**3GPP TSG-RAN WG4 Meeting # 97-e-Bis R4-201xxxx**

**Electronic Meeting, 2 – 13 November 2020**

**Agenda item:** 13.3

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [94e Bis][142] FS\_NR\_eff\_BW\_util

# Introduction

This email discussion is for FS\_NR\_eff\_BW\_util study item. The main objective of the study is on efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidth. The following is the agreed agenda:

* Study on Efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidths
  + General and work plan
  + Input on operator licensed channel bandwidths in FR1 that do not align with existing NR channel bandwidths
  + Evaluation of use of larger channel bandwidths than operator licensed bandwidth
  + Evaluation of use of overlapping UE channel bandwidths (from both UE and network perspective)
    - UE perspective
    - Network perspective
  + Others

The following topics are discussed in this email thread:

Topic #1: Workplan, SID, TR Skeleton

Topic #2: General Aspects for Irregular Bandwidths

Topic #3: Overlapping Channel Bandwidths

# Topic #1: Workplan, SID, TR Skeleton

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2016456 | T-Mobile USA, Ericsson | Revised SID (editorial updates) for information |
| R4-2015721 | Ericsson | Work Plan for Study on Efficient utilization of licensed spectrum that is not aligned with existing NR channel bandwidth |
| R4-2015722 | Ericsson | TR Skeleton |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1

*Sub-topic description: Work plan discussion for coming meetings*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Work plan**

* Proposals
  + Option 1: Work plan in R4-2015721
  + Option 2: TBA
* Recommended WF
  + Comment and approve work plan

### Sub-topic 1-2

*Sub-topic description: TR skeleton and SID revision approval*

*Open issues and candidate options before e-meeting:*

**Issue 1-2: SID revision and TR skeleton**

* Proposals
  + Option 1: TR skeleton and SID revision approval
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Nokia | Sub topic 1-1: It is not clear what “initial drafts to TR on BS/UE general requirements” mean. It should be allowed to agree on any text proposal in RAN4#98e if TP is stable enough.  Sub topic 1-2: Option 2, revise TR skeleton. For note in 5.6, analysis/study between solutions (whether they are generic according to objective 6) shall be included. Do we need a conclusion Clause? Furthermore, in the No Markup view, the font size in section 4 below the table requires an editorial fix.  ….  Others: |
| ZTE | Issue 1-2  For TR skeleton, there may be some issues: 1) Contents table not updated ; 2) Section 5.1 “Licence channel Bandwidths not aligned to existing NR CH BW’s” and Section 5.4 “Identification of other operator licenced bandwidths” could be merged into one section as different subsections, e.g.,  Section 5.1 Licence channel Bandwidths not aligned to existing NR CH BW’s  Section 5.1.1 Initial batch of operator licensed bandwidths  Section 5.1.2 Identification of other operator licenced bandwidths |
| Apple | Comments for the TR skeleton:  The second paragraph in section 4 can be removed, it is enough to have Table summarizing current operators’ input. By the way, the table in section 4 does not have a header, e.g.: “Table 4-1: Summary of operators’ input for irregular channel bandwidth”.  We would like to understand the relationship between the table in section 4 and section 5.1 and 5.4. If section 5.1 aims at capturing further operator input on channel bandwidths similar to what the existing table in section 4, then we prefer to have one table in one place without duplicating them. Furthermore, it is somewhat confusing to have section 5.1 with operators input next to sections 5.x summarizing potential solutions.  It is a matter of taste, but should not we have the corresponding RANx WG impact sub-sections under 5.2 and 5.3? It seems logical that every section describing a solution will also provide a summary of how it impacts RAN4 and other WGs. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:* Ericsson to provide a revised Work Plan and TR skeleton based on feedback from round 1.  *Candidate options:*  *Recommendations for 2nd round:* Companies to provide feedback on revised Work Plan and TR skeleton |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2015721 | To be Revised |
| R4-2015722 | To be Revised |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: General Aspects for Irregular Bandwidths

