**3GPP TSG RAN WG1 #101-e** **R1-200XXXX**

**e-meeting, May 25 – June 5, 2020**

**Agenda item: 7.2.2.2.1**

**Source: Moderator (Nokia)**

**Title: Summary of [101-e-NR-unlic-NRU-ChAcc-01] Email discussion/approval on XXXX**

**Document for: Discussion and Decision**

# 1 Introduction

This document captures the discussion in the following RAN1#101s-e email thread:

[101-e-NR-unlic-NRU-ChAcc-01] Email discussion/approval on the following from R1-2004539 by 5/29; if necessary, endorse associated TPs by 6/4 – Timo (Nokia)

* Issue#1: Indication of LBT type, CP extension and CAPC; N1 timeline for UL transmissions with CP extension
* Issue#2: Clarifications to LBT with consecutive UL transmissions

This contribution summarizes the discussion and collects companies views on each question.

# 2. Issue #1

**Issue #1** (Indication of LBT type, CP extension and CAPC; N1 timeline for UL transmissions with CP extension) was discussed in the following contributions

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| N1 timeline for UL transmissions with CP extension | R1-2003656 (p1)R1-2003728 (p2, p3)R1-2004085 (p7) |
| CP extension related | R1-2003728 (p2)R1-2004013 (p5)R1-2004085 (p6) |
| CP extension for semi-static channel access | R1-2004443 (p2) |
| Channel Access for periodic signals / channels | R1-2004275 (p3) |
| Applicability of CP extension for SRS | R1-2003972 (p5)R1-2004275 (p2) |

## 2.1 N1 timeline for UL transmissions with CP extension

Three TDocs addressed the issue of how to determine the processing timeline for UL transmission when CP extension is applied. A related agreement from RAN1#98bis is as follows:

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| Agreement:* For the CP extension prior to at least a dynamically scheduled PUSCH transmission, the CP extension is located in the symbol(s) immediately preceding the PUSCH allocation indicated by SLIV. The supported durations for CP extension at the UE are:
	+ 0 (i.e. no CP extension)
	+ C1\*symbol length – 25 us
	+ C2\*symbol length – 16 us - TA
	+ C3\*symbol length – 25 us – TA
* C1=1 for 15 and 30 kHz SCS, C1=2 for 60 kHz SCS
* FFS: Whether C2/C3 is fixed or implicitly derived based on TA for each subcarrier spacing
* The N2 timeline (UL grant to PUSCH delay) needs to be relaxed to take the CP extension into account
* FFS: Whether the limit as per the previous agreement bounding the resulting CP extension to be less than or equal to one symbol for the given subcarrier spacing should be relaxed
* FFS: Applicability of this to other UL transmissions
* FFS: Whether the number of durations for CP extension that the UE can be signalled dynamically can be configured
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Related proposals in the TDocs are the following:

**R1-2003656:**

Proposal 1: When CP extension is applied to a dynamically scheduled PUCCH transmission, the N1 timeline needs to be relaxed to take the CP extension into account.

**R1-2003728**

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| **------------------------------------------------------- TP2: TS 38.214 section 6.4 ----------------------------------------------------**\*\*\* Unchanged text is omitted \*\*\*6.4 UE PUSCH preparation procedure timeIf the first uplink symbol in the PUSCH allocation for a transport block, including the DM-RS, as defined by the slot offset *K2* and the start and length indicator *SLIV* of the scheduling DCI and including the effect of the timing advance, is no earlier than at symbol *L2*, where *L2* is defined as the next uplink symbol with its CP starting after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the transport block. *- N2* is based on *µ* of Table 6.4-1 and Table 6.4-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µDL*, *µUL*) resulting with the largest *Tproc,2*, where the *µDL* corresponds to the subcarrier spacing of the downlink with which the PDCCH carrying the DCI scheduling the PUSCH was transmitted and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the PUSCH is to be transmitted, and *κ* is defined in subclause 4.1 of [4, TS 38.211].*-* For operation with shared spectrum channel access, is calculated according to [4, TS 38.211], otherwise =0.- If the first symbol of the PUSCH allocation consists of DM-RS only, then *d2,1* = 0*,* otherwise *d2,1* = 1. - If the UE is configured with multiple active component carriers, the first uplink symbol in the PUSCH allocation further includes the effect of timing difference between component carriers as given in [11, TS 38.133]. - If the scheduling DCI triggered a switch of BWP, *d2,2* equals to the switching time as defined in [11, TS 38.133], otherwise *d2,2*=0. - For a UE that supports capability 2 on a given cell, the processing time according to UE processing capability 2 is applied if the high layer parameter *processingType2Enabled* in *PUSCH-ServingCellConfig* is configured for the cell and set to *enable*,- If the PUSCH indicated by the DCI is overlapping with one or more PUCCH channels, then the transport block is multiplexed following the procedure in subclause 9.2.5 of [9, TS 38.213], otherwise the transport block is transmitted on the PUSCH indicated by the DCI.\*\*\* Unchanged text is omitted \*\*\* |

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| **------------------------------------------------------- TP3: TS 38.214 section 5.3 ----------------------------------------------------**\*\*\* Unchanged text is omitted \*\*\*5.3 UE PDSCH processing procedure timeIf the first uplink symbol of the PUCCH which carries the HARQ-ACK information, as defined by the assigned HARQ-ACK timing *K1* and the PUCCH resource to be used and including the effect of the timing advance, starts no earlier than at symbol *L1*, where *L1* is defined as the next uplink symbol with its CP starting after  after the end of the last symbol of the PDSCH carrying the TB being acknowledged, then the UE shall provide a valid HARQ-ACK message. *- N1* is based on *µ* of table 5.3-1 and table 5.3-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µPDCCH*, *µPDSCH*, *µUL*) resulting with the largest *Tproc,1*, where the *µPDCCH* corresponds to the subcarrier spacing of the PDCCH scheduling the PDSCH, the *µPDSCH* corresponds to the subcarrier spacing of the scheduled PDSCH, and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the HARQ-ACK is to be transmitted, and κ is defined in subclause 4.1 of [4, TS 38.211]. *-* For operation with shared spectrum channel access, is calculated according to [4, TS 38.211], otherwise =0.*-* If the PDSCH DM-RS position for the additional DM-RS in Table 7.4.1.1.2-3 in subclause 7.4.1.1.2 of [4, TS 38.211] is then *N1,0=14* inTable 5.3-1*,* otherwise *N1,0=13.*- If the UE is configured with multiple active component carriers, the first uplink symbol which carries the HARQ-ACK information further includes the effect of timing difference between the component carriers as given in [11, TS 38.133].\*\*\* Unchanged text is omitted \*\*\* |

**R1-2004085**

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| ***Proposal 7:*** *The starting position of the CP extension of the first uplink symbol of PUSCH or PUCCH in shared spectrum shall start no earlier than the symbol L2 or L1.** *Adopt TP7 into section 6.4 of TS 38.214.*
* *Adopt TP8 into section 5.3 of TS 38.214.*

----------------------------------- TP7: Start of TP 38.214 section 6.4 ----------------------------------------------6.4 UE PUSCH preparation procedure timeIf the first uplink symbol or the first uplink symbol with its CP extension with shared spectrum channel access in the PUSCH allocation for a transport block, including the DM-RS, as defined by the slot offset *K2* and the start and length indicator *SLIV* of the scheduling DCI, or by *ChannelAccess-CPext or ChannelAccess-CPext-CAPC* with shared spectrum channel access, and including the effect of the timing advance, is no earlier than at symbol *L2*, where *L2* is defined as the next uplink symbol with its CP starting after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the transport block. <Unchanged parts are omitted>----------------------------------------End of TP 38.214 section 6.4 ---------------------------------------------------------------------------------- TP8: Start of TP 38.214 section 5.3 ----------------------------------------------5.3 UE PDSCH processing procedure timeIf the first uplink symbol or the first uplink symbol with its CP extension with shared spectrum channel access of the PUCCH which carries the HARQ-ACK information, as defined by the assigned HARQ-ACK timing *K1* and the PUCCH resource to be used, or by *ChannelAccess-CPext* with shared spectrum channel access, and including the effect of the timing advance, starts no earlier than at symbol *L1*, where *L1* is defined as the next uplink symbol with its CP starting after  after the end of the last symbol of the PDSCH carrying the TB being acknowledged, then the UE shall provide a valid HARQ-ACK message. <Unchanged parts are omitted>----------------------------------------End of TP 38.214 section 5.3 ----------------------------------------------- |

Companies are asked to provide their views related to the above proposals with the table below:

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| --- | --- |
| Company | Comment |
| OPPO | To us, different TPs are on the same page in principle, we are fine to accept either one.  |
| ZTE, Sanechips | We have no particular preference for these TPs mentioned above. |
| Intel | Our view is that given that a CP extension may be appended right before either a PUSCH and a PUCCH, both N2 and N1 timelines should be relaxed. As for the TP to support, both TPs proposed in R1-2003728 and R1-2004085 are equivalent, but the first seems more concise. We would like also to point out that on top of the TPs proposed above, similar changes should be also applied in 38.213 in Sec. 9.2.5, and 10.2, and some further discussion may be needed. |
| Huawei, HiSilicon | We agree that both N2 and N1 timelines should be relaxed to accommodate CP extension.We prefer the proposed TPs in R1-2003728Relevant spec in 38.213 should be updated accordingly as mentioned by Intel  |
| Charter Communications | Agree with OPPO and ZTE. TP from R1-2003728 is more readable in our view. |
| Qualcomm | Prefer TP in R1-2003728 |
| LG | We think that "the first uplink symbol" described in the current specification means a symbol that already contains a CP. Therefore, if there are needs for additional clarification, the conclusion without specification impact might be enough.  |
| vivo | Prefer TP in R1-2003728 |
| Nokia, NSB | We are ok with the TP in R1-2003728 |
| Ericsson | TP in R1-2003728 is preferred. |
| Sharp | OK with TP in R1-2003728 |
| WILUS | OK with TP in R1-2003728 |

## 2.2 Other CP extension / LBT type indication related issues

One Tdoc addressed the issue of the duration of CP extension being capped to 1 symbol, e.g. in the case of misaligned assumption of the TA value at the UE and gNB. The related proposal is listed below:

**R1- 2004013**

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| **Proposal #5: If , the UL transmission performed with Cat-1 or Cat-2 LBT should be dropped, and the UL transmission performed with Cat-4 LBT can be transmitted with CP extension length of .** |

Companies are asked to provide their views related to the proposal above with the table below:

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| --- | --- |
| Company | Comment |
| OPPO | We don’t think the proposal completely solves the problem. The issue is that the gNB does not know where exactly the starting point for the UE performing LBT. Even the UE thinks the gap, e.g. 25 us, is satisfied, it does not know the gap is actually 25 us. It depends on the transmission before the UE’s LBT starting location. Thus, this LBT gap ambiguity is present in general even with the proposal. In this sense, we think we don’t have time to solve this issue in this release.  |
| ZTE, Sanechips | Share the same view as OPPO. |
| Intel | We think that the following proposal is not needed, and we were under the impression that we already conveyed that there is misalignment in terms of TA between UE and gNB, since the gNB provides explicit indication about the TA to the UE. |
| Huawei, HiSilicon | Agree with OPPO and ZTE |
| Charter Communications | Agree with OPPO and ZTE |
| Qualcomm | Support the proposal. This follow the same philosophy to lower bound the CP extension by 0. |
| LG | The background of this proposal is that if C2 or C3 is configured for the length of CP extension to exceed one symbol at UE side due to mismatch of TA value between gNB and UE, the duration of CP extension transmitted by UE may differ from the duration of CP extension scheduled by gNB. For example, if 25us Cat-2 LBT and 25us+TA gap is indicated by gNB, the length of CP extension can be changed to one symbol from the actual length of CP extension (larger than one symbol) after applying . In this case, the actual gap length is larger than 25us and the UE can transmit the UL transmission after the successful LBT. Then, the gNB may not infer whether multiple DL-to-UL switching is possible or not because gNB does not know the actual gap length between DL and UL. It shoSuld be noted that the multiple DL-UL switching is not allowed in case any gap between DL and UL is longer than 25 us. The exact same problem can be also occurred for the case of Cat-1 LBT.Therefore, If , the UL transmission scheduled by (or performed with) Cat-1 or Cat-2 LBT can be dropped, and the UL transmission scheduled by (or performed with) Cat-4 LBT can be transmitted with CP extension length of . |
| vivo | Agree with OPPO and ZTE |
| Broadcom | Support the proposal. |
| Nokia, NSB | we agree that some degree of ambiguity will always be there, but such cases occur fairly seldom. We are in principle of with the proposal, but see this as non-essential. |
| Ericsson | Based on explanation provided, we could be OK with proposal, although we don’t find it essential as Nokia mentioned. |
| Sharp | Agree with OPPO. |

Another Tdoc discusses the case where multiple DL assignments schedule a PUCCH transmission for the same PUCCH. The related proposal is as follows:

**R1-2004085**

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| ***Proposal 6:*** *The LBT type indication in the last DL grant should be used for PUCCH transmission if multiple DL grants indicate a same PUCCH transmission.** *Adopt TP6 into section 4.2.1 of TS 37.213.*

------------------------------------TP6: Start of TP 37.213 section 4.2.1 ---------------------------------------------4.2.1 Channel access procedures for uplink transmission(s)<Unchanged parts are omitted>A UE shall use Type 1 channel access procedures for PUCCH transmissions unless stated otherwise in this subclause. If a last DL grant among the DL grants that scheduling a PUCCH transmission on a same slot indicates Type 2 channel access procedures, or a random access response (RAR) message for successRAR scheduling a PUCCH transmission indicates Type 2 channel access procedures, the UE shall use Type 2 channel access procedures. <Unchanged parts are omitted>----------------------------------------End of TP 37.213 section 4.2.1 --------------------------------------------- |

Companies are asked to provide their views related to the proposal above with the table below:

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| --- | --- |
| Company | Comment |
| OPPO | When multiple DCIs point to the same PUCCH, the LBT type indication should follow the last detected DCI. This seems to be reasonable and it is inline with DAI determination. For this reason, we support the above TP.  |
| ZTE, Sanechips | It seems like a simple and reasonable method, we tend to support this proposal. However, specific TP can be discussed and determined on the text proposal phase. |
| Intel  | We are fine with the proposal for the case the type 2 channel access procedure is indicated by the last DCI. Another case that we should also consider and discuss is when the UE detects DCI format 2\_0 and knows gNB’s COT. In this case, the UE could switch LBT to type 2 for PUCCH, if the assigned PUCCH is within the gNB’s COT. |
| Huawei, HiSilicon | Agree with Proposal 6 in R1-2004085. Exact wording of the TP needs to be discussed As for the other case mentioned by Intel upon detection of GC DCI, we think it is already covered by the current spec in Section 4.2.1.0.0If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:- The UE may switch from Type 1 channel access procedures as described in clause 4.2.1.1 to Type 2A channel access procedures as described in clause 4.2.1.2.1 for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy. In this case, if the UL transmissions are PUSCH transmissions on configured resources, the UE may assume any priority class for the channel occupancy shared with the gNB.   |
| Qualcomm | Support the proposal |
| LG | We support this TP with the same reason from OPPO. |
| vivo | Support the proposal |
| Broadcom | Support the proposal. |
| Nokia, NSB | We are fine with the proposal. |
| Ericsson | Support the proposal. The exact wording of TP can be updated a bit, i.e. ”… among the DL grants ~~that~~ scheduling a PUCCH…” |
| Sharp | Support the proposal. |
| WILUS | We are fine with the proposal. |

Yet another TDoc proposes a way of calculating the values for C2 and C3 for contention based random access or in absence of higher-layer configuration.

**R1-2003728:**

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| **Proposal 1: For contention-based random access, or in absence of higher-layer configuration of C2 and C3, the value of Ci shall be set to the largest integer fulfilling for each of the values of i ∈ {2,3} the following equation:**Given the proposal above, the following text should be implemented in Sec. 5.3.1 of TS 38.211:

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| **-----------------------------------------------------   TP1: TS 38.211 section 5.3.1  ----------------------------------------------------**\*\*\* Unchanged text is omitted \*\*\*For contention-based random access, or in absence of higher-layer configuration of and , the value of shall be set to the largest integer fulfilling for each of the values of .\*\*\* Unchanged text is omitted \*\*\* |

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Companies are asked to provide their views related to the proposal above with the table below:

|  |  |
| --- | --- |
| Company | Comment |
| ZTE, Sanechips | We are not sure if such modification can actually solve this issue.  |
| Intel  | As detailed in our tdoc, if we consider the case when a gap assumes a value in between the symbol length of the first OFDM symbol in an half of a subframe and that of the rest of the OFDM symbols, i.e. , and the SLIV starts from the OFDM symbol #2 within half of a subframe, then the current specification text leads to a non-positive CP extension, and an incorrect value for .As an example, let’s consider the case when = 16 + TA, =1, and , and the UL transmission starts from symbol =2, as illustrated in the figure belowFig. 1 – Illustration of a possible error case, when = 16 + TA, and .Based on the fact that , and and based on the description above highlighted in yellow, a UE must pick the largest C2 that satisfywhich translates to the following hypothesis that a UE must check:1. If C2=1, then < --- valid case
2. If C2=2, then + --- invalid case
3. If C2=3, then + --- invalid case

Given that hypothesis I is the only one satisfying the rules described in the specification, then C2=1 is picked. However, for C2=1, this also implies that , which means that , which is not feasible. In order to solve the issue describe above, the related rule can be modified so that is set to the largest integer fulfilling for each of the values of . By applying this modification, then in the example above C2=2 will be chosen given the following hypothesis:1. If C2=1, then < --- valid case which still leads to it is
2. If C2=2, then + --- valid case
3. If C2=3, then + --- invalid case

