**3GPP TSG-RAN WG4 Meeting # 102-e R4-2206333**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 10.16.1, 10.16.2, 10.16.7, 10.16.9

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for [102-e][133] NR\_ext\_to\_71GHz\_Part\_1

**Document for:** Information

# Introduction

*This document captures RAN4 discussions for the NR extension to 71GHz work item, including general aspects, band planning, and system parameters.* *The covered agenda items are: 10.16.1, 10.16.2, 10.16.7, and 10.16.9.*

# Topic #1: General (AI 10.16.1)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203581**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203581.zip)Draft LS on sensing beam characteristics to RAN1 | Ericsson | Proposal: RAN4 should not define new requirements for directional LBT characteristics related to beam quality for traffic and sensing beam for gNB and UE operating within FR2-2 based on reasons mentioned above.**LS content:**Identified issues if requirements related to gain or beamwidth on the receive side is defined:1. The need for directional LBT and associated relations between sensing beam and traffic beams has not been motivated and is not mandated by regulation.
2. There are no beam quality requirement limits (such as antenna gain or beamwidth) defined in NR RF specifications.
3. Defining parameters such antenna gain (directivity) and beamwidth looks simple at first glance but finding relevant conditions and test cases is much more difficult.
4. Testing beamwidth or antenna gain will significantly add to the conformance test specification complexity.

RAN4 discussed the issue of sensing beam “covers” transmission beam and have the following understanding. 1) Selecting sensing beam at the gNB is up to gNB’s implementation.2) Selecting sensing beam at UE is up to UE’s implementation.RAN4 will not define new requirements for directional LBT characteristics related to beam quality for traffic and sensing beam for gNB and UE operating within FR2-2. |
| [**R4-2203807**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203807.zip)On sensing beam selection on the UE side | Apple | **Proposal 1:** No RF requirements are specified for sensing beam or transmission beam properties such as beam gain or beam width in R17. It is left to implementation to ensure sensing beam(s) “covers” the transmission beam(s) if needed. |
| **[R4-2203937](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203937.zip)**Draft reply LS on sensing beam selection | CATT | **Proposal:** The following information can be captured in the reply LS to RAN1.1) Selecting sensing beam at the gNB is up to gNB’s implementation.2) Selecting sensing beam at UE is up to UE’s implementation.3) RAN4 will define LBT requirements for both gNB (in TS 37.107) and UE (in TS 37.106) to guarantee the sensing beam covers transmission beam. |
| [**R4-2203938**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203938.zip)Discussion on the FR2-2 LBT requirement | CATT | **Observation 1:** LBT requirements belong to the core part of 71 GHz WI. **Proposal 1**: Update the 71GHz WID to include TS 37.107 and TS 37.106 in the list of the impacted specifications.**Proposal 2:** The channel access parameters use Table 1 and Table 2 to define BS/UE LBT requirements.Table 1: Channel access parameters for PDSCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| LBT measurement bandwidth | MHz | [400] |
| Energy detection threshold | [dBm/400 MHz] | [$-54$] or X |
| Maximum channel occupancy time | ms | 5 |
| NOTE: The specific value X is declared by the vendor. |

Table 2: Channel access parameters for PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| LBT measurement bandwidth (BW) | MHz | [400] |
| Energy detection threshold | dBm/BW  | [-54] |
| Detection timing | microseconds | 8 |

**Observation 2:** BS LBT requirements directions can be defined based on declaration. UE approach needs more discussion.Two draft CRs are available for further discussion under Sub-topic 4-1. |
| [**R4-2203941**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203941.zip)Draft reply LS on the minimum guard period between two SRS resources for antenna switching | CATT | The switching time is the same for FR1 and FR2-1. For FR2-2, there’s no new requirements/performance improvement related to the antenna switching time, such as transient period, LO retuning time, etc.*Draft LS reply content***Answer from RAN4:** The absolute switching time for FR2-2 is the same as the capability evaluated in R15. The detail evaluation conclusions are included in the R15 reply LS R4-1710048 [1]. Therefore, the symbol(s) needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz are shown in the following table, according to RAN4 understanding.

|  |  |  |
| --- | --- | --- |
|  |  | ***Y* [symbol]** |
| 5 | 480 | 8 |
| 6 | 960 | 16 |

The final decision is up to RAN1 discussion based on the absolute switching time in R4-1710048. |
| R4-2204620Reply LS on a minimum guard period between two SRS resources for antenna switching | Ericsson | Ericsson: withdrawn |
| [**R4-2204932**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204932.zip)Draft CR for TS 38.101-2: Introduction of system parameters for FR2-2 | vivo | The draft CR adds relevant FR2-2 system parameters content to the following clauses of TS 38.101-2: General, Operating bands, UE channel bandwidth and Channel/Sync raster |
| [**R4-2204936**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204936.zip)Discussion and draft reply LS on sensing beam selection | vivo | Overall, it is suggested that RAN4 will not define any RF requirement for sensing beam ‘covers’ transmission beams.**Proposal 1:** It is suggested that no RF requirement/test procedure is needed to guarantee sensing beam(s) “covers” the transmission beam(s).**Proposal 2:** Leave it to UE’s or gNB’s implementation to guarantee sensing beam(s) “covers” the transmission beam(s). |
| [**R4-2205129**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205129.zip)Discussion and draft reply LS on minimum guard symbol of SRS | Xiaomi | **Observation 1:** For current TS 38.214 minimum guard symbols as 1,1,1,2 for 15,30,60,120kHz SCS, it is to account for 15us for different antenna ports of SRS antenna switching.**Observation 2:** As 120kHz is mandatory supported in FR2-2, it is reasonable to reuse the 15us antenna switching time in FR2-2.**Proposal 1:** it is proposed to use 7 symbols and 15 symbols for 480kHz and 960kHz respectively for the minimum guard period between two SRS resources for antenna switching.**Proposal 2:** To agree the attached draft reply LS (copied below).*Draft reply LS*Considering the SRS antenna switching for different antenna ports have been agreed as 15us since Rel-15 for both FR1 and FR2-1, it is agreed in RAN4 to reuse the 15us for FR2-2.With that, the symbols that are needed to accommodate the 15us as minimum guard time for SRS antenna switching for 480 and 960kHz are 7 and 15 respectively. |
| [**R4-2205190**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205190.zip)Reply LS on the minimum guard period between two SRS resources for antenna switching | Huawei, HiSilicon | *Reply LS*In Rel-15 RAN4 had discussed on the guard period between two SRS resources for antenna switching and agreed on the value of 15us regardless of SCS type. For 480 and 960 kHz SCS in question, the same 15us guard period applies.The guard period would have impact on demodulation of the symbol within the period, therefore blanked symbols would be helpful to guarantee the performance. |
| [**R4-2205732**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205732.zip)Views on sensing beam selection on the UE side | Sony | **Observation 1:** the existing beam correspondence test can not verify if the UE uses the same beam for sensing and transmission, regardless of the beam correspondence capability. **Observation 2:** it is hard to define and adopt the X dB beamwidth method in practical UE RF requirements and tests. **Observation 3:** the common spherical coverage concept may potentially be used as a starting point to define the relation between sensing beam and transmission beam |
| [**R4-2205997**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205997.zip)UE feature list for NR ext. to 71GHz | Intel Corporation | **Proposal 1:** Adopt the UE features listed below for NR\_ext\_to\_71GHz. ON/ON transient period feature is contingent on the outcome of core discussions.* FR2-2 channel bandwidths for each SCS in each band for DL and UL for a single CC
* [Improved ON/ON transient period]
 |
| [**R4-2206047**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206047.zip)Sensing beam for LBT in FR2-2 | Nokia, Nokia Shanghai Bell | **Observation 1:** Current ETSI (303 753, 303 722) and FCC (FCC 47 CFR § 15.255) rules do not mandate usage of specific channel bandwidths or channel rasters and therefore also channel alignment is optional.**Observation 2:** ETSI EN 302 567 already includes LBT sensing beam and transmit beam requirements, and this correspondence will in practice be mandatory for LBT based equipment on the 57-71 GHz band.**Observation 3:** Shared spectrum channel access requirements are not specified in TS 38.104.**Observation 4:** Specification impact to requirements and conformance tests for shared spectrum channel access is not part of the WID and therefore LBT requirements cannot be specified.**Proposal 1:** Leave sensing beam and its relationship to transmission beam to gNB and UE implementation. |
| [**R4-2206048**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206048.zip)SRS antenna switching in FR2-2 | Nokia, Nokia Shanghai Bell | **Observation 1:** SRS antenna switching time applies for both switching within and switching between panels.**Observation 2:** RAN4 has intended to look into shorter switching times already in rel-15.**Observation 3:** No guard symbol is specified in RAN4 specifications in FR2 for SRS antenna switching.**Observation 4:** The agreed SRS antenna switching time for FR2 of 15 us is equivalent to 96% of the slot length when using 960 kHz SCS and 48% of the slot length when using 480 kHz SCS.**Proposal 1:** RAN4 to consider shorter SRS antenna switching time for FR2-2 compared to FR2-1 |

## Open issues summary

### Sub-topic 1-1: Specification updates

**Issue 1-1: TS 38.101-2 update**

*Draft CR R4-2204932 introduces system parameters content to various clauses of TS 38.101-2.*

* Recommended WF
	+ Moderator suggests companies provide any feedback on draft CR R4-2204932 directly into Section **1.3.2 CRs/TPs** **comments collection**.

### Sub-topic 1-2: UE feature list for NR ext. to 71 GHz

*Two UE features to support FR2-2 operation are proposed in R4-2205997 and are listed below, along with the corresponding NR\_ext\_to\_71GHz feature list table.*

* *Channel bandwidth for a single CC*
* *Improved ON/ON transient period capability*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| x-1 | FR2-2 channel bandwidths for each SCS in each band for DL and UL for a single CC | Support of FR2-2 channel bandwidths 1) 120 kHz SCS: {100, 400} MHz CBW2) 480 kHz SCS: {400, 800, 1600} MHz CBW3) 960 kHz SCS: {400, 800, 1600, 2000} MHz CBW | FFS | Yes | No | UE cannot support some UE channel bandwidths | Per band | N/A | Applicable to FR2-2 only | N/A | UE indicating the support of specific SCS per band (RAN1 features X-Y) is required to support all CBWs corresponding to this SCSNo additional capability signalling is needed. | NA |
| x-2 | [Improved ON/ON transient period] | 1) Support of improved ON/ON transient period of X < 5us (X is FFS) | FFS | Yes | No | UE does not support improved ON/ON transient period and support 5us transient period | Per UE | N/A | Applicable to FR2-2 only | N/A | Further RAN4 discussion is required on whether to support improved ON/ON transient period and X value | Optional with capability signalling |

**Issue 1-2: UE feature list**

* Recommended WF
	+ Moderator suggests companies provide feedback on the first UE feature listed above (channel bandwidths for each SCS) to the UE feature list dedicated thread [143]. If needed based on discussion progress, we can further discuss this feature in round 2.
	+ Pending the outcome of core discussions in thread [134], the improved ON/ON transient period can be addressed during the second round of discussions.

