**3GPP TSG RAN WG1 #100bis-e** **R1-200XXXX**

**e-meeting, April 20-30, 2020**

**Agenda item: 7.2.2.2.1**

**Source: Moderator (Nokia)**

**Title: Summary of [100b-e-NR-unlic-NRU-ChAcc-01] Email discussion/approval on clarifications to LBT with consecutive UL transmissions**

**Document for: Discussion and Decision**

# 1 Introduction

This document captures the discussion in the following RAN1#100bis-e email thread:

[100b-e-NR-unlic-NRU-ChAcc-01] Email discussion/approval on clarifications to LBT with consecutive UL transmissions by 4/23; if necessary, followed by endorsing the corresponding TPs by 4/28 – Timo (Nokia)

During the preparation phase it was identified that the following TDocs and proposals relate to corrections and clarifications to consecutive UL transmissions:

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

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| Clarifications to LBT with consecutive UL transmissions | R1-2001534 (2.7)R1-2001652 (2.3)R1-2001705 (2.2)R1-2001759 (2.1)R1-2001935 (p7)R1-2001987 (p3)R1-2002117 (p2, p3)R1- 2002193 (p4)R1-2002383 (p1)R1-2002530 (p1)R1-2002632 (p4, p5) |

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

# 2. Issues identified in the contributions

## 2.1 LBT type after failing to transmit first PUSCH(s) of a set scheduled by an UL grant

Several TDocs addressed the issue of how to determine the UL channel access type and the value for CP extension in case channel access is not successful prior to the first PUSCH.

The current specification text is inherited from LTE LAA, and works as such for UL channel access Type 2A. However, NR also support new UL Channel Access Types 2B and 2C, and the specifications will need to be updated to cover those cases as well.

**Type 2B UL channel Access indicated for the 1st of the consecutive UL transmissions**

Several companies proposed that if a UE fails to access the channel with UL Type 2B channel access, Type 2A UL channel access shall be used for the following consecutively scheduled transmissions. There is also a related proposal to allow for transmitting with Type 2C at the start of the transmission burst for up to 0.584 ms, in case Type 2B LBT fails..

**FL Proposal #1**: *If a UE fails to access the channel with UL Type 2B channel access, Type 2A UL channel access shall be used for the following consecutively scheduled transmissions*.

- *Discuss whether the UE could also perform Type 2C channel access and transmit accordingly in case Type 2B fails.*

**Type 2C UL channel Access indicated for the 1st of the consecutive UL transmissions**

Similar considerations were there for Type 2C channel access as well. A difference is that Type 2C channel access does not involve channel sensing and will therefore always be successful. On the other hand, the duration of a UL transmission following Type 2C channel access can be at most 0.584 ms, after which the UE must stop the transmission, which as such resembles an LBT failure.

In the case of consecutive UL transmissions starting with Type 2C LBT, one option is to first perform Type 2C LBT, and then stop the transmissions at the time when the next transmission would exceed the 0.584 ms limit. Another option would be the also perform Type 2B LBT at the same time, and Type 2B is successful, transmit all the UL transmissions at the same go, and otherwise fallback to Type 2C and transmit only up to 0.584 ms. This assumes that the DL-UL gap is exactly 16 us.

**FL Proposal #2**: *If a UE fails to access the channel after transmitting with UL Type 2C channel access (e.g. due to transmission duration exceeding 0.584 us), Type 2A UL channel access shall be used for the following consecutively scheduled transmissions.*

*- Discuss whether the UE could also perform Type 2B channel access at the start of the transmission burst.*

**CP extension for the consecutively scheduled UL transmissions other than the first one**

A few companies also discussed the issue of determining the length of CP extension for the consecutively scheduled UL transmissions, in case the LBT fails prior to the first transmissions. There seems to be consensus to use “0 “CP extension for the subsequent UL transmissions irrespective of the CP extension indicated in the scheduling grant.

**FL Proposal #3**: *If a UE fails to access the channel prior to the first of the consecutive UL transmissions, it shall use “0” CP extension for the subsequent UL transmissions irrespective of the CP extension indicated in the scheduling grant(s).*

Once the preferences related to the above proposals are clear, a TP will be drafted to reflect the agreed behaviour.

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| **Company / Org.** | **Views on FL proposals #1-3** |
| ZTE, Sanechips | Firstly, I would like to confirm whether the current spec has supported the following situations:* **Case 1**: Type 1 (e.g., Cat 4 LBT) for the 1st of the consecutive UL transmissions, if LBT failure, gNB will indicate Type 2A (e.g., 25us Cat2 LBT) to UE to continue performing channel access for next UL transmission; or gNB will indicate Type 1 for next UL transmission
* **Case 2**: Type 2A (e.g., 25us Cat2 LBT) for the 1st of the consecutive UL transmissions, if LBT failure, gNB will indicate Type 2A or Type 1 to UE to continue performing channel access for next UL transmission.

