**N3GPP TSG RAN WG1 Meeting #110bis-e R1-22xxxxx**

**e-Meeting, October 10 – 19, 2022**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary of [110bis-e-NR-R15-07] Discussion on** **parallel transmission of PRACH and SRS/PUCCH/PUSCH**

**Document for: Discussion and Decision**

# Introduction

This document is created to collect company views on R1-2209849 [1] and R1-2209836 [2]. Both papers try to address issues related to parallel transmission of PRACH and SRS/PUCCH/PUSCH.

# First round

## Issue#1: R1-2209849

In RAN1#109-e, it was agreed to introduce a new feature group X-2 and a new Rel-17 RRC parameter for parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in **intra-band non-contiguous CA**.

Agreement

Introduce feature groups X-1 and X-2 as described below.

* Introduce a new Rel-17 RRC parameter (UE-specific) to enable the UE behavior under X-2.

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| X. TEI | X-2 | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA |  | *Yes* | n/a | UE cannot transmit parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA | Per BC | No | Yes | n/a | This feature is the same as parallelTxPRACH-SRS-PUCCH-PUSCH, but for intra-band non-contiguous CA. This feature is enabled by a new UE-specific RRC parameter *intraBandNC-PRACH-simulTx-r17* | Optional with capability signaling |

According to [1], the above agreement has already been reflected in TS38.214 V17.3.0 but it has not been captured in TS38.213 V17.3.0. Based on current specification in TS 38.213, the UE can not transmit PRACH and PUSCH/PUCCH/SRS simultaneously in intra-band non-contiguous CA. Hence, the following changes was proposed in [1]

## 8.1 Random access preamble

========================= Unchanged parts =========================

For single cell operation or for operation with contiguous carrier aggregation in a same frequency band or for operation with non-contiguous carrier aggregation in a same frequency band if the UE is not configured with higher layer parameter *intraBandNC-PRACH-simulTx-r17*, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the SCS configuration for the active UL BWP. For a PUSCH transmission with repetition Type B, this applies to each actual repetition for PUSCH transmission [6, TS 38.214].

**Q1: Do you agree with the analysis in [1] that based on current specification in TS 38.213, a UE cannot transmit PRACH and PUSCH/PUCCH/SRS simultaneously in intra-band non-contiguous CA? If not, why?**

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| **Company** | **Agree or not** | **Comment** |
| Nokia | No | In our understanding 38.214 is clear that the UE can transmit the two signals simultaneously |
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**Q2: If the answer to Q1 is “yes”, do you agree with the change proposed in [1]?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comment** |
| QC | Yes | We support the CR to add clarity to the spec. We also assume the change is for Rel-17 spec. Can moderator please confirm? |
| Samsung |  | We think the proposed change is already clear from 38.214 and is therefore unnecessary. If majority wants to clarify this in 38.213 v17.x.x, we are OK to discuss. However, although *intraBandNC-PRACH-simulTx-r17* is captured in 38.214, no such parameter is identified in 38.331. Can the moderator please clarify? Further, in order to have consistent specification text, "higher layer parameter" should be removed as it is not used in TS 38.213 and "configured" should be changed to "provided" – e.g.  “For single cell operation or for operation with contiguous carrier aggregation in a same frequency band or for operation with non-contiguous carrier aggregation in a same frequency band if the UE is not provided with *intraBandNC-PRACH-simulTx-r17*, …” |
| Nokia, NSB |  | Agree with Samsung that the CR is not necessary as the simultaneous transmission should be obvious from 38.214. That said we are not vehemently opposed of the change either as it is for Rel-17. The isolated impact analysis is missing from the cover page of 9849. This is sort of OK for a Rel-17 CR, but as this is a fix to Rel-15 basic definition to differentiate between the new capability/configuration it would be good to introduce one. Something like:* **Impacted functionality:** Simultaneous transmission of PRACH on one uplink carrier and PUSCH/PUCCH/SRS on another uplink carrier in intra-band non-contiguous CA and with UE supporting *intraBandNC-PRACH-simulTx-r17* configuration
* **If the UE is implemented according to the CR and the gNB is not**: The UE can transmit the two signals on the two carriers as intended and there is no interoperability issue
* **If the gNB is implemented according to the CR and the UE is not:** The UE may not be able to transmit the two signals on the two carriers as intended and the usefulness of this UE capability is lost. There is no interoperability issue.
 |
| CATT |  | We support the CR for 38.213 to avoid potential confliction between specs. The revision from Samsung is fine with us. |
| MTK |  | (Same as CATT) We support the CR for 38.213 to avoid potential confliction between specs. The revision from Samsung is fine with us. |
| LGE |  | Although we share similar view with Nokia and Samsung that 38.214 is clear for this clarification, we are OK with the CR for 38.213 if majority wants to have the same clarification also in 38.213. |
| Intel |  | We share similar view other companies that text in 214 is clear and no need for the update in 213. We can be also okay if majority supports the clarification.  |
| Ericsson |  | We are in principle OK to add the clarification in 38.213. As commented by Samsung, *intraBandNC-PRACH-simulTx-r17* seems to be not captured in latest 38.331 h20.  |
| Apple |  | OK with Samsung’s revision |
| **Moderator** | Yes | From moderator point of view, there is indeed some inconsistency between TS38.213 and TS38.214. * In TS 38.213, it says “operation with carrier aggregation in a same frequency band” which include both contiguous and non-contiguous CA. Hence, a UE cannot transmit PRACH and PUSCH/PUCCH/SRS simultaneously in intra-band non-contiguous CA under the given condition.
* In TS38.214, a UE can transmit PRACH and PUSCH/PUCCH/SRS simultaneously in intra-band non-contiguous CA if the UE indicates the capability and gNB provides higher-layer configuration.

Therefore, it is suggested to fix the inconsistency in TS38.213. I don’t see strong concerns from companies.@QCThe correction is proposed for Rel-17 same as the 214 CR in R1-2205625. @Samsung On the parameter name, *intraBandNC-PRACH-simulTx-r17* can be found in the endorsed RAN1 NR UE feature list in R1-2205608 (the second last column for FG39-2). It is also used in the 214 CR in R1-2205625. I have not found it 331. I think it would be okay to take the name as it is now. In case there is a change in 331, they can be fixed in both 213 and 214 later. In addition, LS can be sent to RAN2 inform the situation.Regarding the proposed change from “configured with higher-layer parameter” to “provided”, it looks fine and I don’t think will be controversial.@NokiaThanks for the suggestion on the impact analysis. I would also like to encourage the companies to check the proposal from Nokia. |

## Issue#2: R1-2209836

For intra-band CA, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when the gap between PRACH and PUSCH/PUCCH/SRS is less than N symbols. The value of N is dependent on the SCS. The corresponding specification is copied below:

|  |
| --- |
| **TS38.213-ff0**For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than  symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where  for  or ,  for  or , and  is the SCS configuration for the active UL BWP. |

For intra-band CA with different SCS, it is not clear which SCS should be used to determine the duration of the slot. For example, for CC1 with 15kHz SCS and CC2 with 30kHz SCS as shown in Figure 1, if 15kHz is used, the UE would not transmit the PRACH and PUCCH/PUSCH/SRS as they are in the same 15kHz slot. But if 30kHz SCS is used, the UE would transmit the PRACH and PUCCH/PUSCH/SRS as they are in the different 30kHz slot.



Figure 1: It is not clear whether the PRACH in CC1 and PUCCH/PUSCH/SRS in CC2 are in the same slot or not. The UE would not transmit both if they are in the same slot. Otherwise, the UE would transmit both.

Besides, it is also not clear whether the N (N=2 in the above example) symbols are based on 15kHz SCS or 30kHz SCS as shown in Figure 2. If the N symbols are N 15kHz symbols, then PUSCH/PUCCH/SRS in CC2 should be later than 4th symbol of slot 2 in CC2. If the N symbols are N 30kHz symbols, then PUSCH/PUCCH/SRS in CC2 should be later than 2nd symbol of slot 2 in CC2.



Figure 2: It is not clear whether N (e.g. N=2) symbols gap between PRACH and PUCCH/PUSCH/SRS in the spec is N 15kHz symbols or N 30kHz symbols.

To resolve the above ambiguity, it was proposed to use the smallest SCS among the multiple CCs to determine the duration of the slot and the N symbols in [2], i.e. the UE would not transmit the PRACH and PUCCH/PUSCH/SRS in Figure 1 as they are in the same 15kHz slot. If 30kHz SCS is used, the UE would be required to transmit both PRACH and PUCCH/PUSCH/SRS. However, the timing advance are different between PRACH and PUCCH/PUSCH/SRS, then the UE may need to apply different timing advance in a 15kHz slot. And the symbol boundary among these two CCs in this case will not be aligned. This would complicate the UE implementation. Based on the above analysis, the following TP is proposed

--------------------------------------------------------Start of the TP------------------------------------------------

## 8.1 Random access preamble

================================= Unchanged parts =============================

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot with respect to the smallest SCS configuration for the active UL BWP(s) or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the smallest SCS configuration for the active UL BWP(s).

--------------------------------------------------------End of the TP--------------------------------------------------

**Q1: Do you agree with the analysis in [2] that it is not clear which SCS is used to determine “the duration of the slot” and “N symbols gap” according to the current specification? If not, why?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comment** |
| QC | Agree |  |
| Spreadtrum | Agree |  |
| Samsung | Agree |  |
| Nokia, NSB | Agree |  |
| CATT | Agree |  |
| MTK | Agree |  |
| LGE | Agree |  |
| ZTE | Agree |  |
| Intel | Agree |  |
| Ericsson | Agree |  |

**Q2: Which SCS do you think should be used to determine “the duration of the slot” and “N symbols gap”?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comment** |
| Spreadtrum | Agree | We support to use the smallest SCS |
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**Q3: Do you agree with the change proposed in [2]?**

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| **Company** | **Agree or not** | **Comment** |
| QC | Agree | We agree with the change in the CR. But we’d like to understand the change is proposed for which release. We are not acceptable to change Rel-15 spec at this stage. We prefer to adopt the change to Rel-17 spec. For Rel-16, we are open to discuss.  |
| Spreadtrum | Agree | We are fine with the CR from Rel-16. |
| Samsung | Agree | We are OK with the change for Rel-16/17. No need for the ‘(s)’ even if there is only one active UL BWP. |
| Nokia, NSB | Disagree | The SCS choice should be between the two carriers taking part in the simultaneous transmission of the two signals. Now the text proposal pics all the UL BWPs of the CA config, not just the two that are being evaluated. |
| CATT | Agree | We are fine with the CR from Rel-16/17. |
| MTK | Agree | Similar view as QC, while Nokia’s concern seems valid and can be checked/addressed. |
| LGE | Agree | We are OK with the CR in principle for Rel-16/17. |
| ZTE | Agree | Support in principle. But the concern from Nokia can be further checked. |
| Intel | Agree | We are fine with the Rel-16/17 CR.  |
| Ericsson | Not agree | We agree with Nokia. Only the SCSs of carriers of PRACH and PUSCH/PUCCH/SRS transmissions should be considered. |
| Apple | Agree | We are fine with the CR for R16/17. |
| **Moderator** |  | @AllIt seems that the majority are fine to make change for Rel-16 and Rel-17.@ Nokia, NSB, EricssonI think this is another alternative. Let us take this into account in the next step discussion. |

# Second round

## Issue#1: R1-2209849

As per Chairman’s guidance, the moderator would like to trigger further discussion on the detailed changes. A draft Rel-17 CR is prepared under the same folder [here](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Inbox/drafts/7.1%28NR_R15_Maint%29/%5B110bis-e-NR-R15-07%5D/Draft%20CR%20R1-22xxxxx%20Correction%20on%20parallel%20transmission%20of%20PRACH%20and%20SRS%2CPUCCH%2CPUSCH.docx).

The TP was updated based on the comment from Samsung in the first round, which seems to be acceptable to all companies. The higher-layer parameter *intraBandNC-PRACH-simulTx-r17* is still used assuming that later an LS will sent to RAN2 and ask RAN2 to capture it into TR 38.331. In addition, Nokia proposed to include the following isolated impact analysis. Companies are invited to check the draft CR.

**Q1: Do you agree with the draft CR? Any further comments?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comment** |
| Nokia, NSB | Agree | Even though 38.214 should be clear already on the matter, the CR does eliminate an inconsistency between the 38.213 and 38.214 and we can accept it to Rel-17. |
| MTK | Agree |  |
| Samsung | Agree |  |
| CATT | Agree |  |
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## Issue#2: R1-2209836

As per Chairman’s guidance, the moderator would like to trigger some further discussion. In the first round, 10 companies agree with the proposed change while 2 companies propose to only consider the SCSs of carriers of PRACH and PUSCH/PUCCH/SRS transmission. From the moderator point of view, both alternatives could work. Based on above, two TPs are prepared. I would like to have a quick check on whether companies have a strong preference to one or the other.

**Alternative 1:**

--------------------------------------------------------Start of the TP------------------------------------------------

## 8.1 Random access preamble

=============================== Unchanged parts =============================

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot with respect to the smallest SCS configuration for the active UL BWP or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the smallest SCS configuration for the active UL BWP.

--------------------------------------------------------End of the TP--------------------------------------------------

**Alternative 2:**

--------------------------------------------------------Start of the TP------------------------------------------------

## 8.1 Random access preamble

=============================== Unchanged parts =============================

For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot with respect to the smallest SCS configuration for the active UL BWP with the PRACH and PUSCH/PUCCH/SRS transmissions or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the smallest SCS configuration for the active UL BWP with the PRACH and PUSCH/PUCCH/SRS transmissions.

--------------------------------------------------------End of the TP--------------------------------------------------

**Q1: Which alternative do you prefer? Do you have a strong preference?**

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| --- | --- | --- |
| **Company** | **Alt.1 or Alt.2** | **Comment** |
| Nokia, NSB | Prefer the Alt.2 approach | Alt.1 as it now stands doesn’t work. It refers to “the smallest SCS configuration for the active UL BWP”, as in one BWP (but which one?) and there is of course just one SCS configured for any one BWP.Alt.2 is a bit broken too: “for the active BWP with the PRACH and PUSCH/PUCCH/SRS” refers to one single BWP that is carrying the two signals. Suggest“…a same slot with respect to the smallest SCS of the UL BWP with the PRACH and the UL BWP with the PUSCH/PUCCH/SRS transmissions or…”“…and $μ$ is the smallest SCS of the UL BWP with the PRACH and the UL BWP with the PUSCH/PUCCH/SRS transmissions.” |
| MTK |  | We prefer Nokia’s revision. |
| ZTE |  | We can accept the revision from Nokia. It is more accurate. |
| Samsung | Alt. 2 in principle | It seems to be reasonable that smallest SCS is selected between two carriers taking part in the simultaneous transmission of the PRACH and PUSCH/PUCCH/SRS. If Alt. 1 is used, smallest SCS is always conservatively determined. We are OK with Nokia’s revision. However, we prefer to reuse existing specification, e.g., in section 8.1 of TS 38.213, “…corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH order and the SCS configuration of the corresponding PRACH transmission.”Thus, we suggest changing it as follows:“…a same slot with respect to the smallest SCS configuration between the SCS configuration of the PRACH and the SCS configuration of the PUSCH/PUCCH/SRS or…”“…$μ$ is the smallest SCS configuration ~~for the active UL BWP~~ between the SCS configuration of the PRACH and the SCS configuration of the PUSCH/PUCCH/SRS …” |
| Ericsson | Alt.2 | We prefer Nokia’s version. Since only two BWPs are mentioned, we suggest an editorial change based on Nokia’s version below. It still works if PUSCH, PUCCH and SRS are scheduled in different BWPs, and it means SCS of PRACH BWP is compared with that of every other UL transmission’s BWP.“…a same slot with respect to the ~~smallest~~ smaller SCS of the UL BWP with the PRACH and the UL BWP with the PUSCH/PUCCH/SRS transmissions or…”“…and $μ$ is the ~~smallest~~ smaller SCS of the UL BWP with the PRACH and the UL BWP with the PUSCH/PUCCH/SRS transmissions.” |
| CATT | Alt. 2 | We are fine with Nokia’s version or Ericsson’s version.If we go with Nokia’s version, we suggest to make the following update considering PUSCH/PUCCH/SRS transmissions in different UL BWPs.“…a same slot with respect to the smallest SCS of the UL BWP with the PRACH and the UL BWP(s) with the PUSCH/PUCCH/SRS transmissions or…”“…and $μ$ is the smallest SCS of the UL BWP with the PRACH and the UL BWP(s) with the PUSCH/PUCCH/SRS transmissions.”We are also open to further refinement as suggested by Samsung. But the current proposal from Samsung is different from Nokia’s proposal since SCS configuration of PRACH is different from SCS configuration of UL BWP with PRACH transmission. |
| **Moderator** |  | According to the feedback, it seems that companies are fine with the direction of Alt.2. On the detailed change, it is the moderator’s understanding that the original intention of Alt.2 is to select the smaller SCS between SCS of the UL BWP with PRACH transmission and the SCS of UL BWP with PUSCH/PUCCH/SRS transmission. Hence the comparison is done only between two UL BWPs. Hence the suggestion from CATT to use UL BWP(s) is not. In addition, Samsung proposed another alternative, instead of using the SCS of the UL BWPs carrying the PRACH and PUSCH/PUCCH/SRS transmission, the SCS of PRACH and the SCS of PUCCH/PUSCH/SRS are used. The reasoning is to follow a similar approach as the PDCCH order PRACH in section 8.1 of TS38.213. Note that in section 8.1, there is following description highlighted in yellow to address the case for PRACH using 1.25kHz or 5Hz.--- TS38.213, Section 8.1---If a random access procedure is initiated by a PDCCH order, the UE, if requested by higher layers, transmits a PRACH in the selected PRACH occasion, as described in [11, TS 38.321], for which a time between the last symbol of the PDCCH order reception and the first symbol of the PRACH transmission is larger than or equal to $N\_{T,2}+ ∆\_{BWPSwitching}+∆\_{Delay}+T\_{switch}$ msec, where - $N\_{T,2}$ is a time duration of $N\_{2}$ symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming $μ$ corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH order and the SCS configuration of the corresponding PRACH transmission - $∆\_{BWPSwitching}=0$ if the active UL BWP does not change and $∆\_{BWPSwitching}$ is defined in [10, TS 38.133] otherwise - $∆\_{Delay}=0.5$ msec for FR1 and $∆\_{Delay}=0.25$ msec for FR2- $T\_{switch}$ is a switching gap duration as defined in [6, TS 38.214] For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N\_{2}$ assuming SCS configuration $μ=0$.- End--Based on the above, the moderator provides two TPs below: * Alt 2.1 is more aligned with the original intention with some update
* Alt 2.2 is the new proposal from Samsung.

From the moderator’s point of view, both alternatives could work. **Companies are encouraged to indicate your preference.** **Alt 2.1**For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot with respect to the smaller SCS configuration of the UL BWP with the PRACH and the UL BWP with PUSCH/PUCCH/SRS transmissions or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the smaller SCS configuration of the active UL BWP with the PRACH and the UL BWP with PUSCH/PUCCH/SRS transmissions.**Alt 2.2**For single cell operation or for operation with carrier aggregation in a same frequency band, a UE does not transmit PRACH and PUSCH/PUCCH/SRS in a same slot with respect to the smaller SCS configuration between the SCS configuration of the PRACH transmission and the SCS configuration of the UL BWP with PUSCH/PUCCH/SRS transmissions or when a gap between the first or last symbol of a PRACH transmission in a first slot is separated by less than $N$ symbols from the last or first symbol, respectively, of a PUSCH/PUCCH/SRS transmission in a second slot where $N=2$ for $μ=0$ or $μ=$1, $N=4$ for $μ=2$ or $μ=3$, $N=16$ for $μ=5$, $N=32$ for $μ=6$, and $μ$ is the smaller SCS configuration between the SCS configuration of the PRACH transmission and the SCS configuration of the UL BWP with PUSCH/PUCCH/SRS transmissions. For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N\_{2}$ assuming SCS configuration $μ=0$. |
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Companies are encouraged to indicate your preference.

**Q2: Which alternative do you prefer, Alt 2.1 or Alt 2.2? Do you have a strong preference?**

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| **Company** | **Alt.1 or Alt.2** | **Comment** |
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# References

1. R1-2209849, “Correction on parallel transmission of PRACH and SRS/PUCCH/PUSCH”, Huawei, HiSilicon
2. R1-2209836, “On parallel transmission of PRACH and SRS/PUCCH/PUSCH”, Huawei, HiSilicon