### Sub-topic 1-3: LS reply to RAN1 on sensing beam characteristics

*To provide an answer to a RAN1 LS on sensing beam selection for LBT operation (R1-2112806), RAN4 started discussing whether requirements/test procedures to ensure a sensing beam covers the transmission beam need to be specified (R4-2202327).*

**Issue 1-3a: Whether we need to define the requirement and test procedure for LBT in FR2-2**

* Option 1: No
	+ Proposal 1: RAN4 should not define new requirements for directional LBT characteristics related to beam quality for traffic and sensing beam for gNB and UE operating within FR2-2 based on reasons mentioned above. (Ericsson)
	+ Proposal 2: No RF requirements are specified for sensing beam or transmission beam properties such as beam gain or beam width in R17. It is left to implementation to ensure sensing beam(s) “covers” the transmission beam(s) if needed. (Apple)
	+ Proposal 3: Leave sensing beam and its relationship to transmission beam to gNB and UE implementation. (Nokia)
		- Observation: Specification impact to requirements and conformance tests for shared spectrum channel access is not part of the WID and therefore LBT requirements cannot be specified.
	+ Proposal 4: It is suggested that no RF requirement/test procedure is needed to guarantee sensing beam(s) “covers” the transmission beam(s). (vivo)
* Option 2: Yes
	+ Proposal 1: RAN4 will define LBT requirements for both gNB (in TS 37.107) and UE (in TS 37.106) to guarantee the sensing beam covers transmission beam. (CATT)
		- Observation: LBT requirements belong to the core part of 71 GHz WI
		- If agreed, the WID will be updated accordingly to include TS 37.107 and TS 37.106 in the list of the impacted specifications.
* Option 3: Other
* Recommended WF
	+ Based on contributions in this meeting, it seems most prefer not to define requirements and test procedures. Moderator recommends companies share their views on the above options for Rel-17.
	+ Additionally, discuss if defining LBT requirements can be approached as described in Option 2 (R4-2203938).

**Issue 1-3b: LS reply**

* Option 1: Ericsson (R4-2203581)
	+ Includes identified issues
	+ Selecting sensing beam at the gNB is up to gNB’s implementation.
	+ Selecting sensing beam at UE is up to UE’s implementation.
	+ RAN4 will not define new requirements for directional LBT characteristics related to beam quality for traffic and sensing beam for gNB and UE operating within FR2-2
* Option 2: CATT (R4-2203937)
	+ Selecting sensing beam at the gNB is up to gNB’s implementation.
	+ Selecting sensing beam at UE is up to UE’s implementation.
	+ RAN4 will define LBT requirements for both gNB (in TS 37.107) and UE (in TS 37.106) to guarantee the sensing beam covers transmission beam.
* Option 3: vivo (R4-2204936)
	+ RAN4 decides not to define any RF requirement/test procedure to guarantee sensing beam(s) “covers” the transmission beam(s) and leaves it to UE’s or gNB’s implementation to guarantee sensing beam(s) “covers” the transmission beam(s).
* Recommended WF
	+ There is alignment in all the replies regarding leaving the beam selection up to gNB and UE implementation. Based on the discussions during the last meeting (R4-2202327), Moderator suggests using Ericsson’s LS reply as baseline and for companies to provide feedback on specific wording and/or edits needed.

### Sub-topic 1-4: LS reply to RAN1 on minimum guard period between two SRS resources for antenna switching

*RAN4 received an LS from RAN1 (R1-2200796) with the following question:*

**Question to RAN4**: How many symbol(s) is/are needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz respectively, in FR2-2?

For reference, the following was specified in Rel-15 (38.214 Section 6.2.1.2) for subcarrier spacing $∆f$ up to 120 kHz:

**Table 6.2.1.2-1: The minimum guard period between two SRS resources of an SRS resource set for antenna switching**

|  |  |  |
| --- | --- | --- |
|  |  | ***Y* [symbol]** |
| 0 | 15 | 1 |
| 1 | 30 | 1 |
| 2 | 60 | 1 |
| 3 | 120 | 2 |

**Issue 1-4a: SRS antenna switching time in FR2 (FR2-1, FR2-2)**

*Based on the contributions in this meeting, there seem to be two different views of the SRS antenna switching time in FR2. Therefore, it is better to further discuss and align on this issue.*

* Recommended WF
	+ Moderator recommends companies share their views on the FR2-1 SRS switching time situation

**Issue 1-4b: LS reply on minimum guard period**

* **Option 1:** CATT

[Answer from RAN4] The absolute switching time for FR2-2 is the same as the capability evaluated in R15. The detail evaluation conclusions are included in the R15 reply LS R4-1710048 [1]. Therefore, the symbol(s) needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz are shown in the following table, according to RAN4 understanding.

|  |  |  |
| --- | --- | --- |
|  |  | ***Y* [symbol]** |
| 5 | 480 | 8 |
| 6 | 960 | 16 |

The final decision is up to RAN1 discussion based on the absolute switching time in R4-1710048.

* **Option 2:** Xiaomi

Considering the SRS antenna switching for different antenna ports have been agreed as 15us since Rel-15 for both FR1 and FR2-1, it is agreed in RAN4 to reuse the 15us for FR2-2.

With that, the symbols that are needed to accommodate the 15us as minimum guard time for SRS antenna switching for 480 and 960kHz are 7 and 15 respectively.

* **Option 3:** Huawei

In Rel-15 RAN4 had discussed on the guard period between two SRS resources for antenna switching and agreed on the value of 15us regardless of SCS type. For 480 and 960 kHz SCS in question, the same 15us guard period applies.

The guard period would have impact on demodulation of the symbol within the period, therefore blanked symbols would be helpful to guarantee the performance.

* Recommended WF
	+ May be impacted by outcome of previous issues. Moderator suggests companies provide feedback on the three reply options, as well as their preference out of the three, if any. Content may be edited or combined in the final reply.

## Companies’ views - collection for 1st round

### Open issues

Issue 1-2: UE feature list 🡪 provide feedback to thread [143]

Issue 1-3: LS reply on sensing beam characteristics

 Issue 1-3a: Whether to define requirements/test procedure in Rel-17

 Issue 1-3b: LS reply – feedback, wording, and edits

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 1-3aOption 1. No.Issue 1-3bEither Option 1 or Option 3 is OK. |
| MediaTek | Issue 1-3a　Option 1. No for UE.Issue 1-3b　Clearly say “RAN4 will not define new requirements for LBT” is fine.  |
| OPPO | Issue 1-3a: Option 1, no.Issue 1-3b: Option 1 is ok. |
| Nokia, Nokia Shanghai Bell | Issue 1-3a: Option 1. This can be left for implementation both for UE and gNB as explained in our Tdoc.Issue 1-3b: We agree with the recommended WF. |
| LGE | Issue 1-3a: We support the moderator proposal: *“Based on contributions in this meeting, it seems most prefer not to define requirements and test procedures.”*Issue 1-3b: We support the moderator proposal: *“There is alignment in all the replies regarding leaving the beam selection up to gNB and UE implementation. Based on the discussions during the last meeting (R4-2202327), Moderator suggests using Ericsson’s LS reply as baseline and for companies to provide feedback on specific wording and/or edits needed.”* |
| Ericsson | Issue 1-3a: Since no regulatory recommendations mandate LBT in this frequency range we do not see the need to defined requirements for sensing beam characteristics. Also, we see a challenge in Rel-17 to complete the work to define OTA requirements for LBT. Proposals in draft CRs last meeting was based on a conducted approach that is not feasible for FR2-2. Considering time spent on previous OTA work, we see a risk to include an optional feature like LBT within the scope of Rel-17.Issue 1-3b: We support the moderator proposal and refine the LS initially drafted last meeting.  |
| Sony | Issue 1-3a: option 1. There are significant technical issues need to be tackled in our view, which seems not feasible to deal in the late stage of Rel-17. Issue 1-3b: we support the recommended WF. |
| Apple | Issue 1-3a: Option 1.Issue 1-3b: We are OK to use Ericsson’s LS as a baseline. Two suggested revisions:1. Remove the statement “The need for directional LBT and associated relations between sensing beam and traffic beams has not been motivated and is not mandated by regulation.” In our understanding, LBT is mandated in EN 302 567.
2. Change “antenna gain” to “beam gain”
 |
| QCOM | **Issue 1-3a: Our views**1 - Our view is FR2-2 UEs should be declare beam correspondence. Non-beamcorrespondence was conceived when much less was known about the performance of mmWave antenna designs for mobile devices. If we take this approach the question is not longer relavant2 – If non-BC FR2-2 UEs are allowed then we agree with the principle of CATT R4-2203938 and RAN4 should develop requirements for the concept of “cover” to ensure the expected performance of the UE in rel172a – For CATT why is there an X value in the detection threshold? (NOTE: The specific value X is declared by the vendor.).**Issue 1-3b:** if we can’t agree with all FR2-2 UEs supporting BC, then we support CATT R4-2203937 |
| Xiaomi | Issue 1-3a: Option 1, We prefer not to define new requirement especially for UE. |
| CATT | Issue 1-3a: Whether to define requirements/test procedure in Rel-17Thanks all for the comments and questions. First, technically we think LBT requirements belong to core part. 3GPP spec is a global requirement, when there’s a regulation mandatory, there should be a requirement. Actually, LBT is defined in RAN1 not RAN4. RAN4 just defines the measurement requirement. Currently, LBT, including the procedure and the threshold, is in the 38.213 draft CR and LBT is also discussed in RAN4 RRM. So we don’t understand why RF part will not define the measurement requirement. When BS and UE support LBT, how to know they implement the operation correctly. So we still think LBT should be defined in the core part. We understand the timeline issue of this WI, but think we should first discuss this issue from technical point of view then discuss how to handle it. To reply to Qualcomm question: Thanks for the question. The X is for BS and inherited from the approach of FR1 LAA and NR-U. Unfortunately, I didn’t find the clear minutes and history for this discussion. We definitely need to discuss the details if it’s agreed that LBT requirements should be defined.Issue 1-3b: LS reply – feedback, wording, and editsThanks Qualcomm for the support. We’re ok using the LS in last meeting as baseline, but think including LBT requirement part in our contribution R4-2203937 are the clearest reply to RAN1. Only depending on implementation, to be honest, the question from RAN1 is not completely solved. As we have another opportunity to refine the wording, maybe the first 3 paragraphs can be simplified to avoid any possible confusion. The information in the first 3 paragraphs may not be that important and helpful for RAN1 to understand the reply. And agree with Apple that LBT is mandatory in some regulation. |
| Intel | Issue 1-3a:While this is not explicitly captured in the WID, our understanding is that defining requirements for LBT is part of the WI. Considering how involved the alternative is, we can discuss the approach suggested in R4-2203938, and the parameters in the tables. The WID can be updated to include TS 37.106 and TS 37.107 to the list of impacted specifications.For the parameters in the tables, our understanding is that the LBT measurement bandwidth can be equivalent to CBW. We are also aware that this topic is under discussion in RAN1, and we can wait for its conclusion.That being said, we are ok if majority view is to not define requirements right now.Issue 1-3b:Recommendation is agreeable. LS reply content to be updated according to feedback received on Issue 1-3a and companies’ comments. |