**Secondly, for the three proposals listed by FL, my answer is as follows:****For proposal 1:*** Support the main bullet
* For sub-bullet, if Type 2C is supported for the 1st UL transmission, I don’t know whether there is a gap between 1st and 2rd UL transmission to be used to perform Type2A. in my understanding, there is no gap for consecutive UL transmission(s). So I don’t tend to support Type2C for 1st UL transmission.

**For proposal 2:**I don’t support fallback to Type 2C when channel is detected as busy with Type2B. Considering if channel is assessed as busy, it means the current channel is being occupied. Even if UE is allowed to transmit 0.584ms by using Type 2C, its performance is also hard to be guaranteed. So it is not a nice choice.* For sub-bullet, my suggestion is if Type 2B is indicated and LBT success, the UE will continue transmission of the remaining UL transmissions. Otherwise, UE continues to try channel access using Type 2A in the next UL transmission

**For Proposal 3:**I tend to support “0” CP extension for remaining UL transmissions after the first UL transmission due to LBT successful |
| Intel | We support all three proposals. |
| Huawei, HiSilicon | For the **Case** 1 and **Case 2** mentioned by ZTE, the spec currently does not capture them. Therefore, we proposed to adopt the top part of our TP7 in R1-2001534 as also captured in our *Proposal 10* in the summary below.**FL proposals:****For FL Proposal #1:** We support the main bullet* If Type 2B has been indicated for the first transmission, a gap 16us is already assumed before that first transmission
	+ If Type 2B fails, and the scheduled UL burst duration <= 0.584 us, then transmitting according to Type 2C channel access is technically possible. **However, gNB should have indicated Type 2C in the first place. Performing Type 2A before the subsequent transmission in burst is not applicable here.**
	+ If Type 2B fails, and the scheduled UL burst duration > 0.584 us, **then transmitting according to Type 2C channel access is not possible**. Type 2A should be performed before the subsequent transmission in burst
		- If “condition is met” refers only to the duration of the 1st transmission being <= 0.584us, then **that would imply UE purposely stops any subsequent transmissions not fully contained in the 0.584us and then applies Type 2A before later transmissions if any 🡪 similar concern as for FL Proposal #2**

**For FL Proposal #2:*** + If Type 2C has been indicated, and the scheduled UL burst duration > 0.584 us, then transmitting according to Type 2C channel access is not possible. **gNB should have indicated Type 2B in the first place and the case should be avoided**
		- If UE purposely stops any subsequent transmissions not fully contained in the 0.584us and then applies Type 2A before later transmissions**🡪 Not an appealing option since it is known to replace a 16us CAT2 (with a proper indication) by a later 25us CAT2 that is more stringent and more likely to fail due to stopping the transmission within burst**