Therefore, the proposed text solves the highlighted issue. |
| Huawei, HiSilicon | In the agreement below, the condition is that CP extension is < symbol length. Agreement:For UL transmissions prior to dedicated RRC configuration or in CBRA, C2 and C3 before RRC configuration are set to the maximum integers which satisfy following:* C2\*symbol length – 16 us – TA < symbol length
* C3\*symbol length – 25 us – TA < symbol length

“symbol length” is commonly understood to be the length of the symbol immediately preceding the first allocated symbol.Even if we agree that “symbol length” could be any symbol length of the symbols preceding the 1st allocated symbol as in the example Intel used, after implementing the proposal in that example, the ‘valid case’ identified as case II results in +  That is greater than length of the immediately preceding symbol After applying the following capping formulae, which still relies on the length of the immediately preceding symbol as an upper bound,  the actual CP extension applied will be . This means that the gap within will be effectively longer than the intended 16us. So, we do not see the benefit of the proposal given that C2=1 would be otherwise chosen in that example and the actual CP extension will be lower bounded to 0 which results in a gap shorter than 16us.  |
| Qualcomm | Consider the ROs are normally back to back, it may not necessary to add a CP extension, at least for the ROs not in the beginning of the ROs in the slot. Also the UE does not know when the gNB will end the DL transmission, so adding CP extension may not help much to achieve a certain gap. |
| LG | It seems that this TP only deal with very rare and specific cases. I’m not sure any other problems can be covered by this modification. Therefore, we think that this TP is not needed. |
| Nokia, NSB | We are ok with the clarification, but this seems non-essential |
| Ericsson | We share the same view as others and don’t think the TP is needed. |
| Sharp | Agree with Qualcomm. This is not necessary. |
| WILUS | We think that this TP is not needed. |

## 2.3 CP extension and LBT type for semi-static channel access

R1-2003728 points out that the Type 2A channel access definition may not be quite the same as the LBT type used with semi-static channel access, and proposes introducing a new Type 2D DL channel access procedure in to 37.213:

**R1-2003728**

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| **-------------------------------------------------- TP4: TS 37.213 --------------------------------------------------**\*\*\* Unchanged text is omitted \*\*\*4.1.2.4 Type 2D DL channel access procedureAn eNB/gNB may transmit a DL transmission immediately after sensing the channel to be idle for at least a sensing interval . consists of a duration immediately followed by one sensing slot and includes a sensing slot at start of . The channel is considered to be idle for if at least one of the sensing slots of is sensed to be idle.\*\*\* Unchanged text is omitted \*\*\*4.2.1.2.4 Type 2D UL channel access procedureIf a UE is indicated to perform Type 2D UL channel access procedures, the UE uses Type 2D UL channel access procedures for a UL transmission. The UE may transmit the transmission immediately after sensing the channel to be idle for at least a sensing interval . consists of a duration immediately followed by one slot sensing slot and includes a sensing slot at start of . The channel is considered to be idle for if at least one of the sensing slots of is sensed to be idle.\*\*\* Unchanged text is omitted \*\*\* |

Correspondingly, R1-2003728 also suggests changes to 38.212, such that in the case of semi-static channel access, a reference is made to Type 2D channel access. Moreover, R1-2003728 further points out a typo in section 8.1 of 38.213, where “*ChannelAccessType-r16*” should be replaced with “*ChannelAccessMode-r16*”,

Companies are asked to provide their views related to the above proposals with the table below:

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| Company | Comment |
| OPPO | We don't see a clear motivation of the new LBT type introduction. What is the issue if we don’t introduce this new LBT type? |
| ZTE, Sanechips | In my view, the current type 2B can be used for FBE, it is not necessary to introduce a new channel access Type. |
| Intel  | The first thing that should be noted is that the LBT procedure for FBE is different than that for LBE. In fact, for FBE a channel is assessed to be idle if at least in one of the observation windows of which the CCA is composed of the channel was sensed to be idle. On the other hand, for type 2A a channel is assessed to be idle only if the channel was sensed to be idle in both observation windows. Per se, the text above may not be needed, since some description of the above behaviour is provided in Sec. 4.3. However, by creating specific sections defining a new type of LBT for FBE make it easier to reference this procedure along the specification for either remaining discussions related to FBE or for future feature that may rely on it.  |
| Huawei, HiSilicon  | Agree with ZTE |
| Charter Communications | FBE channel access requires a single observation slot in 301 893, and this can be met by Type 2B channel access. |
| Qualcomm | For FBE, the LBT is different from Type 2A/2B. In the current version of 37.213, it is already captured so. Introducing a new type 2D is possible but not necessary. |
| LG | The channel access procedures for semi-static channel occupancy is defined precisely in Section 4.3 of TS 37.213. It is not necessary to introduce a new LBT type for semi-static channel access. |
| vivo | Agree with Qualcomm and LG |
| Nokia, NSB | Reading 37.213, Sections 4.1 and 4.3 together, the operation with respect to LBT seems sort of clear. However, we may need to consider this issue together with the indication of the LBT type for FBE (the next issue in this summary, as well as the editorial correction in the other email thread).  |
| Ericsson | We don’t see the need of introducing Type 2D.From LBT procedures, 4.3 is clear. There might be a need to interpret the DCI fields for LBT indication for case of FBE. |
| Sharp | Agree with ZTE that the current type 2B can be used and it is not necessary to introduce a new LBT type. |
| WILUS | We don’t see a clear motivation to introduce a new type 2D for FBE. It seems to be already defined well in section 4.3 of 37.213 for FBE. |

**R1-2004443,** Section 4 discusses also issues related to semi-static channel access, proposing the following: unlike in the current specs, the CPext-ChannelAccess- CAPC is included into the DCI formats. The UE ignores CAPC value; UE does not expected to be configured entries with cat 4 LBT; UE does not expect to be configured with entries with CP extension values other than C2\*symbol length – 16 us – TA or 0.

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| **Proposal 2. ChannelAccess-CPext-CAPC and ChannelAccess-CPext fields are applicable for DCI 0\_1 and 1\_1 respectively for FBE as well, though some combinations may not be valid for FBE and gNB should not configure those.** |

Companies are asked to provide their views related to the above proposals with the table below:

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | We remember that in last meeting, we raised a similar issue for CG-UE COT sharing, i.e. since FBE does not support UE-COT sharing, the UE shall not expect to be configured COT sharing info in CG-UCI. But majority companies think it should be left for gNB implementation. Here it is a similar problem, thus we can leave for gNB implementation. |
| ZTE, Sanechips | It can be handled by implementation. |
| Intel | We believe that despite of what the gNB configures, the values within the field ChannelAccess-CPext-CAPC and ChannelAccess-CPext cannot be used by the UE when operating in FBE, and some rules and UE’s behaviour should be specified in this case.For instance, for any CAPC indication, which is always carried in DCI 0\_1 within the field ChannelAccess-CPext-CAPC, the UE may need to ignore this information. Also for ChannelAccess-CPext, type 2A is signalled, but for FBE as the channel access is different and follows the behaviour described in our previous comments.  |
| Huawei, HiSilicon | We think such an extension is an enhancement that is not critical to the FBE operation  |
| Qualcomm | This is not an enhancement. In the current 38.212, the ChannelAccess-CPext-CAPC is not in DCI 0\_1 for FBE mode. The spec says: ChannelAccess-CPext-CAPC – 0, 1, 2, 3, 4, 5 or 6 bits. The bitwidth for this field is determined as bits, where *I* is the number of entries in the higher layer parameter *ul-dci-triggered-UL-ChannelAccess-CPext-CAPC-r16* for operation in a cell with shared spectrum channel access and *ChannelAccessMode-r16* = "*dynamic*"; otherwise 0 bit.But for FBE, we still need the functionality to indicate it is no LBT or one-shot LBT at least. CP extension is also useful to control 16us gap for no-LBT. The CAPC is not defined for FBE though, so we propose to ignore (note there is no way for gNB not to configure CAPC from Table 7.3.1.1.2-35). For the others LBT types, the proposal is to let gNB handle (do not configure invalid ones, such as cat 4 LBT). |
| LG | I agree with ZTE’s comments that it can be handled by gNB implementation. |
| vivo | Not an essential problem. The only benefit is no LBT indication by DCI 0\_1 and DCI 1\_1, which could also be achieved by DCI 0\_0 and 1\_0. If introducing it in DCI 0\_1 and DCI 1\_1, more interpretation is needed. Considering the spec impact with marginal benefit, there is no need to make this change. |
| Nokia, NSB | We agree that the specs are not clear in this respect. In 37.213, Section 4.3, the following is said: A UE may transmit UL transmission burst(s) after DL transmission burst(s) within the channel occupancy time as follows:- If the gap between the UL and DL transmission bursts is at most 16 us, the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time without sensing the channel.- If the gap between the UL and DL transmission bursts is more than 16 us, the UE may transmit UL transmission burst(s) after a DL transmission burst(s) within the channel occupancy time after sensing the channel to be idle for at least a sensing slot duration 9 us within a 25 us interval ending immediately before transmission.However, it is not clear how the UE knows how long the gap is. In the LBE case, the duration of the gap is implicitly indicated to the UE via the DCI that signals the LBT type. We believe the same should be the case with FBE too, although as pointed out by QCOM, some of the DCI fields are not meaningful. It is too restrictive not to support DCI 0\_1 and 1\_1 with FBW. |
| Ericsson | Agree with QC and Nokia |