Issue 1-4: LS reply on minimum guard period

 Issue 1-4a: SRS antenna switching time in FR2

 Issue 1-4b: LS reply – discussion, preferred option, general feedback

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 1-4aReuse 15us for SRS switching time.Issue 1-4bOption 2 is preferred. |
| OPPO | Issue 1-4a: SRS antenna switching time in FR2Reuse 15us is ok considering there is no more time in Rel-17 to further reduce the switching time although in our view much smaller switching time is enough.Issue 1-4b: LS reply – discussion, preferred option, general feedbackOption 1 is ok. |
| Nokia, Nokia Shanghai Bell | Issue 1-4a: While 15 us was agreed in FR2-1 in rel-15, there was also discussion on further studying faster SRS antenna switching time. It would make sense to consider faster switching time for FR2-2 given the higher SCS and loss of multiple symbols if 15 us switching time is maintained.Issue 1-4b: None of the replies consider faster than 15us switching time. This would need to be considered. |
| Huawei | Issue 1-4a: Same as Rel-15, 15 us shall applyIssue 1-4b: Informing RAN1 15us is needed for antenna switching. Number of symbols could be left for RAN1 decision, especially the choice of 15 or 16 for 960kHz. |
| Apple | Issue 1-4a: Reusing 15us is OK.Issue 1-4b: Informing RAN1 15us is needed for antenna switching. Number of symbols can be left for RAN1 decision. Shouldn’t 14 symbols be enough for 960kHz?Also, we wonder why this issue is not being discussed in thread 134. |
| Ericsson | RAN1 is asking RAN4 for an assessment of a ‘real’ transient time relevant for FR2-2 that is faster than scaling the FR1/FR-2 to derive the Y values (noting that the guard symbols Y for FR1 imply far longer gaps than transient times for some SCS). Scaling the 120 kHz guard symbols to Y = 8/16 for 480/960 kHz would not be feasible from a functionality standpoint, e.g. a 16 symbol guard time would mean that it is not possible to put two SRS resources in the same slot, even if the UE supports the RAN1 Rel-16 feature group that allows SRS resources to be located in any OFDM symbol of the slot.Then the UE would have to support the new RAN1 Rel-17 feature group that enables aperiodic SRS resources for antenna switching to be located in different slots if it supports 480/960 kHz.RAN4 should discuss the matter further before responding to RAN1. |
| QCOM | **Issue 1-4a**15us for SRS switching time.**Issue 1-4b**Agree with WF |
| Xiaomi | **Issue 1-4a**From RAN1 LS, they only ask for 480 and 960kHz SCS guard period which means for the same FR2-2, 120kHz SCS with 4 symbols has already been identified. In this case, we see no reason that to have faster switching time for 480 and 960kHz SCS for the same UE who will mandatory support 120kHz 4 symbol guard period. In this case, reusing 15us is appropriate.**Issue 1-4b**For the time slots, we tend to agree with Huawei that only to send the 15us to RAN1 as before and left the symbol numbers discussion for RAN1. |
| CATT | Issue 1-4a: SRS antenna switching time in FR2We agree that 15us is reused. That’s the very simplest case, so we think referring R4-1710048 is a good choice in the reply LS.Issue 1-4b: LS reply – discussion, preferred option, general feedbackFor number of the symbols, I discussed with our RAN1 colleague internally, it may be better that RAN4 only reply the time, the number of the symbols can be decided by RAN1. So our reply can be refined as following,[Answer from RAN4] The absolute switching time for FR2-2 is the same as the capability evaluated in R15, **i.e. the antenna switching time is 15 usec.** The detail evaluation conclusions **for every cases** are included in the R15 reply LS R4-1710048 [1]. **The decision on** the symbol(s) needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz **is up to RAN1** discussion based on the absolute switching time in R4-1710048.We’re happy to lead this reply LS if companies are ok. |
| Intel | **Issue 1-4a:**Further studying SRS antenna switching time was intended in Rel-16. Considering this has not happened, 15µs may apply to the entire FR2 range, otherwise we have no value for it. Additionally, we note that previously RAN4 did not have a conclusion on whether 15µs applies to the multi-panel device case and it can be communicated to other WGs.**Issue 1-4b:**Depends on the outcome of Issue1-4a. If majority view is to reuse the 15µs, then we can further discuss the LS reply content.The reply may capture that while 15µs currently applies to FR2, RAN4 may revisit this number in a future study and a faster value might be agreed. However, we note that the discussion shall focus on the full FR2 range, rather than FR2-2. |

### CRs/TPs comments collection

*Moderator suggests companies comment directly for feedback on the CRs below*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2204932 | Vivo: We can focus on the channel/sync raster part. Other parts aside from channel/sync raster were endorsed in the last meeting.  |
| Nokia: Given the status of no-LBT operation for this operating band, we think the note limiting the band for shared spectrum access defined in TS 37.213 should be removed. Alternative note could be added to state: “This band is only applicable subject to regional and/or country specific restrictions” similar as being discussed for n96/n102. Further updates may be needed when channel raster discussion has concluded. This cannot be endorsed as it is now given that discussion is on-going. |
| Ericsson: this is pending agreement on the raster for n263. The reference 37.213 should be discussed further since LBT is not mandatory like in the 5 and 6 GHz band. A normative reference to 37.213 in a table note is not appropriate since LBT is optional. |

## 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 #1-3: LS reply on sensing beam characteristics** | **Issue 1-3a: Whether to define requirements/test procedure in Rel-17***Candidate options:** Option 1: No
	+ Proposal 1: RAN4 should not define new requirements for directional LBT characteristics related to beam quality for traffic and sensing beam for gNB and UE operating within FR2-2 based on reasons mentioned above. (Ericsson)
	+ Proposal 2: No RF requirements are specified for sensing beam or transmission beam properties such as beam gain or beam width in R17. It is left to implementation to ensure sensing beam(s) “covers” the transmission beam(s) if needed. (Apple)
	+ Proposal 3: Leave sensing beam and its relationship to transmission beam to gNB and UE implementation. (Nokia)
		- Observation: Specification impact to requirements and conformance tests for shared spectrum channel access is not part of the WID and therefore LBT requirements cannot be specified.
	+ Proposal 4: It is suggested that no RF requirement/test procedure is needed to guarantee sensing beam(s) “covers” the transmission beam(s). (vivo)
* Option 2: Yes
	+ Proposal 1: RAN4 will define LBT requirements for both gNB (in TS 37.107) and UE (in TS 37.106) to guarantee the sensing beam covers transmission beam. (CATT)
		- Observation: LBT requirements belong to the core part of 71 GHz WI
		- If agreed, the WID will be updated accordingly to include TS 37.107 and TS 37.106 in the list of the impacted specifications.
* Option 3: Other

*Majority of companies support Option 1 (not defining requirements). However, three companies want to further discuss, in part because view is that defining requirement for LBT is part of the WI. If defining requirements is needed, we should align on the approach used to define them and when we may reasonably complete them (based on effort required).**Recommendations for 2nd round:* *Confirm whether RAN4 needs to define LBT requirements. If so, further discuss what approach should be taken (i.e., R4-2203938, other) and when we can reasonably conclude this.***Issue 1-3b: LS reply – feedback, wording, and edits***Candidate options:** Option 1: Ericsson (R4-2203581)
* Option 2: CATT (R4-2203937)
* Option 3: vivo (R4-2204936)

*Recommendations for 2nd round:* *Use Ericsson’s LS reply (R4-2203581) as baseline and edit the content according to the outcome of Issue 1-3a discussions and additional feedback on the wording* |
| **Sub-topic #1-4: LS reply on minimum guard period** | **Issue 1-4a: SRS antenna switching time in FR2***While majority view is for 15µs to be reused, some companies want to further discuss RAN1’s request before replying. Additionally, there was mention of considering a faster switching time for FR2-2.**Recommendations for 2nd round:* *Further discuss RAN1’s question to RAN4. Confirm whether 15µs will be reused. Because of the larger SCS, discuss if a faster switching time should be considered for FR2-2 and how we may potentially include this in the reply.***Issue 1-4b: LS reply – discussion, preferred option, general feedback***Candidate options:** **Option 1:** CATT (R4-2203941)
* **Option 2:** Xiaomi (R4-2205129)
* **Option 3:** Huawei (R4-2205190)

*Recommendations for 2nd round:* *Work on LS reply content using CATT’s document (R4-2203941) as baseline. The content should reflect the outcome of Issue 1-4a discussions and feedback on the specific wording.* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 5 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2204932 | *Return to**Content depends on discussions and potential agreements for channel raster. Revision likely needed.* |

## Discussion on 2nd round (if applicable)

**TBA**

# Topic #2: Operation bands and system parameters (channelization, raster, CBW) – AI 10.16.2

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203805**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203805.zip)Remaining issues on system parameters for NR operation in 52.6GHz - 71GHz | Apple | **Proposal 1:** Use 100MHz with 100.8MHz channel spacing as the building block for larger CBWs. As a result, it can ensure the channel spacing of adjacent channels is multiples of 960kHz for contiguous CA of any two 400/800/1600/2000MHz CBW. **Proposal 2:** The channel placement proposal in [R4-2201924] can be used as the baseline.**Proposal 3:** It is preferred to seek some degree of alignment with IEEE 802.11ad/ay channels when deciding the NR channel placement. **Observation 1:** no clear benefit of letting unlicensed bands use the subset of sync raster of licensed bands. **Proposal 4:** The optionality of CBW is agreed as follows: * 120 kHz: mandatory (100 MHz), optional (400 MHz)
* 480 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz)
* 960 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz, 2000 MHz)