**For FL Proposal #3:** We support this proposal |
| NTT DOCOMO | Support FL proposals #1-3.Regarding the discussion point in FL proposal #1, as Type 2B channel access is applicable only when gNB indicates it by DCI to the UE (i.e., it is intended by the gNB), Type 2C channel access should not be applicable when Type 2B fails.Regarding the discussion point in FL proposal #2, same as above, as Type 2C channel access is applicable only when gNB indicates it by DCI to the UE (i.e., it is intended by the gNB), Type 2B channel access should not be applicable at the same time. |
| Samsung | Agree with FL proposal #1 and #3. gNB should not indicate type 2C channel access if the consecutive UL transmissions would exceed 0.584ms. Instead, gNB can transmit two UL grants, one UL grant schedules consecutive UL transmissions ≤ 0.584ms with type 2C LBT, and another UL grant schedules remaining UL transmission with type 2A or 2B if still within COT. Therefore, no need to discuss TP #2 case. |
| WILUS | We support both the main bullet of FL proposal #1 and FL proposal #3.Regarding FL proposal #2, we share the view with Samsung and HW. If a duration of UL transmission burst scheduled by a UL grant is > 0.584ms, a gNB should have indicated Type 2B via UL grant assuming that the gap is equal to 16us or a gNB should have indicated Type 2A via UL grant within a COT shared by gNB. Therefore, I think no issue to discuss on Type 2C LBT (no LBT) failure case.  |
| Charter Communications | For proposal #1, we support falling back to Type 2A channel access for remaining UL transmissions if the first Type 2B access fails. We don’t agree with the associated proposal of allowing Type 2C access, this would result in intentional collision with another on-going transmission.For proposal #2, we don’t think stopping after 0.584 ms is equivalent to LBT failure. If the UE has consecutive UL transmissions that exceed a cumulative duration of 0.584 ms, then the gNB should not have indicated a Type 2C channel access for the entire UL CO to begin with. The correct approach would be to break up the transmissions into two grants, the first starting with Type 2C, and the second starting with Type 2B or 2A.For proposal #3, we are fine with “0” CP extension.  |
| LG | We support FL proposal #3 and FL proposal #1 and #2 need to be clarified.For FL proposal #1 and #2, it is necessary to clarify whether consecutive UL transmissions are scheduled by a single UL grant (i.e., multi-TTI scheduling) or multiple UL grants.For the multi-TTI scheduling case, the Type 2A channel access is applicable to the following consecutively scheduled transmissions if a UE fails to access the channel with UL Type 2B or Type 2C channel access that is indicated in multi-TTI scheduling DCI.However, for the multiple UL grants case, the Type 2B or Type 2C channel access should not be indicated to the subsequent transmissions, and Type 2C channel access should not be supported for the 1st UL transmission if the set of consecutive UL transmissions prolong more than 0.584 ms. Therefore, Type 2B channel access to the 1st UL transmission followed by the Type 2A channel access to the following consecutively scheduled transmissions or Type 2B channel access to the whole consecutive UL transmissions are only allowed to be scheduled in this case. |
| vivo | Support proposl#1 and #3.For proposal 2, gNB should not indicated Type 2C if the scheduled UL transmission exceeds 0.584ms, which is not a reasonable case since type 2C LBT is only applicable for transmissions less than 0.584ms. |
| Lenovo, Motorola Mobility | FL Proposal #1: We support to use Type 2A for the multi-TTI scheduling case. For multiple UL grants case, we should still follow the indicated Type for the consecutively scheduled transmission. We don't support using Type 2C in case Type 2B fails.FL Proposal #2: We disagree with the proposal. In our view, the problematic situation can be easily avoided by gNB scheduling. Therefore we don't need a solution for this case.FL Proposal #3: We support 0 CP extension in case of multi-TTI scheduling. For the multiple UL grants case, we don't see a need to override the indicated CP extension.In addition, we are wondering whether we may need to revisit the current spec text saying:"A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions."In our reading,Type 2A/2B/2C are "different channel access types" in terms of that statement. But it may be useful to allow 2C for the last slot with 2A/2B for the slot preceding that. |
| Sharp | We support Proposal #1 and #3.For Proposal #2, we share the views from Huawei, Samsung, Wilus and Charter. We don’t see the need to discuss it, as Type 2C should not be indicated if a total duration of scheduled UL exceeds 0.584 ms. |
| Broadcom | Support Proposal 1, as long as the PUSCH transmissions are within a gNB COT. Do not support the sub-proposal of fallback to Type 2C.Do not support Proposal 2. The gNB shall not indicate Type 2C in this case.Support Proposal 3. |
| OPPO | Proposal #1: we are ok, but we think type 2C is not allowed due to the gap cannot be guaranteedProposal #2: this case should be considered as error case, i.e. gNB cannot assign type 2C if the scheduled PUSCH transmission duration is larger than 0.584ms. Proposal #3: we are ok. |
| Ericsson | Proposal 1# We are supportive of the main bullet. We are supportive of the sub-bullet of proposal 1 and would like to discuss it further. It seems the intention is that if UE chooses to do 2C instead of 2B (since the gap size is the same for both), the UE should follow the restriction on transmission duration, etc corresponding to an LBT. We are open to discuss this. Basically, the uplink transmission can be two consecutive segments, 1st one is not more than 0.5 ms that the UE can transmit if LBT Type 2B fails. If LBT Type 2B doesn’t fail, both segments can be transmitted. Proposal 2# Main bullet is not needed. We would like to discuss this option together with sub-bullet of proposal 1. We understand the intention, but better operation in this case is to indicate 2B, not 2C. However, considering the sub-bullet in Proposal #1, if the UE is indicated 2B, in case 2B fails, the UE has a choice to do 2C and first a segment not more than 0.5 and skip the rest, or try at the 2A for the next segment.Proposal #3: we are ok. |
| Qualcomm | For proposal 1, we support main bullet. Additionally, we can further clarify for a consecutive UL burst, the UE should ignore the LBT type indication received in DCIs scheduling the later UL transmissions in the burst. For the sub-bullet, since the UE failed the first LBT, the gap will be longer than 25us, so Type 2C for later transmission may not be reasonable.For proposal 2, we support the main bullet and the sub-bullet. If we don’t have the UE behaviour that it can automatically try Type2B LBT (as in the sub-bullet), the main bullet might be a corner case and may be not very useful. The gNB should avoid this situation in the beginning, if it plans ahead. The situation only happens if the traffic arrives late, so after gNB schedules type 2C based short UL transmission, new traffic arrives (say a CA case, so SR/BSR is received through another CC), the gNB schedules more UL. In this case, UE can drop some UL transmission in the burst to create a gap for LBT. But if we do have the sub-bullet behaviour as an UE implementation, the main bullet behaviour can be beneficial.We support proposal 3. Additionally, we can further clarify that the UE should ignore the CP extension indicated in DCIs scheduling the later UL transmission in the burst. |
| Nokia NSB | We support all proposals, including the sub-bullets.Regarding the sub bullets for proposals 1 and 2, the important point is that the UE should be able to benefit from Type 2C LBT wherever possible, also in the case of consecutively scheduled UL transmission. In that respect, the case of Proposal 1 is the more important one. Related to proposal 1, if a contiguous UL burst is scheduled for the UE, in many cases the most critical information (PUCCH) is right at the beginning of the burst, and should be transmitted Type 2C LBT, even if Type 2B LBT would fail. I.e. UE does both Type 2B and 2C LBT at the same time at the start of the UL burst, and in case Type 2B LBT fails, the UE shall only transmit up to 0.584 ms. Without this functionality, a gap needs to be left between the PUCCH with Type 2C and the remaining UL with Type 2B, which means just unnecessary overhead.The sub-bullet in proposal 2 relates to the opposite case, where type 2C LBT is indicated to the UE at the start of the burst. One might argue that if P1 including Type2B-2C fallback is supported, this option is not that necessary, so as Ericsson mentioned, both could be discussed jointly.In any case, the conditions for indicating Type 2C LBT will need to be clarified further.Related to the point Lenovo raised :” A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions.": This does not seen fully accurate in NR anymore, unlike in LAA where Type 2A is always used within a eNB COT.The gNB can e.g. schedule the first transmission with Type 2B or 2C, followed by further consecutive transmissions, but the UE may miss the first UL grant. In such case, the UE should not obviously assume that the subsequent consequent transmissions can also use Type2B/C, but instead gNB should schedule them with Type 2A LBT.The simplest thing might be just to remove this sentence from the spec, since the gNB can anyhow ensure that the LBT type it indicates to the UE satisfies all necessary conditions. |

