3GPP TSG-RAN WG1 Meeting #100bis-e R1-20xxxxx

e-Meeting, April 20th – 30th, 2020

Agenda Item: 6.2.1.4

Source: Moderator (Ericsson)

Title: Feature lead summary #2 for NR coexistence performance improvements for LTE-MTC

Document for: Discussion, Decision

# Introduction

In the Rel-16 work item on “Additional MTC enhancements for LTE” [1], one of the objectives is to specify performance improvements for LTE-MTC coexistence with NR.

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| The objective is to specify the following set of improvements for machine-type communications for BL/CE UEs.[...]**Coexistence with NR:*** Specify the following performance improvements for LTE-MTC coexistence with NR [RAN1, RAN2, RAN4]
	+ LTE-MTC resource reservation in the DL frequency domain and the DL/UL time domain with slot-level and symbol-level granularity to avoid resource overlap between NR and LTE-MTC when LTE-MTC is deployed within an NR carrier
	+ LTE-MTC subcarrier puncturing for 1 or 2 LTE-MTC DL subcarriers (excluding CRS) to reduce the number of NR resource blocks that need to be reserved for LTE-MTC when LTE-MTC is deployed within an NR carrier
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RAN1 agreements made until RAN1#99 are summarized in [2] and RAN1 agreements made in RAN1#100e are listed below. RAN2 agreements are summarized in [3]. The endorsed L1 configuration parameter list can be found in [4], the initial RAN1 UE feature list in [5], and the endorsed RAN1 CRs in [6] – [16].

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| [**R1-2001058**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001058.zip) Feature lead summary for NR coexistence performance improvements for LTE-MTC Ericsson[**R1-2001186**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001186.zip) Feature lead summary#2 for NR coexistence performance improvements for LTE-MTC Ericsson[**R1-2001221**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001221.zip) Feature lead summary#3 for NR coexistence performance improvements for LTE-MTC Ericsson[100e-LTE-eMTC5-NR-coexistence-01] – Johan (Ericsson)Email discussion/approval focusing on the following issues (refering to section 2 of [R1-2001186](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001186.zip)):* UE-specific resource reservation (including configuration aspects and Type0-CSS aspects)
* Clarification of handling of fully and partially reserved subframes
* Resource reservation in special subframes in TDD
* Definition of subcarrier puncturing

by 2/27; if there is a spec impact, followed by endorsing the corresponding TP by 3/2**Decision:** As per email decision posted on Mar. 4th,AgreementIssue #1: UE-specific resource reservation (including configuration aspects and Type0-CSS aspects)* The 36.211 TPs in Section 2.1 in FL summary in [R1-2001186](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001186.zip) are endorsed. TP to be included in 36.211 editor’s CR.
* The 36.212 TPs in Section 2.1 in FL summary in [R1-2001186](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001186.zip) are endorsed with the following change: the words “given by C-RNTI or SPS C-RNTI” are removed in all four places. TP to be included in 36.212 editor’s CR.
* It should be possible to enable the resource reservation feature using UE-specific signaling, separately for DL and UL. Indicate this in the updated L1 parameter list. The details are up to RAN2.

Issue #2: Clarification of handling of fully and partially reserved subframes* The 36.213 TP in Section 2 in FL summary in [R1-2001221](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001221.zip) is endorsed. TP to be included in 36.213 editor’s CR.
* The 36.211 TP in Section 3 in FL summary in [R1-2001221](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001221.zip) is endorsed. TP to be included in 36.211 editor’s CR.

Issue #4: Definition of subcarrier puncturing* The 36.211 TP on definition of subcarrier puncturing in Section 2.4 in FL summary in [R1-2001186](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001186.zip) is endorsed. TP to be included in 36.211 editor’s CR.
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This document provides a prioritized list of issues and proposals based on the contributions in [17] – [25].

# Issue #1: LS response to RAN2

RAN2 has sent questions regarding configuration of LTE-MTC/NB-IoT resource reservation to RAN1 in the LS in [18], and several companies have provided discussion and proposed answers in [18][19][20][21][23]. The LS response will be discussed in a separate email discussion joint for LTE-MTC and NB-IoT.