**Proposal 5:** RAN4 deprioritize the work related to CA within band n263 in Rel-17. |
| [**R4-2203936**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203936.zip)ON channelization and sync raster entries for up to 71GH | CATT | **Proposal 1:** Take Table 1 as the baseline to choose the NREF entries for both licensed and unlicensed bands.**Table 1: Whole NREF candidates for 57-71 GHz**

|  |  |
| --- | --- |
| **Item** | **Candidates NREF for 57-71 GHz(First – <Step size> – Last)** |
|
|
| Whole range of ARFCN | 2562499 – <1> – 2795832 |
| With step size 2 | 2562499 – <2> – 2795831 |
| With step size 8 | 2562499 – <8> – 2795827 |
| With step size 16 | 2562507 – <16> – 2795819 |

**Proposal 2:** The NREF for 66-71 GHz are defined as Table 2 shows.**Table 2: NREF proposal for 66-71 GHz**

|  |  |
| --- | --- |
| ΔFRaster(kHz) | Uplink and DownlinkRange of NREF for 66-71 GHz(First – <Step size> – Last) |
| 120 | 2712499 – <2> – 2795831 |
| 480 | 2712499 – <8> –2795827 |
| 960 | 2712507 – <16> – 2795819 |

**Proposal 3: C**hannel raster granularity for 120kHz SCS is 100MHz for all of the CBW. Channel raster granularity for 480kHz and 960kHz SCS are 200MHz for all of the CBW.**Proposal 4:** The NREF for n263 is defined as Table 6.**Table 6: NREF proposal for n263 (57-71 GHz)**

|  |  |  |  |
| --- | --- | --- | --- |
| ΔFRaster(kHz) | CBW(MHz) | Granularity(MHz) | Uplink and DownlinkRange of NREF for n263 |
| 120 | 100 | 100 | 2563339+1664\*N+16\*floor((N+1)/6), N=0:139 |
| 120 | 400 | 100 | 2565835+1664\*N+16\*floor((N+3)/6), N=0:136 |
| 480, 960 | 400, 800, 1600, 2000 | 200 | 2565835+3328\*N+16\*floor((N+1)/3), N=0:68 |

**Proposal 5: SS raster entries for n263 is proposed as Table 7 shows.****Table 7: SS raster entries proposal for n263**

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | SS Block SCS | SS Block pattern(NOTE 1) | Range of GSCN(First – <Step size> – Last) |
| n263 | 120 kHz | Case E | GSCN = 24153 - <step\_size(i)> - 24958, M = {1: 138}.step\_size = 4 for i= 8, 24, 40, 56, 64, 72, 80, 96, 104, 120, 128, 136;step size = 5 for i = 16, 32, 48, 88, 112; step\_size =6 for i = others. |
| 480 kHz | Case F | GSCN = 24165 - <step\_size(i)> - 24947, i = {1: 67}.step\_size = 11 for mod(i,2)=1;step\_size = 12 for mod(i,2)=0. |

 |
| [**R4-2204933**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204933.zip)Further discussion on channel raster and sync raster for 52.6~71 GHz | vivo | *Sync raster for licensed bands***Table 3. Applicable SS raster entries for band 66-71 GHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NR Operating Band** | **SS Block SCS** | **Range of GSCN****(First – <Step size> – Last)** | **Number of sync raster entries** | **Total** |
| Licensed band66~71GHz | 120 kHz | 24672-<3>-24960 | 96 | 150 |
|  | 480 kHz | 24672-<15>-24957 | 19 |
|  | 960 kHz | 24672-<8>-24952 | 35 |

*Channelization for unlicensed bands***Table 5. Applicable NR-ARFCN per operating band (n263)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel bandwidths****(MHz)** | **Applicable Channel Centre Frequency (MHz)** | **Applicable NR-ARFCN** | **The Range of N** |
| 100 | 57050+100\*N | (57050+100\*N -24250.08)/0.06+2016667 | N=0,1…, 139 |
| 400 | 57200+400\*N | (57200+400\*N -24250.08)/0.06+2016667 | N=0,1…34 |
| 800 | 57400+800\*N | (57400+800\*N -24250.08)/0.06+2016667 | N=0,1…16 |
| 1600 | 57800+1600\*N | (57800+1600\*N -24250.08)/0.06+2016667 | N=0,1,2,3…7 |
| 2000 | 58000+2000\*N | (58000+2000\*N -24250.08)/0.06+2016667 | N=0,1, 2,3 …6 |

**Table 7. Applicable SS raster entries per operating band**

|  |  |  |  |
| --- | --- | --- | --- |
| **NR Band** | **SS Block SCS** | **Range of GSCN** | **Total** |
| n26357~71GHz | 120 kHz | (32,733.1+n\*100)/17.28+22256, n=1~140 | 210 |
|  | 480 kHz | (32,682.64+n\*400)/17.28+22256, n=1~35 |
|  | 960 kHz | (32,624.8+n\*400)/17.28+22256,n=1~35 |

 |
| [**R4-2205020**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205020.zip)Draft CR to TS 38.104: Channel arrangement | Ericsson | The conclusion from RAN4 #101-bis-e meeting as guidance for the RAN4 #102e meeting was added to TS 38.104 for reference. |
| [**R4-2205021**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205021.zip)Draft CR to TS 38.101-2: Channel arrangement | Ericsson | Draft CR introduces the band and channel arrangement for 66-71 GHz: band definition, channel bandwidth, channel- and synchronization raster to TS 38.101-2 |
| [**R4-2205022**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205022.zip)52.6-71 GHz System Parameters | Ericsson | **Observation 1**: With the proposed floating channelization design in Table 1, a complete simple design is available [1][2] for 66-71 GHz.Table 1: Proposed floating channelization design for the 66 – 71 GHz band

|  |  |  |  |
| --- | --- | --- | --- |
| **SSB SCS** | **ARFCN Range and** **<Step Size>**Total UE SSB Search Complexity for Initial Access (120) | **GSCN Range and** **<Step Size>** | **Number of Sync Raster Points** |
| 120 kHz | 2563333 <2> 2794999(66050.04 - 70950.00 MHz) | 24674 <3> 24959(66033.12 - 70957.92 MHz) | 96 |
| 480 kHz | 2565835 <8> 2792499(66200.16 - 70800.00 MHz) | 24677 <12> 24953(66084.96 - 70854.24 MHz) | 24 |
| 960 kHz | 2565835 <16> 2792491(66200.16 - 70799.52 MHz) | 24680 <6> 24950(66136.80- 70802.40 MHz) | 46 |

**Observation 2:** a floating raster allows reuse of the CA channel arrangement for FR2-2 without constraints compared to unclarity of fixed raster operator of CA channel arrangement**Observation 3:** Adopting a floating channelization scheme as in Rel-15 FR2 results in flexible and forward compatible design that can be used for any operating band that is introduced in Rel-17 and later release. Such a design allows for configuration of any channel centre frequency (with granularity equal to the SCS). This is beneficial to support both licensed and unlicensed band definitions and naturally supports alignment with channels of other technologies if coexistence is deemed to be important for a given deployment. **Observation 4:** Given the minimum required spectral utilization for RAN1 design needed is 85%, and UE output power should be constrained within 70% of the declared nominal channel bandwidth; together with BS/UE RF design considerations initial spectral utilization should be considered as a range between 85-95%. **Observation 5:** Boundary ARFCN/GCSN at 66 GHz will be required to be defined**Observation 6:** The overlapping region, 66-71 GHz, containing both fixed and floating raster will cause unnecessary complexity in design and require UEs which support both licensed and unlicensed operator to have increased search complexity.**Proposal 1:** Spectral utilization initial consideration of a range between 85-95%. **Proposal 2**: Specify 66 – 71 GHz band for licensed usage |
| [**R4-2205233**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205233.zip)60GHz channel and synchronization raster | LG Electronics Finland | **Proposal 1:** In order to have common and simplified ARFCN scheme that could be applied to all FR2-2 bands a proposal to use channel raster step size of 960kHz is made, which is the same as the largest supported SCS.Table 5.4.2.3-1: Applicable NR-ARFCN per operating band

|  |  |  |
| --- | --- | --- |
| Operating Band | ΔFRaster(kHz)  | Uplink and DownlinkRange of NREF(First – <Step size> – Last) |
| n257 | 60 | 2054166 – <1> – 2104165 |
| 120 | 2054167 – <2> – 2104165 |
| n258 | 60 | 2016667 – <1> – 2070832 |
| 120 | 2016667 – <2> – 2070831 |
| n260 | 60 | 2229166 – <1> – 2279165 |
| 120 | 2229167 – <2> – 2279165 |
| n261 | 60 | 2070833 – <1> – 2084999 |
| 120 | 2070833 – <2> – 2084999 |
| … |  |  |
| n263 | 120 | 2563339– <16> – 2794987 |
| 480 | 2565835 – <16> – 2792491 |
| 960 | 2565835 – <16> – 2792491 |

**Proposal 2:** As per agreement in [1] a floating raster is to be used for the licensed bands. Again, in order to harmonize and simplify the GSCN grid it is proposed that similar GSCN grid will be used for all licensed bands within RF2-2 and GSCN raster size of <3> is used for 120kHz SCS and <12> for 480kHz SCS. The GSCN locations for 480kHz SCS are down-selected from 120kHz locations.Example for defining the SS raster entries

|  |  |  |  |
| --- | --- | --- | --- |
| NR Operating Band | SS Block SCS | SS Block pattern1 | Range of GSCN(First – <Step size> – Last) |
| 52.6-57GHz | 120kHz |  | 23898 < 3 > 24150 |
| 480kHz |  | 23904 < 12 > 24144 |
| 66-71GHz | 120kHz |  | 24675 < 3 > 24960 |
| 480kHz |  | 24681 < 12 > 24957 |
| NOTE1: SS Block pattern is defined in sub clause 4.1 in TS 38.213 [10] |