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014895 | Apple | Summary of observed solutions:  Table 3.4-1: Summary of the solutions.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Option | New channel bandwidth for BS | New channel bandwidth for UE | Specification impact for 38.101 | Full usage of spectrum at BS | Full usage of spectrum at UE | | Carrier Aggregation | No | No | No | Yes/No | Yes/No | | Next smaller bandwidth | No | No | No | No | No | | Next larger bandwidth | No | No | To be checked within this SI | Yes | Yes | | Overlapping carriers | Yes | No | No | Yes/No | No |   Observation 1: Adding new channel bandwidths, which have not been specified yet, will result in significantly higher complexity of use cases and significantly higher development and test effort for the UE.  Observation 2a: Contiguous intra-band CA can be used to support non-standard channel bandwidths which are not multiples of 5MHz.  Observation 2b: Contiguous intra-band CA cannot address efficiently small channel bandwidths, which are not multiple of 5MHz, such as 7 and 13MHz.  Observation 3a: Using the next smaller channel bandwidth can be acceptable when the difference between the bandwidth of the operator’s spectrum and the next lower channel bandwidth is not large.  Observation 3b: Using the next larger channel bandwidth can be acceptable when the difference between the bandwidth of the operator’s spectrum and the next larger channel bandwidth is not large.  Observation 3c: If the next larger channel is relatively large, then the overall utilisation becomes lower, which is especially the case for 30kHz SCS.  Observation 3d: Using the next larger channel bandwidth might require some amount of 3GPP efforts to define number of schedulable RBs and to check ACS and the emission requirements.  Proposal 1: Capture in the SI TR further technical details on how solutions – next smaller and next larger channel, overlapping carriers – can be used to support irregular channel bandwidth. |
| R4-2015723 | Ericsson | Proposal 1: As an initial consideration for nominal granularity consider only 7 MHz between 5- 10 MHz, and 2 MHz steps for 50-100MHz |
| R4-2014507 | Skyworks Solutions Inc | Proposal 1:   * 30 kHz SSB is not applicable to Band n5 irregular channel bandwidth (at least for 7 MHz) * Only 30 MHz UE bandwidth is considered for 33 MHz in Band n28 with current position limitations (note 7 in 38.101-1 Table 5.3.5-1) * For Band 29, current maximum BW is 10 MHz but since it is a DL only band and thus no regulatory emissions apply, support of 11 MHz can be studied * Use of the immediately higher bandwidth is not supported in UL to avoid specifying and testing NS related emissions, if needed asymmetric UL/DL UE operation can be used.   Proposal 2:   * Usage of the immediately lower existing UE channel bandwidth is the default UE mode of operation in UL and DL * When overlapped immediately lower existing UE channel bandwidths are used only one channel is scheduled to the EU: the overlapping is from network point of view only   Proposal 3: The solutions for lower UE BW in following Table are adopted for further study:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Target BW | SCS | UE CH BW /  RB / SU% | BS RB /  SU % | SSB constraint | other | | 6 MHz | 15 kHz only | 5 / 25 / 75% | 30 / 90% | Common in exact 20RB overlap  Need to be on SSB raster point | 50kHz GB shift | | 7 MHz | 15 kHz and  30 kHz | 5 / 25 / 64% | 35 / 90% | 15kHz Partial overlap only, need to be staggered in time and SSB raster point | Lost BW due to SSB resources | | 11 MHz | 15 kHz only | 10 / 52 / 85% | 57 / 93% | Common 15 kHz SSB | 50kHz GB shift | | 12 MHz | 15 kHz and  30 kHz | 10 / 52 / 78%  10 / 24 / 72% | 62 / 93%  29 / 87% | Common 15 kHz SSB | none | | 12.5 MHz | 15 kHz and  30 kHz | 10 / 52 / 75%  10 / 24 / 69% | 62 / 89%  29 / 84% | Use 12 MHz solution | | | 13 MHz | 15 kHz and  30 kHz | 10 / 52 / 72%  10 / 24 / 67% | 62 / 86%  29 / 80% | Use 12 MHz solution | | | 15 kHz only | 10 / 52 / 72% | 67 / 93% | Common 15 kHz SSB | 50kHz GB shift | | 33 MHz | 15 kHz and  30 kHz | 30 / 160 / 87%  30 / 78 / 85% | 170 / 93%  83 / 91% | Common 15 kHz SSB |  | | 15 kHz only | 30 / 160 / 87% | 175 / 96% | Common 15 kHz SSB | 50kHz GB shift |   Observation: The SSB design for 7 MHz and 6 MHz bandwidths needs further study with possible SSB raster points in the actual band and its position within the band to know if the solution is feasible.  Proposal 4:   * Solution using the immediately higher existing UE channel bandwidth can be further studied for DL only:   + It should be an optional UE capability   + It should be compatible with the default UL/DL operation using immediately lower existing UE channel BW * No change to the EU specification should be assumed and ACS/blocking/REFSENS characteristics are those of the related existing UE channel bandwidth: It may not be feasible for all channel bandwidths and deployments   Proposal 5:   * Irregular channel bandwidths should be an integer multiple of 1 MHz * Applying irregular channel bandwidths agreed in this SI to new bands should be done with agreement at plenary * Adding new irregular channel bandwidths in this SI to existing or new bands should be done with agreement at plenary |
| R4-2016111 | ZTE | Observation 1: BS or UE passing the RF conformance testing requirement for larger regular NR channel bandwidth doesn’t mean it could pass the that for lower irregular NR channel bandwidth.  Observation 2: if any irregular NR channel bandwidth defined in MHz units requested to be supported in future, then any fractional sampling in DDC/DUC need also to be supported which will increase lots of implementation difficulty.  Observation 3: if new irregular NR bandwidth requested need significant BW extensions vs the existing maximum supported channel bandwidth, CFR/DPD/DDC/DUC/front-end duplexer module would be impacted. |
| R4-2016201 | Nokia, Nokia Shanghai Bell | Conformance testing needs to take into account that the support of a carrier by overlapping channel bandwidths consumes two RF carriers.  Each of the 2 RF carriers clearly defines the size and position of the guard band on its side of the combined channel bandwidth. This allows for an unambiguous placement of the overlapping channel filters and thus prevents problems with OBUE, ACS or in-band blocking. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1

*Sub-topic description: It is needed to ensure a baseline set of bandwidths of which need to be studied for this SI and approach to discuss future coming irregular bandwidths*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Step size for irregular bandwidths for study**

* Proposals
  + Option 1: Integer multiple step irregular bandwidth approach (e.g. 1 MHz, 2 MHz, 5MHz)
  + Option 2: Study only irregular bandwidths requested which do not have immediate issues (e.g. SSB raster alignment, etc)
  + Option 3: Adding new irregular channel bandwidths in this SI to existing or new bands should be done with agreement at plenary
  + Option 4: Applying irregular channel bandwidths agreed in this SI to new bands should be done with agreement at plenary
  + Option 5: Only 30 MHz UE bandwidth is considered for 33 MHz in Band n28 with current position limitations (note 7 in 38.101-1 Table 5.3.5-1)
  + Option 6: A generic, future proof solution shall be chosen such that it can support also other possible FR1 frequency blocks than the current requested ones, the bandwidth granularity being determined by the method
* Recommended WF
  + Continue to discuss in second round