# Issue #2: Special subframes

RAN1#100e discussed whether and how to support resource reservation in special subframes in TDD without reaching a conclusion. Based on the input in contributions [21][22][23][24][25], the following can be considered.

1. Symbol-level granularity resource reservation is not applied in special subframes.

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| **Company** | **Comments on Proposal 1** |
| ZTE | We support Proposal 1. |
| Nokia, NSB | We are fine with the proposal. |
| Ericsson | We support Proposal 1. |
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If above proposal can be agreed, the following 36.211 TP from Huawei’s contribution [21] can be considered.

1. Consider the following 36.211 TP on transmission in special subframes.

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| 4.2 Frame structure type 2**<Unchanged parts are omitted>**For frame structure type 2, if higher layer parameter *ce-reserved-resource-DL-time* is configured, *ce-reserved-resource-DL-time-symbol-bitmap1* and *ce-reserved-resource-DL-time-symbol-bitmap2* is not applied to special subframes.4.3 Frame structure type 3**<Unchanged parts are omitted>** |

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| **Company** | **Comments on Proposal 2** |
| ZTE  | We are fine with Proposal 2. |
| Nokia, NSB | We are fine with the proposal. Our understanding here is that slot-level configuration from ce-reserved-resource-DL-time would still apply in the special subframes. |
| Ericsson | We are fine with the TP in principle. We have the same understanding as expressed in the Nokia/NSB comment above. The following alternative simplified 36.211 TP be considered:For frame structure type 2, higher-layer parameters *ce-reserved-resource-DL-time-symbol-bitmap1* and *ce-reserved-resource-DL-time-symbol-bitmap2* do not apply to special subframes. |
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# Issue #3: DL DMRS

Qualcomm’s contribution [23] has the following 36.211 TP on DL DMRS transmission (see contribution for further discussion).

1. Consider the following 36.211 TP on DL DMRS transmission.

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| 6.10.3.2 Mapping to resource elements**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PDSCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space,- If and only if all OFDM symbols in a PRB are reserved, the demodulation reference signal transmission in that PRB is dropped.**<Unchanged parts are omitted>**6.10.3A.2 Mapping to resource elements**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, then in case of MPDCCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space,- If and only if all OFDM symbols in a PRB are reserved, the demodulation reference signal transmission in that PRB is dropped.**<Unchanged parts are omitted>** |

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| **Company** | **Comments on Proposal 3** |
| ZTE | From the original wording, it is clear DMRS is dropped only for a PRB if all symbols in this PRB are reserved. It is not necessary to add ‘and only if’. |
| Nokia, NSB | We think the specification is clear and this clarification is not needed. |
| Ericsson | We support the 36.211 TP. As discussed in Qualcomm‘s contribution [23], it is not entirely clear from the current specification text what should happen if DMRS REs are reserved, and this TP will clarify that. |
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# Issue #4: UL DMRS

Huawei’s contribution [21] has the following 36.211 TP on UL DMRS transmission (see contribution for further discussion).

1. Consider the following 36.211 TP on UL DMRS transmission.

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| 5.5.2.1.2 Mapping to physical resources**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter ce-reserved-resource-UL-time is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission associated with C-RNTI or SPS C-RNTI,- In a subframe that is partially reserved, the demodulation reference signal transmission in a SC-FDMA symbol that is reserved is dropped.**<Unchanged parts are omitted>** |