## 2.4 Channel Access for UL Signals and Channels in a gNB COT

One contribution discusses UL channel access for periodic signals and channels, as well as transmissions scheduled with Type 1 UL channel access falling within a gNB COT, and proposes to generalize the current specifications text in 37.213, Section 4.2.1.0.0 to also cover the cases where the DL-UL gaps is 16 us or less. The related proposal is as follows:

**R1-2004275:**

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| ***Proposal 3*** *: When a UL transmission scheduled with Type 1 UL channel access (either dynamically scheduled or configured) falls within a gNB COT, the UE may switch to either Type 2A, 2B, or 2C channel access, when the related conditions (duration of the gap and duration of the UL transmission) are met*-------- Beginning of Text Proposal, TS 37.213 ------------============================<<unchanged text omitted>>===============================4.2.1.0.0 Channel access procedures upon detection of a common DCIIf a UE detects 'UL duration and offset' field in DCI Format 1C as described in clause 5.3.3.1.4 of [5], the following are applicable:- If the 'UL duration and offset' field indicates an 'UL offset' and an 'UL duration' for subframe , then the scheduled UE may use channel access procedures Type 2 for transmissions in subframes where , irrespective of the channel access Type signalled in the UL grant for those subframes, if the end of UE transmission occurs in or before subframe .- If the 'UL duration and offset' field indicates an 'UL offset' and an 'UL duration' for subframe and the 'COT sharing indication for AUL' field is set to '1', then a UE configured with autonomous UL may use channel access procedures Type 2 for autonomous UL transmissions assuming any priority class in subframes where , if the end of UE autonomous UL transmission occurs in or before subframe and the autonomous UL transmission between and shall be contiguous.- If the 'UL duration and offset' field indicates an 'UL offset' and an 'UL duration' for subframe and the 'COT sharing indication for AUL' field is set to '0', then a UE configured with autonomous UL shall not transmit autonomous UL in subframes where .If a UE determines the duration in time domain and the location in frequency domain of a remaining channel occupancy initiated by the gNB from a DCI format 2\_0 as described in clause 11.1.1 of [7], the following is applicable:- The UE may switch from Type 1 channel access procedures as described in clause 4.2.1.1 to Type 2A, Type 2B, and Type 2C channel access procedures as described in clauses 4.2.1.2.1, 4.2.1.2.2, and 4.2.1.2.3, respectively, for its corresponding UL transmissions within the determined duration in time and location in frequency domain of the remaining channel occupancy, when the conditions in clause 4.2.1.0.3 are met. In this case, if the UL transmissions are PUSCH transmissions on configured resources, the UE may assume any priority class for the channel occupancy shared with the gNB. ============================<<unchanged text omitted>>===============================-------- End of Text Proposal ------------ |

Companies are asked to provide their views related to the above proposals with the table below:

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | We would like to understand that a DCI originally indicates type 1 channel access for the UE, then how does the UE determine which type among type 2A, 2B and 2C to be used for the LBT type switching? |
| ZTE, Sanechips | My understanding is that UE may not know the exact gap length between DL and UL. Further, it also does not determine which type of LBT it should switch to. |
| Intel  | The same discussion was hold under the “DL channel” agenda and the conclusion was that only Type 2A can be used for UL transmission in LBT type switching. Therefore, we think the current specification text correctly reflects the prior discussions, and there is no need for additional text.  |
| Huawei, HiSilicon | We think that Type 2A is the adequate channel access procedure in such a case. Agree with ZTE that UE may not know that exact gap duration to decide on the appropriate Type 2 channel access procedure |
| Charter Communications | Agree with Intel. |
| Qualcomm | Agree with Intel.  |
| LG | Agree with Intel. |
| vivo | Agree with Intel |
| Broadcom | The LBT type switch is possible only to Type 2A. |
| Nokia, NSB | For UL transmissions falling within the gNB COT, it the UE knows based on e.g. DCI 2\_0 or PDSCH reception that the gap from the DL is 16 us or less, it should be allowed to also use Type 2B or 2C LBT. Otherwise, multiplexing of UL transmissions is unnecessarily complicated or even prevented in some of the cases.  |
| Ericsson | Agree with OPPO and Intel. |
| Sharp | Agree with Intel. |
| WILUS | Agree with Intel |

## 2.5 Applicability of CP extension for SRS

Two Tdocs discuss the applicability of CP extension for SRS:

**R1-2003972**

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| **Proposal 5:** The CP extension is additionally supported for SRS transmission. |

**R1-2004275:**

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| ***Proposal 2*** *When Aperiodic SRS is triggered with a DCI (0\_1, 1\_1) that also includes indication of CP extension, the CP extension applies to SRS as well.*------------- Beginning of Text Proposal, 38.211 ------------In case of cyclic prefix extension of the first OFDM symbol allocated for PUSCH, SRS or PUCCH transmission, the time-continuous signal for the interval preceding the first OFDM symbol for PUSCH, SRS or PUCCH is given bywhere refers to the signal in the previous subframe and - for dynamically scheduled PUSCH, SRS and PUCCH transmissions------------- End of Text Proposal ------------ |

Companies are asked to provide their views related to the above proposals with the table below:

|  |  |
| --- | --- |
| Company | Comment |
| OPPO | Fine with the TP |
| ZTE, Sanechips | agree |
| Intel  | We are fine with the TP |
| Huawei, HiSilicon | We agree with the TP |
| Qualcomm | Agree with TP |
| LG | It seems that extending the applicability of CPE for SRS is an optimization issue. Moreover, it may be necessary to discuss how to indicate each CPE for PUSCH and SRS when the PUSCH and SRS are scheduled by a single UL grant. Therefore, we do not support this TP. |
| vivo | Agree with the TP. The CP extension can also be applied to SRS when it is the first UL signal in the UL burst, e.g. SRS only transmission, SRS+PUSCH transmission. For SRS+PUSCH, SRS is used to fill in the gap between the PUSCH transmission and the time when channel access is successful. |
| Nokia, NSB | Agree with the TP. Otherwise FDM of a transmissions starting with SRS with other transmissions becomes unnecessarily complicated. |
| Ericsson | Agree with TP |
| Sharp | Agree with the TP |
| WILUS  | We are fine with the TP |

# 3. Issue #2

**Issue #2** Clarifications to LBT with consecutive UL transmissions

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| --- | --- |
| Clarifications to LBT with consecutive UL transmissions | R1-2003370 (p6, p7)R1-2003450 (p2, p3)R1-2003512 (p13, p14, p15, p16)R1-2003843 (p1)R1-2003860 (p5)R1-2004013 (p1)R1-2004085 (p2, p3)R1-2004275 (p4)R1-2004443 (p1)R1-2004521 (p4, p5, p6) |

## 3.1 CG UL transmission cancellation

A few TDocs addressed the issue of cancelling CG UL transmissions, when CG and dynamically scheduled UL transmission occur back-to back. At RAN1#100bis-e following was agreed:

Agreement:

Back-to-back transmission of GC-PUSCH and dynamically scheduled PUSCH is supported in NR-U with restrictions similar to those in LTE LAA.

