**3GPP TSG-RAN4 Meeting #98bis-e *R4-21xxx***

**Electronic Meeting, 12 April – 20 April** **2021**

**Source:** Ericsson

**Title:** Evaluation of IrregularBW Approaches Against SI Objectives

**Agenda item:** 9.2

**Document for:** Approval

# 1. Summary of Evaluation

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| SI Objective (RP-210706 Clause 4) | Overlapping CA (two cells)  (R4-2106486) | Combined UE CBW (One cell)  (R4-2107040) | Overlapping UE CBW (One cell)  (R4-2106689)  (R4-2104887) | Wider CBW~~Blanking Approach~~ (one cell)  (R4-2104587) |
| 1. Identify operator licensed channel bandwidths in FR1 that do not align with existing NR channel bandwidths.    1. Only licensed spectrum wider than 5 MHz to be considered in this SID.    2. Spectrum block of 33MHz in n28 require further investigation since there is dual duplexer assumption (2x30MHz) for this band. At RAN4 #98e it was decided to eliminate spectrum block of 33 MHz for n28. | N/A | N/A | N/A | N/A |
| 1. Evaluate the potential use of larger channel bandwidths than operator licensed bandwidth, including the impacts on regulatory emission requirements/UE output power implications and UE ACS/blocking impacts depending on the guard band and the SCS. | N/A | N/A | N/A | -A “Fall back” mode to the small regular BW can be used and handled by NW implementation for scenarios where near-far effect has potential problems.How does it work?  -Tx (BS/UE) SEM needs definition for irregularBW  -Equal UL/DL SU |
| 1. Study the use of overlapping UE channel bandwidths (from both UE and network perspective) to cover operator’s license spectrum for both UL and DL, and if new gNB channel bandwidths are needed.   NOTE: For all considered solutions, new (dedicated) channel filters (e.g. non-integer-multiples of 5MHz) are not considered for the UE and not prioritized for the gNB. | -BS define overlapping CA to cover irregularBW  -For UE, significant implementation effort, especially for UL  -For UE, overlapping CA is optional support in DL only.  -new gNB CBW does not required | - adopt 5/10MHz existing requirements for each overlapping carrier to ensure co-existence  -from UE perspective, overlapping channels supported in DL only  - from the UE perspective, quite noticeable implementation efforts and potentially changes in the internal design  -does not require new channel filters for UE and gNB | -DL/UL of UE smallerCHBW only  -gNB define irregularBW for regulatory requirements | N/A |
| 1. Identify operator licensed bandwidths that are not compatible with the use of techniques like overlapping UE channel bandwidths. Every proposed method shall be summarized with respect to whether all considered spectrum scenarios are supported or whether there are specific limitations. Some limitations for a specific method shall not disqualify such method if there is a trade-off between flexibility and implementation challenges. | From network perspective, SU >= 90%  UE smallerCHBW SU >=90% | BS IrregularBW SU >=90%  UE IrregularBW SU in DL >=90%  UE smallerCHBW SU in UL >=90% | UE smallerCHBW SU >= 90 %  BS IrregularCHBW SU>= 90% | UE smallerCHBW SU >= 90 %  BS IrregularCHBW SU >= 90% |
| 1. Study the complexity and efficiency of adding new channel bandwidths vs. using other including testing aspects. | -UE testing for irregularBW is needed. The CA framework can be reused.  FFS if RB alignment between the two CCs should be required | -One carrier from BB perspective (~~single FFT is possible)~~, and two carriers from RF perspective  -RF capability of non-continuous intra-band CA is needed in DL, an optional UE capability  Legacy UE will only access the network with one carrier.  .  BS will maintain phase continuity between the two carriers | - coordination for SSB overlap between UE CHBW #1 and UE CHBW #2  -may require duplicated SSBs/other radio resources which may conflict in frequency domain -> SSB to be transmitted in a staggered manner in time domain (scheduler complexity)  -the complexity is the same as introduce number of the BS new channel bandwidth | -WiderCHBW alignment and its allocated BWP depending on the irregular CHBW position in the band needs to be determined  (ref: R4-2107253)  - new channel filter implementation?  -how co-existence is ensured?  -How to define the number of blanking RBs?  How coexistence will be ensured? |
| 1. Generic solution(s) should be intended as much as possible, with priority should be given to approaches that avoid the introduction of new channel BWs on the UE side. Proprietary solutions if proven relevant should not be precluded. Spectrally efficient methods providing a fine channel bandwidth granularity as well as low to moderate guard band width and signalling overhead should be preferred | -  - no new UE channel BWs is introduced  - in general two SSBs are configured per carrier. Single SSB is only configured for Pcell is not excluded, e.g. for the case new UE is the majority. | -yes applies for all licensed spectrum wider than 5 MHz  -generic and future proof solution  - low guard band width and signalling overhead since there is only one carrier from baseband perspective | -some additional implimentation efforts needed to TDM SSB for irregularBW > 10 MHz | -even it can apply for all licensed spectrum wider than 5 MHz, each scenario requires the set of relevant requirements |
| 1. Impact on RAN1 and RAN2 should be considered and minimized | -no impact to RAN1 and RAN2 except UE capability to enable overlapping CA.  FFS if there is RAN2 impact | - UE capability signalling  FFS if there is RAN1/2 impact (UE BWP needs to be fully contained in carrierbandwidth | -no change | -UE capability signalling  -How to let UE know the RBs are blanking? |
| 1. For any considered solution, UEs not supporting such solution (both legacy and new UEs) should be able to use the next lower supported channel bandwidth in the UL and DL without implications. | -  - support legacy UE in both sides of irregularBW  -new UE is optional suport the irregularBW via overlapping CA | -works for legacy and new UEs | -legacy UEs | -legacy or new UEs |
| 1. Impact (if any) on RAN4 requirements should be identified for the preferred solutions. | -Define CA combinations + define overlapping CA channel spacing. The existing CA requirements can be reused  FFS there is significant RAN4 impact | -very limited since requirements would be based on existing requirements for 5/10MHz CHBW | -BS irregularBW (Indicated carrierbandwidth will be one of the regular CBWs) | -BS irregularBW (Indicated carrierbandwidth will be one of the regular CBWs) BS will need to meet the OOBE requirements corresponding to the operator’s block  -FFS UE TX SEM if the UE supports using the entire operator’s block  -set of new RF requirements for each scenario |
| Benefits from system and UE point of view (comparisons among all candidate solutions)   * SSB/raster positions * How many PRBs will be used based on one example * Gain vs. BS and UE implementation complexities | Benefits to be shown in comparison with non-overlapping CA | One SSB, SU for both gNB and new UEs:  6MHz – 30 PRBs (90%)  7MHz – 36 PRBs (92.6%)  11MHz – 58 PRBs (94.9%)  12MHz – 63 PRBs (94.5%)  13MHz – 69 PRBs (95.5%)   * Future proof solution (not limited to considered spectrum blocks within this SI) * No impact to RAN2 signaling as well as to RAN1 specifications * No additional channel filters need to be designed and tested * Ensured co-existence with very limited impact to RF core requirements (adopt 5/10MHz existing requirements for each overlapping carrier) * SU >=90%, the signalling overhead for the additional RF carrier is small since there is only one carrier from baseband perspective |  |  |