling FG developed in Rel-17 CovEnh WI for same TB can be applied to FR2-2 with 120 kHz SCS. |

### DMRS bundling for same TB in FR2-2 with 120 kHz SCS

The following conclusion was reached in RAN1#107bis-e.

Conclusion

DMRS bundling across multiple PUSCHs scheduled by a single DCI is not supported for NR operation in FR2-2 in Rel-17.

* Note: applicability of DMRS bundling FG developed in CovEnh WI for same TB to FR2-2 with 120 kHz SCS can be further discussed.

Regarding the remaining issue whether DMRS bundling FG developed in CovEnh WI for same TB can be applied to FR2-2 with 120 kHz SCS, the following contributions expressed their views.

[1, Huawei] argued that coverage issue also exits in FR2-2 due to larger path loss than FR2-1 with the higher frequency range. Extending this feature to FR2-2 for 120kHz SCS is beneficial to enrich the usage scenario without additional standard effort.

[3, InterDigital] noted that TB repetition across multiple contiguous slots can be supported in FR2-2 by using the existing features. In such a situation, DMRS bundling FG developed in CovEnh WI could be used to improve the channels estimation performance. Therefore, the use of this FG developed in CovEnh WI should not be prohibited in FR2-2.

[4, vivo] observed that for PUSCH repetition with 120 kHz SCS, PUSCH DMRS bundling was introduced in Rel-17 CovEnh WI. This feature is not restricted to specific frequency band, and it is beneficial for PUSCH performance when the phase coherency and power consistency are guaranteed across repetitions of a PUSCH.

Moderator’s comment:

The performance benefits (coverage and channel estimation for PUSCH) of extending DMRS bundling for same TB in FR2-2 with 120 kHz SCS are identified. With no additional standard effort, it does make sense to allow this FG for FR2-2 with 120 kHz SCS. With that, the following proposal is formulated for consideration.

Proposal 2-1 (high priority)

DMRS bundling FG developed in CovEnh WI for the same TB is supported in FR2-2 with 120 kHz SCS.

Companies are encouraged to provide comments.

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| --- | --- |
| Company Name | Comments/Views |
| Intel | Coverage enhancements has been excluded from the WID.  Out preference is not agree at this stage. However, we would be ok to accept this only if there are no specification impact (other than allowing capability change to support FR2-2) associated with this conclusion.  Ideally, we would like to have this as working assumption to make sure there is no other impact. If some specification efforts are identified, we think it should not be agreed at this stage. |
| Huawei, HiSilicon | Support the proposal. we think there is no additional standard impact if same mechanism is adopted as CovEnh. |
| ZTE, Sanechips | We agree with Intel’s idea of changing Proposal 2-1 to a working assumption. We can further agree on this issue if there is no specification impact found by other companies. |
| Moderator | Wording updated into Proposal 2-1a below to address comments. |

##### Proposal 2-1a (as working assumption, high priority)

DMRS bundling FG developed in CovEnh WI for the same TB is supported in FR2-2 with 120 kHz SCS.

* Note: can be revisited if specification impact other than that for UE feature/capability signaling is identified

Companies are encouraged to provide comments.

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| --- | --- |
| Company Name | Comments/Views |
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## 2.3. Other issue(s)

Companies are encouraged to provide comments below if any missing issue(s) related to bandwidth/timeline/reference signals.

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| --- | --- |
| Company Name | Comments/Views |
|  |  |
|  |  |
|  |  |

# Recommendation for GTW/email approval

TBD

# Conclusion

TBD

# Reference

1. [R1-2202490](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202490.zip) Remaining issues of PDSCH/PUSCH enhancement for 52-71GHz spectrum Huawei, HiSilicon, revision of [R1-2200956](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2200956.zip)
2. [R1-2200990](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2200990.zip) Remaining issues in PDSCH/PUSCH enhancements for Beyond 52.6GHz FUTUREWEI
3. [R1-2201037](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201037.zip) Remaining issues for PDSCH/PUSCH enhancements to supporting 52.6-71 GHz band in NR InterDigital, Inc.
4. [R1-2201088](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201088.zip) Remaining issues on PDSCH/PUSCH enhancements for NR operation from 52.6GHz to 71GHz vivo
5. [R1-2201269](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201269.zip) Discussion on remaining issue for PDSCH/PUSCH enhancements OPPO
6. [R1-2201354](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201354.zip) Remaining issues on PDSCH/PUSCH enhancements for up to 71GHz operation CATT
7. [R1-2201392](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201392.zip) Remaining issues on the data channel enhancements for 52.6 to 71GHz ZTE, Sanechips
8. [R1-2201433](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201433.zip) Discussion on PDSCH/PUSCH enhancements for NR 52.6-71 GHz Panasonic Corporation
9. [R1-2201436](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201436.zip) Remaining issues of multi-PDSCH scheduling via a single DCI Fujitsu
10. [R1-2201473](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201473.zip) Remaining issues on PDSCH/PUSCH enhancements for NR in FR2-2 NTT DOCOMO, INC.
11. [R1-2201665](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201665.zip) PDSCH/PUSCH enhancements Nokia, Nokia Shanghai Bell
12. [R1-2201691](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201691.zip) Discussion on PDSCH/PUSCH enhancements for extending NR up to 71 GHz Intel Corporation
13. [R1-2201739](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201739.zip) PDSCH-PUSCH Enhancements Ericsson
14. [R1-2201767](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201767.zip) On remaining issues for PDSCH PUSCH Enhancements Apple
15. [R1-2201900](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201900.zip) Remaining issues on PDSCH enhancement for NR operation from 52.6GHz to 71GHz NEC
16. [R1-2201915](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2201915.zip) Remaining issues on PDSCH and PUSCH enhancements for NR 52.6-71GHz Xiaomi
17. [R1-2202007](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202007.zip) Maintenance on PDSCH/PUSCH enhancements for NR from 52.6 GHz to 71 GHz Samsung
18. [R1-2202074](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202074.zip) Remaining discussion on multi-PDSCH scheduling design for 52.6-71 GHz NR operation MediaTek Inc.
19. [R1-2202132](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202132.zip) PDSCH/PUSCH enhancements for NR in 52.6 to 71GHz band Qualcomm Incorporated
20. [R1-2202283](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202283.zip) Discussion on multi-PUSCH scheduling ASUSTeK
21. [R1-2202338](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_108-e/Docs/R1-2202338.zip) PDSCH/PUSCH enhancements to support NR above 52.6 GHz LG Electronics