Agreement:

Adopt TP #2.1 and TP#2.2 in R1-2003062 for TS 37.213, Section 4.2.1.0.1

**R1- 2003370**

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| *Proposal 6: The cancellation rule in TS38.214 Section 6.1 can also be applied to NR-U.**Proposal 7: The earliest time where the CG UL transmission can be dropped is the starting boundary of the last slot before the DG UL transmission, or the symbol to which the duration from the ending symbol of the UL grant scheduling the DG PUSCH is equal to or larger than the UE processing time, whichever comes last.* |

**R1-2003450**

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| --------------------------------------------------------- Start of TP #2-----------------------------------------------------------------4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) For UL transmission(s) following autonomous UL transmission(s), the following are applicable: <unchanged part omitted>If a UE is scheduled ~~by a UL grant received from an eNB on a channel~~ to transmit a PUSCH transmission(s) starting from symbol i in ~~subframe~~ slot on the same channel using Type 1 channel access procedure without CP extension and if ~~at least for the first~~ scheduled ~~subframe~~ UL transmission(s) occupies all of resource blocks of the same channels occupied by the configured grant UL transmission(s) and ~~the indicated PUSCH starting position is OFDM symbol zero, and if~~ the UE starts ~~autonomous~~ configured grant UL transmissions before symbol i ~~subframe~~ slot ~~using Type 1 channel access procedure on the same channel~~, the UE may transmit scheduled UL transmission(s) ~~according to the received UL grant~~ from symbol i in ~~subframe~~ slot without a gap, if the priority class value of the performed channel access procedure is larger than or equal to priority class value corresponding to the scheduled UL transmission(s) ~~indicated in the UL grant~~, and the ~~autonomous~~ configured grant UL transmission ~~in the subframe preceding subframe~~ shall end at the last OFDM symbol before symbol i in slot n ~~of the subframe regardless of the higher layer parameter endingSymbolAUL~~. The sum of the lengths of the ~~autonomous~~ configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the priority class value used to perform the ~~autonomous~~ configured grant uplink channel access procedure. Otherwise, the UE shall terminate the ongoing ~~autonomous~~ configured grant UL transmission(s) by dropping at least the last configured grant UL transmission ~~at least one subframe~~ before the start of the scheduled UL transmission from symbol i in slot n ~~according to the received UL grant on the same channel~~.--------------------------------------------------------- End of TP #2-----------------------------------------------------------------**Proposal 2**: **It is proposed to capture a missing agreement “Back-to-back transmission of GC-PUSCH and dynamically scheduled PUSCH is supported in NR-U with restrictions similar to those in LTE LAA” in Section 4.2.1.0.1 of the latest version of TS 37.213.**--------------------------------------------------------- Start of TP #3-----------------------------------------------------------------4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) For UL transmission(s) following autonomous UL transmission(s), the following are applicable: <unchanged part omitted>If a UE is scheduled ~~by a UL grant received from an eNB on a channel~~ to transmit a PUSCH transmission(s) starting from symbol i in ~~subframe~~ slot on the same channel using Type 1 channel access procedure without CP extension and if ~~at least for the first~~ scheduled ~~subframe~~ UL transmission(s) occupies all of resource blocks of the same channels occupied by the configured grant UL transmission(s) and ~~the indicated PUSCH starting position is OFDM symbol zero, and if~~ the UE starts ~~autonomous~~ configured grant UL transmissions before symbol i ~~subframe~~ slot ~~using Type 1 channel access procedure on the same channel~~, the UE may transmit scheduled UL transmission(s) ~~according to the received UL grant~~ from symbol i in ~~subframe~~ slot without a gap, if the priority class value of the performed channel access procedure is larger than or equal to priority class value corresponding to the scheduled UL transmission(s) ~~indicated in the UL grant~~, and the ~~autonomous~~ configured grant UL transmission ~~in the subframe preceding subframe~~ shall end at the last OFDM symbol before symbol i in slot n ~~of the subframe regardless of the higher layer parameter endingSymbolAUL~~. The sum of the lengths of the ~~autonomous~~ configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the priority class value used to perform the ~~autonomous~~ configured grant uplink channel access procedure. Otherwise, the UE shall terminate the ongoing ~~autonomous~~ configured grant UL transmission(s) by dropping symbol(s) for the last configured grant UL transmission ~~at least one subframe~~ before the start of the scheduled UL transmission from symbol i in slot n ~~according to the received UL grant on the same channel~~. Configured grant UL transmission in a slot is omitted according to the mechanism in Clause 11.1 of [6, TS38.213] relative to a last symbol of a CORESET where the UE detects the DCI format.--------------------------------------------------------- End of TP #3-----------------------------------------------------------------**Proposal 3**: **For back-to-back transmission of CG-PUSCH and dynamically scheduled PUSCH, cancellation rule and granularity should be considered in Section 4.2.1.0.1 of the latest version of TS 37.213.** |

**R1-2003512**

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| ***Proposal 13：For the back-to-back transmission of GC-PUSCH and dynamically scheduled PUSCH in NR-U, the following is applicable:**** ***The duration for which the transmission on CG-PUSCH is dropped should be determined by UE implementation such that at least the transmission on the symbols of the last CG-PUSCH before the beginning of the DG-PUSCH should be dropped***
* ***If the UE cannot terminate the configured grant UL transmission(s), the UE ignores the scheduling UL grant.***

***Proposal 14：Adopt TP8 into section 4.2.1.0.1 of TS 37.213.***

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| \*\*\* <Beginning of **Text Proposal 8**> \*\*\*4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) \*\*\* Unchanged text is omitted \*\*\*For UL transmission(s) following autonomous UL transmission(s), the following are applicable:- If a UE is scheduled by an eNB to transmit on channel by a UL grant received on channel , , and if the UE is transmitting using autonomous UL on channel , the UE shall terminate the ongoing PUSCH transmissions using the autonomous UL at least one subframe before the UL transmission according to the received UL grant.- If a UE is scheduled by a UL grant received from an eNB on a channel to transmit a PUSCH transmission(s) starting from subframe on the same channel using Type 1 channel access procedure and if at least for the first scheduled subframe occupies resource blocks and the indicated PUSCH starting position is OFDM symbol zero, and if the UE starts autonomous UL transmissions before subframe using Type 1 channel access procedure on the same channel, the UE may transmit UL transmission(s) according to the received UL grant from subframe without a gap, if the priority class value of the performed channel access procedure is larger than or equal to priority class value indicated in the UL grant, and the autonomous UL transmission in the subframe preceding subframe shall end at the last OFDM symbol of the subframe regardless of the higher layer parameter *endingSymbolAUL*. The sum of the lengths of the autonomous UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the priority class value used to perform the autonomous uplink channel access procedure. Otherwise, the UE shall terminate the ongoing autonomous UL transmission at least one subframe before the start of the UL transmission according to the received UL grant on the same channel.For UL transmission(s) following configured grant UL transmission(s), the following are applicable:- If a UE is scheduled to transmit UL transmission(s) starting from symbol in slot using Type 1 channel access procedures without CP extension with a corresponding CAPC, and if the UE starts configured grant UL transmissions before slot using Type 1 channel access procedures with a corresponding CAPC, and the scheduled UL transmission(s) occupies all the RBs of the same channels occupied by the configured grant UL transmission(s) or all the RBs of a subset thereof, the UE may directly continue to transmit the scheduled UL transmission(s) to the corresponding CAPC from symbol in slot without a gap, if the CAPC value of the performed channel access procedure is larger than or equal to the CAPC value corresponding to the scheduled UL transmission(s). The sum of the transmission durations of the configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the MCOT duration corresponding to the CAPC value used to transmit the configured grant UL transmission(s). Otherwise, the UE shall terminate the configured grant UL transmission(s) by dropping the transmission on the symbols of at least the last configured grant UL transmission before symbol in slot and attempt to transmit the scheduled UL transmission(s) according to the corresponding CAPC. PUSCH transmission with a configured grant in a slot is dropped according to the mechanism in Clause 11.1 of [7, TS 38.213] relative to a last symbol of a CORESET where the UE detected the scheduling DCI. In this case, if the UE cannot terminate the configured grant UL transmission(s), the UE ignores the scheduling DCI.\*\*\* Unchanged text is omitted \*\*\*\*\*\* <End of **Text Proposal 8**> \*\*\* |

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**R1-2003843**

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| **============= TP1 for Clause 4.2.1.0.1 of TS 37.213 ==================**4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) ============= <<Unchanged text is omitted>> ==================For UL transmission(s) following configured grant UL transmission(s), the following are applicable:-     If a UE is scheduled to transmit UL transmission(s) starting from symbol *i* in slot *n* using Type 1 channel access procedures without CP extension with a corresponding CAPC, and if the UE starts configured grant UL transmissions before slot *n* using Type 1 channel access procedures with a corresponding CAPC, and the scheduled UL transmission(s) occupies all of  the RBs of the same channels occupied by the configured grant UL transmission(s), the UE may continue to transmit the scheduled UL transmission(s) to the corresponding CAPC from symbol *i* in slot *n* without a gap, if the following conditions are fulfilled:- the CAPC value of the performed channel access procedure is larger than or equal to the CAPC value corresponding to the scheduled UL transmission(s), and- the sum of the transmission durations of the configured grant UL transmission(s) and the scheduled UL transmission(s) do not exceed the maximum channel occupancy time corresponding to the CAPC value used to transmit the configured grant UL transmission(s). Otherwise, the UE shall cancel any transmission attempt at least on the configured grant resource before symbol *i* in slot *n* and shall attempt to transmit the scheuled UL transmission(s)according to the corresponding CAPC. For cancellation of the configured grant UL transmission, the UE expects the time interval between the end of the UL grant and the start of the corresponding configured UL grant resource meets the cancellation time requirement as described in Clause 6.1 of [8]. |

