3GPP TSG RAN WG1 #106bis-e R1-210xxxx

e-Meeting, October 11 - 19, 2021

**Agenda item: 5**

**Source: Moderator (Nokia)**

**Title:** **[106bis-e-AI5-LSs-01] Moderator summary**

**WI: FS\_NR\_eff\_BW\_util**

**Document for: Discussion and Decision**

# 1 Introduction

This document is facilitating the RAN1#106bis-e email discussion [106bis-e-AI5-LSs-01] Discuss incoming LS on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths for a possible reply LS by October 18. The discussion thread is related to an LS from RAN4 in [R1-2108700/R4-2114751](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106b-e/Docs/R1-2108700.zip)

The following set of documents were identified as relevant to this discussion:

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R1-2108700**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108700.zip) | LS on specification impact for methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | RAN4, Nokia |
| [**R1-2108948**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2108948.zip) | Discussion on RAN4 LS regarding methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | vivo |
| [**R1-2109027**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109027.zip) | Discussion on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | ZTE |
| [**R1-2109028**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2109028.zip) | [DRAFT] Reply LS on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | ZTE |
| [**R1-2110010**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110010.zip) | Discussion on RAN4 LS on irregular channel bandwidths | Apple |
| [**R1-2110011**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110011.zip) | Draft Reply to RAN4 LS on irregular channel bandwidths | Apple |
| [**R1-2110296**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110296.zip) | DRAFT LS on specification impact for methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | Nokia, Nokia Shanghai Bell |
| [**R1-2110304**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110304.zip) | On efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths | Ericsson |
| [**R1-2110336**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106b-e/Docs/R1-2110336.zip) | [Draft] Reply LS on synchronous operation between Uu and SL in TDD band | Ericsson |

# 2 RAN4 LS questions to RAN1 and RAN2

The RAN4 LS posed the following questions to RAN1

RAN4 is currently studying four methods [1] on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths. One of the Study Item objectives is to evaluate and minimize the impact to RAN1 and RAN2.

RAN4 respectfully requests to provide information if each studied method is compatible with RAN1/RAN2 specifications and in particular to clarify/confirm the following aspects:

* For the wider CBW:
	+ clarify if there is any limitation for the UL carrier positions (not just BWP positions) legacy UEs support for uplinkChannelBW-PerSCS-List and scs-SpecificCarrierList in symmetric operating bands with a fixed duplex distance and asymmetric UL/DL channel bandwidth.
	+ confirm UE behaviour if it is possible to configure a carrier that is not fully contained in the NR band, i.e. the carrier can extend beyond the low edge of the band and/or the high edge of the band?
* For the overlapping CBWs from network perspective (one cell approach):
	+ clarify whether a single SSB and CORESET (e.g. for cases where irregular BWs >10 MHz where a 4.28 MHz wide initial BWP can be in the common frequency range), can be used to configure UEs with different channel BWs on different parts of the BS channel.
	+ clarify whether two time staggered SSBs and CORESET#0 on the same frequency (when the frequency separation is not enough to send them simultaneously at the same time and thus time staggering is needed) are supported in RAN1/2 specifications so that UEs configured with left and right channels of the next smaller regular size can track their own time staggered SSB and CORESET#0.
* For the overlapping CBWs from UE perspective (two cell approach / CA approach):
	+ if two different Bandwidth Parts for the UE are overlapping, and both contain a subset of CSI-RS resources that are mapped to the same subset of overlapping RBs for the same UE, please clarify how does UE report CSI for the overlapped part, e.g. does UE report CSI for each cell separately, or just once for the overlapping part, or something else?
	+ clarify how PDCCH reception in overlapped CA when PCell and SCell PDCCH resources partially overlap and whether there are any impacts to cross-carrier scheduling
* For the overlapping CBWs from UE perspective (one cell approach):
	+ Is it possible to configure the UE with a dedicated carrierBandwidth in the ServingCellConfig that is wider than/partially outside the carrierBandwidth configured in SIB1?
	+ Clarify for equalization purposes in the DL, does the BS need to know the split between the subset of PRBs from a main RF carrier versus PRBs from an additional RF carrier are received on different channel/antenna before combining. If pre-coding assumes all PRBs experience the same channel/antenna, is signalling required so that BS pre-coding can account for the path differences of main carrier PRBs and additional carrier PRBs.

# 3 Reply LS drafting

## 3.1 For the wider CBW

**RAN4 question:**

* For the wider CBW:
	+ clarify if there is any limitation for the UL carrier positions (not just BWP positions) legacy UEs support for *uplinkChannelBW-PerSCS-List* and *scs-SpecificCarrierList* in symmetric operating bands with a fixed duplex distance and asymmetric UL/DL channel bandwidth.
	+ confirm UE behaviour if it is possible to configure a carrier that is not fully contained in the NR band, i.e. the carrier can extend beyond the low edge of the band and/or the high edge of the band?

### 3.1.1 Round #1

**Proposed RAN1 reply:**

* RAN1 specifications require placing the BWP within the *carrierBandwidth* of the *scs-SpecificCarrier*, a BWP cannot extend outside the configured *carrierBandwidth*.
* RAN1 specifications do not place any limitations on the frequency location of the *scs-SpecificCarrier.*

**Comments on the proposal:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | Fine in general |
| QC | We are fine with the second bullet in the proposal. For the first bullet, although the content in the bullet is correct, but the proposed RAN1 reply does not answer RAN4’s question. RAN4 question is “confirm UE behaviour if it is possible to configure a carrier that is not fully contained in the NR band, i.e. the carrier can extend beyond the low edge of the band and/or the high edge of the band?” In our understanding, it is better to answer RAN4 question directly to give a firm yes/no answer, as suggested in the following. **QC’s answer to RAN4 question is: UE behaviour is not clear for this case. RAN1 has no plans to clarify the support of this particular configuration** |
| ZTE | For the first question, it doesn’t fall into RAN1’s scope thus RAN1 doesn’t have any answer for it. For the second question, at least for now, all RAN1 specifications assume that the carrier bandwidth is within one band. It is not clear what the UE behaviour is if a carrier that is not fully contained in the NR band. |
| NTT DOCOMO | We are generally fine with the proposed reply. |
| Huawei, HiSi | For bullet 1, UE behaviour is undetermined.For bullet 2, ok |
| Ericsson | For the first question, our understanding is that there are no such limitations in RAN1 specifications. For the second question, given that the RAN1 specifications are band agnostic, we do not see that it would be RAN1 specifications that would handle the case of placing the carrier outside the band edges, but this would be a discussion for RAN4. Hence, RAN1 should not answer that the UE behavior is undetermined but send the question back to RAN4. |
| Nokia, NSB | We’d be OK with the original proposals in general. We tend to agree that it is not possible to place a carrier outside a band, but this is not something that RAN1 specs state. The bands are visible in RAN2 and RAN4 specs and RAN4 doesn’t need to send an LS to RAN1 so that we can explain RAN4 specs and what they mean back to them. Hence we don’t see any reason why RAN1 specifications would lead to undefined UE behaviour if a carrier is placed fully in an NR band, though. |

## 3.2 For the overlapping CBWs from network perspective (one cell approach)

**RAN4 question:**

* For the overlapping CBWs from network perspective (one cell approach):
	+ clarify whether a single SSB and CORESET (e.g. for cases where irregular BWs >10 MHz where a 4.28 MHz wide initial BWP can be in the common frequency range), can be used to configure UEs with different channel BWs on different parts of the BS channel.
	+ clarify whether two time staggered SSBs and CORESET#0 on the same frequency (when the frequency separation is not enough to send them simultaneously at the same time and thus time staggering is needed) are supported in RAN1/2 specifications so that Ues configured with left and right channels of the next smaller regular size can track their own time staggered SSB and CORESET#0.

### 3.2.1 Round #1

**Proposed RAN1 reply:**

* In idle mode, all Ues “camp” on the same initial BWP. Once connected, each UE can be configured to different parts of the carrier using a dedicated BWP. A single SSB is enough if a SSB position can be found that allows two Ues placed at either end of the frequency allocation and still receive the SSB within their respective dedicated BWPs.
* RAN1 specifications allow for configuring staggered SSBs and CORESET#0s on the same frequency so that Ues configured with left and right channels of the next smaller regular size can track their own time staggered SSB and CORESET#0.

**Comments on the proposal:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | Fine in general.  |
| QC | We are fine with the spirit of the proposal. We have some suggested editorial change as following.* In idle mode, all Ues “camp” on the same initial BWP. Once connected, each UE can be configured to different parts of the carrier using a dedicated BWP. A single SSB is enough if a SSB position can be found that allows two Ues placed at either end of the frequency allocation and still receive the SSB within their respective dedicated BWPs, as long as the configuration on each cell in this “one cell” approach is compliant with existing requirements in RAN1, RAN2, and RAN4 specifications.
* RAN1 specifications allow for configuring staggered SSBs and CORESET#0s on the same frequency so that Ues configured with left and right channels of the next smaller regular size can track their own time staggered SSB and CORESET#0, as long as the configuration on each cell in this “one cell” is compliant with existing requirements in RAN1, RAN2, and RAN4 specifications.
 |
| ZTE | OK with the draft reply. |
| NTT DOCOMO | We are generally fine with the proposed reply. |
| Huawei, HiSi | Ok with the original texts. The texts from QC are unnecessary since this is the legacy behaviour in our assessment. |
| Ericsson | We are fine with the draft response. The Qualcomm additions are also OK. |
| Nokia, NSB | We are OK with the original proposal with the fix of Ues to UEs. We don’t see the Qualcomm-proposed addition necessary. |

## 3.3 For the overlapping CBWs from UE perspective (two cell approach / CA approach)

**RAN4 question:**

For the overlapping CBWs from UE perspective (two cell approach / CA approach):

* + if two different Bandwidth Parts for the UE are overlapping, and both contain a subset of CSI-RS resources that are mapped to the same subset of overlapping RBs for the same UE, please clarify how does UE report CSI for the overlapped part, e.g. does UE report CSI for each cell separately, or just once for the overlapping part, or something else?
	+ clarify how PDCCH reception in overlapped CA when PCell and Scell PDCCH resources partially overlap and whether there are any impacts to cross-carrier scheduling

### 3.3.1 Round #1

**Proposed RAN1 reply:**

* RAN1 specification do not prevent configuring overlapping carriers for CA for a single UE. In case of CA, the CSI-RS measurement and reporting for the component carriers are performed independently per-carrier and PDCCH monitoring are also performed independently for each component carrier.
* gNB scheduler is responsible for avoiding collisions of different transmissions in general, this would be the case with overlapped CA as well.
* There is no impact to cross-carrier scheduling

**Comments on the proposal:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | Although it is true that RAN1 spec does not prevent overlapping CA, but it was not a use case that RAN1 agreed to support in Rel-15/16 either. It is unclear if the current specification is sufficient to enable such deployment, for example, there is no solution provided in the current spec to handle the resource collision between the overlapping carriers. It is also unclear if gNB scheduler is able to fully handle all the collision cases, as it depends on the target carrier BW and the size of the overlapping portion. We suggest to also inform RAN4 about the above issues.  |
| QC | We are fine with the proposal in general. We request to add a sub-bullet to clarify if this “two cell approach” is introduce, a new UE capability signalling should be added, i.e., add a sub-bullet as the following* A new UE capability is added to with this “two cell” approach
 |
| ZTE | Ok with the draft reply. |
| NTT DOCOMO | We are generally fine with the proposed reply, although configuring overlapping carriers for CA to a single UE has not been assumed/discussed in RAN1. |
| Huawei, HiSi | RAN4 questions seems not being fully addressed yet. It can be more specific like,* RAN1 specification do not prevent configuring overlapping carriers for CA for a single UE. In case of CA, the CSI-RS measurement and reporting for the component carriers are performed independently per-carrier and PDCCH monitoring are also performed independently for each component carrier.
* gNB scheduler is responsible for avoiding collisions of different transmissions in general, this would be the case with overlapped CA including cross-carrier scheduling as well.
	+ The UE behaviour is undetermined otherwise when CSI-RS resources are overlapped and a UE is required to measure/report the overlapping part simultaneously for both carriers.
	+ The UE behaviour is undetermined otherwise when CORESET/SS resources are overlapped and a UE is scheduled by the PDCCHs from two carriers in the overlapping part simultaneously.
* ~~There is no impact to cross-carrier scheduling~~
 |
| Ericsson | We are fine with the proposed reply. Given that this is a RAN4 work item, needed UE capabilities can be given be discussed in RAN4. |
| Nokia, NSB | We tend to agree with vivo and Qualcomm that even though the spec support seems to be there, one cannot really expect the UEs to accept that sort of configurations even if they indicate support for intra-band CA. This maybe worthwhile communicating to RAN4. |