**Proposal 3:**For un-licensed band of n264 following GSCN grid is proposed:1. One SSB location is defined for each 100MHz channel2. Two SSB locations are defined for 480kHz SCS and 400MHz channel. SSB locations for 400MHz reuse the down selected center frequencies from 120kHz SSB. Two SSB locations is selected for each 400MHz of spectrum with 480kHz SCS.Number of SS raster entries

|  |  |  |  |
| --- | --- | --- | --- |
|  | Channels | Locations per channel | Total |
| 120k SCS | 140 | 1 | 140 |
| 480k SCS | 35 | 2 | 70 |
| **TOTAL** |  |  | **210** |

 |
| [**R4-2205313**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205313.zip)System parameters for a NR band in the range 52.6GHz – 71GHz | Nokia, Nokia Shanghai Bell | **Proposal 1:** Adopt synchronization raster points shown in Table 2 for n263**Proposal 2:** RF channel raster is floating based on 120 kHz SCS, network implementation will take care that SSB and coreset#0 fit within channel bandwidth**Proposal 3:** Consider similar spectrum utilization for scenarios with 800MHz and 1600MHz as already endorsed for 120 kHz SCS in FR2-2. **Proposal 4:** Support reduced spectrum utilization for 960 kHz SCS & 2 GHz CBW**Proposal 5:** As each SCS is optional to support, further optionality on maximum channel bandwidth support is not required.**Proposal 6:** For optional ON-ON transient time, only one value among 1 us or 2 us is specified. |
| [**R4-2205315**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205315.zip)60 GHz system parameters | Qualcomm Incorporated | *Mandatory channel bandwidths***Proposal:** 120 kHz SCS 100 MHz(mandatory), 400 MHz (optional)**Proposal:** 480 kHz SCS: 400 MHz(mandatory): other CCBWs optional**Proposal:** 960 kHz SCS: 400 MHz(mandatory): other CCBWs optional |
| **[R4-2205988](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205988.zip)**Further discussion on the channel raster and sync raster in FR2-2 | Huawei, HiSilicon | **Proposal 1:** For licensed band, support floating channelization with 120/480/960 kHz step gap for 120/480/960kHz SCS respectively. The corresponding ARFCN are given in Table 1.Table 1: Applicable NR-ARFCN for band 66~71 GHz

|  |  |  |
| --- | --- | --- |
| Operating Band | ΔFRaster(kHz)  | Uplink and DownlinkRange of NREF(First – <Step size> – Last) |
| nxxx | 120 | 2713332– <2> – 2794998 |
| 480 | 2715832 – <8> – 2792496 |
| 960 | 2715832 – <16> – 2792504 |

**Proposal 2:** For the unlicensed band n263, support fixed channelization. For 100MHz or 200MHz channel bandwidth, the gap between two adjacent channels is about 100MHz or 200 MHz respectively. For channel bandwidth not smaller than 400MHz, the gap between two channel rasters is about 400MHz. the corresponding ARFCN are given in Table 2.**Proposal 3:** For 66~71 GHz licensed band, support candidate SS raster in Table 3 for 120 kHz and 480 kHz SCS. For n263 unlicensed band, support candidate SS raster in Table 4 and Table 5 for 120 kHz and 480 kHz SCS, respectively.Table 4: Sync Raster for 120 kHz SSB in 57GHz-71GHz (SSREF = 24250.08 MHz + Sync Raster \*17.28 MHz)Table 5: Sync Raster for 480 kHz SSB in 57GHz-71 GHz (SSREF = 24250.08 MHz + Sync Raster \*17.28 MHz) |
| **[R4-2205998](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205998.zip)**Views on FR2-2 channelization | Intel Corporation | **Proposal 1:*** For 100 MHz channel bandwidth, NREF = {2564083 + 1680\*N, N = 0:137}
* For 400 MHz channel bandwidth, NREF = {2571643, 2578363, 2585083, 2591803, 2598523, 2606923, 2613643, 2620363, 2627083, 2633803, 2642203, 2648923, 2655643, 2662363, 2669083, 2679163, 2685883, 2692603, 2699323, 2706043, 2714443, 2721163, 2727883, 2734603, 2741323, 2751403, 2758123, 2764843, 2771563, 2778283, 2786683, 2600203, 2640523, 2647243, 2653963, 2660683, 2667403, 2674123}
* For 800 MHz channel bandwidth, NREF = {2575003, 2588443, 2603563, 2617003, 2630443, 2645563, 2659003, 2672443, 2689243, 2702683, 2717803, 2731243, 2744683, 2761483, 2774923, 2788363, 2581723, 2595163, 2610283, 2623723, 2638843, 2652283, 2665723, 2682523, 2695963, 2711083, 2724523, 2737963, 2754763, 2768203, 2781643}
* For 1600 MHz channel bandwidth, NREF = {2581723, 2623723, 2652283, 2695963, 2724523, 2768203, 2610283, 2637163, 2664043, 2753083, 2781643}
* For 2000 MHz channel bandwidth, NREF = {2585083, 2620363, 2655643, 2692603, 2727883, 2764843}

Table 5.4.2.3-2: Applicable NR-ARFCN per *operating band* in FR2

|  |  |  |
| --- | --- | --- |
| NR *operating band* | ΔFRaster(kHz)  | Uplink and Downlinkrange of NREF(First – <Step size> – Last) |
| … | … | … |
| n2631 | 120 | 2563347– <2> – 2794995 |
| 480 | 2565843– <8> – 2792499 |
| 960 | 2565843– <16> – 2792499 |

**Proposal 2:*** For 120 kHz PCell and PScell, GSCN = {24157 + 6\*N – floor((N-2)/6) - 1, N=0:137}.
* For 480 kHz PCell and PScell, GSCN = {24180, 24203, 24227, 24250, 24273, 24279, 24303, 24326, 24349, 24373, 24396, 24402, 24419, 24425, 24443, 24448, 24466, 24472, 24489, 24495, 24513, 24518, 24536, 24553, 24577, 24600, 24623, 24647, 24653, 24676, 24699, 24723, 24746, 24769, 24804, 24828, 24851, 24874, 24898, 24927}.
* For 960 kHz, no applicable SS raster entries exist for PCell and PScell.

Table 5.4.3.3-2: Applicable SS raster entries per *operating band* (FR2)

|  |  |  |  |
| --- | --- | --- | --- |
| NR *operating band* | SS Block SCS | SS Block pattern(note) | Range of GSCN(First – <Step size> – Last) |
| … | … | … | … |
| n2632 | 120 kHz | Case D | 24153 – <1> – 24960 |
| 480 kHz | Case F | 24155– < 1 > – 24958 |
| 960 kHz | Case G | 24158– < 1 > – 24954 |

 |

## Open issues summary

### Sub-topic 2-1: Band definition

**Issue 2-1: Should a licensed band from 66 to 71 GHz be specified now**

* Proposal 1: Specify 66 – 71 GHz band for licensed usage (Ericsson)
* Recommended WF
	+ Moderator suggests companies share their views on Proposal 1

### Sub-topic 2-2: Channelization

*In RAN4 #101Bis-e, the following agreement was captured (R4-2202327)*

Agreement:

Consider the different channelization for licensed band(s) and unlicensed band(s)

* Fixed sync raster for unlicensed bands
	+ Fixed scheme should not be constrained by IEEE channel raster
	+ Send LS to RAN1 to make sure that RAN1 accommodates the solution already now for both fixed and floating sync raster.
	+ For the contiguous carrier aggregation, the channel spacing of adjacent channels should be multiple of the larger SCS, i.e., 960KHz, used by two channels/CCs
* Floating sync raster for licensed bands
* Stick to the agreement last meeting for 3 x 17.28MHz as the minimum granularity.
	+ Refer to gap between adjacent GSCN values is not smaller than 3 x 17.28MHz
* FFS: Unlicensed bands tries to use the sub-set of sync raster for licensed bands

*Channelization solutions in this meeting are still diverse. For better alignment, we can focus on specific parameters to help build the base of each channelization solution.*

**Issue 2-2a: Channelization for unlicensed bands**

*Fixed sync raster parameters*

* Channel locations for 100 MHz
	+ Raster step size options for 120 kHz 100 MHz
		- 1664 (99.84 MHz)
		- 1680 (100.8 MHz)
		- Mix of 1664 and 1680
	+ Other options not precluded
* Channel locations for 400 MHz,
* Channel locations for 800 MHz
* Channel locations for 1600 MHz
* Channel locations for 2000 MHz
* GSCN step size options for 120 kHz
	+ <3>
	+ Mix {<4>,<5>}
	+ Mix {<5>,<6>}
	+ Mix {<3>,<6>}
	+ Other options not precluded
* GSCN step size options for 480 kHz
	+ <11,12>
	+ <12>
	+ <15>
	+ <16>
	+ Other
* Recommended WF
	+ Moderator suggests companies share their views on this approach and their preferred option for each parameter listed above
	+ Additionally, companies may indicate if they support any of the available proposals to be used as baseline for channel placement

*Based on the parameters chosen, we can further refine our channelization solution by analyzing the overall complexity (total number of raster entries) and supported channels considering several regulatory regions. For a comprehensive assessment, additional aspects can be added to the table below to help finalize the solution for unlicensed operation.*

*Fixed sync raster assessment*

|  |  |  |  |
| --- | --- | --- | --- |
| **Description/type** | **Search complexity** | **Supported channels based on regulatory regions** | **Contiguous CA** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

* Recommended WF
	+ Companies are encouraged to provide feedback on additional aspects to consider in the baseline solution so we may finalize the channelization definition for unlicensed operation in FR2-2.

**Issue 2-2b: Channelization for licensed bands**

*Floating sync raster parameters*

* Raster step size options for 120 kHz 100 MHz
	+ 2 (120 kHz)
	+ 16 (960 kHz)
	+ Other options not precluded
* GSCN step size options for 120 kHz
	+ <3>
	+ Other
* GSCN step size options for 480 kHz
	+ <8> (480 kHz)
	+ <12>
	+ <15>
	+ Other
* Recommended WF
	+ Moderator suggests companies comment on their preferred option for the parameters
	+ Companies may also indicate if they support any of the available proposals to be used as baseline

*Floating sync raster assessment*

* Recommended WF
	+ Companies are encouraged to provide feedback on additional aspects to consider in the baseline solution for licensed operation in FR2-2

### Sub-topic 2-3: Channel bandwidth

**Issue 2-3: Mandatory channel bandwidths**

* Proposal 1: The optionality of CBW is agreed as follows: (Apple, Qualcomm)
	+ 120 kHz: mandatory (100 MHz), optional (400 MHz)
	+ 480 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz)
	+ 960 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz, 2000 MHz)
* Proposal 2: As each SCS is optional to support, further optionality on maximum channel bandwidth support is not required. (Nokia, Intel)
* Recommended WF
	+ Companies should share their views on Proposal 1 and Proposal 2

### Sub-topic 2-4: Carrier aggregation

**Issue 2-4: FR2-2 CA work in Rel-17**

* Proposal 1: RAN4 deprioritize the work related to CA within band n263 in Rel-17. (Apple)
* Recommended WF
	+ Companies should confirm if CA work for band n263 can be deprioritized in Rel-17.

