**3GPP TSG-RAN WG1 #105-e R1-210xxxx**

**e-Meeting, May 10th – 27th, 2021**

**Source: Apple Inc.**

**Title: Feature Lead summary #2 for NRU RRM Operation**

**Agenda item:** **7.2.2**

**Document for:** **Discussion and Decision**

# 1 Introduction

One LS [1] was received from RAN2 about the random subframe offset value generation for NR-U RRM measurement, if *rmtc-SubframeOffset* is not configured.

In TS38.331, it defines if rmtc-SubframeOffset is not configured, the UE chooses a random value. But it’s not clear if this random value generation is performed per rmtc-Periodicity, or per every reportInterval configured in ReportConfigNR, or upon every RRCReconfiguration message.



Previously RAN2 merely followed the agreement on LAA made in RAN1 [1], which was then inherited into NR-U. Thus, RAN2 would like to respectfully request RAN1’s understanding on this issue. In addition, it would be helpful for RAN1 to let RAN2 know if the same understanding should be applied to LAA as well.

**Q1:** When *rmtc-SubframeOffset* is not configured, should UE generate the random value per *rmtc-Periodicity*, or per every *reportInterval* configured in *ReportConfigNR,* or upon every *RRCReconfiguration* message?

**Q2:** Should the potential understanding achieved for Q1 apply to LAA as well?

This document summarizes the relevant contributions made under Agenda Item 5 and Agenda Item 7.2.2 of RAN1 #105-e for random subframe offset value generation for NR-U RRM measurement.

Follow the naming convention in this example:

* NRU-04-v000.docx
* NRU-04-v001-CompanyA.docx
* NRU-04-v002-CompanyA-CompanyB.docx
* NRU-04-v003-CompanyB-CompanyC.docx

# 2. Discussions

The purpose of configuring the UE to perform RSSI measurements is to enable the gNB to detect if the UE suffers from interference from a hidden node.

The RSSI measurement configuration consists of the following IE in which the UE is configured with an RSSI measurment periodicity *rmtc-Periodicity* (40, 80, 160, 320, or 640 ms) and potentially a subframe offset *rmtc-SubframeOffset* (0 .. 640 ms). The latter indicates the first subframe within the periodicity for which the RSSI measurement starts. The parameter *rmtc-SubframeOffset* is optional, and according to the current spec, the subframe offset is randomized if this parameter is not configured.

RMTC-Config-r16 ::= SEQUENCE {

 rmtc-Periodicity-r16 ENUMERATED {ms40, ms80, ms160, ms320, ms640},

 rmtc-SubframeOffset-r16 INTEGER(0..639) OPTIONAL, -- Need M

 measDurationSymbols-r16 ENUMERATED {sym1, sym14or12, sym28or24, sym42or36, sym70or60},

 rmtc-Frequency-r16 ARFCN-ValueNR,

 ref-SCS-CP-r16 ENUMERATED {kHz15, kHz30, kHz60-NCP, kHz60-ECP},

 ...

}

In case the subframe offset parameter is not configured, it can be beneficial to randomize the subframe offset to increase the chances of measuring a hidden node with potentially asynchronous interference. RAN2 found the field description ambiguous and seeks for RAN1’s guideline on how to exactly determine the value for *RMTC-SubframeOffset* if it is not explicitly configured.

Three options were identified by RAN2 as listed in [1]:

* Opt.1: Per rmtc-Periodicity.
* Opt.2: Per every reportInterval configured in ReportConfigNR.
* Opt.3: Upon every RRCReconfiguration message

The views from companies were a bit split as summarized in Table 1:

**Table 1: Views on ‘rmtc-SubframeOffset’ value for NRU RRM Measurement**

|  |  |  |  |
| --- | --- | --- | --- |
| # | Companies | Reasoning | # Companies |
| Opt.1: Per rmtc-Periodicity. | Ericsson [2]ZTE [3][4]LGE [7]Vivo [8]Apple [10] | * Beneficial to randomize the subframe offset as often as possible to increase the chances of measuring a hidden node with potentially asynchronous interference and Opt.2 is NOT sufficient [2] [3] [4][7][10]
 | 5 |
| Opt.2: Per every reportInterval configured in ReportConfigNR.  | None |  |  |
| Opt.3: Upon every RRCReconfiguration message | None |  |  |
| Opt.4: left for UE implementation | Nokia [5]Samsung [6]Huawei [9]Apple [10] | * How UE generates the random value is unknown at gNB/eNB and it makes little sense to specify the exact UE behaviour [5].
* Keep a same handling for LAA and NRU for UE implementation [6]
 | 4 |

Another question asked in RAN2 LS [1] is whether the common understanding, if achieved in RAN1, is applicable for LAA.