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| *R1-2001534:**Proposal 10：If a UE is scheduled to transmit a set of contiguous PUSCHs using a UL grant, and if the UE cannot access the channel prior to the last PUSCH transmission, the UE shall attempt to transmit the next transmission according to the channel access procedure type indicated in the UL grant unless Type 2B or Type 2C is indicated for which case the UE assumes Type 2A.**Proposal 13：If a UE is scheduled to transmit a set of contiguous PUSCHs using one or more UL grants, and if 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.*\*\*\* <Beginning of **Text Proposal 7**> \*\*\*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, the UE shall attempt to transmit the next transmission according to the channel access procedure type indicated in the UL grant if Type 1 or Type 2A UL channel access procedure is indicated, the UE shall attempt to transmit the next transmission according to Type 2A if a different UL channel access procedure is indicated otherwise. \*\*\* <End of **Text Proposal 7**> \*\*\*\*\*\* <Beginning of **Text Proposal 8**> \*\*\*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 2A UL channel access procedure. - 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 8**> \*\*\* |
| *R1- 2001652**Proposal 3: The indicated Type 2B LBT should be allowed to change to Type 2A for multi-PUSCH transmission within the gNB initiated COT if the channel is sensed to be busy before the first PUSCH. The indicated CP extension is only applicable to the first PUSCH transmission.* |
| *R1-2001705***Proposal 2**: ***It is proposed to reuse a similar way on “channel access procedures for consecutive UL transmissions” for NR-U UE and capture it in Section 4.2.1.0.1 of the latest version of TS 37.213.***4.2.1.0.1 Channel access procedures for consecutive UL transmission(s)--------------------------------------------------------- Start of TP #2------------------------------------------------------------------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 to eNB/gNB , and if the UE cannot access the channel for a transmission in the set prior to the last transmission, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant, or the channel access type used by the previous PUSCH transmission. - If a UE is scheduled to transmit a set of consecutive UL transmissions without gaps including PUSCH using one or more UL grant(s) to eNB/gNB, and the UE transmits one of the scheduled UL transmissions in the set after accessing the channel according to one of Type 1 or Type 2A UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions. <unchanged part omitted> |
| *R1-2001759****Proposal 1:*** *For contiguous uplink transmissions, if LBT for the first uplink transmission fails, type-2A channel access procedure with CP extension of 0 can be used if the later uplink transmission is within a gNB’s COT, otherwise, type-1 channel access procedure with CP extension of 0 shall be used.* ----------------------------------- TP1: 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:- 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, 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 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 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.- 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 cannot access the channel for the first transmission, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedures if Type 2A, Type 2B, or Type 2C UL channel access procedures is indicated in the UL grant, otherwise, the UE shall attempt to transmit the next transmission according to Type 1 UL channel access procedures. The UE shall assume CP extension length is 0 for the next transmission no matter which CP extension length is indicated in the UL grant.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions. <Unchanged parts are omitted>----------------------------------------End of TP 37.213 section 4.2.1.0.1 ----------------------------------------- |
| *R1-2001987*Proposal 3: If LBT fails for the first PUSCH in case of multi-TTI PUSCH scheduling, * if the CAT-4 LBT is indicated, the UE continues CAT-4 LBT operation for the subsequent PUSCH;
* if the CAT-1 or CAT-2 LBT is indicated, UE performs 25us CAT-2 LBT for the subsequent PUSCH;
* CP extension of 0 us applies to the subsequent PUSCH.