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| **Company** | **Comments on Proposal 4** |
| ZTE | We are fine with Proposal 4. |
| Nokia, NSB | We are fine with the proposal. |
|  | We propose the following alternative 36.211 TP for the UL DMRS related clauses 5.5.2.1.2, 5.5.2.1A.4 and 5.5.2.2.2, aligning them with the formulations in PUSCH/PUCCH clauses 5.3.4 and 5.4.3:**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission with  associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space,- In a subframe that is fully reserved as defined in clause 8.0 in [4], the demodulation reference signal transmission is postponed until the next BL/CE uplink subframe that is not fully reserved.- In a subframe that is partially reserved, the demodulation reference signal transmission in a SC-FDMA symbol that is reserved is dropped.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission with  associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space,- In a subframe that is fully reserved as defined in clause 8.0 in [4], the demodulation reference signal transmission is postponed until the next BL/CE uplink subframe that is not fully reserved.- In a subframe that is partially reserved, the demodulation reference signal transmission in a SC-FDMA symbol that is reserved is dropped.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, then in case of PUCCH transmission with  associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space,- In a subframe that is fully reserved as defined in clause 8.0 in [4], the demodulation reference signal transmission is postponed until the next BL/CE uplink subframe that is not fully reserved.- In a subframe that is partially reserved, the demodulation reference signal transmission in a SC-FDMA symbol that is reserved is dropped.**<Unchanged parts are omitted>** |
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# Issue #5: SRS

ZTE’s contribution [22] proposes that SRS transmission that would fall into a reserved UL resource should be dropped (see contribution for further discussion).

1. Consider the following 36.213 TP on SRS transmission.

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| 8.2 UE sounding procedure**<Unchanged parts are omitted>**For a BL/CE UE not configured with the higher layer parameter *srs-UpPtsAdd*, for a SRS transmission in subframe *n* and if the UE transmits PUSCH/PUCCH in subframe *n* and/or *n+1*, the UE shall not transmit the SRS in subframe *n* if the SRS transmission bandwidth in subframe *n* is not completely within the narrowband of PUSCH/PUCCH in subframe *n* and/or *n+1* A BL/CE UE not configured with the higher layer parameter *srs-UpPtsAdd* shall not transmit SRS in UpPTS if SRS frequency location is different from DwPTS reception narrowband in the same special subframe.For a BL/CE UE, the SRS transmission that falls into the reserved symbol of a BL/CE UL subframe is dropped.**<Unchanged parts are omitted>** |

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| **Company** | **Comments on Proposal 5** |
| ZTE | We think there is a need to clarify how to handle SRS transmission in the reserved resource. We support Proposal 5. |
| Nokia, NSB | We agree with ZTE that SRS handling should be specified and are fine with the proposal. |
| Ericsson | We are fine with the 36.213 TP in principle. Depending on whether Proposal 1 is agreed or not, there may be a need for further updates in 36.211 and/or 36.213 to handle the case when a TDD special subframe contains an SPS transmission longer than a single symbol (which was introduced in Rel-14). |
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# Issue #6: SPS

Ericsson’s contribution [24] proposes to discuss whether and how to update the formulation “associated with C-RNTI or SPS C-RNTI using UE-specific MPDCCH search space” in 36.211 and 36.213 to cover MPDCCH-less SPS PUSCH transmission in the intended way (see contribution for further discussion).

1. Consider the following 36.211 TP on SPS for clauses 5.3.4, 5.4.3, 5.5.2.1.2, 5.5.2.1A.4, 5.5.2.2.2, 6.4.1, 6.8B.5, 6.10.3.2 and 6.10.3A.2.