**R1-2003860**

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| ================================= Start of TP for TS 37.213 =================================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s)================================ Unchanged Texts Omitted =================================For UL transmission(s) following configured grant UL transmission(s), the following are applicable:- If a UE is scheduled by a DCI format to transmit a PUSCH transmission(s) without CP extension starting from symbol *i* in slot *n* using Type 1 channel access procedure with a corresponding CAPC according to Clause 4.2.1.1, and if the UE starts configured grant UL transmission(s) before slot n using Type 1 channel access procedures with a corresponding CAPC, and the scheduled PUSCH transmission(s) occupies a subset or all of the RBs of the same channels occupied by the configured grant UL transmission(s), the UE may continue to transmit the scheduled UL transmission(s). The sum of the transmission durations of the configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the CAPC used to transmit the configured grant UL transmission(s). Otherwise, the UE shall cancel the configured grant UL transmission(s) in symbols of at least the last configured grant UL transmission before the symbol *i* in slot *n* that occur, relative to a last symbol of a CORESET where the UE detects the DCI format, after a number of symbols that is greater than or equal to the PUSCH preparation time Tproc,2, for corresponding PUSCH processing capability [8, TS38.214], and attempt to transmit the scheduled UL transmission(s) according to the corresponding CAPC.================================ Unchanged Texts Omitted ================================= |

**R1-2004013**

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| ================================ Start of TP#1 for TS 37.213 ================================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s)================================ Unchanged Texts Omitted =================================For UL transmission(s) following configured grant PUSCH transmission(s), the following is applicable:- If a UE is scheduled by a DCI received from a gNB to transmit UL transmission(s) starting from symbol in slot using Type 1 channel access procedure without CP extension, and if the UE starts configured grant UL transmissions before slot using Type 1 channel access procedure, and the scheduled UL transmission(s) occupies all the RBs of the same channels occupied by the configured grant UL transmission(s) or all the RBs of a subset thereof, the UE may directly transmit the scheduled UL transmission(s) according to the received DCI from symbol in slot without a gap, if the priority class value of the performed channel access procedure is larger than or equal to the priority class value indicated in the DCI, and the configured grant UL transmission shall end at the symbol preceding symbol . The sum of the lengths of the configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the priority class value used to transmit the configured grant UL transmission(s). Otherwise, the UE shall terminate the configured grant UL transmission(s) by dropping the transmission of at least the configured grant PUSCH transmission before symbol in slot and transmit the scheduled UL transmission(s) according to the received DCI.================================ Unchanged Texts Omitted ================================================================== End of TP#1 for TS 37.213 =============================================================== Start of TP#2 for TS 38.214 ===============================6.1 UE procedure for transmitting the physical uplink shared channel================================ Unchanged Texts Omitted =================================A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell overlapping in time with a transmission occasion, where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321], starting in a symbol on the same serving cell if the end of symbol is not at least symbols before the beginning of symbol . The value in symbols is determined according to the UE processing capability defined in Clause 6.4, and and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH with configured grant and the subcarrier spacing of the PDCCH scheduling the PUSCH.A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell immediately after a transmission occasion, where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321], starting in a symbol on the same serving cell if the end of symbol is not at least *Tproc,2* before the beginning of symbol assuming *d2,1*=1.================================ Unchanged Texts Omitted ================================================================== End of TP#2 for TS 38.214 =============================== |

**R1-2004085:**

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| ----------------------------------- TP2: Start of TP 37.213 section 4.2.1.0.1 ---------------------------------------4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) For contiguous UL transmission(s), the following are applicable:<Unchanged parts are omitted>- If a UE is scheduled, by a DCI format, to transmit UL transmission(s) starting from symbol *i* in slot *n* using Type 1 channel access procedures without CP extension with a corresponding CAPC, and if the UE starts configured grant UL transmissions before slot *n* using Type 1 channel access procedures with a corresponding CAPC, and the scheduled UL transmission(s) occupies a subset all of  the RBs of the same channels occupied by the configured grant UL transmission(s), the UE may continue to transmit the scheduled UL transmission(s) to the corresponding CAPC from symbol *i* in slot *n* without a gap, if the CAPC value of the performed channel access procedure is larger than or equal to the CAPC value corresponding to the scheduled UL transmission(s). The sum of the transmission durations of the configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the CAPC value used to transmit the configured grant UL transmission(s). Otherwise, the UE shall terminate the configured grant UL transmission(s) by dropping the transmission on the symbols of at least the last configured grant UL transmission of before symbol *i* in slot *n* that occur, relative to a last symbol of a CORESET where the UE detects the DCI format after a number of symbols that is greater than or equal to the PUSCH preparation time  for corresponding UE processing capability [6, TS 38.214], and attempt to transmit the scheduled UL transmission(s) according to the corresponding CAPC.<Unchanged parts are omitted>----------------------------------------End of TP 37.213 section 4.2.1.0.1 ----------------------------------------- |

**R1-2004521**

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| ===========================Start of Text Proposal for TS37.213===========================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) ============================<<unchanged text omitted>>===============================For UL transmission(s) following autonomous UL transmission(s), the following are applicable:- If a UE is scheduled by an eNB to transmit on channel by a UL grant received on channel , , and if the UE is transmitting using autonomous UL on channel , the UE shall terminate the ongoing PUSCH transmissions using the autonomous UL at least one subframe before the UL transmission according to the received UL grant.- If a UE is scheduled by a UL grant received from an eNB on a channel to transmit a PUSCH transmission(s) starting from subframe on the same channel using Type 1 channel access procedure and if at least for the first scheduled subframe occupies resource blocks and the indicated PUSCH starting position is OFDM symbol zero, and if the UE starts autonomous UL transmissions before subframe using Type 1 channel access procedure on the same channel, the UE may transmit UL transmission(s) according to the received UL grant from subframe without a gap, if the priority class value of the performed channel access procedure is larger than or equal to priority class value indicated in the UL grant, and the autonomous UL transmission in the subframe preceding subframe shall end at the last OFDM symbol of the subframe regardless of the higher layer parameter *endingSymbolAUL*. The sum of the lengths of the autonomous UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the priority class value used to perform the autonomous uplink channel access procedure. Otherwise, the UE shall terminate the ongoing autonomous UL transmission at least one subframe before the start of the UL transmission according to the received UL grant on the same channel.For UL transmission(s) following configured grant UL transmission(s), the following are applicable:- If a UE is scheduled by a UL grant to transmit UL transmission(s) starting from symbol in slot using Type 1 channel access procedure without CP extension with a corresponding CAPC, and if the UE starts configured grant UL transmissions before slot using Type 1 channel access procedure with a corresponding CAPC, and the scheduled UL transmission(s) occupies a subset all of RBs of the same channels occupied by the configured grant UL transmission(s), the UE may transmit the scheduled UL transmission(s) according to the received DCI from symbol in slot without a gap, if the CAPC value of the performed channel access procedure is larger than or equal to the CAPC value indicated in the DCI. The sum of the transmission duration of the configured grant UL transmission(s) and the scheduled UL transmission(s) shall not exceed the maximum channel occupancy time corresponding to the CAPC value used to transmit the configured grant UL transmission(s). Otherwise, the UE shall terminate the ongoing configured grant UL transmission(s) at least one slot before symbol in slot and attempt to transmit the scheduled UL transmission(s) according to the corresponding CAPC.============================<<unchanged text omitted>>==========================================================End of Text Proposal for TS37.213======================================================Start of Text Proposal for TS38.214===========================6.1 UE procedure for transmitting the physical uplink shared channel=========================<<unchanged text omitted>>===========================A UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell for a given HARQ process, if there is a transmission occasion where the UE is allowed to transmit a PUSCH with configured grant according to [10, TS38.321] with the same HARQ process on the same serving cell starting in a symbol after symbol , and if the gap between the end of PDCCH and the beginning of symbol is less than symbols. The value in symbols is determined according to the UE processing capability defined in Clause 6.4, and and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH with configured grant and the subcarrier spacing of the PDCCH scheduling the PUSCH.For operation with shared spectrum channel access, a UE is not expected to be scheduled by a PDCCH ending in symbol to transmit a PUSCH on a given serving cell for a given HARQ process where the PUSCH corresponding to the configured grant starts in a symbol , and if the gap between the end of PDCCH and the beginning of symbol is less than symbols. The value in symbols is determined according to the UE processing capability defined in Clause 6.4, and and the symbol duration are based on the minimum of the subcarrier spacing corresponding to the PUSCH with configured grant and the subcarrier spacing of the PDCCH scheduling the PUSCH.=========================<<unchanged text omitted>>=====================================================End of Text Proposal for TS38.214=========================== |

Companies are asked to provide their views related to the above proposals with the table below, including:

* which of the TPs should serve as the starting point?
* is a CR needed for both 37.213 and 38.214, or 37.213 only?