TS 37.213\*\*\* Unchanged text is omitted \*\*\***4.2.1.0.1Channel 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, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant if the indicated channel access type is either 1 or 2A. -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, the UE shall attempt to transmit the next transmission according to the channel access type 2A if the indicated channel access type is 2B or 2C -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 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any. -A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions.  \*\*\* Unchanged text is omitted \*\*\*TS 38.214, S 6.1.2.1.\*\*\* Unchanged text is omitted \*\*\*If *pusch-TimeDomainAllocationList* in *pusch-Config* contains row indicating resource allocation for two to eight contiguous PUSCHs, *K2* indicates the slot where UE shall transmit the first PUSCH of the multiple PUSCHs. Each PUSCH has a separate SLIV and mapping type. The number of scheduled PUSCHs is signalled by the number of indicated valid SLIVs in the row of the *pusch-TimeDomainAllocationList* signalled in DCI format 0\_1. For operation with shared spectrum channel access, if the UE fails to access the channel for the first PUSCH, 0 value of a cyclic prefix extension *Text* is applied for the transmission of the subsequent PUSCHs according to [4, TS 38.211]. \*\*\* Unchanged text is omitted \*\*\* |
| *R1-2002117*Proposal 2: For multi-PUSCH scheduling, if Type 2B channel access is indicated by the UL grant, UE shall perform Type 2B channel access for the first scheduled PUSCH and switch to Type 2A channel access for next PUSCH transmission if UE fails to access the channel for first scheduled PUSCHs.================================= Start of TP for TS 37.213 ================================4.2.1.0.1 Channel access procedures for consecutive UL transmission(s)================================ Unchanged Texts 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, the UE shall attempt to transmit the next transmission according to the channel access type indicated in the UL grant if the indicated channel access type is Type 1 or Type 2A or Type 2C, otherwise, UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedure. - 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 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions. ================================ Unchanged Texts Omitted ================================= |
| *R1-2002193****Proposal 4****: Any of the UL channel access types can be indicated for UL transmissions without gaps.*

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| Channel access type indicated for the first of the consecutive UL transmissions | LBT for the 1st UL transmission | LBT for the later UL transmissions |
| Type 1 | Type 1  | If 1st LBT fails: Type 1 |
| Type 2A | Type 2A  | If 1st LBT fails: Type 2A |
| Type 2B | Type 2B: if type 2B fails, use Type 2C if related conditions are met | If 1st Type 2B LBT fails: Type 2A |
| Type 2C | Type 2C; Also perform Type 2B at the same time if the gap=16 us | If 1st LBT (Type 2B) fails: Type 2A |

See also the related TP in the TDoc |
| *R1-2002383*Proposal 1:- TS37.213 to capture channel access type switching to Type-2A for the second or later attempts for consecutive UL transmissions. Adopt the following Text proposal #1.**Text proposal #1**--------- beginning of text proposal for TS 37.213 **<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 Type 1 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 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 Type 2A, Type 2B or Type 2C UL channel access procedures, the UE shall attempt to transmit the next transmission according to Type 2A UL channel access procedures. - 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 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions.  |
| *R1-2002530*Proposal 1. For multiple consecutive UL transmission, the CP extension and LBT type (other than cat 4 LBT) are applicable to the first scheduled transmission only. If the first transmission did not happen due to LBT failure, as the gap is larger than planned, the UE should use 25us Cat 2 LBT and CP extension 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 , and if the UE cannot access the channel for a transmission in the set prior to the last transmission, 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 to transmit a set of consecutive UL transmissions without gaps including PUSCH using one or more UL grant(s) and if the UE cannot access the channel for the first transmission in the set, the UE may attempt to transmit for later UL transmissions. If the first transmission is scheduled to access the channel using Type 1 UL channel access procedure, the UE shall attempt to access the channel with Type 1 UL channel access procedure for later UL transmissions in the set. If the first transmission is scheduled to access the channel using Type 2A, Type 2B, Type 2C UL channel access procedures, the UE shall attempt to access the channel with Type 2A UL channel access procedure with CP extension length 0 for later UL transmissions in the set.- 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 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.- A UE is not expected to be indicated with different channel access types for any consecutive UL transmissions without gaps in between the transmissions. ----Unchanged part omitted--------------------================================================= |
| *R1-2002632*Proposal 5: We propose to choose one of the following options at the RAN1#100 e-Meeting.- Option 1: The UE should attempt to transmit a later UL transmission using 16us Cat-2 LBT indicated in the DCI according to the current TS37.213 specification after failure of 16us Cat-2 LBT in the set of consecutive UL transmission.- Option 2: The UE should attempt to transmit a later UL transmission using Type 2A UL channel access procedure after failure of 16us Cat-2 LBT in the set of consecutive UL transmission.- Option 3: The UE should attempt to transmit a later UL transmission using Type 1 UL channel access procedure in the set of consecutive UL transmission. |