### Sub-topic 2-2

*Sub-topic description: Additional numerology aspect to consider for SI*

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Aspects pertaining to 30 kHz SCS**

* Proposals
  + Option 1: Include 15 kHz and 30 kHz SCS into SI
  + Option 2: 30 kHz SSB is not applicable to Band n5 irregular channel bandwidth (at least for 7 MHz)
  + Option 3: If the next larger channel is relatively large, then the overall utilisation becomes lower, which is especially the case for 30kHz SCS.
* Recommended WF
  + Continue to discuss in second round

### Sub-topic 2-3

*Sub-topic description: Conformance aspects for irregular bandwidth*

*Open issues and candidate options before e-meeting:*

**Issue 2-3: Conformance and regulatory considerations**

* Proposals
  + Option 1: Adding new channel bandwidths, which have not been specified yet, will result in significantly higher complexity of use cases and significantly higher development and test effort for the UE.
  + Option 2: Use of the immediately higher bandwidth is not supported in UL to avoid specifying and testing NS related emissions, if needed asymmetric UL/DL UE operation can be used.
  + Option 3: No change to the UE specification should be assumed and ACS/blocking/REFSENS characteristics are those of the related existing UE channel bandwidth: It may not be feasible for all channel bandwidths and deployments
  + Option 4: BS or UE passing the RF conformance testing requirement for larger regular NR channel bandwidth doesn’t mean it could pass the that for lower irregular NR channel bandwidth.
  + Option 5: For Band 29, current maximum BW is 10 MHz but since it is a DL only band and thus no regulatory emissions apply, support of 11 MHz can be studied
  + Option 6: Solution using the immediately higher existing UE channel bandwidth can be further studied for DL only:
    - It should be an optional UE capability
    - It should be compatible with the default UL/DL operation using immediately lower existing UE channel BW
  + Option 7: In the framework of overlapping channel bandwidths, each of the two overlapping RF carriers clearly defines the size and position of the guard band on its side of the combined channel bandwidth. This allows for an unambiguous placement of the overlapping channel filters and thus prevents problems with OBUE, ACS or in-band blocking.
* Recommended WF
  + Continue to discuss in second round