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| --- | --- |
| Company | Comment |
| OPPO | We are fine with the TPs proposed by R1-2003450 (ZTE) TP3, R1-2003512 (HW), R1-2003860 (Samsung), R1-2004085 (OPPO). But we are not ok with the TP proposed by R1-2003843 (Ericsson), R1-2004013 (LG TP1), R1-2004521 (WILUS TP1), where the CG cancelling is proposed to be CG-PUSCH resource level. In many cases, for cancelling a CG resource, only part of the symbols are met the processing time, in this case, the UE should be allowed to cancel only part of the CG resource that satisfies the processing time.For R1-2004013 (LG TP2), R1-2004521 (WILUS TP2), the proposed scheduling restriction is not meaningful, the gNB does not know in advance if the CG resources are to be used by the UE, imposing a scheduling restriction based on the configured CG resources will have huge impact on the scheduling efficiency and that was the reason in R15 such restriction was not introduced.  |
| ZTE, Sanechips | 1. We tend to suggest our TP3 R1-2003450, or R1-2003860, R1-2004085 is used as a starting point for discussion.

For R1-2003512 TP8, we reckon whether to ignore the scheduling DCI should be further discussed when UE cannot terminate CG-PUSCH transmission.For R1-2003843, R1-2004013 and R1-2004521, we share the same views as OPPO.1. CR should be captured in TR37.213 only.
 |
| Intel | 1. We are fine to use as a starting point the related TP in either R1-2003450, R1-2003512, R1-2003860, or R1-2004085. As for the other TPs, we also share same view as OPPO.
2. It would be preferable to constrain the text only to TS 37.213 only.
 |
| Huawei, HiSilicon | We also prefer to capture the changes in TS 37.213 onlyWe are not OK to use the TPs in R1-2003860, R1-2004085, R1-2004521 as the condition for FullBW allocation is not captured correctly by “the scheduled PUSCH transmission(s) occupies a subset or all of the RBs of the same channels occupied by the configured grant UL transmission(s),” or “the scheduled UL transmission(s) occupies a subset all of  the RBs of the same channels occupied by the configured grant UL transmission(s)”It worth noting that, in addition to cancellation rule, the proposed TP8 in R1-2003512 correctly captures the Full BW allocation condition while giving more flexibility in terms of allowing the scheduled UL to occupy **all the RBs of a subset of the same channels occupied by the CG transmission rather than all RBs of all the same channels.** It also captures the case when the UE cannot cancel/terminate the CG-PUSCH in accordance with the cancellation rule (which needs further discussion as ZTE mentioned)  |
| Qualcomm | Prefer to capture in 37.213.For the TP, would like to discuss behaviour first, before comparing TPs. |
| LG | We think that the exact gap duration to be needed to perform Cat-4 LBT for DG-PUSCH cannot be predicted by gNB. Therefore, the only thing that gNB can do is to guarantee the minimum processing time for a UE to cancel the CG-PUSCH located before DG-PUSCH and this minimum time from the last symbol of UL grant to the first symbol of the CG-PUSCH should be at least *Tproc,2* assuming *d2,1*=1. It is noted that the minimum processing time to cancel the CG-PUSCH when DG-PUSCH is scheduled overlapping in time with CG-PUSCH is already defined by *N2* symbols in Section 6.1 of TS 38.214. Therefore, the minimum processing time (*Tproc,2* assuming *d2,1*=1) for back-to-back transmission should be captured in the same section.  |
| vivo | Agree with Qualcomm that UE behaviour should be discussed first |
| Broadcom | We prefer to discuss the desired behaviour before comparing the specific texts in the TPs. |
| Nokia, NSB | Our preference is to have the change fully confined in 37.213.We also think cancellation on a symbol level is preferred.Considering all aspects, the TP by Huawei in R1-2003512 is probably the best starting point for a TP.  |
| Ericsson | We have the same understanding as LG as described in our contribution. With respect to OPPO’s comment, we agree that it is not important, or necessary whether the UE cancels completely or partially a CG-PUSCH. What is important is that enough gap for performing Type 1 LBT and enough time for cancellation is provided.The eventual TP is better to be captured in 37.213.For a TP to be captured in 37.213, it is preferred not to use terminologies or parameter names specific to NR, such as CORESET or Tproc,2, etc. |
| WILUS | We basically prefer to have the change in 37.213 in the generic way. But it still needs to discuss scheduling restriction with the addition in 38.214 in order to avoid complicate cancellation rule. |

## 3.2 UL transmission in a contiguous UL transmission burst

Three TDocs discuss clarifications and corrections to UE operation when selecting the LBT type for UL transmissions in a contiguous UL TX burst.

**R1-2004443:**

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| **Proposal 1. For LBT type and CP extension, of a contiguous burst of UL transmission (including PUCCH, PUSCH and SRS) scheduled by one or more DL or UL grants, where the first scheduled transmission is indicated to use UL Type 2A, Type 2B, or Type 2C channel access, if the UE failed the LBT to transmit the first scheduled transmission, for the later transmissions, the UE will use Type 2A UL channel access with CP extension of 0.**=====TP for 37.213 4.2.1.0.1================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) For contiguous UL transmission(s), the following are applicable:- If a UE is scheduled to transmit a set of UL transmissions including PUSCH using a UL grant, PUCCH using a DL grant, or SRS with either a DL grant or UL grant , and if the UE cannot access the channel for a transmission in the set prior to the last transmission according to one of Type 1, Type 2, or Type 2A UL channel access procedures, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the DL grant or UL grant. Otherwise, if the UE cannot access the channel for the first of the consecutive UL transmissions according to Type 2B UL channel access procedure, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedure.-  If a UE is scheduled by a gNB to transmit a set of UL transmissions including PUSCH using a UL grant, PUCCH using a DL grant, or SRS with either a DL grant or UL grant, the UE shall not apply a CP extension for the UL transmissions except for the first of the consecutive UL transmissions.- If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using one or more UL grant(s), PUCCH using one or more DL grant(s), or SRS with one or more DL grant(s) or UL grant(s) and the UE transmits one of the scheduled UL transmissions in the set after accessing the channel according to one of Type 1, Type 2, Type 2A, Type 2B or Type 2C UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.-    If a UE is configured to transmit a set of consecutive PUSCH, PUCCH, or SRS transmissions on resources configured by the gNB, the time domain resource configuration defines multiple transmission occasions, and if the UE cannot access the channel according to Type 1 UL channel access procedure for transmitting in a transmission occasion prior to the last transmission occasion, the UE shall attempt to transmit in the next transmission occasion according to Type 1 UL channel access procedure. If the UE transmits in one of the multiple transmission occasions after accessing the channel according to Type 1 UL channel access procedure, the UE may continue transmission in the remaining transmission occasions in the set, wherein each transmission occasion starts at the starting symbol of a configured grant PUSCH, periodic PUCCH, or periodic SRS within the duration of the COT.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions, except if Type 2B or Type 2C UL channel access procedures are identified for the first of the consecutive UL transmissions. ============================<<unchanged text omitted>>=============================== |

**R1-2003512**

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| ***Proposal 15：If a UE is scheduled by a gNB to transmit a set of contiguous PUSCHs using one or more UL grants, and if the UE has stopped transmitting during or before one of these UL transmissions, the UE may transmit a later UL transmission in the set using Type 2A UL channel access procedure without applying a CP extension.******Proposal 16：Adopt TP9 into section 4.2.1.0.1 of TS 37.213.***

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| \*\*\* <Beginning of **Text Proposal 9**> \*\*\*4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) \*\*\* Unchanged text is omitted \*\*\*For contiguous UL transmissions(s) including a transmission pause, the following are applicable:- If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps using one or more UL grant(s), and if the UE has stopped transmitting during or before one of these UL transmissions in the set and prior to the last UL transmission in the set, and if the channel is sensed by the UE to be continuously idle after the UE has stopped transmitting, the UE may transmit a later UL transmission in the set using Type 2 channel access procedure or Type 2A UL channel access procedure without applying a CP extension. - If a channel sensed by a UE is not continuously idle after the UE has stopped transmitting, the UE may transmit a later UL transmission in the set using Type 1 channel access procedure with the UL channel access priority class indicated in the DCI corresponding to the UL transmission.\*\*\* Unchanged text is omitted \*\*\*\*\*\* <End of **Text Proposal 9**> \*\*\* |