## 2.2 LBT type for consecutive CG transmissions

One contribution proposes to add a clarification related to the agreement ant RAN1#97:

RAN1 #97

Agreement:

UE can only start transmissions accessing transmission opportunities provided by a configured grant at the configured/indicated starting position.

**FL Proposal #4**: *Discuss whether and how to capture in the specifications the limitation based on the RAN1#97 agreement “UE can only start transmissions accessing transmission opportunities provided by a configured grant at the configured/indicated starting position.”*

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| **Company / Org.** | **View on FL proposal #4** |
| ZTE, Sanechips | I suggest that this content should be placed in AI 7.2.2.2.4 to capture and consider. Besides, the specific starting position of CG have not been determined yet and being discussed in CG. |
| Intel | We are supportive for the second part of the following TP. First part of the TP is related to the discussion within the previous section. |
| Huawei, HiSilicon | We support the second part of the TP for this discussion. Regardless of the CPE duration configured for the 1st CG-PUSCH, we need to capture the behaviour that the UE shall proceed with Type 1 channel access towards the remaining consecutive transmission occasions if the LBT fails. Therefore, it is more relevant to this discussion. |
| NTT DOCOMO | OK with the second part of the TP. First part of the TP should be discussed together with the issues in Section 2.1 |
| Samsung | OK with the TP. In addition, we may need to add “if the UE transmits one of the configured UL transmissions in the set after accessing the channel according to one of Type 1 or Type 2 UL channel access procedures, the UE may continue transmission of the remaining UL transmissions in the set, if any.” |
| WILUS | We support the second part of TP related to this discussion. |
| Charter Communications | Fine with second part of the TP. |
| LG | We also support the second part of TP but the first part of the TP can be addressed in Section 2.1 as mentioned by DOCOMO. |
| vivo | The second part of the TP can be considered as a baseline for discussion. The first part of the TP should be discussed in section 2.1. |
| Lenovo, Motorola Mobility | Generally fine with the second part of the TP. However "may" could be a bit misleading in this case. Our understanding is that transmission occasions are defined at which the UE may access the channel, but for each of those occasions it shall use Type 1 UL channel access procedure. |
| Sharp | Agree with Docomo and LG. Support the second part of the TP. The first part should be addressed in Section 2.1. |
| Broadcom | Agree to the second part of the TP. The first part of the TP should be discussed separately. |
| OPPO | OK with the second part of TP |
| Ericsson | We don’t think the TP is needed. In 38.214, it is clear when a UE transmit PUSCH on a configured grant resource, including CP extension.  |
| Qualcomm | Understand the motivation of the 2nd part, but the language may need some discussion. For the first transmission occasion the UE actually use (not the first transmission occasion configured), the CP extension should be added, and for the remaining transmission occasions the UE uses, there should be no CP extension and UE starts at the first symbol of the occasion. |
| Nokia, NSB | The main question to answer is what is done in the following case:* multiple consecutive PUSCH resources are configured for the UE
* UE chooses to start transmitting from a resource other than the firs consecutive one (e.g. due to LBT failing prior to the first resources, or just since there was no data to transmit
* shall the UE apply CP extension in this case, or not?

In our view, the CP extension is use always prior to the 1st resource that the UE uses. The TP, as it currently stands, is not clear how to take CP extension into account. Therefore we think this issue required further discussion |

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| *R1-2001534:****Proposal 11：Capture the UE channel access procedure based on the above agreement in TS 37.213**** ***A subclause for CG transmissions should be inserted in Section 4.2.1.0.1 ‘Channel access procedures for consecutive UL transmission(s)’ under “For contiguous UL transmissions…” as shown in TP7.***

\*\*\* <Beginning of **Text Proposal 7**> \*\*\*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, the UE shall attempt to transmit the next transmission according to the channel access procedure type indicated in the UL grant if Type 1 or Type 2A UL channel access procedure is indicated, the UE shall attempt to transmit the next transmission according to Type 2A if a different UL channel access procedure is indicated otherwise. - 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 or Type 2 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 at which the UE may access the channel according to Type 1 UL channel access procedure, 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 consecutive UL transmissions without gaps in between the transmissions. \*\*\* <End of **Text Proposal 7**> \*\*\* |

## 2.3 Direct transmission of UL transmission(s) following configured grant UL transmission(s)

Back-to-back Configured Grant and Dynamically scheduled UL transmissions were discussed in a couple of TDocs. Both TDocs propose supporting a behaviour similar to Rel-15 LAA AUL.

