3GPP TSG-RAN WG2 Meeting #116 Electronic [R2-210xxxx](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-210xxxx.zip)

Elbonia, 01 – 12 November 2021

**Agenda item: 8.24.1**

**Source: Nokia (Rapporteur)**

**Title: Summary of [AT116-e][022][NR17] Irregular BW (Nokia)**

**WID/SID: FS\_NR\_eff\_BW\_util - Release 17**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion:

Irregular BW

Offline first

* [AT116-e][022][NR17] Irregular BW (Nokia)

 Scope: Treat [R2-2109353](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109353.zip), [R2-2109353](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109353.zip), [R2-2109889](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109889.zip), [R2-2109890](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109890.zip), [R2-2111153](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111153.zip), [R2-2110787](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110787.zip), [R2-2109794](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109794.zip), [R2-2109795](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109795.zip), [R2-2110086](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110086.zip), [R2-2110087](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110087.zip)

 Determine agreeable parts, e.g. Reply LS. Identify discussion points for online (if needed).

 Intended outcome: Report (Reply LS in ph2)

 Deadline: Friday W1 (CB online)

[R2-2109353](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109353.zip) LS on specification impact for methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths (R4-2114751; contact: Nokia) RAN4 LS in Rel-17 FS\_NR\_eff\_BW\_util To:RAN1, RAN2

[R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip) Reply LS on specification impact for methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths (R1-2110584; contact: Nokia) RAN1 LS in Rel-17 FS\_NR\_eff\_BW\_util To:RAN4, RAN2

[R2-2109889](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109889.zip) Discussion on irregular bandwidth ZTE Corporation, Sanechips discussion Rel-17 FS\_NR\_eff\_BW\_util

[R2-2109890](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109890.zip) Reply LS on irregular bandwidth ZTE Corporation, Sanechips LS out Rel-17 FS\_NR\_eff\_BW\_util To:RAN4, RAN1

[R2-2111153](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111153.zip) On efficient utilization of irregular spectrum Huawei, HiSilicon discussion Rel-17 FS\_NR\_eff\_BW\_util

[R2-2110787](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110787.zip) Specification impact for methods on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths Ericsson discussion

[R2-2109794](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109794.zip) Flexible bandwidth utilization Nokia, Nokia Shanghai Bell discussion Rel-17 FS\_NR\_eff\_BW\_util

[R2-2109795](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109795.zip) Reply LS on flexibile bandwidth utilization Nokia, Nokia Shanghai Bell LS out Rel-17 FS\_NR\_eff\_BW\_util To:RAN4 Cc:RAN1

[R2-2110086](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110086.zip) Discussion on irregular channel bandwidth LS from RAN4 Apple discussion Rel-17 FS\_NR\_eff\_BW\_util

[R2-2110087](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2110087.zip) [Draft] reply LS on irregular channel bandwidth feature Apple LS out Rel-17 FS\_NR\_eff\_BW\_util To:RAN4 Cc:RAN1

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Nokia (Rapporteur) | Tero Henttonen | tero.henttonen@nokia.com |
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# 3 RAN4 questions to RAN1/RAN2

## 3.0 Background

RAN4 has been doing a study on how to support irregular bandwidths, for example 6, 7, 8, 11, 12, or 13 MHz that occur for certain operators. The work has been ongoing for a while, with RF aspects being discussed quite a bit but discussions taking a long time. To finalize the work, RAN4 sent the LS [R2-2109353](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2109353.zip) to both RAN1 and RAN2, and RAN1 already responded to it in [R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip). The LS asks questions on each of the four main potential solution directions discussed in RAN4:

As per [TR38.844](https://www.3gpp.org/DynaReport/38844.htm), there are basically 4 different mechanisms considered in RAN4 (note that these are given in the order of the questions in the LS, which differs from the order in the TR):

1) Wider CBW (using of next larger channel bandwidth, e.g. 10 MHz CBW in case of 7 MHz spectrum, with scheduling restricted to the 7 MHz part only)

2) Overlapping CBW from network perspective (with UE being assigned two channel bandwidths that are partly overlapping to cover the desired area, e.g. using two 5 MHz blocks to cover 7 MHz spectrum)

3) Overlapping CBW from UE perspective, with two cells (i.e. using CA with overlapping spectrum to cover the desired area, e.g. PCell 5 MHz and SCell 5 MHz overlapping to create overall 7 MHz covered spectrum)

4) Overlapping CBW from UE perspective, with one cell (using next-smallest BWP/CBW in SIB1 and larger BWPs in CONNECTED, cell, e.g. using 5 MHz BWP/CBW in SIB1 and then 7 MHz CBW/BWP for new UEs in CONNECTED to cover 7 MHz spectrum)

Each of these has two questions associated with them, so the rest of the document considers the RAN2 aspects to answer those questions.

## 3.1 Wider CBW questions

The following RAN4 questions and RAN1 answers can be found in [R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip) for this topic:

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| * 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.
	+ RAN1 response: RAN1 specifications do not place any limitations to this for FDD bands as RAN1 specifications are agnostic to the definitions of operating bands, bandwidths and duplex distances while for TDD bands RAN1 requires that the active UL and DL BWP pair must have the same center frequency. It is RAN1 understanding that RAN2 capability and configuration signalling and RAN4 band, duplex and bandwidth definitions place restrictions to carrier positions.
	+ 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?
	+ RAN1 response: RAN1 understanding is that there is no defined UE behaviour for a carrier that is not fully contained in a NR band as the UE capability of supported maximum bandwidth is defined on a per CC/per Band/Per BC basis, which assumes the indicated BW for a given CC is within a defined NR band.
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The RAN2 answers to these questions from companies seem mainly that there are few limitations apart from RRC assumptions. Some companies raise that the general assumption for the second question is that network should follow UE capabilities, but no other specific restrictions exist. The moderator also notes that RAN2 should focus on the RAN4 specification aspects when answering (e.g. justifying something on RAN4 specifications is perhaps not the most useful when answering to RAN4 - they should know their specifications already).

**Question 2**: What should be in RAN2 answers to the questions on wider CBW approach?

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| Answers to Question 1 |
| Company | Yes/No | Technical Arguments |
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**Summary 1**: TBD.

**Proposal 1**: TBD.

## 3.2 Overlapping CBWs from network perspective (one cell)

The following RAN4 questions and RAN1 answers can be found in [R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip) for this topic:

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| * 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.
	+ **RAN1 response**: In idle mode and inactive state, 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, obviously as long as the configuration on each cell in this “one cell” approach is configured in compliance with the RAN1/2/4 specifications.
	+ 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.
	+ **RAN1 response:** 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.
 |

These questions are more about RAN1 details, and there are decent answers already, but RAN2 could offer some complementary answers on e.g. BWP handling for IDLE/INACTIVE, CD-SSB role and other SSB configuration aspects.

**Question 2**: What should be in RAN2 answers to the questions on overlapping CBW from network perspective (one cell) approach?

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| Answers to Question 2 |
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**Summary 2**: TBD.

**Proposal 2**: TBD.

## 3.3 Overlapping CBWs from network perspective (two cells/CA)

The following RAN4 questions and RAN1 answers can be found in [R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip) for this topic:

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| * 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
* RAN1 response:
	+ RAN1 specification do not restrict configuring overlapping carriers for CA for a single UE. However, RAN1 would like to note that in Rel-15/16 RAN1 did not discuss UE capabilities for overlapped CA in Rel-15/16, and it is RAN1 understanding that RAN2-specified UE capability signalling does not provide any possibility for UE to indicate support for overlapped CA.
	+ In case of CA, the CSI-RS measurement and reporting for the component carriers are specified in TS38.213 to be performed independently per-carrier and PDCCH monitoring are also specified in TS38.213 to be performed independently for each component carrier.
	+ gNB scheduler is responsible for avoiding collisions of different transmissions as a network restriction for the overlapping part with overlapped CA including cross-carrier scheduling as well.
	+ RAN1 would like to note that overlapped CA configuration case has not been considered in RAN1 and the UE capabilities agreed in RAN1 for Rel-15/16 were not designed to be able to indicate UE’s support for overlapped CA configuration.
 |

These questions seem almost solely about RAN1 aspects, but RAN2 could note that from configuration viewpoint, two cells have independent configurations. But overall most companies already think these questions are mainly for RAN1 to answer, and they have already done that. What RAN2 can add is mainly the configuration and UE capability details.

**Question 3**: What should be in RAN2 answers to the questions on overlapping CBW from network perspective (two cells/CA) approach?

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| Answers to Question 3 |
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**Summary 3**: TBD.

**Proposal 3**: TBD.

## 3.4 Overlapping CBWs from UE perspective (one cell)

The following RAN4 questions and RAN1 answers can be found in [R2-2111209](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_116-e/Docs/R2-2111209.zip) for this topic:

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| * 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?
	+ RAN1 response: RAN1 leaves the configuration related question for RAN2 to answer.
	+ 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.
	+ RAN1 response: RAN1 has not evaluated, nor plans to evaluate the need for the gNB to know this aspect.
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The first question is asking about RAN2 specification restrictions and can be answered by RAN2, but the second question clearly seems to be about RAN1 (and RAN4!) aspects. There are some different views among the companies on the first question, so it would be good to highlight the background to their proposed answer in more details.

**Question 4**: What should be in RAN2 answers to the questions on overlapping CBW from UE perspective (one cell) approach?

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| Answers to Question 4 |
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**Summary 4**: TBD.

**Proposal 4**: TBD.

# 4 Conclusion

TBD.