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**R1-2004275**

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| ***Proposal 4****: A UE is allowed to transmit according to Type 2C UL channel access for up to 0.584 ms also when type 2B channel access has been indicated in the DCI.* -------- Beginning of Text Proposal ------------============================<<unchanged text omitted>>===============================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) For contiguous UL transmission(s), the following are applicable:- If a UE is scheduled to transmit a set of UL transmissions including PUSCH using a UL grant , and if the UE cannot access the channel for a transmission in the set prior to the last transmission according to one of Type 1, Type 2, or Type 2A UL channel access procedures, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant. Otherwise, if the UE cannot access the channel for a transmission in the set prior to the last transmission according to Type 2B UL channel access procedure, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedure. If a UE cannot access the channel for transmission according to a Type 2B UL channel access procedure, the UE may access the channel according to Type 2C UL channel access procedure.-  If a UE is scheduled by a gNB to transmit a set of UL transmissions including PUSCH using a UL grant, the UE shall not apply a CP extension for the remaining UL transmissions in the set after the first UL transmission after accessing the channel.- If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using one or more UL grant(s) and the UE transmits one of the scheduled UL transmissions in the set after accessing the channel according to one of Type 1, Type 2, Type 2A, Type 2B or Type 2C UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.-    If a UE is configured to transmit a set of consecutive PUSCH transmissions on resources configured by the gNB, the time domain resource configuration defines multiple transmission occasions, and if the UE cannot access the channel according to Type 1 UL channel access procedure for transmitting in a transmission occasion prior to the last transmission occasion, the UE shall attempt to transmit in the next transmission occasion according to Type 1 UL channel access procedure. If the UE transmits in one of the multiple transmission occasions after accessing the channel according to Type 1 UL channel access procedure, the UE may continue transmission in the remaining transmission occasions in the set, wherein each transmission occasion starts at the starting symbol of a configured grant PUSCH within the duration of the COT.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions, except if Type 2B or Type 2C UL channel access procedures are identified for the first of the consecutive UL transmissions. ============================<<unchanged text omitted>>===============================-------- End of Text Proposal ------------ |

**R1-2004521**

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| * *Proposal 4: Adopt the following text proposal on TS 37.213.*

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| ===========================Start of Text Proposal for TS37.213===========================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s) ============================<<unchanged text omitted>>===============================For contiguous UL transmission(s), the following are applicable:- If a UE is scheduled to transmit a set of UL transmissions including PUSCH using a UL grant, and if the UE cannot access the channel for a transmission in the set prior to the last transmission according to one of Type 1, Type 2, or Type 2A UL channel access procedures, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant. Otherwise, if the UE cannot access the channel for a transmission in the set prior to the last transmission according to Type 2B UL channel access procedure, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedure.-  If a UE is scheduled by a gNB to transmit a set of UL transmissions including PUSCH using a UL grant, the UE shall not apply a CP extension for the remaining UL transmissions in the set after the first UL transmission after accessing the channel.- If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using more UL grants, and if the UE cannot access the channel for a transmission in the set prior to the last transmission regardless of any Type of UL channel access procedures, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant.-  If a UE is scheduled by a gNB to transmit a set of UL transmissions without gaps including PUSCH using more UL grant, the UE shall not apply a CP extension for the remaining UL transmissions in the set after the first UL transmission after accessing the channel.- If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using one or more UL grant(s) and the UE transmits one of the scheduled UL transmissions in the set after accessing the channel according to one of Type 1, Type 2, Type 2A, Type 2B or Type 2C UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.-   If a UE is configured to transmit a set of consecutive PUSCH transmissions on resources configured by the gNB, the time domain resource configuration defines multiple transmission occasions, and if the UE cannot access the channel according to Type 1 UL channel access procedure for transmitting in a transmission occasion prior to the last transmission occasion, the UE shall attempt to transmit in the next transmission occasion according to Type 1 UL channel access procedure. If the UE transmits in one of the multiple transmission occasions after accessing the channel according to Type 1 UL channel access procedure, the UE may continue transmission in the remaining transmission occasions in the set, wherein each transmission occasion starts at the starting symbol of a configured grant PUSCH within the duration of the COT.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions, except if Type 2B or Type 2C UL channel access procedures are identified for the first of the consecutive UL transmissions. ============================<<unchanged text omitted>>=========================================================End of Text Proposal for TS37.213=========================== |

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Companies are asked to provide their views related to the four proposals above with the table below:

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| Company | Comment |
| OPPO | We are fine with R1-2004443(QC) with the following proposed change. If a UE is scheduled to transmit a set of UL transmissions including PUSCH using a UL grant, PUCCH using a DL grant, or SRS with either a DL grant or UL grant , and if the UE cannot access the channel for a transmission in the set prior to the last transmission according to one of Type 1, Type 2, or Type 2A UL channel access procedures, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the DL grant or UL grant. Otherwise, if the UE cannot access the channel for the first of the consecutive UL transmissions according to Type 2B UL channel access procedure, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedure.We are fine with R1-2003512 (HW).For R1-2004275 (NOK), what is the reason behind: if the UE cannot access the channel with type2B, the UE is allowed to retry LBT type 2C? Our understanding for type 2C is that the gap <16us should be met, but obviously in the above case, the gap is met.  |
| ZTE, Sanechips | Support R1-2004443, but detailed TP modification can be discussed in the text proposal phase.Support TP9 from R1-2003512.For R1-2004275, in my view, if UE cannot access channel with Type 2B, it implies that the current channel state is not suitable for transmission, even if transmission, the result of this is that this transmission will cause some interference to ongoing transmission of nodes, which is extremely detrimental to principle of fair and friendly coexistence. So we disagree such switching behavior from type2B to Type2C when type2B is performed to fail.For R1-2004521, we think same rules agreed in the last meeting for “If a UE is scheduled to transmit a set of UL transmissions including PUSCH using a UL grant....” can be reused for the case “If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using more UL grants”. |
| Intel | We are fine with the issues highlighted in the TPs proposed in R1-2004443, R1-2003512, and R1-2004521, but exact text may need to be discussed.As for the TP in R1-2004275, it is not clear what is the use case that this TP aims to solve, and how a UE can guarantee a gap less than 16us after Type 2B has failed.  |
| Huawei, HiSilicon | Support TP9 from R1-2003512 as it is more concise.We are also not supportive of falling back Type 2C if Type 2B fails  |
| Charter Communications | Support the TP from R1-2004443. It is not clear how falling back to Type 2C access is logical if Type 2B access fails, there may be an out-of-cell entity occupying the channel that caused Type 2B to fail. |
| Qualcomm | We support TP in R1-2004443.For TP in R1-2003512, we support in principle. The text may need some update. Might be better to say:* If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps using one or more UL grant(s), and if the UE has stopped transmitting during or before one of these UL transmissions in the set and prior to the last UL transmission in the set, and if the channel is sensed by the UE to be continuously idle after the UE has stopped transmitting, the UE may transmit a later UL transmission in the set using Type 2A channel access procedure without applying a CP extension.

Our understanding of the TP in R1-2004275 is, if the UE failed Type 2B LBT, the UE still can transmit up to 0.584ms. We don’t think this is allowed.For TP in R1-2004521, the first change is not necessary, consider we already agree to use type 2A LBT for later transmissions. The second change on not using CP extension is fine. |
| LG | For the TP in R1-2004443, we support the third bullet of TP in R1-2004443 but first two bullets are not clear. Since the original first and second bullets are for the multiple consecutive PUSCH by a single UL grant, does the proposed TP means scheduling the multiple consecutive SRS or PUCCH with a single UL grant?We support TP9 from R1-2003512.For the TP in R1-2004275, the gNB should indicate proper LBT type according to the duration of UL transmission that Type 2C for the duration smaller than 0.584 ms and Type 2B for the duration larger than 0.584ms in a first place. We think that TP in R1-2004521 is not needed.  |
| vivo | Support TP in R1-2004443 and R1-2003512.For the TP in R1-2004275, fallback to type 2C is not needed. |
| Broadcom | We support the TP in R1-2004443.We support the TP in R1-2003512 in principle, along with the changes proposed by Qualcomm. We oppose the TP in R1-2004275 (i.e. fallback to Type 2C on failure of Type 2B). |
| Nokia, NSB | **R1-2004443:** a TP like this is good to have, since the current wording is limited to PUSCH only. Details may need fine tuning still.**R1-2003512:** we support this TP **R1-2004275:** we support this TP. The point is that if UE cannot access the channel according to Type 2B LBT, it should still be allowed to transmit according to 2C LBT, for a duration of up to 0.584 ms. There is no issue with the duration of the gap, since Type 2 B is used with aa gap of 16 us and in such case Tpye 2C can be applied too at the same time. **R1-2004521:** To us the TP in R1-2004443 seems to do the same and more. Nevertheless, this TP could be taken into account as well when updating R1-2004443. |
| Ericsson | Supportive of TPs in R1-2004443, R1-2003512 and R1-2004275 in general. Exact wording may need some adjustment.Our understanding on 4275 is similar to Nokia. The reason is not fall-back to 2C. The reason is when the gap is applicable to both 2C and 2B, there is a choice to skip LBT but instead restrict the consequent transmission as oppose to perform 2B LBT without restriction on transmission. |
| Sharp | We support the TP in R1-2004443 and the TP in R1-2003512. The changes in R1-2004521 is covered by R1-2004443.The proposal in R1-2004275 should not be adopted.  |
| WILUS | We are ok that R1-2004521 is merged with R1-2004443 or covered by R1-2004443. We support the TP in R1-2003512 to cover both eLAA and NR-U rather than with the changes proposed by QC.For the TP in R1-2004275, fallback to type 2C is not needed. |

# 4. Conclusions

TBA

# References