**FL Proposal #5**: *Discuss whether and how to capture in the specifications the channel access behaviour for back-to-back CG and dynamically scheduled UL transmissions.*

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| **Company / Org.** | **View on FL proposal #5** |
| ZTE, Sanechips | support |
| Intel | We support this proposal. However, we believe that back-to-back CG and dynamically scheduled UL transmissions can be always supported, as long as the occupied RBs for the latter overlaps with some or all of the occupied RBs for the CG transmission occurring right before.  |
| Huawei, HiSilicon | Support the proposal. I think the following addresses Intel’s comment but for the multi-channel case “all the RBs of the same channels occupied by the configured grant UL transmission(s) or all the RBs of a subset thereof” Our understanding of the FeLAA behaviour is that it is meant for Full BW scheduled UE. In case of a Partial BW scheduled UE, there could be other multiplexed UEs that would fail LBT if that UE with immediately preceding AUL applies direct transmission. |
| NTT DOCOMO | Agree to capture the behaviour. In our understanding, the bandwidth of DG-PUSCH is not necessary to be the same as that of CG-PUSCH if DG-PUSCH is allocated to a subset of or all RB sets where CG-PUSCH is transmitted |
| Samsung  | Reuse Rel-15 LAA AUL behaviour with additional restriction that the RB set(s) of DG-PUSCH is the same or a subset of the RB set(s) of CG-PUSCH. |
| WILUS | We are supportive to have similar behaviour as Rel-15 LAA AUL with the additional restriction that the RB set(s) of DG-PUSCH is the same or a subset of that of CG-PUSCH. |
| Charter Communications | Proposal and TP is agreeable. |
| LG | We support this proposal. DG-PUSCH(s) immediately following CG-PUSCH(s) should be supported if the conditions for bandwidth are met.  |
| vivo | The back-to-back CG and DG UL transmission should be supported. However, it must make sure that the scheduled resources for DG PUSCH is fully overlapped with that of the CG PUSCH, i.e., DG PUSCH can use part of or all of the RB set(s) for CG PUSCH. |
| Lenovo, Motorola Mobility | We are in general supportive of the back-to-back transmission and the TP. However, the suggested text following "Otherwise" would need further consideration. Dropping "at least the CG-PUSCH before symbol *i* in slot *n*" is too vague and ambiguous in our view, as it would allow the UE to drop many more symbols thereby creating a long gap. |
| Sharp | Share the views from Docomo and Wilus. We support this behavior with a RB set based restriction. |
| Broadcom | Support Proposal 5, if the resources for DG PUSCH are the same or a subset of the resources for CG PUSCH. |
| OPPO | We agree the TP in principle, but we would like to point out that based on 38.213 for CG-PUSCH cancelling rule, the CG-PUSCH cancellation granularity is at symbol level instead of PUSCH resource level. Moreover, the CG-PUSCH cancellation should respect to a processing time. Therefore, we propose the following modifications. Another clarification, the current TP restricts to CG-PUSCH using Type 1 channel access procedure. But if CG-PUSCH is based on type 2 channel access, shall we allow direct transmission for DG-PUSCH?Proposed TP:For UL transmission(s) following configured grant UL transmission(s), the following are applicable:- If a UE detects a DCI format from a gNB indicating to the UE 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 DCI format 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 of the scheduled UL transmission, 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 by dropping the transmission on the symbols of at least the last CG-PUSCH before symbol in slot 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 the corresponding UE processing capability [6, TS 38.214], and transmit the scheduled UL transmission(s) according to the received DCI. |
| Ericsson | We are supportive of the proposal. It seems we missed it for NR-U. We would like to discuss the exact TP later, given the comments provided. |
| Qualcomm | Agree with the proposal in principle. A few details needs to be clarified. For the RB allocation restriction, agree with HW’s observation. Even in LTE-feLAA, there is no requirement to align the RB allocation between AUL and scheduled UL. The concern is other possible configured grant UL FDM with scheduled UL needs an LBT gap. So the continuous transmission was only supported when the scheduled UL is full band transmission so there is no other AUL UE in the beginning. Therefore, to follow the same design principle, instead of saying the RB allocation is fully overlapping or a subset, we should say the DG PUSCH should take all interlaces of all or a subset of RB sets of the previous CG-PUSCH.For the CP extension, instead of requiring CP extension to be 0 for DG-PUSCH, we can simply allow the UE to ignore the CP extension field |
| Nokia, NSB | We support the proposal, with the clarification that the RB sets used for the transmissions should be the same, or the latter transmission uses a subset of the RBs of the first transmission.  |

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| *R1-2001534:****Proposal 15： A behavior similar to that of FeLAA for UL transmission(s) immediately following autonomous UL transmission(s) should be supported in NR-U for UL transmission(s) immediately following configured grant UL transmission(s).***\*\*\* <Beginning of **Text Proposal 9**> \*\*\*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 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 by dropping the transmission of at least the CG-PUSCH before symbol in slot and transmit the scheduled UL transmission(s) according to the received DCI.\*\*\* Unchanged text is omitted \*\*\*\*\*\* <End of **Text Proposal 9**> \*\*\* |
| *R1- 2001935*Proposal #7: The CG-DG PUSCH back-to-back transmission is supported in NR-U when the following conditions in addition to conditions defined for LTE LAA are satisfied:* The DG-PUSCH can be transmitted without performing the LBT immediately after the CG-PUSCH only when there is no timing gap between the ending symbol of CG-PUSCH and the starting symbol of DG-PUSCH and the bandwidth of DG-PUSCH is the same as the bandwidth of CG-PUSCH. Otherwise, UE should terminate CG PUSCH at least X (FFS on whether X is predefined as 1 slot or semi-statically configured) symbols before the starting symbol of DG-PUSCH.
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# 3. Conclusions

Based on the discussion related to the contributions, the following was agreed on the RAN1 email reflector:

**Section 2.1:**

Agreement:

For LBT type and CP extension, after failing to transmit first PUSCH(s) of a set scheduled by a single UL grant,

* If a UE fails to access the channel with UL Type 2B channel access, Type 2A UL channel access shall be used for the following consecutively scheduled transmissions.
* If a UE fails to access the channel prior to the first of the consecutive UL transmissions, it shall use “0” CP extension for the subsequent UL transmissions irrespective of the CP extension indicated in the scheduling grant.

Would a text proposal be needed for the above or is the plan to leave it to the editor? If a TP is needed, it can be discussed until 4/28.

**Section 2.3:**

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.

Discuss the exact TP taking TP#9 in R1-2001534 as the starting point (until 4/28)

**Section 2.2:**

Finally, regarding the proposal to discuss the TP on LBT type for consecutive CG transmissions, in general we should work on TPs in the second phase only if there is consensus that there is something missing that needs to be captured in a TP. It was not clear that is the case here, but let’s continue discussion as Timo recommends.

Discuss if the second change in TP7 of R1-2001534 is agreeable, possibly with some modifications until 4/28

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | [**R1-2001534**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001534.zip) | Maintainance on the channel access procedure | Huawei, HiSilicon |
| 2 | [**R1-2001652**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001652.zip) | Remaining issues on the channel access procedures | vivo |
| 3 | [**R1-2001705**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001705.zip) | Remaining issues on the channel access procedure for NR-U | ZTE, Sanechips |
| 4 | [**R1-2001759**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001759.zip) | Discussion on the remaining issues of channel access procedure | OPPO |
| 5 | [**R1-2001935**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001935.zip) | Remaining issues of channel access procedure for NR-U | LG Electronics |
| 6 | [**R1-2001987**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2001987.zip) | Channel access mechanism for NR-unlicensed | Intel Corporation |
| 7 | [**R1-2002031**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002031.zip) | Channel access procedures | Ericsson |
| 8 | [**R1-2002117**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002117.zip) | Channel access procedures for NR-U | Samsung |
| 9 | [**R1-2002193**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002193.zip) | Remaining Issues on Channel Access Procedures for NR-U | Nokia, Nokia Shanghai Bell |
| 10 | [**R1-2002247**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002247.zip) | Remaining issues on channel access procedures for NR-U | ETRI |
| 11 | [**R1-2002383**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002383.zip) | Remaining issues and corrections on channel access procedure for NR-U | Sharp |
| 12 | [**R1-2002405**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002405.zip) | Remaining issues on channel access for NR-U operation | MediaTek Inc. |
| 13 | [**R1-2002434**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002434.zip) | Remaining issues on channel access procedures for NR-U | NTT DOCOMO, INC. |
| 14 | [**R1-2002465**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002465.zip) | TP on shared spectrum in NR-U | NEC |
| 15 | [**R1-2002530**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002530.zip) | TP for Channel access procedures for NR unlicensed | Qualcomm Incorporated |
| 16 | [**R1-2002632**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002632.zip) | Remaining issues on channel access procedure for NR-U | WILUS Inc. |
| 17 | [**R1-2002684**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_100b_e/Docs/R1-2002684.zip) | COT sharing information in CG-UCI | Lenovo, Motorola Mobility |