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |
| Qualcomm | These options are quite confusing because they are not exclusive. First a higher level discussion is needed and then details of what each solution implies can be debated/agreed. Are we supposed to pick between them or comment on which is feasible or not? Many of the options are more like observations that we agree with(Option 4, for example) |
| Skyworks | Issue 2-1: we do not believe it is even agreed to enable any BW to any band so there no step size discussion, only the request BW that are in the WI should be studied case by case thus both option 3 and 4 are reasonable for the R17 scope.  In any case there is no way nor justification to enable 2MHz granularity >50MHz. in our opinion above 50% there is no real case or the loss in SU is small by default so the efficiency discussion is on important at low channel BW. Both Option 1 or Option 6 do not reflect what has been agreed. Depending on the solution found for the current cases we can look later on at what can be supported.  We support option 5 for n28 as 33MHz is not compatible with today’s implementations and has further issues.  Issue 2-2: this issue has to be clarified. The main issue is which SSB SCS can be supported. For now only n5 has 30kHz SSB so if that can be excluded then we can find solution for 15kHz SSB first. 30kHz SSB need at least 7.2MHz TX BW (NRB)  Issue 2-3:  Some solutions are not exclusive to each other. In UL at least using the immediately lower channel BW is the only way to not have any impact to spec AND guarantee regulatory requirements.  In fact all option are true to some extent and point at the fact that on the UE side using the immedaitelly lower channel BW should be the default and some cases with immediately higher channel BW can be studied for DL as an optional UE solution assuming no change in ACS/blocking |
| Nokia | Sub topic 2-1: In this early phase of 5G, is makes sense to address once and for all the operators' problem of spectrum blocks whose bandwidth does not match today's NR channel bandwidths. Hence, we support option 6 which is aligned with SID objective 6), bandwidth granularity shall be determined on the basis of the respective studied method(s). It should be noted different spectrum blocks (whose bandwidth does not match today's NR channel bandwidths) for UL and DL should not be excluded from the study. A comparison of the achievable spectrum utilization may be based on the exemplary bandwidths in section 3 of the SID.  Sub topic 2-2: Support option 1, both 15 and 30kHz SCS shall be considered.  Sub-topic 2-3: Support option 1 and 7, for overlapping channel bandwidths method where there are two overlapping carriers, there is a clear size and position of the guard band which indicates the placement of overlapping channel filters and satisfies regulatory requirements.  Others:  Proposal 4 of R4-2014507 which is reflected in option 6 of issue 2-3 does not provide details about wherein the optional UE capability consists, the more so as the same proposal 4 of R4-2014507 explicitly assumes no UE specification changes. |
| Huawei | Issue 2-1: Step size for irregular bandwidths for study  New request should be done with agreement at plenary.  Issue 2-2: Aspects pertaining to 30 kHz SCS  Option 1 and it should be studied case by case.  Issue 2-3: Conformance and regulatory considerations  Use of the immediately higher channel bandwidth is an implementation option and may be only applicable to certain scenarios where bandwidth difference is relative small. |
| Intel | Issue 2-1: Option 6. This option is aligned with the SID.  Issue 2-2: Option 1. 30 kHz SCS might not be applicable to all the cases but it should be evaluated at least during SI phase. |
| ZTE | Issue 2-1: Step size for irregular bandwidths for study  Option 4. Actually this issue does not comply to the work plan, where “identification of other operators license bandwidth” is one of the objectives in this SID, we don’t think that we can go that far at this moment to decide a generic step size for potential license bandwidths without sufficient discussions and studies.  Issue 2-2: Aspects pertaining to 30kHz SCS  At this stage we may not go down to this detail without revolving high level issues.  Issue 2-3: Conformance and regulatory considerations  The listed options seem not in parallel. If one option has to be chosen, then Option 4. |
| DISH | Issue 2-1: The SID was started to address operators irregular spectrum holdings; we should not start with downscoping the BW’s mentioned for each band in the SID. We are not ok to exclude 6MHz or 7MHz BW from n29 and n26, respectively. We agree with options 3 and 4. |
| Apple | Issue 2-1: Option 3/4: The issue can be re-formulated as whether we plan to consider any irregular channel size or whether the scope is limited only to those channel bandwidths which are mentioned in the SI. To avoid enlarging the SI scope, our preference is close to Option 3 and 4, i.e. we focus only on those channel bandwidths which are approved at the RAN plenary. New channel bandwidths shall be explicitly reflected in the corresponding summary table before RAN4 starts considering them. From that perspective Option 1 might give a wrong impression that we plan to address any irregular channel bandwidth.  Issue 2-1: Option 5: We support not having 33MHz for band n28 as it is not compatible with today’s implementations.  Issue 2-2: Option 1: As a general principle, both 15kHz and 30kHz SCS can be discussed. As presented in our paper, sometimes 30kHz SCS is not possible or has low spectrum utilization, but it can be up to the operator which configuration to use.  Issue 2-3: It seems that this issue mixes up feedback and observations that concern different solutions, so it is better to address them under the corresponding topics. Nevertheless:  Option 1: agree with the observation;  Option 2: we agree with the main principle of this observation, it should be studied further;  Option 3: we agree with the main principle of this observation that UE changes should be avoided/minimized;  Option 5: Using next larger channel bandwidth to support 11MHz on band n29 needs more analysis because 38.101-1 does not define 15MHz for band n29 which we can use as the next larger bandwidth.  Option 6: We are open to study further a solution with the next larger channel that will apply only in DL, but it does not preclude analyzing whether next larger channel can be used both in DL and UL.  Option 7: we agree with this observation |
| Ericsson | Issue 2-1:  Given the various options and inputs on e.g granularity. We suggest modifying the table on Band/bandwidths form the SID by removing 33 MHz for n28 and 12.5 MHz for n5. The updated table copied below. And have this table as a baseline for the further work within the SI.   |  |  | | --- | --- | | Band (s) | Channel Bandwidth(s) | | n5 | 7, 11 MHz | | n12 | 12 MHz | | n26 | 7 MHz | | n28 | 13 MHz | | n29 | 6, 11 MHz |   Note: If this is agreed the WID needs to be updated accordingly.  The table above contains example of irregular BWs to study but this does not prevent a generic solution.  Issue 2-2:  Supportive of option 1: Study both 15 and 30kHz SCS as part of the SI, case by case some SCS’s might be found not feasible for a particular solution depending on BW.  Issue 2-3:  Highly dependent on the solution, as stated in the options. Regulatory (and inter-operator co-existence) requirements obviously need to be fulfilled or ensured for any irregular BWs |
| T-Mobile USA | **Issue 2-1:**  Option 1: We would be OK with 1 MHz increments, but if we have a generic approach it may not be limited to 1 MHz increments  Option 2: I don’t understand what we would do with the irregular BWs requested that do have issues like SSB raster alignment  Option 3 and 4: Agree that new requests should be agreed at RAN Plenary.  Option 5; No Opinion  Option 6: Agree  **Issue 2-2:** Option 1, but 30 kHz SCS should be limited to channel BWs > 10 MHz  **Issue 2-3:**  Option 1: Agree  Option 2: Agree that immediately higher BW should not be used in UL due to regulatory compliance concerns  Option 3: Sounds like a reasonable goal.  Option 4: We agree that BS or UE passing conformance tests for the larger BW doesn’t ensure it would meet the requirements for the smaller BW.  Option 5: No opinion  Option 6: Blocking needs to be considered if using the next higher channel BW for DL UE Rx. We would be concerned about regulatory emission requirements if the next higher channel BW is used for BX Tx.  Option 7: Agree. |
| AT&T | **Issue 2-1:** We support the comments from DISH that the SID was started to address operator irregular spectrum holdings and downscoping should not be considered as the CBW requests are meant to make efficient use of the spectrum for the particular operating bands indicated. We are not OK to exclude 6MHz from n29. Agree that any updates need to be addressed at RAN Plenary based on normal operating procedures.  **Issue 2-3:** For option 5, we assume that this comment does not propose to remove 6MHz allocation from n29. In general, it seems a bit early to be discussing conformance test impacts at this part of the Study Item. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  Generic solution(s) should be prioritized. Generic solution(s) may not require definition of bandwidth granularity.Study solutions which consider bandwidth inputs should consider integer 1MHz bandwidth granularity up to 13 MHz  33 MHz not to be considered for n28. 30 MHz should be used instead.  New irregular bandwidth requests to be studied must be approved at the RAN plenary.  *Candidate options:*  *Recommendations for 2nd round:* Confirm Tentative agreements |
| **Sub-topic#2** | *Tentative agreements:*  Study only 15 kHz SCS for bandwidths < 10 MHz and both 15 kHz and 30 kHz SCS for bandwidths > 10 MHz  Solutions which have low spectral utilization for 30 kHz SCS can be removed from consideration  *Candidate options:*  *Recommendations for 2nd round:* Confirm Tentative agreements |
| **Sub-topic#3** | *Tentative agreements:*  For configuring immediately larger channel bandwidth approach, concerns have been raised on how to ensure conformance/regulatory requirements are met for both UE/gNB. Study aspects for largest acceptable difference between irregular bandwidth and next larger channel bandwidth; as an example next larger channel bandwidth for 11 MHz is 15 MHz while next larger channel bandwidth 13 MHz is 15 MHz.  *Candidate options:*  *Recommendations for 2nd round:* Continue to discuss any possible conformance regulatory impacts to larger channel bandwidth approach. For both gNB and UE. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on Irregular Channel Bandwidths | Ericsson |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### Sub-topic 2-1