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| - If higher layer parameter *ce-reserved-resource-UL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission with  associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a subframe that is fully reserved as defined in clause 8.0 in [4], the PUSCH transmission is postponed until the next BL/CE uplink subframe that is not fully reserved.- In a subframe that is partially reserved, the reserved SC-FDMA symbols shall be counted in the PUSCH mapping but not used for transmission of the PUSCH.**<Unchanged parts are omitted>**- If higher layer parameter *ce-reserved-resource-UL-time* is configured, then in case of PUCCH transmission with  associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a subframe that is fully reserved as defined in clause 8.0 in [4], the PUCCH transmission is postponed until the next BL/CE uplink subframe that is not fully reserved.- In a subframe that is partially reserved, the reserved SC-FDMA symbols shall be counted in the PUCCH mapping but not used for transmission of the PUCCH.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission with  associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a slot that is fully reserved, the demodulation reference signal transmission is dropped.- In a SC-FDMA symbol that is reserved, the demodulation reference signal transmission is dropped.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PUSCH transmission with  associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a slot that is fully reserved, the demodulation reference signal transmission is dropped.- In a SC-FDMA symbol that is reserved, the demodulation reference signal transmission is dropped.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-UL-time* is configured, then in case of PUCCH transmission with  associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a slot that is fully reserved, the demodulation reference signal transmission is dropped.- In a SC-FDMA symbol that is reserved, the demodulation reference signal transmission is dropped.**<Unchanged parts are omitted>**- If higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PDSCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a subframe that is fully reserved as defined in clause 7.1 in [4], the PDSCH transmission is postponed until the next BL/CE downlink subframe that is not fully reserved.- In a subframe that is partially reserved, the reserved resource elements shall be counted in the PDSCH mapping but not used for transmission of the PDSCH.**<Unchanged parts are omitted>**- If higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, then in case of MPDCCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- In a subframe that is fully reserved as defined in clause 7.1 in [4], the MPDCCH transmission is postponed until the next BL/CE downlink subframe that is not fully reserved.- In a subframe that is partially reserved, the reserved resource elements shall be counted in the MPDCCH mapping but not used for transmission of the MPDCCH.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, and the Resource reservation field in the DCI is set to 1, then in case of PDSCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- If all OFDM symbols in a PRB are reserved, the demodulation reference signal transmission in that PRB is dropped.**<Unchanged parts are omitted>**For BL/CE UEs, if higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured, then in case of MPDCCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- If all OFDM symbols in a PRB are reserved, the demodulation reference signal transmission in that PRB is dropped. |

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| **Company** | **Comments on Proposal 6** |
| ZTE | We are fine with Proposal 6. |
| Nokia, NSB | We are fine with the proposal. |
| Ericsson | We support the 36.211 TP. |
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1. Consider the following 36.213 TP on SPS for clauses 7.1 and 8.0.

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| For BL/CE UEs, the set of BL/CE DL subframes is indicated as follows- If higher layer parameter *ce-reserved-resource-DL-freq* or *ce-reserved-resource-DL-time* is configured,- for PDSCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- if the Resource reservation field in the DCI is set to 0, then the set of BL/CE DL subframes corresponds to all downlink subframes during the PDSCH transmission;- if the Resource reservation field in the DCI is set to 1, then the set of BL/CE DL subframes corresponds to all downlink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all OFDM symbols of all PRBs of the PDSCH transmission are reserved in the subframe);- for MPDCCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- the set of BL/CE DL subframes corresponds to all downlink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all OFDM symbols of all PRBs of the MPDCCH transmission are reserved in the subframe).- In all other cases, the set of BL/CE DL subframes is indicated by the higher layers according to *fdd-DownlinkOrTddSubframeBitmapBR* [11].**<Unchanged parts are omitted>**For BL/CE UEs, the set of BL/CE UL subframes is indicated as follows- If higher layer parameter *ce-reserved-resource-UL-time* is configured,- for PUSCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- if the Resource reservation field in the DCI is set to 0, then the set of BL/CE UL subframes corresponds to all uplink subframes during the PUSCH transmission;- if the Resource reservation field in the DCI is set to 1, then the set of BL/CE UL subframes corresponds to all uplink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all SC-FDMA symbols of the PUSCH transmission are reserved in the subframe);- for PUCCH transmission associated with C-RNTI using UE-specific MPDCCH search space or with SPS C-RNTI,- the set of BL/CE UL subframes corresponds to all uplink subframes that are not fully reserved according to higher layer parameters (a subframe is considered fully reserved if and only if all SC-FDMA symbols of the PUCCH transmission are reserved in the subframe).- In all other cases, the set of BL/CE UL subframes is indicated by the higher layers according to *fdd-DownlinkOrTddSubframeBitmapBR* and *fdd-UplinkSubframeBitmapBR* [11]. |

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| **Company** | **Comments on Proposal 7** |
| ZTE  | We are fine with Proposal 7. |
| Nokia, NSB | We are fine with the proposal. |
| Ericsson | We support the 36.213 TP. |
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# References

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2. [R1-2002513](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100b_e/Docs/R1-2002513.zip), “Feature lead summary for NR coexistence performance improvements for LTE-MTC”