### Sub-topic 2-5: Specification updates

*Draft CR R4-2205020 adds the conclusion from RAN4 #101-e meeting to TS 38.104 as guidance towards RAN4 #101Bis-e-meeting for reference (R4-2120061).*

**Issue 2-5a: TS 38.104 update**

* Recommended WF
	+ Moderator suggests companies provide any feedback on draft CR R4-2205020 directly into Section **2.3.2 CRs/TPs** **comments collection**.

**Issue 2-5b: TS 38.101-2 update**

* Recommended WF
	+ Depends on the outcome of Issue 2-1. Moderator suggests companies provide any feedback on draft CR R4-2205021 directly into Section **2.3.2 CRs/TPs** **comments collection**.

## Companies’ views – collection for 1st round

### Open issues

Sub-topic 2-1: Band definition

 Issue 2-1: Defining a licensed band from 66 to 71 GHz

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | For licensed band 66-71 GHz, regulation across regions is not clear yet. We can postpone licensed band definition in this release. |
| MediaTek | Recap prior agreement “Licensed band: Agree to define a band [66-71] GHz, based on which the system parameters discussion can proceed with an aim to harmonize for both licensed and unlicensed bands. The work except system parameters on this band will start when regulations become clear”.We’d like to learn whether regulations are clear enough. |
| Nokia, Nokia Shanghai Bell | Currently spectrum regulations are missing for the 66-71 GHz frequency range and due to that out-of-band requirements cannot be considered. Therefore, this band cannot be specified at the moment. However, when the regulations are clear the band can be introduced as release independent from rel-17. |
| Ericsson | The band definition is required to capture channelization agreements for 66-71 GHz range. Companies against the introduction of this band, please indicate how the channelization design shall be captured in draft CR (RAN4 #101-e meeting guidance by chair)The 66-71 GHz range was identified for IMT-2020 at WRC-19. We note that much of the n263 work has been based on references to harmonized standards that are not published or even incomplete.  |
| Apple | We also feel RAN4 needs to wait until regulations become clear. |
| QCOM | We support introduction of licensed band after the spectrum and regulatory rules are defined. That has not happened yet. In future once a band, the rules, and with some operator support a band could be added. |
| Xiaomi | Agree that to wait for regulation become clear for licensed band. |
| CATT | We support to include the licensed bands to capture the system parameter conclusions. |
| Intel | We think licensed band definition and introduction can be postponed until regulations are clear |
| Huawei | Being aware of the regulatory status (ITU RR 5.559AA, WRC-19 Resolution 241), we would be supportive of the licensed band definition, at least to allow proper system parameters implementation. More discussion during 2nd round may be helpful. |

Sub-topic 2-2: Channelization

Issue 2-2a: Channelization for unlicensed bands

Issue 2-2b: Channelization for licensed bands

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 2-2a Channelization for unlicensed bandsIn our contribution we calculated channel center frequency for each channel bandwidths, then convert this frequency to NR-ARFCN.For GSCN step size, we have following comments:* Do we need to consider SSB SCS 960kHz in the GSCN calculation?
* What is the SSB location related to the fixed channel?
* GSCN step size is related to SU and GB for each minimum channel bandwidth. Therefore, what kind of assumption should be used in the calculation?

We should clarify the factors related to calculation of GSCN first.Issue 2-2b Channelization for licensed bandsFor channel raster, SCS based channel raster is used for licensed bands. Therefore, the step size for channel raster should be 2 for 120kHz, 8 for 480kHz and 16 for 960kHz.For the sync raster calculation, we should align our assumptions for calculating GSCN, such as SU and GB. |
| Nokia, Nokia Shanghai Bell | Issue 2-2a: In our view it is necessary to agree on the principle of how to define the sync and RF channel rasters before debating the exact raster points. Firstly, we do not see any need to limit the RF raster to other than floating raster based on SCS, as UE is always told where the RF channel is. There is no added complexity from floating RF channel. However, to define the synchronization raster, we have used a nominal fixed channel raster to assign the sync raster points. For 100 MHz 100.8 MHz spacing is preferred to* Keep spacing multiple of 960 kHz for CA compatibility
* Avoid adjacent channels from overlapping

For similar reasons 400.32 MHz spacing was used for 400 MHz and wider channels. Using this nominal design sync raster points can be chosen so that there is one raster point within each 100 MHz channel. Freedom to place the RF channels minimizes loss of spectrum in different regulatory regions. gNB implementation will take care that SSB and coreset#0 always fit within the channel bandwidth. Issue 2-2b: GSCN step sizes should be * 3 for 120 kHz
* 12 for 480 kHz
* 6 for 960 kHz

Even though there is no initial access for 960 kHz SCS, SSBs are still required. |
| LGE | Issue 2-2a: We understand that reuse of floating channel raster from FR2-1 maximizes the flexibility but at the same time we question the need to have raster with few ppm step size (60e3/60e9= 1e-6), especially for 14GHz wide unlicensed band and 100MHz minimum CBW. The UE is always told where RF channel is, but mandatory capability to support dense raster makes is also impossible to simplify the current and future implementations.For 120kHz GSCN step size we support Mix {<5>,<6>} option as combination of these steps makes it possible to place one SSB/100MHz of spectrum. For 480k the GSCN locations should be down selected from 120kHz locations. |
| Ericsson | RAN4 #101-bis-e meeting agreement to keep spacing multiple of 960 kHz for CA:* + For the contiguous carrier aggregation, the channel spacing of adjacent channels should be multiple of the larger SCS, i.e., 960KHz, used by two channels/CCs

Issue 2-2b: GSCN step sizes should be as outlined in Ericsson draft CRs* 3 for 120 kHz
* 12 for 480 kHz
* 6 for 960 kHz
 |
| MediaTek | 2-2a: Please could LGE explain why they believe that 2 GSCNs per 400MHz channel is required for 480kHz SCS? We would consider 140 + 35 to be sufficient.2-2b: The 100MHz spaced GSCN raster would still provide FULLY-FLOATING channel location flexibility for channel bandwidths larger than the minimum bandwidth.Agreements from last meeting should be maintained.For 960kHz SCS, if we include GSCN locations for that, there should be a NOTE added to the spec/table indicating that “960kHz SSB configuration is not applicable for idle mode cell acquisition”. |
| Apple | Issue 2-2a: Per agreement at the last meeting, fixed raster will be used for unlicensed band. In our understanding, a reasonable approach would be to decide on the placement of 100MHz channels, the minimum building blocks and then overlay the larger channels by assembling the smaller channels. For 100MHz channels, the channel spacing is 100.8MHz to ensure the channel spacing of adjacent channels is multiples of 960kHz for contiguous CA of any two adjacent 100/400/800/1600/2000MHz CBW.  |
| CATT | In general, we agree that we should settle a channelization baseline, then design sync raster, then revisit them as a whole. And propose to have two companies to lead the detail design discussion for unlicensed and licensed bands when some high level principles are agreed. Because they’re really very detail, every position may need to be checked one by one.**Issue 2-2a: Channelization for unlicensed bands**For channelization, we should first agree the granularity for each CBW.For 100MHz CBW, we support option 3. The nearest Nref for the center of each 100MHz CBW are found in our contribution, considering the 960kHz integer multiplies. Then the distance will be a mix of 99.84MHz and 100.8 MHz. This will make each CBW being inside every 100MHz CBW block. But if use only 99.84 or 100.8, with 140 channels, the channels will not align with the 100MHz blocks. For some region, only part of the spectrum is available, then there’re some difficulties to use all of the spectrum. For example, in China, the spectrum is only 59-64GHz, option 3 can accommodate it perfectly.For other CBW, we need to agree if all of the CBW should consider the alignment with WIFI channels and how they’re aligned, either depends on the proper granularity as following or only design the channel positions specifically like the following,Our understanding is that all of the CBW should be considered to allow CA. Then granularity methodology may be better because other spectrum can also be used when LBT is not mandatory and WIFI alignment is not needed. The second methodology may have some spectrum wasted. For the granularity, we’re ok with 200MHz or 400MHz granularity. The 400MHz granularity may not easily to align with WIFI channels, 200MHz granularity need the specific handling for the sync rasters, which we missed this aspect in our contribution.**Issue 2-2b: Channelization for licensed bands**For channel raster, as the agreement is SCS based, so we don’t think it’s necessary to stick the multiplies of 960kHz principle. Thus 2, 8, 16 step sizes are ok.The only thing we would like to remind is that a baseline for the whole 57-71GHz should be assumed then choose the part of the 66-71GHz to maintain the orthogonality for the licensed band and unlicensed band. We have the proposal Table 1 in our contribution R4-2203936. The other thing is that the sync raster should be on he channel rasters, so the beginning of the channel raster should be chosen carefully. For sync raster, the methodology is similar that a whole range for 57-71 can be set, then choose the 66-71 part. 960, 480 being subsets of 120 may bring some benefit for implementation. To our understanding, 960 may need to be designed although it’s not supported in cell search, the positions are needed for the SSB/CORESET offset and can be some reference for the CA deployment. |
| Intel | Issue 2-2a:It would be good to first agree to some high-level constructs that will help finalize the channelization.1) Channel locations for 100 MHz:Agree that channel locations for 100 MHz will be with spacing of 100.8 MHz (1680) starting from some frequency near 57.0 ~ 57.1GHz and end at some frequency near 70.9 ~ 71 GHz.2) channel locations for 400/800/1600/2000 MHzFrom the 100 MHz channel locations, RAN4 can further determine the locations of 400/800/1600/2000 MHz by sampling (or selecting) the center of 4/8/16/20 aggregated 100 MHz channel AFRCN values.3) GSCN for 120 kHzSelect GSCN such that there is only 1 valid GSCN entry per each 100 MHz CBW. Given that guard bands for each CBW have not been determined, select the GSCN with conservative spectrum utilization estimates (e.g., 87%).- GSCN step size mixture of <5.6> or <3,6> both seem to able to meet this suggested requirement.4) GSCN for 480 kHzSelect GSCN such that there is at most 2 valid GSCN entry per each 400 MHz CBW. Given that guard bands for each CBW have not been determined, select the GSCN with conservative spectrum utilization estimates (e.g. 87%).- There are many choices. Either down selecting from GSCN for 120 kHz or down selecting from GSCN with step size of <12> or mixture of <12,11> seem to able to meet this suggested requirement.* For 100 MHz channel bandwidth, NREF = {2564083 + 1680\*N, N = 0:137}
* For 400 MHz channel bandwidth, NREF = {2571643, 2578363, 2585083, 2591803, 2598523, 2606923, 2613643, 2620363, 2627083, 2633803, 2642203, 2648923, 2655643, 2662363, 2669083, 2679163, 2685883, 2692603, 2699323, 2706043, 2714443, 2721163, 2727883, 2734603, 2741323, 2751403, 2758123, 2764843, 2771563, 2778283, 2786683, 2600203, 2640523, 2647243, 2653963, 2660683, 2667403, 2674123}
* For 800 MHz channel bandwidth, NREF = {2575003, 2588443, 2603563, 2617003, 2630443, 2645563, 2659003, 2672443, 2689243, 2702683, 2717803, 2731243, 2744683, 2761483, 2774923, 2788363, 2581723, 2595163, 2610283, 2623723, 2638843, 2652283, 2665723, 2682523, 2695963, 2711083, 2724523, 2737963, 2754763, 2768203, 2781643}
* For 1600 MHz channel bandwidth, NREF = {2581723, 2623723, 2652283, 2695963, 2724523, 2768203, 2610283, 2637163, 2664043, 2753083, 2781643}
* For 2000 MHz channel bandwidth, NREF = {2585083, 2620363, 2655643, 2692603, 2727883, 2764843}
* Alternative 1) selected GSCN such that RB offsets are optimized for unlicensed operation
	+ For 120 kHz PCell and PScell, GSCN = {24157 + 6\*N – floor((N-2)/6) - 1, N=0:137}.
	+ For 480 kHz PCell and PScell, GSCN = {24180, 24203, 24227, 24250, 24273, 24279, 24303, 24326, 24349, 24373, 24396, 24402, 24419, 24425, 24443, 24448, 24466, 24472, 24489, 24495, 24513, 24518, 24536, 24553, 24577, 24600, 24623, 24647, 24653, 24676, 24699, 24723, 24746, 24769, 24804, 24828, 24851, 24874, 24898, 24927}.
* Alternative 2) strict subset of 3x subsample GSCN for 120kHz, and 12x subsample GSCN for 480 kHz (may result in functional but not optimal RB offsets, i.e. SSB not aligned with left or right edge of CORESET#0).
	+ For 120 kHz PCell and PScell, GSCN = {24157 + 6\*N – 3\*floor((N+11)/18), N=0:137}.
	+ For 480 kHz PCell and PScell, GSCN = {24187, 24211, 24235, 24259, 24283, 24307, 24331, 24355, 24379, 24403, 24427, 24451, 24475, 24487, 24499, 24511, 24523, 24535, 24559, 24583, 24607, 24631, 24655, 24679, 24703, 24727, 24751, 24775, 24811, 24835, 24859, 24883, 24907, 24931}