*Sub-topic description: It is needed to ensure a baseline set of bandwidths of which need to be studied for this SI and approach to discuss future coming irregular bandwidths*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Step size for irregular bandwidths for study**

* Option 1: Confirm agreement on the following:
  + Generic solution(s) would be prioritized. Generic solution(s) may not require definition of bandwidth granularity.
  + Study solutions which consider bandwidth inputs should consider integer 1 MHz bandwidth granularity up to 13 MHz.
  + 33 MHz not to be considered for n28. 30 MHz should be used instead.
  + New irregular bandwidth requests to be studied must be approved at the RAN plenary.
* Option 2: Other
* Recommended WF
  + TBA

### Sub-topic 2-2

*Sub-topic description: Additional numerology aspect to consider for SI*

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Aspects pertaining to 30 kHz SCS**

* Option 1: Confirm agreement on the following:
  + Study only 15 kHz SCS for bandwidths < 10 MHz and both 15 kHz and 30 kHz SCS for bandwidths > 10 MHz
  + Solutions which have low spectral utilization for 30 kHz SCS can be removed from consideration
* Option 2: Other
* Recommended WF
  + TBA

### Sub-topic 2-3

*Sub-topic description: Conformance aspects for irregular bandwidth*

*Open issues and candidate options before e-meeting:*

**Issue 2-3: Conformance and regulatory considerations**

* Discuss on the following areas:
  + Interested parties encouraged to bring in contributions showing how regulatory and blocking issues can be dealt with if the next higher channel BW is used.
  + Discuss how to handle much larger channel bandwidths when applying next larger channel bandwidth approach i.e. what is the limiting bandwidth difference from irregular bandwidth to next larger channel bandwidth that may still make selecting larger channel bandwidth feasible.
  + Option 3: Other.
* Recommended WF
  + TBA

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  Sub topic 2-3: |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Overlapping Channel Bandwidths

