**3GPP TSG-RAN WG1 Meeting #104bis-eR1-210xxxx**

**e-Meeting, April 12th – 20th, 2021**

**Agenda item:** **7.2.5**

**Source: Moderator (Apple Inc.)**

**Title: Summary of [104b-e-NR-L1enh-URLLC-03] on PUSCH enhancements for NR eURLLC in AI 7.2.5**

**Document for: Discussion and Decision**

# 1 Introduction

This contribution provides the summary for the following email discussion:

[104b-e-NR-L1enh-URLLC-03] Email discussion/approval on remaining issues on PUSCH enhancements – Sigen (Apple):

·        Issue #1: Channel inference assumption for a PUSCH transmission with repetition Type B

·        Issue #3: Processing order of UL cancellation by SFI/DG and UL multiplexing

·        (editorial/clarification):  Clarification on the same TB across repetitions for PUSCH repetition Type B

Sections 2 summarizes the issues raised in the contributions submitted for eURLLC PUSCH enhancements under AI 7.2.5. Section 3 captures the detailed email discussions. The outcome of the email discussions is provided in Section 4.

# 2 Issues

## Issue #1: Channel inference assumption for a PUSCH transmission with repetition Type B

The following CR was proposed in [1] to clarify the assumption for channel inference for PUSCH repetition Type B.

**The draft CR for TS 38.211 Clause 6.2 in [1]:**

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| --- |
| 6.2 Physical resourcesThe frame structure and physical resources the UE shall use when transmitting in the uplink transmissions are defined in Clause 4.The following antenna ports are defined for the uplink:- Antenna ports starting with 0 for demodulation reference signals for PUSCH- Antenna ports starting with 1000 for SRS, PUSCH- Antenna ports starting with 2000 for PUCCH- Antenna port 4000 for PRACHIf PUSCH repetition Type B as described in clause 6.1 of [6, TS38.214] is applied to a physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed if the two symbols correspond to the same actual repetition of a PUSCH transmission with repetition Type B.If intra-slot frequency hopping is not enabled by higher layer parameter for a physical channel and PUSCH repetition Type B is not applied to the physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed if the two symbols correspond to the same slot.If intra-slot frequency hopping is enabled by higher layer parameter for a physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed only if the two symbols correspond to the same frequency hop, regardless of whether the frequency hop distance is zero or not. |

## Issue #2: Clarification on the same TB across repetitions for PUSCH repetition Type B

The following TP was proposed in [2]. Note that similar language exists for PUSCH repetition Type A.

**Reasons for change**

It is not clear whether or not the same TB is transmitted across actual PUSCH repetitions for PUSCH repetition Type B.

**Summary of changes**

Add the corresponding changes to make the specification complete.

**Specs/Sections impacted**

TS 38.214 Section 6.1.2.1.

**Consequences if not approved**

The spec is incomplete.

**Text proposal**

---------------------------------Start of Text Proposal on TS 38.214 v16.5.0-----------------------

6.1.2.1 Resource allocation in time domain

<Unchanged parts are omitted>

For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213]. The UE shall repeat the TB across actual repetitions. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2.

<Unchanged parts are omitted>

----------------------------------End of Text Proposal on TS 38.214 v16.5.0-------------------------

## Issue #3: Processing order of UL cancellation by SFI/DG and UL multiplexing

In [3], it is mentioned that when a UE is configured by higher layers with parameter *SlotFormatIndicator* and the UE does not detect a DCI format 2\_0 providing a slot format for the slot, the following agreement is not reflected in the specification:

**Agreement**

Confirm the following working assumption and remove the brackets as follows:

* A UE behavior of handling intra-UE prioritization/multiplexing for overlapping UL transmissions on semi-static flexible symbols is not affected by UL cancellation due to dynamic SFI or ~~[~~DL grant~~]~~

Note: The UE performs prioritization/multiplexing first and once done applies dynamic SFI

Based on above, the following TP is proposed:

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| --- |
| -------------------------------------------------- Start of text proposal ------------------------------------------------------11.1.1      UE procedure for determining slot format<Unchanged text omitted>For a set of symbols of a slot that are indicated as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, or when *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* are not provided to the UE, and if the UE does not detect a DCI format 2\_0 providing a slot format for the slot- the UE receives PDSCH or CSI-RS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format- the UE transmits PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format, a RAR UL grant, fallbackRAR UL grant, or successRAR- the UE receives PDCCH as described in Clause 10.1- if the UE is configured by higher layers to receive PDSCH in the set of symbols of the slot, the UE does not receive the PDSCH in the set of symbols of the slot- if the UE is configured by higher layers to receive CSI-RS in the set of symbols of the slot, the UE does not receive the CSI-RS in the set of symbols of the slot, except when UE is provided *CO-DurationsPerCell* and the set of symbols of the slot are within the remaining channel occupancy duration.- if the UE is configured by higher layers to receive DL PRS in the set of symbols of the slot, the UE receives the DL PRS- if the UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH, or PRACH in the set of symbols of the slot and the UE is not provided *enableConfiguredUL*, the UE - does not transmit the PUCCH, or the PUSCH, or an actual repetition of the PUSCH [6, TS 38.214], as determined in Clauses 9 and 9.2.5 or in Clause 6.1 of [6. TS 38.214], or the PRACH in the slot and does not transmit the SRS in symbols from the set of symbols in the slot, if any, starting from a symbol that is after PUSCH preparation time $T\_{proc,2}$ for the corresponding PUSCH timing capability [6, TS 38.214] assuming $d\_{2,1}=1$ after a last symbol of a CORESET where the UE is configured to monitor PDCCH for DCI format 2\_0 and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format 2\_0 and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15kHz or higher; otherwise $μ\_{r}=0$- does not expect to cancel the transmission of the SRS, or the PUCCH, or the PUSCH, or the PRACH in symbols from the set of symbols in the slot, if any, starting before a symbol that is after the PUSCH preparation time $T\_{proc,2}$ for the corresponding PUSCH timing capability [6, TS 38.214] assuming $d\_{2,1}=1$ after a last symbol of a CORESET where the UE is configured to monitor PDCCH for DCI format 2\_0 and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format 2\_0 and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15kHz or higher; otherwise $μ\_{r}=0$- if the UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH, or PRACH in the set of symbols of the slot and the UE is provided *enableConfiguredUL*, the UE can transmit the SRS, or PUCCH, or PUSCH, or PRACH, respectively.----------------------------------------------------- End of text proposal ------------------------------------------------------ |

# 3 Email discussions

## Issue #1: Channel inference assumption for a PUSCH transmission with repetition Type B

### Proposal 1:

Adopt the following TP for TS 38.211:

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| --- |
| 6.2 Physical resourcesThe frame structure and physical resources the UE shall use when transmitting in the uplink transmissions are defined in Clause 4.The following antenna ports are defined for the uplink:- Antenna ports starting with 0 for demodulation reference signals for PUSCH- Antenna ports starting with 1000 for SRS, PUSCH- Antenna ports starting with 2000 for PUCCH- Antenna port 4000 for PRACHIf PUSCH repetition Type B as described in clause 6.1 of [6, TS38.214] is applied to a physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed if the two symbols correspond to the same actual repetition of a PUSCH transmission with repetition Type B.If intra-slot frequency hopping is not enabled by higher layer parameter for a physical channel and PUSCH repetition Type B is not applied to the physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed if the two symbols correspond to the same slot.If intra-slot frequency hopping is enabled by higher layer parameter for a physical channel, the UE transmission shall be such that the channel over which a symbol on the antenna port used for uplink transmission is conveyed can be inferred from the channel over which another symbol on the same antenna port is conveyed only if the two symbols correspond to the same frequency hop, regardless of whether the frequency hop distance is zero or not. |

Companies please indicate if you support the intention of the TP.

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| **Yes** |  |
| **No** |  |

Please provide detailed comments if any.

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## Issue #2: Clarification on the same TB across repetitions for PUSCH repetition Type B (editorial/clarification)

### Proposal 2:

Adopt the following TP for TS 38.214:

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| ---------------------------------Start of Text Proposal on TS 38.214 v16.5.0-----------------------6.1.2.1 Resource allocation in time domain<Unchanged parts are omitted>For PUSCH repetition Type B, after determining the invalid symbol(s) for PUSCH repetition type B transmission for each of the *K* nominal repetitions, the remaining symbols are considered as potentially valid symbols for PUSCH repetition Type B transmission. If the number of potentially valid symbols for PUSCH repetition type B transmission is greater than zero for a nominal repetition, the nominal repetition consists of one or more actual repetitions, where each actual repetition consists of a consecutive set of all potentially valid symbols that can be used for PUSCH repetition Type B transmission within a slot. An actual repetition with a single symbol is omitted except for the case of *L*=1. An actual repetition is omitted according to the conditions in Clause 9, Clause 11.1 and Clause 11.2A of [6, TS38.213]. The UE shall repeat the TB across actual repetitions. The redundancy version to be applied on the *n*th actual repetition (with the counting including the actual repetitions that are omitted) is determined according to table 6.1.2.1-2. <Unchanged parts are omitted>----------------------------------End of Text Proposal on TS 38.214 v16.5.0------------------------- |

Companies please indicate if you support the TP.

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| **Yes** |  |
| **No** |  |

Please provide detailed comments if any.

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## Issue #3: Processing order of UL cancellation by SFI/DG and UL multiplexing

### Proposal 3:

Adopt the following TP for TS 38.213:

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| --- |
| -------------------------------------------------- Start of text proposal ------------------------------------------------------11.1.1      UE procedure for determining slot format<Unchanged text omitted>For a set of symbols of a slot that are indicated as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, or when *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* are not provided to the UE, and if the UE does not detect a DCI format 2\_0 providing a slot format for the slot- the UE receives PDSCH or CSI-RS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format- the UE transmits PUSCH, PUCCH, PRACH, or SRS in the set of symbols of the slot if the UE receives a corresponding indication by a DCI format, a RAR UL grant, fallbackRAR UL grant, or successRAR- the UE receives PDCCH as described in Clause 10.1- if the UE is configured by higher layers to receive PDSCH in the set of symbols of the slot, the UE does not receive the PDSCH in the set of symbols of the slot- if the UE is configured by higher layers to receive CSI-RS in the set of symbols of the slot, the UE does not receive the CSI-RS in the set of symbols of the slot, except when UE is provided *CO-DurationsPerCell* and the set of symbols of the slot are within the remaining channel occupancy duration.- if the UE is configured by higher layers to receive DL PRS in the set of symbols of the slot, the UE receives the DL PRS- if the UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH, or PRACH in the set of symbols of the slot and the UE is not provided *enableConfiguredUL*, the UE - does not transmit the PUCCH, or the PUSCH, or an actual repetition of the PUSCH [6, TS 38.214], as determined in Clauses 9 and 9.2.5 or in Clause 6.1 of [6. TS 38.214], or the PRACH in the slot and does not transmit the SRS in symbols from the set of symbols in the slot, if any, starting from a symbol that is after PUSCH preparation time $T\_{proc,2}$ for the corresponding PUSCH timing capability [6, TS 38.214] assuming $d\_{2,1}=1$ after a last symbol of a CORESET where the UE is configured to monitor PDCCH for DCI format 2\_0 and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format 2\_0 and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15kHz or higher; otherwise $μ\_{r}=0$- does not expect to cancel the transmission of the SRS, or the PUCCH, or the PUSCH, or the PRACH in symbols from the set of symbols in the slot, if any, starting before a symbol that is after the PUSCH preparation time $T\_{proc,2}$ for the corresponding PUSCH timing capability [6, TS 38.214] assuming $d\_{2,1}=1$ after a last symbol of a CORESET where the UE is configured to monitor PDCCH for DCI format 2\_0 and $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH carrying the DCI format 2\_0 and the SCS configuration of the SRS, PUCCH, PUSCH or $μ\_{r}$, where $μ\_{r}$ corresponds to the SCS configuration of the PRACH if it is 15kHz or higher; otherwise $μ\_{r}=0$- if the UE is configured by higher layers to transmit SRS, or PUCCH, or PUSCH, or PRACH in the set of symbols of the slot and the UE is provided *enableConfiguredUL*, the UE can transmit the SRS, or PUCCH, or PUSCH, or PRACH, respectively.----------------------------------------------------- End of text proposal ------------------------------------------------------ |

Companies please indicate if you support the intention of the TP.

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| **Yes** |  |
| **No** |  |

Please provide detailed comments if any.

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# References

1. R1-2103469, Remaining issue on channel inference for PUSCH with repetition Type B for NR URLLC, Sharp
2. R1-2103558, Correction on PUSCH enhancements for Rel-16 URLLC, NTT DOCOMO, INC.
3. R1-2102593, “Remaining issues on scheduling and HARQ enhancements,” CATT