|  |  |  |  |
| --- | --- | --- | --- |
| **Description/type** | **Search complexity** | **Supported channels based on regulatory regions** | **Contiguous CA** |
| Intel alt 1 | For 120 kHz: 138For 480 kHz: 40 | Channels are defined such that there is at least one of 100/400/800/1600/2000 MHz that is aligned with IEEE.Channels are defined so that it can maximize number of channels that can fit within each of the following regulatory domain: (1) 57-71 GHz (e.g. USA, Europe), (2) 57-66 GHz (e.g. South Africa), (3) 57-64 GHz (e.g. Japan, Korea), (4) 59-64 GHz (e.g. China) | Always results in channel spacing multiple of 100.8MHz (multiple of 960 kHz) |
| Intel alt 2 | For 120kHz: 138For 480 kHz: 34 | Channels are defined such that there is at least one of 100/400/800/1600/2000 MHz that is aligned with IEEE.Channels are defined so that it can maximize number of channels that can fit within each of the following regulatory domain: (1) 57-71 GHz (e.g. USA, Europe), (2) 57-66 GHz (e.g. South Africa), (3) 57-64 GHz (e.g. Japan, Korea), (4) 59-64 GHz (e.g. China) | Always results in channel spacing multiple of 100.8MHz (multiple of 960 kHz) |

Issue 2-2b:If we do not define a licensed band in rel-17, not sure if there needs to be standards effort in finalizing the licensed channel/sync rasters.If the goal is to have some ideas and thoughts so that companies review the compatibility of licensed cases with unlicensed cases, then RAN4 can focus on getting some guidance for GSCN step sizes assumed for floating channelization for licensed cases.For those, we think GSCN step sizes can be <3> for 120 kHz, <12> for 480 kHz, and <6> for 960 kHz.If floating channel raster step size information is needed for RAN1 to determine the required kSSB signaling values, then we think step size of <16> for 120 kHz, <16> for 480 kHz, and <32> for 960 kHz are suitable values. |
| Huawei | Issue 2-2a:unlicensed band: support fixed channelization. For 100MHz or 200MHz channel bandwidth, the gap between two adjacent channels is about 100MHz or 200 MHz respectively. For channel bandwidth not smaller than 400MHz, the gap between two channel rasters is about 400MHz. Issue 2-2b:licensed band: support floating channelization with 120/480/960 kHz step gap for 120/480/960kHz SCS respectively. |

Sub-topic 2-3: Channel bandwidth

 Issue 2-3: Mandatory channel bandwidths

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 2-3Prefer P1. |
| OPPO | Proposal 1. |
| Nokia, Nokia Shanghai Bell | We submitted proposal 2. Given the optionality of each SCS and n263 width of 14 GHz, it is not reasonable to limit mandatory UE support to 100 MHz. |
| Apple | Proposal 1. The rationale behind our proposal is detailed in R4-2203805, covering aspects related to UE implementation challenges in supporting larger than 400MHz CBWs such as power consumption, power control, DPD, ADC/DAC, baseband processing, etc., different UE types, and deployment scenarios. While support of 480/960kHz SCS is optional, it is meaningful and necessary to decide which of their associated CBWs is optional/mandatory to UEs. For the UEs that can support 400MHz but not 800/1600/2000MHz, they will have a chance to support 480/960kHz SCS, which would allow more UEs to support and use such SCSs. Without such a granularity, those UEs would be forced to claim that they don’t support 480/960kHz SCSs, which is clearly a loss to operators who choose to deploy such SCSs. It is also worth noting that considering UE support of 400MHz is optional in FR2-1, mandating the support of 400MHz for 480/960kHz SCS indicates an increase in UE implementation complexity. |
| QCOM | **Issue 2-3: Mandatory channel bandwidths**we support proposal 1A comment on Apple paper … some very good points toward optional BW. Choosing a few:* PA power
* RF circuit power
* wide bandwidth eliminates ability to use DPD for PA efficiency
* DAC and ADC power increase
* Baseband power consumption
 |
| Intel | Our preference is Proposal 2. Each SCS is optional to support, further optionality on maximum channel bandwidth support is not needed. |
| Huawei  | Proposal 1 as baseline. |

Sub-topic 2-4: Carrier aggregation

 Issue 2-4: FR2-2 CA work in Rel-17

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 2-4In the last meeting, we already endorsed a draft CR including intra-band CA\_n263. I think we should finish the work in Rel-17. |
| Nokia, Nokia Shanghai Bell | It is not clear what deprioritizing means and what types of CA are in scope of the proposal. In our view it is essential to finalize intra-band contiguous CA in rel-17 and also FR1 + FR2-2 combinations are within the WID. Therefore, we cannot agree with the proposal. |
| Ericsson | Based upon agreement (R4-2202327) “For continuous CA, the channel spacing of adjacent channels should be multiple of the larger SC”, this should be considered as part of CA work in Rel-17 therefore we should not deprioritize the work. |
| Apple | Our understanding is that until the generic CA requirements are defined, the CA band combination within band n263 cannot be added to Rel-17. Considering that RAN4 #102 is the last meeting of Rel-17 Core work scope, it is proposed to deprioritize the CA related work. |
| QCOM | We should attempt to complete intra-band contiguous CA in rel17. |
| Intel | Deprioritizing CA will impact how 3GPP technology can be marketed in the 57-71GHz unlicensed market segment.As other companies have commented, we should aim to finalize the intra-band contiguous CA and FR1-FR2-2 combination in Release 17. |
| Huawei | As commented above, part of the CA work was already endorsed.  |

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing Wis, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205020 | Vivo: for licensed band n264, we are not sure we should introduce this band for now. |
| Nokia: This CR cannot be endorsed with n264 in it. This is related to issue 2-1.QCOM: we can’t agree with endorsing with n264 in it. |
| R4-2205021 | Vivo: for licensed band n264, we are not sure we should introduce this band for now. |
| Nokia: This CR cannot be endorsed with n264 in it. This is related to issue 2-1.QCOM: same comment on n264 |

## 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 #2-1: Band definition** | **Issue 2-1: Should a licensed band from 66 to 71 GHz be specified now***Candidate option:** Proposal: Specify 66 – 71 GHz band for licensed usage

*Majority view is that defining a licensed band should be postponed until regulations become clear. However, some companies want to discuss further to consider channelization and regulatory status.**Tentative agreements: Wait for regulations to be clear before introducing a licensed band**Recommendations for 2nd round: Further discuss the issue and whether tentative agreement is agreeable* |
| **Sub-topic #2-2: Channelization** | **Issue 2-2a: Channelization for unlicensed bands***Candidate proposal options:** Option 1: CATT (R4-2203936)
* Option 2: vivo (R4-2204933)
* Option 3: Huawei (R4-2205988)
* Option 4: Intel (R4-2205998)

*Recommendations for 2nd round:* *Companies are encouraged to provide their views of the available proposals and may also provide an alternative concrete proposal for consideration.* *If aligning on the above options is too difficult, we can focus on agreeing on a potential principle or approach for how to define the sync and RF channel rasters first.**Consider discussing the points below for GSCN step size:** *Do we need to consider SSB SCS 960kHz in the GSCN calculation?*
* *What is the SSB location related to the fixed channel?*
* *GSCN step size is related to SU and GB for each minimum channel bandwidth. Therefore, what kind of assumption should be used in the calculation?*

**Issue 2-2a: Channelization for licensed bands***Candidate options for GSCN:** Option 1: GSCN step sizes (Nokia, Ericsson, Intel)
	+ 3 for 120 kHz
	+ 12 for 480 kHz
	+ 6 for 960 kHz

*Candidate options for channel:** Option 1: SCS based channel raster is used for licensed bands. Therefore, the step size for channel raster should be: (vivo)
	+ 2 for 120kHz
	+ 8 for 480kHz
	+ 16 for 960kHz
* Option 2: If floating channel raster step size information is needed for RAN1 to determine the required kSSB signaling values, then we think step sizes below are suitable:
	+ <16> for 120 kHz
	+ <16> for 480 kHz
	+ <32> for 960 kHz

*Recommendations for 2nd round: Further discuss the candidate options. Companies may also provide an alternative concrete proposal for consideration.*  |
| **Sub-topic #2-3: Channel bandwidth** | **Issue 2-3: Mandatory channel bandwidths***Candidate options:** Proposal 1: The optionality of CBW is agreed as follows:
	+ 120 kHz: mandatory (100 MHz), optional (400 MHz)
	+ 480 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz)
	+ 960 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz, 2000 MHz)
* Proposal 2: As each SCS is optional to support, further optionality on maximum channel bandwidth support is not required.