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014487 | Qualcomm Incorporated | Proposal: Introduce new channel BW only for gNBs and use existing channel BW for UE, by means of offset to carrier configured between UE1 and UE2 |
| R4-2015562 | Intel Corporation | Observation #1: RB scheduling restricion on channel edge(s) is required to comply regulartory requirements.  Observation #2: RB scheduling restriction on channel edge(s) is still required in an overlapping channel bandwidths from network perspective, to comply with regulartory requirements.  Observation #3: Even with RB scheduling restriction, overlapping channel bandwith from network perspective could have a benefit to utilize an operator holding spectrum.  Observation #4: Unoverlapped channel bandwidth should be larger than SSB bandwidth, i.e., 3.6 MHz and 7.2 MHz with 15 kHz and 30 kHz SCS, respectively.  Observation #5: Overlapping channel bandwidth from UE perspective requires more implementation complexity compared to define a dedicated channel bandwidth. |
| R4-2015724 | Ericsson | Observation 1: RB placement needs to be further considered.  Observation 2: Emissions requirements based upon wider channel bandwidth which may not meet regulatory license conditions  Observation 3: Using the larger bandwidth approach may not provide sufficient protection for ACS and blocking requirements.  Observation 4: Additional conformance testing may be needed for partial use of channel bandwidths |
| R4-2015713 | Huawei, HiSilicon | Observation 1: for channel bandwidths less than 50 MHz, integer-multiples of 5MHz channel bandwidths are supported/will be supported in BS/UE specifications.  Observation 2: The impact to RF core requirements is very limited to support intra-band overlapping CA.  Proposal 1: New dedicated channel bandwidths are not considered for both BS and UE.  Proposal 2: Intra-band overlapping CA is optional support from both UE and network perspective |
| R4-2016201 | Nokia, Nokia Shanghai Bell | Proposal 1: The study of overlapping channel bandwidths from UE perspective, according to objective 3 of the SID, shall include an approach with a single carrier from baseband perspective, allowing for a single BWP to cover the combined channel bandwidths. |
| R4-2016455 | T-Mobile USA | Observation 1: With 6 MHz of licensed spectrum it is possible that a single SSB can be used for two overlapping 5 MHz carriers, but the frequency position would be limited by the SSB raster  Observation 2: With 8 or 9 MHz of licensed spectrum, overlapping 5 MHz carriers can use separate SSBs that are time aligned, although frequency position for covering 8 MHz might be limited by the SSB raster  Observation 3: With 7 MHz of licensed spectrum, separate SSBs that overlap in frequency but not in time will be required.  Proposal 1: RAN4 needs to decide if subcarrier alignment or RB alignment is required.  Proposal 2: Any potential issues for overlapping carriers need to be addressed including increased overhead and handover issues when the gNB moves UEs from one carrier to the overlapping carrier. |
| R4-2014507 | Skyworks Solutions Inc | Proposal 1:   * 30 kHz SSB is not applicable to Band n5 irregular channel bandwidth (at least for 7 MHz) * Only 30 MHz UE bandwidth is considered for 33 MHz in Band n28 with current position limitations (note 7 in 38.101-1 Table 5.3.5-1) * For Band 29, current maximum BW is 10 MHz but since it is a DL only band and thus no regulatory emissions apply, support of 11 MHz can be studied * Use of the immediately higher bandwidth is not supported in UL to avoid specifying and testing NS related emissions, if needed asymmetric UL/DL UE operation can be used.   Proposal 2:   * Usage of the immediately lower existing UE channel bandwidth is the default UE mode of operation in UL and DL * When overlapped immediately lower existing UE channel bandwidths are used only one channel is scheduled to the EU: the overlapping is from network point of view only   Proposal 3: The solutions for lower UE BW in following Table are adopted for further study:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Target BW | SCS | UE CH BW /  RB / SU% | BS RB /  SU % | SSB constraint | other | | 6 MHz | 15 kHz only | 5 / 25 / 75% | 30 / 90% | Common in exact 20RB overlap  Need to be on SSB raster point | 50kHz GB shift | | 7 MHz | 15 kHz and  30 kHz | 5 / 25 / 64% | 35 / 90% | 15kHz Partial overlap only, need to be staggered in time and SSB raster point | Lost BW due to SSB resources | | 11 MHz | 15 kHz only | 10 / 52 / 85% | 57 / 93% | Common 15 kHz SSB | 50kHz GB shift | | 12 MHz | 15 kHz and  30 kHz | 10 / 52 / 78%  10 / 24 / 72% | 62 / 93%  29 / 87% | Common 15 kHz SSB | none | | 12.5 MHz | 15 kHz and  30 kHz | 10 / 52 / 75%  10 / 24 / 69% | 62 / 89%  29 / 84% | Use 12 MHz solution | | | 13 MHz | 15 kHz and  30 kHz | 10 / 52 / 72%  10 / 24 / 67% | 62 / 86%  29 / 80% | Use 12 MHz solution | | | 15 kHz only | 10 / 52 / 72% | 67 / 93% | Common 15 kHz SSB | 50kHz GB shift | | 33 MHz | 15 kHz and  30 kHz | 30 / 160 / 87%  30 / 78 / 85% | 170 / 93%  83 / 91% | Common 15 kHz SSB |  | | 15 kHz only | 30 / 160 / 87% | 175 / 96% | Common 15 kHz SSB | 50kHz GB shift |   Observation: The SSB design for 7 MHz and 6 MHz bandwidths needs further study with possible SSB raster points in the actual band and its position within the band to know if the solution is feasible.  Proposal 4:   * Solution using the immediately higher existing UE channel bandwidth can be further studied for DL only:   + It should be an optional UE capability   + It should be compatible with the default UL/DL operation using immediately lower existing UE channel BW * No change to the EU specification should be assumed and ACS/blocking/REFSENS characteristics are those of the related existing UE channel bandwidth: It may not be feasible for all channel bandwidths and deployments   Proposal 5:   * Irregular channel bandwidths should be an integer multiple of 1 MHz * Applying irregular channel bandwidths agreed in this SI to new bands should be done with agreement at plenary   Adding new irregular channel bandwidths in this SI to existing or new bands should be done with agreement at plenary |
| R4-2014895 | Apple | Observation 4a: Overlapping carriers can utilise full spectrum of "non-standard" channels.  Observation 4b: To use the full spectrum, the BS needs to support the full bandwidth, while from the UE perspective existing standard channels can be used. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1

*Sub-topic description: Items to study for overlapping channel bandwidth approach and/or introducing new channel bandwidth for handling irregular bandwidth*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: Study overlapping channel bandwidths**

* Proposals
  + Option 1: Consider UE scheduling offset from channel edge(s)
  + Option 2: Consider intra-band overlapping CA support
  + Option 3: When overlapped immediately lower existing UE channel bandwidths are used only one channel is scheduled to the UE: the overlapping is from network point of view only
  + Option 4: RAN4 needs to decide if subcarrier alignment or RB alignment is required and if both RF carriers must be positioned on the channel raster
  + Option 5: The study of overlapping channel bandwidths from UE perspective, according to objective 3 of the SID, shall include an approach with a single carrier from baseband perspective, allowing for a single BWP to cover the combined channel bandwidths.
  + Option 6: Any potential issues for overlapping carriers need to be addressed including increased overhead and handover issues when the gNB moves UEs from one carrier to the overlapping carrier.
  + Option 7: Overlapping carriers can utilize full spectrum of “non-standard” channels. The BS needs to support full bandwidth while UE only support standard channels to be used
* Recommended WF
  + TBA

**Issue 3-2: Introduce new channel BW**

* Proposals
  + Option 1: New channel BW only for gNB, use existing channel BW for UE
  + Option 2: New channel BW considered for gNB and UE
  + Option 3: No new channel BW for UE or gNB
  + Option 4: New channel BW not explicitly defined for UE and gNB, irregular channel bandwidths can be supported by overlapping RF carriers
* Recommended WF
  + TBA

### Sub-topic 3-2

*Sub-topic description: Impact to current PHY (specifically SSB) design with overlapping channel bandwidth approach*

