**3GPP TSG RAN WG1 Meeting #114 R1-230xxxx**

**Toulouse, France, August 21st – 25th, 2023**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary of discussions on collision between NR PDSCH DMRS and LTE-CRS**

**Document for: Discussion and Decision**

# Introduction

In NR Rel-16 TEI, a CR [1] was endorsed to handle the collision between PDSCH DMRS symbol and LTE CRS symbol, which shifts the PDSCH DMRS by ONLY 1 symbol if the PDSCH duration is 10 symbols. However, in current specification, PDSCH DMRS symbol can be also shifted due to a collision between NR PDSCH DMRS and NR PDCCH. It is unclear whether both kinds of collisions can occur for one scheduled PDSCH and what the exact number of symbols is shifted for DMRS. More details of analysis can be found in [2]. A CR in [3] is proposed to clarify the applicable scheduling cases for the DMRS shifting, which should meet the following conditions

* the PDSCH duration $l\_{d}=10$ symbols (existing condition)
* the PDSCH starts from the 5th symbol in a slot (new condition)
* The UE is not expected to be configured with a search space set associated with a CORESET that collides with the resulting symbol of the front-loaded DM-RS of the PDSCH allocation. (new condition)

# Discussions

### Question 1-1: Whether shall a UE capable of DMRS 1-symbol shift for DSS support the following scheduling cases?

* **Case 1:** the PDSCH DMRS at symbol #k collides with both NR PDCCH symbol and LTE-CRS symbol and there is also LTE-CRS at symbol #k+1, as illustrated in the following figure where k=0.



* **Case 2:** the PDSCH DMRS at symbol #k collides with LTE-CRS symbol only (or NR PDCCH symbol only) and there is also NR PDCCH (or LTE-CRS) at symbol #k+1, as illustrated in the following figure where k=4.



Companies’ views are welcome.

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### Question 1-2: If yes to Q1-1, what is the exact UE behavior? For example, what is the processing order between the two specified collision handlings? Whether a UE should perform each collision handling only one time or should perform iteration of both collision handlings until no collision is found by either of the two collision handling procedures?

Companies’ views are very welcome.

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### Question 1-3: If no to Q1-1, would the following proposal be sufficient to preclude the two scheduling cases?

***Proposal:*** *For DSS, the start symbol of the PDSCH duration* $l\_{d}=10$ *with mapping type B is only the fifth symbol in a slot. Besides, the UE is not expected to be configured with a search space set associated with a CORESET that collides with the resulting symbol of the front-loaded DMRS of the PDSCH allocation.*

Companies’ views are welcome.

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### Question 1-4: If no to Q1-1, would the CR [3], as copied below, be acceptable?

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| TS 38.2117.4.1.1.2 Mapping to physical resources< Unchanged parts are omitted >For PDSCH mapping type B- if the PDSCH duration $l\_{d}$ $\in \left\{2,3,4,5,6,7,8,9,10,11,12,13\right\}$ OFDM symbols for normal cyclic prefix or $l\_{d}\in \left\{2,4,6\right\}$ OFDM symbols for extended cyclic prefix, and the front-loaded DM-RS of the PDSCH allocation collides with resources reserved for a search space set associated with a CORESET,  shall be incremented such that the first DM-RS symbol occurs immediately after the CORESET and until no collision with any CORESET occurs, and- if the PDSCH duration $l\_{d}$ is 2 symbols, the UE is not expected to receive a DM-RS symbol beyond the second symbol;- if the PDSCH duration $l\_{d}$ is 5 symbols and if one additional single-symbol DMRS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th symbol when the front-loaded DM-RS symbol is in the 1st symbol of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted;- if the PDSCH duration $l\_{d}$ is 7 symbols for normal cyclic prefix or 6 symbols for extended cyclic prefix: - if one additional single-symbol DM-RS is configured, the UE only expects the additional DM-RS to be transmitted on the 5th or 6th symbol when the front-loaded DM-RS symbol is in the 1st or 2nd symbol, respectively, of the PDSCH duration, otherwise the UE should expect that the additional DM-RS is not transmitted;- if the PDSCH duration $l\_{d}$ $\in \left\{5,6,7,8,9,10,11,12,13\right\}$ OFDM symbols, the UE is not expected to receive the front-loaded DM-RS beyond the 4th symbol;- if the PDSCH duration $l\_{d}$ is 12 or 13 symbols, the UE is not expected to receive DM-RS mapped to symbol 12 or later in the slot;- for all values of the PDSCH duration $l\_{d}$ other than 2, 5, and 7 symbols, the UE is not expected to receive DM-RS beyond the $(l\_{d}-1)$:th symbol;- if the PDSCH duration $l\_{d}$ is less than or equal to 4 OFDM symbols, only single-symbol DM-RS is supported. - if the higher-layer parameter *lte-CRS-ToMatchAround*, *lte-CRS-PatternList1*, or *lte-CRS-PatternList2* is configured, the PDSCH duration $l\_{d}=10$ symbols starting from the 5th symbol in a slot for normal cyclic prefix, the subcarrier spacing configuration $μ=0$, single-symbol DM-RS is configured, and at least one PDSCH DM-RS symbol in the PDSCH allocation collides with a symbol containing resource elements as indicated by the higher-layer parameter lte-CRS-ToMatchAround, lte-CRS-PatternList1, or lte-CRS-PatternList2, then $\overbar{l}$ shall be incremented by one in all slots. The UE is not expected to be configured with a search space set associated with a CORESET that collides with the resulting symbol of the front-loaded DM-RS of the PDSCH allocation.The time-domain index $l'$ and the supported antenna ports $p$ are given by Table 7.4.1.1.2-5 where - single-symbol DM-RS is used if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is not configured- single-symbol or double-symbol DM-RS is determined by the associated DCI if the higher-layer parameter *maxLength* in the *DMRS-DownlinkConfig* IE is equal to 'len2'.< Unchanged parts are omitted > |

Companies’ views are welcome.

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#### [2nd round: ]

# Conclusions

TBD

# References

1. R1-1913668, “Introduction of enhanced support for dynamic spectrum sharing”, Ericsson, November 18 – 22, 2019.
2. R1-2308148, “Discussion on collision between NR PDSCH DMRS and LTE-CRS”, Huawei, HiSilicon, August 21-25, 2023
3. R1-2308149, “Correction on collision between NR PDSCH DMRS and LTE-CRS”, Huawei, HiSilicon, August 21-25, 2023

# Appendix