In RAN1 100 e-meeting, the following was agreed to reuse the LTE-LAA RRM measurement framework for NRU:

|  |
| --- |
| Agreement in RAN1 #100-e, Feb 2020:Keep value range for rmtc-Period-r16 and rmtc-SubframeOffset-r16 the same as for LTE-LAA. |

Companies’ views on applicable for LAA are summarized in Table 2 below:

**Table 2: Views on ‘*rmtc-SubframeOffset’* value for LAA RRM Measurement**

|  |  |  |  |
| --- | --- | --- | --- |
| # | Companies | Reasoning | # Companies |
| Opt.1: left to UE implementation | Ericsson [2]Nokia [5]Samsung [6]Huawei [9]Apple [10] | * There are deployed networks in the field, and there could be a risk for non-backward compatible changes [2][6].
* RRM measurement itself is UE-implementation-specific [2]
 | 5 |
| Opt.2: Same understanding is applied for LAA. | ZTE [3][4]Samsung [6]LGE [7]Vivo [8]Apple [10] | * NRU RRM framework is inherited from LTE LAA [3][4][7][10].
 | 5 |

As mentioned by proponent of Opt.1 in Table 2 for LAA, one important fact to be considered is that LTE LAA products have been in the field, which makes almost impossible to change the LTE specification to define new UE behaviours. Hence, Opt.1 in Table 2 i.e., leaving it for UE implementation seems the only wayforward to address this issue for LAA.

For NRU, a same UE behavior is preferable such that a UE behaviour is consistent, and implementation may be simplified. Given the fact that RRM measurement for NRU is inherited from LAA, it sounds wired if we define UE behavior for NRU and left for UE implementation for LAA.

Having said that, moderator still listed all possible combinations and ask companies for inputs:

**Moderator Question 2-1:**

**When *RMTC-SubframeOffset* is not configured, which of the following alternatives is preferred to reply RAN2? Please also kindly indicate which Alternative is NOT acceptable and why, to make discussion more efficient.**

* **Alt.1:**
	+ **For NR-U, the random offset value is generated per rmtc-Periodicity.**
	+ **For LAA, the generation method for the random offset is up to UE’s implementation.**
* **Alt.2:**
	+ **The random offset is generated per rmtc-Periodicity.**
	+ **The generation method is applicable to both Rel-13 LAA and Rel-16 NR-U.**
* **Alt.3:**
	+ **The generation method for the random offset is up to UE’s implementation.**
	+ **The generation method is applicable to both Rel-13 LAA and Rel-16 NR-U.**

## 2.1 <1st Round Comments>

Companies are invited to provide inputs in the table below:

|  |  |  |
| --- | --- | --- |
| **Company** | **Altnatives** | **Comments** |
| Example: Company A | Alt.3 is preferred. Alt.2 is not acceptable. |  |
| Samsung | Alt 3 is preferred. Alt 2 is not acceptable. Alt 1 is not preferable.  | The random offset CAN be generated per rmtc-Periodicity to avoid periodic interference, but not necessarily mandated to be per rmtc-Periodicity. The use case of not configuring a value of the offset from the network side is that network is not aware/sure of the periodic interference, and ask UE to handle it. In this case, UE is the best judger for generating the value of the interference, and whether and how to generate the value should be up to UE’s implementation. The above understanding of LAA should be carried over to NR-U, since there is no explicit new agreement to override it. That’s why Alt 3 is preferred, and Alt 2 is not acceptable (NBC issue). Alt 1 is not preferable since it causes different UE behaviour of LAA and NR-U without explicit support of such agreement, and also has spec impact. We also corrected one view in the summary table, and actually Option 1 and Option 2 in Table 2 are not exclusive to each other.  |
| Nokia, NSB | Alt 3 is preferableAlt 2 is not acceptable. Alt 1 is not acceptable. | Since the random offset value that the UE generates is anyhow unknown to the network, it is unclear if changing the value more or less frequently provides any meaningful benefit. As this was not seen as an issue for LAA, we do not see why things should be changed for NR either. For LAA, it is obviously way too late to discuss a change to UE behaviour, and also for NR-U, there is no reason to deviate from the same approach as used in LAA.Given the above, we think no CR is needed.  |
| LG Electronics | Alt 2 is preferable, but Alt 3 is also acceptable. | Our understanding is that generation of random value per RMTC-SubframeOffset seems consistent with the original purpose of avoiding measurement result from the periodic transmission of other nodes. However, we can accept Alt 3, to have common design both for LAA and NR-U. |
| Ericsson | Alt-1 is preferrableAlt-2 is not acceptableAlt-3 is acceptable (but not our 1st choice) | Alt-2 is not acceptable; already deployed LTE-LAA equipment could become spec non-compliant, which is clearly not desirable.Our thinking on Alt-1 is that it can be beneficial for the UE to do frequent randomization for better identification of hidden nodes, so since NR-U is new, there is an opportunity to do better.We agree with the moderators comment that any potential impact on spec is limited to 38.331. Spec impact analysis can be handled by RAN2, since they asked the question in the first place :-) |
| ZTE, Sanechips | Alt 2 is preferable, but Alt 1 is also acceptable. | As everyone knows in LTE-LAA phase, If *rmtc-SubframeOffset* is not configured, a random value of *rmtc-SubframeOffset* can be used to avoid overlapping between RSSI measurement duration and a periodic transmission. If we support a random value of *rmtc-SubframeOffset is generated*  per every *reportInterval* or upon every *RRCReconfiguration* message, then this will greatly weakens the original intention of introducing timing randomization and the benefits brought by the timing randomization will be also greatly reduced due to the time interval to generate random value is too long. Based on above consideration, we prefer the random offset is generated per rmtc-Periodicity. Further, we know that NR-U RRM framework is inherited from LTE LAA. So, our 1st preference is Alt 2.However, considering NBC issue mentioned by some companies, Alt 1 is also acceptable for us. |
| vivo | Alt-2 is preferableAlt-3 is acceptable | In our understanding, the original intention of random offset is to avoid periodic signal from neighbor nodes. Per **rmtc-Periodicity** generation is the most preferred way to achieve this. This is why Alt-2 is preferable to us.Considering NBC issue and have a common design for LAA and NRU, Alt-3 is also acceptable for us. |
| Intel | Alt 2 is preferable, Alt 3 is acceptable. | The function of random offset is to avoid consist measurement collided with a periodical transmission from a node nearby. Therefore, allowing the random offset updated in each RMTC periodicity maximize such benefit. Alt 2 is preferred. On the other hand, we also fine with Alt 3 if it gets a majority support |
| Huawei, HiSilicon | Alt 3 is preferable.Alt 2 is not acceptable. | We think the generation method should be left for UE implementation as long as the measurement accuracy is ensured. The language in LAA already leave enough flexibility and we do not support to change the existing implementation of LAA.Moreover, it should be further clarified that such random generation of subframe offset is not expected when inter frequency measurement with measurement gap is configured because it contradicts with the behavior defined in RAN4 spec.  |
| MediaTek | Alt 3 is preferableAlt 2 is not acceptable | We share a similar view with Huawei that this can be left to UE implementation. Decisions made now should not impact on LAA products. Hence, Alt 2 is not acceptable.  |

Regarding the specification impacts, contributions [6][9] discussed this aspect and different views are indicated. Contribution [6] indicates that there is no specification impact assuming left for UE implementation. Although contribution [9] has a same preference to left for UE implementation, some potential specification change on TS 38.331 is observed. In general, it should be sufficient to provide RAN1 response as discussed in Question 1 and leave specification impact analysis to RAN2 by considering RAN1 reply.

## 2.2 <1st Round Summary>

Companies’ responses are summarized in Table 3 blow:

**Table 3: Summary of the 1st Round Comments**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Preferred | NOT acceptable | Not preferred but can accept |
| Alt.1 | Ericsson, Apple  | Nokia, NSB,  | Samsung, ZTE, Sanechips,  |
| Alt.2 | LG Electronics, ZTE, Sanechips, vivo, Intel  | Samsung, Nokia, NSB, Ericsson, Huawei, HiSilicon, MediaTek  |  |
| Alt.3 | Samsung, Nokia, NSB, Huawei, HiSilicon, MediaTek  |  | LG Electronics, Ericsson, vivo, Intel, Apple  |

Based on Table 3, Alt.3 seems the only way forward that is acceptable for all companies to address this issue. Hence, the following was proposed by moderator to adopt Alt.3:

**Moderator Proposal #1:**

* **When *RMTC-SubframeOffset* is not configured,**
	+ **The generation method for the random offset is up to UE’s implementation.**
	+ **The generation method is applicable to both Rel-13 LAA and Rel-16 NR-U.**

## 2.3 <2nd Round Comments>

Companies are invited to provide inputs in the table below on ‘Moderator Proposal #1’ above:

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes | While not our first preference, we can support the moderator's Proposal #1. |
| LG Electronics | Yes | Support Moderator Proposal #1. |
| Huawei, HiSilicon | Yes | Support Moderator Proposal #1 |
| ZTE, Sanechips | Yes | We can accept to support Moderator Proposal #1 to push the discussion forward.  |

# 3. Draft LS reply

The following LS reply was prepared for discussion based on the Moderator Proposal #1:

|  |
| --- |
| RAN1 would like to thank RAN2 for their LS on random value generation for *rmtc-SubframeOffset*. RAN1 has discussed the questions asked by RAN2 and RAN1 answers are provided below.**RAN2’s Q1:** When *rmtc-SubframeOffset* is not configured, should UE generate the random value per *rmtc-Periodicity*, or per every *reportInterval* configured in *ReportConfigNR,* or upon every *RRCReconfiguration* message?**RAN1’s answer:** when *RMTC-SubframeOffset* is not configured, the generation method for the random offset value is up to UE’s implementation. **RAN2’s Q2:** Should the potential understanding achieved for Q1 apply to LAA as well?**RAN1’s answer:** Yes, when *RMTC-SubframeOffset* is not configured, the same generation method for random offset value is applicable to both Rel-13 LAA and Rel-16 NR-U i.e., left for UE’s implementation. |

## 3.1 <1st Round Comments>

Companies are invited to provide inputs in the table below:

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Ericsson | Yes (with suggested edit) | Since a UE may still implement things differently for LAA and NR-U, it is perhaps better to use the following alternative wording on Q2:Yes, the same understanding should apply to LAA, i.e., when *RMTC-SubframeOffset* is not configured, the ~~same~~ generation method for random offset value is ~~applicable to both Rel-13 LAA and Rel-16 NR-U i.e.,~~ left for UE’s implementation |
| LG Electronics | OK with Ericsson’s edits |  |
| Huawei, HiSilicon | OK with answer to Q1.See comment on Q2 | Comment to Q2:To our understanding, there is no intention to update LAA spec according to the clarification of NRU behaviour. Instead, similar description might be inherited from LAA. Suggest further edit based on Ericsson’s version~~Yes, the same understanding should apply to LAA, i.e.,~~ In LAA, when *RMTC-SubframeOffset* is not configured, the ~~same~~ generation method for random offset value is ~~applicable to both Rel-13 LAA and Rel-16 NR-U i.e.,~~ left for UE’s implementation |
| Intel | OK with Huawei’s revisions | Agree with Huawei there is no intention to change anything for LAA. Therefore direct clarification on LAA operation sounds better |
| ZTE, Sanechips | Yes | Regarding UE’s implementation method applied for both Rel-13 LAA and Rel-16 NR-U, in our understanding, Rel-13 LAA UE and Rel-16 NR-U UE can have different generation methods to determine random offset in the process of implementation. And we also agree HW’s and Intel’s views that there is no need to change LAA spec. Thus, we tend to support HW’s modification but to avoid ambiguity, we propose to add a note in the answer to Q2 for the reference, as below:**RAN2’s Q2:** Should the potential understanding achieved for Q1 apply to LAA as well?**RAN1’s answer:** Yes. ~~Yes, the same understanding should apply to LAA, i.e.,~~ In LAA, when *RMTC-SubframeOffset* is not configured, the ~~same~~ generation method for random offset value is ~~applicable to both Rel-13 LAA and Rel-16 NR-U i.e.,~~ left for UE’s implementationNotes: in the process of implementation, UE for Rel-13 LAA and UE for Rel-16 NR-U can have different methods to generate random offset for *rmtc-SubframeOffset.* |

# 4. Conclusion

<TBD>

# References

1. R1-2104163 LS to RAN1 on random value generation for RMTC-SubframeOffs, RAN2.
2. [R1-2104459](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2104459.zip) Discussion on LS from RAN2 on random value generation for RMTC-SubframeOffset Ericsson
3. [R1-2104838](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2104838.zip) Draft reply LS on RMTC-subframeoffset ZTE, Sanechips
4. [R1-2104839](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2104839.zip) Discussion on the random value generation for RMTC-subframeoffset ZTE, Sanechips
5. [R1-2105271](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2105271.zip) Discussion on RAN2 LS on random value generation for RMTC-SubframeOffset Nokia, Nokia Shanghai Bell
6. [R1-2105279](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2105279.zip) Discussion on the random value generation for RMTC-SubframeOffset Samsung
7. [R1-2105414](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2105414.zip) Discussion on RAN2 LS on random value generation for RMTC-SubframeOffset LG Electronics
8. [R1-2105450](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2105450.zip) Draft Reply LS on random value generation for RMTC-SubframeOffset vivo
9. [R1-2105933](file:///C%3A%5C%5CUsers%5C%5Cwanshic%5C%5COneDrive%20-%20Qualcomm%5C%5CDocuments%5C%5CStandards%5C%5C3GPP%20Standards%5C%5CMeeting%20Documents%5C%5CTSGR1_105%5C%5CDocs%5C%5CR1-2105933.zip) Discussion on random value generation for rmtc-SubframeOffset Huawei, HiSilicon
10. R1-2105080 Clarification on NR-U RRM measurement operation Apple