*Open issues and candidate options before e-meeting:*

**Issue 3-3: SSB consideration for Overlapping CBW**

* Proposals
  + Option 1: single SSB can be used for two overlapping carriers
  + Option 2: multiple SSBs needed (for each UE) for overlapping carriers
  + Option 3: subcarrier alignment or RB alignment requirement
  + Option 4: increased overhead and handover issues when the gNB moves UEs from one carrier to the overlapping carrier
* Recommended WF
  + Continue discussion in second round

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |
| Qualcomm | Overall these options are also confusing because they are not exclusive, combinations are needed or some are sub-options of others.  **Subtopic 3-1**: Option 3 is the preferred way to go, supported by current specs and implicitly by legacy UEs also.. Option 4 is needed otherwise the implementation, at least on the base station side will be very complicated. Option 5 is based on the assumption that the UE has separate receivers for the 2 overlapped channels, we disagree with this as being unreasonable. For such bandwidth, the UEs will have a single receiver (like for intra-band CA) to process the entire BW. The absolute gain in throughput from adding a few MHz will be too small to justify this extra complexity.  Option 7 is talking about overlapping carriers from a UE or from a BS point of view.  **Sub-topic 3-2**: Option 1 should be the baseline. It has least overall impact. A new filter for gNB will be needed anyway  **Sub-topic 3-3**: Options are not disjoint. Option 1 is clearly preferable because it reduces the overhead. It can be used for all bandwidths other than 7MHz for which 2 SSBs in different locations will be needed. Option 3 is clearly preferable and should be the baseline. Option 4 needs more discussion because the impact is not clear. |
| Skyworks | Agree with Qualcomm that these are not exclusive options.  Subtopic 3-1: Option 3 for us is also the baseline and we have provided detailed analysis for those and what the constraints should be. Once we have a common understanding with these we can look at other solutions but they need to be compatible with the baseline. Option 4 may only be needed for cases where SSBs are partially overlapping and there no solution form SSB raster points but this actually means that:  SSB needs to be staggered in time and guard bands dynamically moved to make sure RB alignment is always achieved for the UE and contains the SSB. This should only be used as a last resort solution based on no solution from baseline. In our analysis is may be critical for 7MHz but even there the 6MHz solution would work with potentially less penalty in term of complexity and single SSB can be used. This is why “option 6” is actually a sanity check that a given solution actually is helping. We suggest this is done for 15kHz SCS only.  We would like to see feedback and/or agreement on rules established in our paper.  Issue 3-2: Option 1 is the only reasonable, for the BS there is an additional constraint/specification but this is OK if this is the exception for only a few bands and associated BW, in that sense it would be useful to understand if bands that have multiple BW request could do with only a limited set as a solution. This is why we don’t think any of the requested BW should become a generic BW.  Issue 3-3: again these are not options. In our analysis there are cases where SSB overlap exists but the issue is when partial overlap is needed since it creates a further dependency on SSB raster. There are good solutions for full overlap or no overlap. Option 3: RB alignment should be the default approach, even for 7MHz reusing the 6MHz solution is feasible and the separate SSB, staggering in time and needed guard bands may not provide significant improvement at the cost of significant complexity and potential RAN1/4 impact. Option 4 is only an issue when partial overlap and SSB need to be staggered in time.  For R4-2014487: although the CA with 1/2/3/4MHz “abutted virtual channels” idea is of interest we are not sure it actually results in a fixed solution in terms of resulting guard bands for carrier spacing and channel edges so may only be further studied in DL assuming that ACS/Blocking performance is not changed, also this will have impact to specification. |
| Nokia | Sub-topic 3-1, issue 3-1: Support option 5. For option 4, we consider PRB alignment as important to keep the design of reference signals throughout the combined channel bandwidths consistent and to make a single, large BWP filling the operator's spectrum block possible. For the channel raster position, as shown in R4-2016201, we see a benefit if one of both carriers need not be positioned on the channel raster.  Issue 3-2: Support option 4.  Sub-topic 3-2 (issue 3-3): Support option 1. For option 4, impacts (e.g., mobility) overheads and spectral efficiency in the case of 2 SSBs would need to be studied, including a potential need to have in addition to the second SSB also further separate broadcast and common control channels.  Others: About the observation #4 in R4-2015562 (related to issue 3-3): No clear reason for the observation is provided. If there were UEs which have a problem when receiving an entire SSB plus a part of another SSB (overlapping in frequency but not in time) in their BWP, the problem should be described more clearly so that it can be considered in the analysis of the proposals' legacy UE impact. |
| Huawei | Issue 3-1: Option 2, we propose to support overlapping CA. It is an optional capability for UE. We believe as long as UE support intra-band CA, there is no issue for UE support overlapping CA. Using subcarrier alignment as CA, the spectrum utilization is always higher than 90%.  Issue 3-2: Introduce new channel BW  Option 3, we think trade-off on the implementation complexity and efficient utilization of operators’ spectrum has already been done in Rel-15 and Rel-16.  Issue 3-3: SSB consideration for Overlapping CBW  We think multiple SSB will be needed which has less impact on specification. And only subcarrier alignment is necessary. RB alignment requirement has lower SU which is not a must for CA. |
| Intel | Issue 3-1: Option 5  Issue 3-2: Option 4 is aligned with the motivation of the SID. RAN4 strives to minimize spec change. |