*Most companies prefer Proposal 1.**Tentative agreements: Approve Proposal 1 as baseline* *Recommendations for 2nd round: Discuss if tentative agreement can be approved* |
| **Sub-topic #2-4: Carrier aggregation** | **Issue 2-4: FR2-2 CA work in Rel-17***Candidate option:** Proposal: RAN4 deprioritize the work related to CA within band n263 in Rel-17.

*Majority view is that CA work should not be deprioritized, as it is within WI scope. Clarification on what is meant by “deprioritizing” was requested. Proponent further explained:**“Our understanding is that until the generic CA requirements are defined, the CA band combination within band n263 cannot be added to Rel-17. Considering that RAN4 #102 is the last meeting of Rel-17 Core work scope, it is proposed to deprioritize the CA related work.”**Recommendations for 2nd round:* *Need to further discuss and verify if companies’ understanding is the same* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 5 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2205020 | *Not agreeable* |
| R4-2205021 | *Not agreeable* |

## Discussion on 2nd round (if applicable)

**TBA**

# Topic #3: FR1 + FR2-2 DC/CA band combinations (AI 10.16.7)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2206053**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206053.zip)CR for 38.101-3 on FR2-2 DC/CA with FR1 anchor | Ericsson GmbH, Eurolab | Adds CA\_n41-n263, CA\_n77-n263 and CA\_n79-n263 combinations into TS 38.101-3 |

## Open issues summary

### Sub-topic 3-1: Specification updates

**Issue 3-1: TS 38.101-3 update**

*Draft CR R4-2206053 introduces the following FR1 + FR2-2 DC/CA combinations into TS 38.101-3: CA\_n41-n263, CA\_n77-n263 and CA\_n79-n263*

* Recommended WF
	+ Moderator suggests companies provide any feedback on draft CR R4-2206053 directly into Section **3.3.2 CRs/TPs** **comments collection**.

## Companies’ views – collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | We are OK to introduce these CA band combinations. |
|  |  |

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing Wis, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2206053 | vivo: this CR is OK. |
| Nokia: It seems the content has been already endorsed, we do not see a need to re-endorse the same content. The content itself is ok. The implementation of the content should take place when FR2-2 is implemented in all specifications. |

## 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:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 5 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2206053 | *Agreeable* |

## Discussion on 2nd round (if applicable)

**None**

# Topic #4: Others (AI 10.16.9)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203939**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203939.zip)Draft CR for TS 37.106: introduction of UE LBT requirement for FR2-2 | CATT | To define the LBT requirements of n263, a new clause of “Downlink channel access procedure for FR2-2” is added to TS 37.106Table 5.2.1-1: Channel access parameters for PUSCH

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| LBT measurement bandwidth (BW) | MHz | [400] |
| Energy detection threshold | dBm/BW  | [-54] |
| Detection timing | microseconds | 8 |

 |
| [**R4-2203940**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203940.zip)Draft CR for TS 37.107: introduction of BS LBT requirement for FR2-2 | CATT | To define the LBT requirements of n263, a new clause of “Downlink channel access procedure for FR2-2” is added to TS 37.107Table 5.2.1-1: Channel access parameters for PDSCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Value** |
| LBT measurement bandwidth | MHz | [400] |
| Energy detection threshold | [dBm/400 MHz] | [-54 or X] |
| Maximum channel occupancy time | ms | 5 |
| NOTE: The specific value X is declared by the vendor. |

 |

## Open issues summary

### Sub-topic 4-1: Specification updates

**Issue 4-1: TS 38.106 and TS 38.107 update**

* Recommended WF
	+ Depends on the outcome of Sub-topic 1-3 discussions. Moderator suggests companies provide any feedback for the two draft CRs directly into Section **4.3.2 CRs/TPs** **comments collection**.

## Companies’ views - collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | For now, TS 37.107 and TS 37.106 are not included in the list of the impacted specifications for the 71GHz WI. So, these draft CRs are not needed. |
| Ericsson | No regulation that requires LBT, and therefore there is no need to define any LBT requirements for now.  |
| CATT | Thanks for the comment. This relies on the decision in Issue 1-3a. The responses for the comments are as below,To Vivo: Yes, if LBT should be defined in core part, the two specifications should be included in the WI.To Ericsson: In our understanding, LBT is mandatory in ETSI EN 302 567, please check if I have any misunderstanding.LBT is mandatory to facilitate spectrum sharing. |

### CRs/TPs comments collection

*Moderator suggests companies comment directly for feedback on the CRs below*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2203939 | Nokia: We do not think introduction of LBT requirements is necessary, see R4-2206047. The specification where changes are proposed is not part of the WID. |
| QCOM: We approve of this document pending the answer to one question, could CATT share where 8 usec came from. |
| CATT: response to QCOM: Please check our contribution R4-2203938. It’s from the RAN1 running CR for TS 37.213.The defer duration is $T\_{d}=8μs $that ends with a sensing slot of a duration $T\_{sl}=5μs$ for performing as least a single measurement to determine whether the channel is idle.Of course, it’s a draft CR, the details can be discussed further if LBT will be defined. |
| R4-2203940 | Nokia: We do not think introduction of LBT requirements is necessary, see R4-2206047. The specification where changes are proposed is not part of the WID. |
| QCOM: We approve of this document |
| CATT: Thanks for the comments. Let’s wait the decision for 1-3a. |

## 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 #4-1:** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 5 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2203939 | *Return to**Depends on outcome of Issue 1-3a and Issue 1-3b* |
| R4-2203940 | *Return to**Depends on outcome of Issue 1-3a and Issue 1-3b* |

## Discussion on 2nd round (if applicable)

*Depending on the outcome of Issue 1-3a and Issue 1-3b, continue discussing content of R4-2203939 and R4-2203940 and potential revisions.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on system parameters of FR2-2 | Intel Corporation |  |
| Draft LS on sensing beam characteristics to RAN1 | Ericsson | Revision of tdoc R4-2203581 |
| Draft reply LS on the minimum guard period between two SRS resources for antenna switching | CATT | Revision of tdoc R4-2203941 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2203581 | Draft LS on sensing beam characteristics to RAN1 | Ericsson | To be revised |  |
| R4-2203805 | Remaining issues on system parameters for NR operation in 52.6GHz - 71GHz | Apple | Noted |  |
| R4-2203807 | On sensing beam selection on the UE side | Apple | Noted |  |
| R4-2203936 | ON channelization and sync raster entries for up to 71GHz | CATT | Noted |  |
| R4-2203937 | Draft reply LS on sensing beam selection | CATT | Noted |  |
| R4-2203938 | Discussion on the FR2-2 LBT requirement | CATT | Noted |  |
| R4-2203939 | Draft CR for TS 37.106: introduction of UE LBT requirement for FR2-2 | CATT | Return to | Depends on outcome of Issue 1-3a and Issue 1-3b |
| R4-2203940 | Draft CR for TS 37.107: introduction of BS LBT requirement for FR2-2 | CATT | Return to | Depends on outcome of Issue 1-3a and Issue 1-3b |
| R4-2203941 | Draft reply LS on the minimum guard period between two SRS resources for antenna switching | CATT | To be revised |  |
| R4-2204620 | Reply LS on a minimum guard period between two SRS resources for antenna switching | Ericsson | Withdrawn |  |
| R4-2204932 | Draft CR for TS 38.101-2: Introduction of system parameters for FR2-2 | vivo | Return to | Content depends on discussions and potential agreements for channel raster |
| R4-2204933 | Further discussion on channel raster and sync raster for 52.6~71 GHz | vivo | Noted |  |
| R4-2204936 | Discussion and draft reply LS on sensing beam selection | vivo | Noted |  |
| R4-2205020 | Draft CR to TS 38.104: Channel arrangement | Ericsson | Not agreeable |  |
| R4-2205021 | Draft CR to TS 38.101-2: Channel arrangement | Ericsson | Not agreeable |  |
| R4-2205022 | 52.6-71 GHz System Parameters | Ericsson | Noted |  |
| R4-2205129 | Discussion and draft reply LS on minimum guard symbol of SRS | Xiaomi | Noted |  |
| R4-2205190 | Reply LS on the minimum guard period between two SRS resources for antenna switching | Huawei, HiSilicon | Noted |  |
| R4-2205233 | 60GHz channel and synchronization raster | LG Electronics Finland | Noted |  |
| R4-2205313 | System parameters for a NR band in the range 52.6GHz – 71GHz | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2205315 | 60 GHz system parameters | Qualcomm Incorporated | Noted |  |
| R4-2205732 | Views on sensing beam selection on the UE side | Sony | Noted |  |
| R4-2205988 | Further discussion on the channel raster and sync raster in FR2-2 | Huawei, HiSilicon | Noted |  |
| R4-2205997 | UE feature list for NR ext. to 71GHz | Intel Corporation | Return to | Depends on discussions in threads [134] and [143] |
| R4-2205998 | Views on FR2-2 channelization | Intel Corporation | Noted |  |
| R4-2206047 | Sensing beam for LBT in FR2-2 | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2206048 | SRS antenna switching in FR2-2 | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2206053 | CR for 38.101-3 on FR2-2 DC/CA with FR1 anchor | Ericsson GmbH, Eurolab | Endorsed |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)