## 3.4 For the overlapping CBWs from UE perspective (one cell approach):

**RAN4 question:**

* For the overlapping CBWs from UE perspective (one cell approach):
	+ Is it possible to configure the UE with a dedicated *carrierBandwidth* in the *ServingCellConfig* that is wider than/partially outside the *carrierBandwidth* configured in SIB1?
	+ Clarify for equalization purposes in the DL, does the BS need to know the split between the subset of PRBs from a main RF carrier versus PRBs from an additional RF carrier are received on different channel/antenna before combining. If pre-coding assumes all PRBs experience the same channel/antenna, is signalling required so that BS pre-coding can account for the path differences of main carrier PRBs and additional carrier PRBs.

### 3.4.1 Round #1

**Proposed RAN1 reply:**

* RAN1 specifications are agnostic to the message in which the *carrierBandwidth* is provided, but it is RAN1 understanding that TS 38.331 prevents configuring the UE with a dedicated *carrierBandwidth* in the *ServingCellConfig* that is wider than/partially outside the *carrierBandwidth* configured in SIB1.
* There is no need for the transmitter to know if there is a frequency discontinuity point within the carrier in the receiver implementation, this will need to be accounted for in the receiver implementation so that channel estimate is not interpolated across the discontinuity.

**Comments on the proposal:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | Fine in general.  |
| QC | We disagree with the proposal. We think the answer to RAN4 question should be the following* Is it possible to configure the UE with a dedicated *carrierBandwidth* in the *ServingCellConfig* that is wider than/partially outside the *carrierBandwidth* configured in SIB1?

Answer: This particular mode of operation is not currently supported and RAN1 has made no plans to introduce it.* Clarify for equalization purposes in the DL, does the BS need to know the split between the subset of PRBs from a main RF carrier versus PRBs from an additional RF carrier are received on different channel/antenna before combining. If pre-coding assumes all PRBs experience the same channel/antenna, is signalling required so that BS pre-coding can account for the path differences of main carrier PRBs and additional carrier PRBs.

Answer: Given the answer to the previous question, RAN1 has made no plans to evaluate this aspect.  |
| ZTE | It seems the first question doesn’t fall into RAN1’s scope. It’s more like a configuration issue, which can be left to RAN2.For the second question, we think some simulations may be needed to evaluate whether/how network can account for the path differences of main carrier PRBs and additional carrier PRBs. If RAN1 is going to do so, then more details from RAN4 may be necessary. |
| NTT DOCOMO | We are generally fine with the proposed reply. |
| Huawei, HiSi | For bullet 1, ran2 to answer.For bullet 2, may need to clarify that this is assuming that the UE capability for each RF part is the same. |
| Ericsson | As indicated in the first answer and stated by ZTE, the RAN2 specifications explicitly prevents this configuration, and we should probably leave the answer to them. Looking at the proposal in total, as indicated in our contribution the problems we see with is the configuration of a BWP that is outside the *carrierBandwidth* and the OFDM generation. Given that the WI does not include RAN1 work, we agree with the answers given by Qualcomm |
| Nokia, NSB | We tend to agree that 1st bullet is for RAN2 and we could just indicate that this is not a RAN1 issue as it is a bit funny for RAN1 to tell RAN4 what RAN2 specs read as if RAN4 guys aren’t allowed to read other than RAN4 specs.In our understanding gNB would be totally unaware if the UE had discontinuity in frequency domain reception, but it might be difficult for the UE to pass performance requirements in all cases. We are anyway OK with an answer along the lines Qualcomm is suggesting. |