| ZTE | Similar views as Qualcomm as an overall comment.  Issue 3-1: Study overlapping channel bandwidths  Options listed in the issue seem not in parallel logically  Issue 3-2 Introduce new channel BW  We don’t think that we could make a decision now without sufficient discussion and studies. If we were able to do it that easily, then there would not have been such an SID created.  Issue 3-3 SSB consideration for overlapping CBW  Options are not logically in parallel. And it is difficult to have only one option for all potential cases. In some cases it is possible to have a single SSB (Option 1), however there may be cases that multiple SSBs needed (Option 2). |
| DISH | Issue 3-1: Options 3, 4, 6, and 7 are ok.  Issue 3-2: Option 1 as baseline. Option 4 we need to understand what would be the practical implications from BS side.  Issue 3-3: Option 1/Option2. This depends on the target BW in question. For instance for 7MHz you need 2 SSB’s, which for 6Mhz single SSB is ok. Option 3 Yes. |
| Apple | Issue 3-1 (Option 3) and 3-2 (Option 1): For overlapping channels, the simplest solution is to overlap channels from the network perspective so that different UEs are scheduled to different carriers. The new channel bandwidth might be defined only for the network side, but not for the UE. Regarding Option 4, both options for RB and sub-carrier alignment are in principle possible, but RAN4 needs to analyse further whether sub-carrier alignment on the 300kHz raster brings any resource utilization benefit over 900kHz raster RB alignment.  Issue 3-3: Option 2: to enable overlapping carriers for legacy devices, each carrier needs its SSB, and both the carrier and SSB must be on the legacy raster points. |
| Ericsson | Issue 3-1:  We do not agree to consider Option 2, high complexity (handling of SSBs, phy channels, scheduler handling etc.) with uncertain SU gain. Also conformance testing will be impacted at least as much as for other solutions. There might lead to potential impact/changes in RAN1/RAN2 specifications.  Option 6: See issue 3-3, Option 4 below.  All the other options in the summary needs to be further investigated, and possibly be decided upon on a case by case basis. Depending on the size of the irregular BW in question.  Issue 3-2:  For Option 1, 2. New channel BWs leads to ever ongoing standardization efforts hence we prefer a generic solution.  Support Option 3, 4  Issue 3-3:  Option 1: Yes, depending on DL channel BW and size of overlapping UE BW’s  Option 2: Depending on DL channel BW and avoid overlapping SSBs.  Option 3: Subcarrier allows common FFT and RB alignment allows common scheduling.  Option 4: Do not really see this as a major problem, gNB could blindly initiate a blind (without measurements etc) intra band/inter freq HO if it decides to move of UE between carriers. Maybe we misunderstood something? What would be the use-case behind a HO?  General feedback: We should weight the cost of the extra overhead to the additional SU weighting the benefit of the solution. |
| T-Mobile USA | **Issue 3-1:**  Option 1: Needs to be considered  Option 2: We agreed to study overlapping channel BWs. Not sure what the definition of overlapping CA is.  Option 3: Support  Option 4: If subcarrier and RB alignment is needed, then carriers can only be offset in 900 kHz increments. We need vendors to look at the complexity and tell us if this is necessary.  Option 5: Not sure that a single BWP needs to cover the combined channel BW.  Option 6: Is new signalling required to tell the UE the SSB offset from the one carrier to the other?  Option 7: Support.  **Issue 3-2:**  Option 2. We are willing to consider how this can be done without new gNB channel BWs, but this needs to be studied.  **Issue 3-3:**  We have described issues with sharing the SSB. If the carrier BW is wide enough relative to the SSB size, the SSB can be shared. But for channel BW less than 10 MHz there are issues that need to be addressed as described in R4-2016455. |
| AT&T | **Issue 3-2:** We support Option 2 as the starting point for the study. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#3-1** | *Tentative agreements:*   1. Consider a solution for overlapping UE carriers with 2. subcarrier alignment 3. RB alignment is required 4. channel raster constraints should also be considered if otherwise there is considerable specification impact. 5. For overlapping UE carriers to minimize specification impact, study solutions whereby new channel BW not explicitly defined for UE and gNB, irregular channel bandwidths can be supported by overlapping RF carriers 6. As an alternative option to (2) also consider a solution where new channel BW only for gNB, use existing channel BW for UE   *Candidate options:*  *Recommendations for 2nd round:* Confirm Tentative agreements |
| **Sub-topic#3-2** | *Tentative agreements:* Further discussion on increased overhead with the use of overlapping channel bandwidth approach for handling irregular bandwidth. Companies are encouraged to study the impact of either using single SSB or multiple SSB.  *Candidate options:*  *Recommendations for 2nd round:* Continue to discuss in second round. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### Sub-topic 3-1

*Sub-topic description: Items to study for overlapping channel bandwidth approach and/or introducing new channel bandwidth for handling irregular bandwidth*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: Study overlapping channel bandwidths**

* Option 1: Confirm agreement on the following:

1. Consider a solution for overlapping UE carriers with
2. subcarrier alignment
3. RB alignment is required
4. channel raster constraints should also be considered if otherwise there is considerable specification impact.
5. To minimize specification impact, study solutions whereby new channel BW not explicitly defined for UE and gNB, irregular channel bandwidths can be supported by overlapping RF carriers
6. As an alternative option to (2) also consider a solution where new channel BW only for gNB, use existing channel BW for UE

* Recommended WF
  + TBA

### Sub-topic 3-2

*Sub-topic description: Impact to current PHY (specifically SSB) design with overlapping channel bandwidth approach*

*Open issues and candidate options before e-meeting:*

**Issue 3-3: SSB consideration for Overlapping CBW**

* Proposals to consider for overlapping channel bandwidth approach for irregular bandwidth. Both options shall consider SSB be on the legacy raster points
  + Option 1: single SSB can be used for two overlapping carriers
  + Option 2: multiple SSBs needed for overlapping carriers
* Recommended WF
  + TBA

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |