**3GPP TSG-RAN WG4 Meeting # 100-e R4-210XXXX**

**Electronic Meeting, 16th – 27th Aug 2021**

**Agenda item:** 9.16.7.1, 9.16.7.2, 9.16.7.3

**Source:** Moderator (Qualcomm)

**Title:** Email discussion summary for [100-e][230] NR\_ext\_to\_71GHz\_RRM\_1

**Document for:** Information

# Introduction

*This discussion covers the documents submitted under AIs - 9.16.7.1, 9.16.7.2, 9.16.7.3*

*RRM issues on the WI NR\_ext\_to\_71\_GHz were first discussed during RAN4#99e (WF: R4-2108354, Summary:* *R4-2108405) where the impact on RRM requirements was discussed on a higher level. In this meeting, we further discuss the impact of higher SCS (480/960kHz) on RRM requirements, for most cases without considering the LBT impact.*

*No CR/TPs are treated during this meeting*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: The following list of open issues was identified, based on the contributions, for the 1st round
	+ General
		- Working assumptions and deployment scenarios
		- RX beam sweeping scaling factor
		- Scheduling restrictions
		- Random access
		- Measurement procedures
	+ Timing requirements
		- UE transmit timing error
		- UE timer accuracy
		- Timing advance
		- MTTD/MRTD
	+ Interruptions
		- Requirement prioritization
		- General principles
		- Interruption requirements
* 2nd round: TBA

# Topic #1: General

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2112488](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112488.zip) | Mediatek | **Proposal 3: RAN4 to discuss whether to conduct system-level-simulation for defining RRM requirements regarding the scaling factor for RX beam sweeping.****Proposal 4: As a starting point, reuse FR2-1 measurement capability of number of cells and beams for FR2-2.****Proposal 5: The existing FR2-1 measurement gap patterns can be reused for FR2-2.****Proposal 6: RAN4 further to discuss whether to introduce independent gap for FR2-2.** |
| [R4-2112548](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112548.zip) | Vivo | **Proposal 1: RAN4 works on RRM requirements for standalone single-carrier and multi-carrier operation (CA) firstly.****Proposal 2: RRM requirements for CA/DC with FR1 and legacy FR2 bands is discussed and specified after corresponding band combinations are introduced.****Proposal 3a: Cell detection requirements for both intra-frequency measurement and inter-frequency measurement for FR2-1 can be reused for FR2-2 under the condition that channel model TDL-A 30ns is assumed.****Proposal 3b: Cell detection requirements for both intra-frequency measurement and inter-frequency measurement for FR2-1 is extended by 3 samples for FR2-2.****Proposal 4: SSB index acquisition delay for FR2-2 should be extended compare to that for FR2-1 and 5 samples are needed for SSB index acquisition for inter-frequency measurement.****Proposal 5: SSB measurement period requirements for FR2-1 can be reused for FR2-2 for both intra-frequency inter-frequency measurements.****Proposal 6: Changing scaling factor for Rx beam sweeping should be well justified.****Proposal 7: Factors that may impact scheduling restriction requirements, if any, would be identified firstly.****Proposal 8: For operation in the new licensed band in FR2-2, necessary RRM requirements are given in Table 5.****Proposal 9: For operation in the new unlicensed band in FR2-2, necessary RRM requirements are given in Table 6.** |
| [R4-2112683](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112683.zip) | LGE | **Proposal 1: RAN4 works on RRM requirements for standalone single carrier operation first, and CA/DC can be considered depending on RF session progress.** **Proposal 2: Define separate scaling factor for Rx beam sweeping in FR2-2****Proposal 3: Consider at least two sets of scaling factors for Rx beam sweeping in FR2-2****Proposal 4: Define scaling factor for Rx beam sweeping in FR2-2 for all UE types defined in FR2-1.****Proposal 5: Scheduling restriction in FR2-2 should be further discussed after the UE beam switching time is finalized.** |
| [R4-2113220](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113220.zip) | Nokia | **Proposal 1: FR2 RRM requirements apply for the operation in FR2-2, unless there is technical justification for a revision of the FR2 requirements.**Observation 1: The calculation of the transmitted power of preamble transmissions in Random Access core requirements are specified independently of the frequency range in the RRM core requirements.Observation 2:The calculation of the transmitted power of preamble transmissions in Random Access core requirements are specified different accuracies for FR1 and FR2 in the RRM core requirements.**Proposal 2: Update if needed power accuracy of PRACH preambles for operation above 52.6GHz once RF has clear agreements on Output power dynamics/power control requirements.**Observation 3: PRACH sequence length of LRA=571 and LRA=1151 are being specified in RAN1 for operation above 52.6 GHz.Observation 4**:** RRM core requirements for random access are agnostic to SCS and preamble length.**Proposal 3: RAN4 to define reuse existing random access requirements for the new SCS and preamble sequence length.**Observation 5:By increasing the beam sweeping scaling factor, the time for the UE completing procedures may be too large and increase measurement overhead in RRM. **Proposal 4: RAN4 to reuse the RX beam sweeping scaling factor from FR2 for the operation on FR2-2.** |
| [R4-2113334](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113334.zip) | Ericsson | Observation 1: To our understanding, Carrier Aggregation and Dual connectivity are important features for operator deployment of new spectrum resources. Standalone single-carrier is more complicated scenario since then RAN4 has to also define requirements for idle mode, HO etc. Observation 2: Some existing RRM requirements are defined as function of SCS and/or slot lengths; some are defined for FR1/FR2.Observation 3: For RRM specifications, differentiation of requirement level approach should be made on a basis of supported SCS (which would anyhow be needed even with introduction of new Frequency Range) and can be adopted since generic and agnostic requirements are difficult to define due to large difference between new specified SCS’s.**Proposal 1: Considering most possible application scenario of frequency range: 52.6-71GHz, we, therefore, suggest to prioritize non-standalone scenario where new band is used for SCell while PCell belongs to FR1 and FR2-1 band. we propose two scenarios: Scenario A and Scenario B shown in below figure, in which Scenarios A has higher priority.**

|  |  |
| --- | --- |
| Scenario | Frequency Range |
| Cell in MCG | Cell in SCG |
| A | FR1 | FR2-2 |
| B | FR2-1 | FR2-2 |

**Proposal 2: In essence, the RRM requirements of FR2-2 as SCG is examined without influence by the type of cell in MCG. If differentiation in requirements is necessary, DC/CA with FR1 and DC/CA with FR2-1 are needed to be checked separately.** **Proposal 3: For RRM requirements defined with SCS already, higher SCS (e.g., 480 kHz and 960 kHz) applicable for 52.6 – 71 GHz can be defined (if needed) as function of SCS within FR2; For RRM requirements defined with FR2, it needs check if involvements of new SCS’s, division of FR2-1/FR2-2 or FR2 already can cover it.** **Proposal 4: For higher SCS (e.g., 480 kHz and 960 kHz) applicable for 52.6 – 71 GHz, the number of SSBs are the same as in FR2 according to RAN1’s decision, therefore UE RX beams is native to be assumed as same as FR2. We do not see any major impact on measurement requirements.** **Proposal 5: While UE may utilize the same solution as FR2 or retain the FR2 architecture, we assume the scaling factor for RX beam sweeping should be the same as FR2, at the very least as a starting point.****Proposal 6: Follow conclusion of FR2, no extra scheduling restriction/availability is needed at the very least as a starting point.** |
| [R4-2114142](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114142.zip) | Huawei | Observation 1: Impacts on current spec should be minimized and inheriting the requirements of legacy FR2 (FR2-1) as much as possible.**Proposal 1: The current requirements for FR2 shall include both FR2-1 and FR2-2 without explicit statement, and the new or updated requirements for FR2-2 should be implemented in the existing sections.** **Proposal 2: The specific scenario shall be decided with more RF inputs.**Observation 2: Narrower beam width can be expected with more antenna elements accommodated within the array.**Proposal 3: Consider increasing the beam sweeping scaler for operation in FR 2-2.****Proposal 4: Updating the scheduling restriction for L1/L3 measurement considering the following aspects:*** + - * **Beam switching time**
			* **Synchronization assumptions with large SCS**

Observation 3: For operation in unlicensed band without LBT, the RRM requirements are same as that of operation in licensed band. **Proposal 5: Define RRM requirements for operation with LBT with more RAN1 inputs.** |
| [R4-2114189](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114189.zip) | Intel | **Proposal 1: RAN4 to deprioritize scenarios with an anchor on FR2-1****Proposal 2: RAN4 to deprioritize NE-DC scenario with NR operating in FR2-2****Proposal 3: For operation with high SCS RAN4 to introduce the scheduled gaps for UE to switch its beam****Proposal 4: Network will apply scheduling restrictions during that scheduled beam switching gap.** **Proposal 5: The beam switching gaps can be scheduled based on UE feedback on the preferable beam switch periodicity** |

## Open issues summary

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

### Sub-topic 1-1: Working assumptions and Deployment scenarios

*Sub-topic description: Discussion on various deployment scenarios applicable to the WI and priorities, if any.*

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

**Issue 1-1-1: Deployment scenarios**

* Proposal 1 (Vivo, LGE): RAN4 works on RRM requirements for standalone single-carrier and multi-carrier operation in FR2-2 first.
	+ CA/DC with FR1 and FR2-1 can be further discussed and specified after corresponding band-combinations are introduced in RF session. (Vivo, LGE, Huawei)
* Proposal 2a (Ericsson): Prioritize non-standalone scenario where new band is used for SCell while PCell belongs to FR1(high priority) and FR2-1 band
* Proposal 2b (Ericsson): RRM requirements of FR2-2 as SCG are examined without influence by the type of cell in MCG. If differentiation in requirements is necessary, DC/CA with FR1 and DC/CA with FR2-1 are needed to be checked separately.
* Proposal 3 (Intel): De-prioritize the following deployment scenarios
	+ FR2-2 CA/DC with anchor on FR2-1
	+ NE-DC scenario with NR operating in FR2-2
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
| XXX |  |

**Issue 1-1-2: Working assumptions for creating new FR2-2 RRM requirements**

* Proposal 1 (Nokia): FR2 RRM requirements apply for the operation in FR2-2, unless there is technical justification for a revision of the FR2 requirements.
* Proposal 2 (Ericsson): For RRM requirements defined with SCS already, higher SCS (e.g., 480 kHz and 960 kHz) applicable for 52.6 – 71 GHz can be defined (if needed) as function of SCS within FR2; For RRM requirements defined with FR2, it needs check if involvements of new SCS’s, division of FR2-1/FR2-2 or FR2 already can cover it.
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
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### Sub-topic 1-2: Rx beam sweeping scaling factor

*Sub-topic description: Discussion on Rx beam sweeping scaling factor.*

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

**Issue 1-2-1: Rx beam sweeping scaling factor**

* Proposal 1 (LGE, Huawei): RAN4 to consider defining new scaling factor for Rx beam sweeping in FR2-1
* Proposal 2 (Nokia, Ericsson): RAN4 to reuse the scaling factor from FR2-1 for operation in FR2-2 as a starting point
* Proposal 3 (Mediatek, Vivo): RAN4 to further study (based on SLS etc.) whether new scaling factor is needed for FR2-2 considering the trade-off between link coverage and measurement delay
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
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### Sub-topic 1-3: Scheduling restrictions

*Sub-topic description:*

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

**Issue 1-3-1: Scheduling restrictions**

* Proposal 1 (Ericsson, Vivo): Follow conclusion of FR2, no extra scheduling restriction/availability is needed at the very least as a starting point
	+ Factors that may impact scheduling restriction requirements, if any, would be identified first. (Vivo)
* Proposal 2 (LGE): Scheduling restriction in FR2-2 should be further discussed after the UE beam switching time is finalized
* Proposal 3 (Huawei): Updating the scheduling restriction for L1/L3 measurement considering the following aspects: (Huawei)
	+ Beam switching time
	+ Synchronization assumptions with large SCS
* Proposal 4 (Intel): For operation with high SCS RAN4 to introduce the scheduled gaps for UE to switch its beam
	+ Network will apply scheduling restrictions during that scheduled beam switching gap
	+ The beam switching gaps can be scheduled based on UE feedback on the preferable beam switch periodicity
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
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### Sub-topic 1-4: Random access

*Sub-topic description:*

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

**Issue 1-4-1: Random access requirements for new SCS/preamble sequence length**

* Proposal 1 (Nokia): RAN4 to reuse existing random-access requirements for the new SCS and preamble sequence length
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
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**Issue 1-4-2: Power accuracy of PRACH preambles**

* Proposal 1 (Nokia): Update, if needed, power accuracy of PRACH preambles for operation above 52.6GHz once RF has clear agreements on Output power dynamics/power control requirements
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
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### Sub-topic 1-5: Measurement procedures

*Sub-topic description:*

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

**Issue 1-5-1: Measurement capability**

* Proposal 1 (Mediatek): As a starting point, reuse FR2-1 measurement capability of number of cells and beams for FR2-2.
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
| XXX |  |

**Issue 1-5-2: Cell detection**

* Proposal 1a (Vivo): Cell detection requirements for both intra-frequency measurement and inter-frequency measurement for FR2-1 can be reused for FR2-2 under the condition that channel model TDL-A 30ns is assumed.
* Proposal 1b (Vivo): Cell detection requirements for both intra-frequency measurement and inter-frequency measurement for FR2-1 is extended by 3 samples for FR2-2.
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
| XXX |  |

**Issue 1-5-3: PBCH detection for SSB index acquisition**

* Proposal 1 (Vivo): SSB index acquisition delay for FR2-2 should be extended compare to that for FR2-1 and 5 samples are needed for SSB index acquisition for inter-frequency measurement.
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
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**Issue 1-5-4: SSB measurements**

* Proposal 1 (Vivo, Ericsson): SSB measurement period requirements for FR2-1 can be reused for FR2-2 for both intra-frequency inter-frequency measurements.
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
| XXX |  |

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

## Discussion on 2nd round (if applicable)

# Topic #2: Timing requirements

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

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112488 | Mediatek | **Observation 1: UL performance will be degraded for higher SCS if the Te is kept as 3\*64\*Tc.****Observation 2: Tightening Te too much will introduce huge impact on UE implementation.** **Proposal 1: RAN4 further to discuss the timing error limit in FR2-2 for SCS of 480 kHz and 960 kHz based on RF’s input****Proposal 2: For FR2-2 MRTD requirements, FR2-1 MRTD requirements are reused as the baseline. FFS separate MRTD requirements for SCS of 480kHz and 960kHz.**  |
| R4-2112135 | Apple | **Proposal 1: RAN4 to discuss the following points before proposing any concrete Te values:** * **How much percent of UL CP length Te can occupy without impacting UL system performance? Note two UEs may have the same amount of Te in plus and minus direction.**
* **How much channel delay spread for this band needs to be accounted for? The general understanding is in this frequency band, the cell coverage is expected to be even smaller than current FR2 bands and even finer beams are going to be used to increase beamforming gain. As such, the channel delay spread is expected to be smaller than that for other FR2 bands.**
* **Is it possible to rule out the case of 120kHz SSB SCS and 480/960kHz UL signal SCS if UE implementation turns out to be too challenging?**
 |
| R4-2112559 | Vivo | **Proposal 1: The uplink signal SCS should be no greater than SSB SCS for 52.6-71GHz.****Proposal 2: Since FR2-1 and FR2-2 is different in content, the initial transmission timing requirements for 24.25-52.6GHz and 52.6-71GHz need to be discussed separately.****Proposal 3: The UE initial transmission timing error shall be less than or equal to Te where the timing error limit value Te is specified in Table 4.**Table 4: Te Timing Error Limit

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 1 | 15 | 15 | 12\*64\*Tc |
|  |  | 30 | 10\*64\*Tc |
|  |  | 60 | 10\*64\*Tc |
|  | 30 | 15 | 8\*64\*Tc |
|  |  | 30 | 8\*64\*Tc |
|  |  | 60 | 7\*64\*Tc |
| 2-1 | 120 | 60 | 3.5\*64\*Tc |
|  |  | 120 | 3.5\*64\*Tc |
|  | 240 | 60 | 3\*64\*Tc |
|  |  | 120 | 3\*64\*Tc |
| 2-2 | 120 | 120 | 3.5\*64\*Tc |
| 480 | 120 | 2.75\*64\*Tc |
| 480 | 2.75\*64\*Tc |
| 960 | 120 | 2.5\*64\*Tc |
| 480 | 2.5\*64\*Tc |
| 960 | 2.5\*64\*Tc |
| Note 1: Tc is the basic timing unit defined in TS 38.211 [6] |

**Proposal 4: The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in Table 7.****Table 7: UE Timing Advance adjustment accuracy**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc | ±4 Tc | ±4 Tc |

 |
| R4-2113221 | Nokia | **Observation 1:** The UL timing error limit and TA command accuracy need to be scaled in order to keep errors within a small fraction of the CP length. **Proposal 1: Define RRM requirements for UE transmit timing such that overall UE transmit timing error divided by CP length is similar to the one for existing SCS.** **Proposal 2: Define timing error limit requirements as in the table below:**

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of SSB signals (kHz) | SCS of uplink signals (kHz) | Te |
| 2-2 | 120 | 480 | 0.9\*64\*Tc |
|  |  | 960 | 0.5\*64\*Tc |
|  | 480 | 480 | 0.9\*64\*Tc |
|  |  | 960 | 0.5\*64\*Tc |
|  | 960 | 960 | 0.5\*64\*Tc |

**Proposal 3: Define UE Timing Advance adjustment accuracy for 480 and 960 kHz SCS as in the table below:**

|  |  |  |
| --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±8 Tc | ±4 Tc |

**Observation 2:** UE timer accuracy requirements relate to accuracy of RRC related timers which vary on orders of tens of milliseconds to seconds. **Observation 3:** UE timer accuracy requirement are defined as band agnostic. **Proposal 4: RAN4 not to define new UE Timer accuracy requirements for the operation above 52.6 GHz.** |
| R4-2113518 | Ericsson | **Proposal 2: In response to adding additional SCS (240kHz, 480kHz, 960kHz) for SSB, and additional SCS(480kHz, 960kHz) for initial access related signals/channels in initial BWP, in this sense, combination of CSC of SSB and uplink signals needs to be checked and Te will be decided based on check results.** **Proposal 3: Add SCS (480kHz, 960kHz) in UE Timing Advance adjustment accuracy**Table 7.3.2.2-1: UE Timing Advance adjustment accuracy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc | ±8 Tc | ±4 Tc |

**Proposal 4: The conclusion in previous 3GPP meeting: scaling MRTD/MTTD with increasing SCS will severely restrict the CA deployment options isn’t valid due to higher SCS in 52.6 – 71 GHz.****Proposal 5: For MTTD, existing FR2 cannot cover higher SCS according to the rationale of existing definitions including FR2. More options for SCS of the pair of TAGs are required.** * **Minimum Requirements for inter-band EN-DC**

Table 7.5.4-1: Maximum uplink transmission timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of TAGs | Maximum uplink transmission timing difference (µs)  |
| FR1 | 34.6 |
| FR2(SCS ≤120KHz) | 8.5 Note1 |
| FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR1 and FR2(SCS ≤120KHz) | 26.1  |
| Between FR1 and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR2(SCS ≤120KHz) and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

* **Minimum Requirements for NR Carrier Aggregation**

Table 7.5.4-1: Maximum uplink transmission timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of TAGs | Maximum uplink transmission timing difference (µs)  |
| FR1 | 34.6 |
| FR2(SCS ≤120KHz) | 8.5 Note1 |
| FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR1 and FR2(SCS ≤120KHz) | 26.1  |
| Between FR1 and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR2(SCS ≤120KHz) and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

* **Minimum Requirements for inter-band NR DC**

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [16].Table 7.5.6-1: Maximum uplink transmission timing difference requirement for inter-band synchronous NR DC

|  |  |
| --- | --- |
| Frequency Range | Maximum uplink transmission timing difference (µs) |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 34.6 |
| FR2(SCS ≤120KHz) | FR2(SCS ≤120KHz) | 8.5 |
| FR1 | FR2(SCS ≤120KHz) | 34.1 |
| FR1 | FR2(120KHz<SCS≤ 960KHz) | TBD |
| FR2(SCS ≤120KHz) | FR2(120KHz<SCS≤ 960KHz) | TBD |

**Proposal 6: For MRTD, existing FR2 cannot cover higher SCS according to the rationale of existing definitions including FR2. More options for Frequency Range of the pair of TAGs are required.*** **Minimum Requirements for inter-band EN-DC**

Table 7.6.4-2: Maximum receive timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference (µs)  |
| FR1 | 33 |
| FR2(SCS ≤120KHz) | 8 note1 |
| FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR1 and FR2FR2(SCS ≤120KHz) | 25  |
| Between FR1 and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR2(SCS ≤120KHz) and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

* **Minimum Requirements for NR Carrier Aggregation**

Table 7.6.4-2: Maximum receive timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference (µs)  |
| FR1 | 33 |
| FR2(SCS ≤120KHz) | 8 note1 |
| FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR1 and FR2(SCS ≤120KHz) | 25  |
| Between FR1 and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Between FR2(SCS ≤120KHz) and FR2(120KHz<SCS≤ 960KHz) | TBD |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

* **Minimum Requirements for inter-band NR DC**

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [16].Table 7.6.6-1: Maximum receive timing difference requirement for inter-band synchronous NR DC

|  |  |
| --- | --- |
| Frequency Range | Maximum receive timing difference (µs)  |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 33 |
| FR2(SCS ≤120KHz) | FR2(SCS ≤120KHz) | 8 |
| FR1 | FR2(SCS ≤120KHz) | 33 |
| FR1 | FR2(120KHz<SCS≤ 960KHz) | TBD |
| FR2(SCS ≤120KHz) | FR2(120KHz<SCS≤ 960KHz) | TBD |

 |
| R4-2114143 | Huawei | **Observation 1: The minimum channel bandwidth for each SCS shall be considered when defining the requirements for transmit timing and timing advance adjustment accuracy.****Observation 2: UE may have better timing accuracy with larger SCS and larger minimum channel bandwidth.****Observation 3: Many components will contribute to the overall timing error, and the accuracy of some components will not change significantly when operating in FR2-2 compared to FR2-1.****Proposal 1: Take the requirements for 120 kHz SCS in FR2-1 as the baseline for Te and TA accuracy requirements.****Proposal 2: Wait for conclusions on TAE before defining the MRTD/MTTD requirements.** |
| R4-2114573 | Qualcomm | **Observation 1: RAN4 specifies the UE transmit timing based on the SSB bandwidth.****Observation 2: An additional margin in the timing error is specified to account for UE artifacts related to DL to UL switching.****Observation 3: The upper limit on the timing error is half CP length on the uplink transmission.****Observation 4: Reduction in CP length of the UL transmission for higher SCS of 480/960kHz leaves the UE with very little timing estimation error margin which does not scales down linearly with wider DL SSB bandwidth.** **Proposal 1: For UL SCS of 480/960 kHz, the UE shall use a Te corresponding to half CP length of the UL transmission.*** **For UL SCS of 480 kHz, Te = 4.5\*32\*Tc**
* **For UL SCS of 960 kHz, Te = 4.5\*16\*Tc**
 |

## Open issues summary

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

### Sub-topic 2-1: UE transmit timing error

*Sub-topic description:*

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

**Issue 2-1-1: General principles in defining the Te requirements**

* Recommended WF
	+ Considering multiple very different proposals on this topic, it is important to first agree on some basic principles in defining the Te requirements. As noted by most of the companies, it is quite challenging for the UE to meet the Te requirements with high SCS of SSB and UL signals. The following questions needs to be addressed before specifying the exact Te values
		1. How much percent of UL CP length Te can occupy without impacting UL system performance?
			- Note two UEs may have the same amount of Te in plus and minus direction.
		2. How much channel delay spread for this band needs to be accounted for?
			- The general understanding is in this frequency band, the cell coverage is expected to be even smaller than current FR2 bands and even finer beams are going to be used to increase beamforming gain. As such, the channel delay spread is expected to be smaller than that for other FR2 bands.
		3. Check the possible combinations of SSB SCS and UL signal SCS for FR2-2 and discuss if it is possible to rule out some of the combinations if UE implementation turns out to be too challenging? E.g.
			- 120kHz SSB SCS and 480/960kHz UL signal SCS
			- Uplink signal SCS is greater than SSB SCS for 52.6-71GHz
		4. Is any input from RF is needed to assist the discussion?

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| **Company** | **Comments** |
| XXX |  |

### Sub-topic 2-2: UE timer accuracy

*Sub-topic description*

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

**Issue 2-2-1: UE timer accuracy requirements**

* Proposal 1 (Nokia): RAN4 not to define new UE Timer accuracy requirements for the operation above 52.6 GHz.
* Recommended WF
	+ Discuss the proposal.

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| **Company** | **Comments** |
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### Sub-topic 2-3: Timing advance

*Sub-topic description*

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

**Issue 2-3-1: UE timing advance adjustment accuracy**

* Proposal 1: The UE shall adjust the timing of its transmissions with a relative accuracy better than or equal to the UE Timing Advance adjustment accuracy requirement in the below table
	+ Option 1 (Vivo):

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| --- | --- | --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc | ±4 Tc | ±4 Tc |

* + Option 2 (Nokia, Ericsson):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| UL Sub Carrier Spacing(kHz) | 15 | 30 | 60 | 120 | 480 | 960 |
| UE Timing Advance adjustment accuracy | ±256 Tc | ±256 Tc | ±128 Tc | ±32 Tc | ±8 Tc | ±4 Tc |

* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
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### Sub-topic 2-4: MTTD/MRTD

*Sub-topic description*

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

**Issue 2-4-1: MRTD/MTTD requirements**

* Proposal 1 (Mediatek): For FR2-2 MRTD requirements, FR2-1 MRTD requirements are reused as the baseline. FFS separate MRTD requirements for SCS of 480kHz and 960kHz.
* Proposal 2 (Huawei): Wait for conclusions on TAE before defining the MRTD/MTTD requirements
* Proposal 3 (Ericsson): For MTTD/MRTD, existing FR2 cannot cover higher SCS according to the rationale of existing definitions including FR2. More options for SCS of the pair of TAGs are required.
* Recommended WF
	+ Discuss the proposals.

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| **Company** | **Comments** |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: Interruptions

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations (Tables are skipped to avoid formatting issues)** |
| R4-2112560 | Vivo | **Observation 1: The value of MRTD would change the interruption requirements. RAN4 can further improve the interruption requirements when the MRTD requirements are completed.****Proposal 1: For Standalone NR Carrier Aggregation, when one SCell is added or released**，**the interruption requirements can be shown in Table 1 and Table 2:****Proposal 2: For Standalone NR Carrier Aggregation, when one SCell is activated or deactivated**, **the interruption requirements can be shown in Table 3 and Table 4:****Proposal 3: For Standalone NR Carrier Aggregation, when BWP is switched on PCell and or SCell**, **the interruption requirements can be shown in Table 5:****Proposal 4: For Standalone NR Carrier Aggregation, when SRS carrier based switching is performed between carriers**, **the interruption requirements on any active serving cell can be shown in Table 6 and Table 7:** |
| R4-2113222 | Nokia | 1. Existing intra-band interruptions for NR-DC and SA consists of 1 ms + SMTC duration for tSCell addition/release and 0.5 ms + SMTC duration for SCell activation deactivation and measurements on SCC. .
2. Define interruption duration requirements for 480 kHz and 960 kHz in Intra-band CA and NR-DC as 1 ms + SMTC duration for tSCell addition/release and 0.5 ms + SMTC duration for SCell activation deactivation and measurements on SCC.
3. Define interruption duration requirements for 480 kHz and 960 kHz SCS in Intra-band CA and NR-DC as in the table below:
4. Interruption duration requirements for intra-frequency for NR SA (CA and NR-DC) with aggressor and victim cells on the same frequency are of 1 ms for SCell addition/release and 0.5 ms for other inter-band requirements.
5. When aggressor and victim cells are in different frequency ranges, the inter-band requirements for 60 kHz and 120 kHz SCS in SA scenarios are increased by 1 slot.
6. Define interruption duration requirements for 480 kHz and 960 kHz SCS in Inter-band CA and NR-DC as in the table below:
 |
| R4-2113336 | Ericsson | **Observation 1: The SCS (e.g., 480 kHz and 960 kHz) applicable for 52.6 – 71 GHz and their corresponding interruption lengths can be included in the tables on the interruption requirements.****Proposal 1: Below three interruptions are prioritised as follows, taking possible application scenarios into account we proposed:****• EN-DC Interruption** **Add SCS (e.g., 480 kHz and 960 kHz)** **• SA: Interruptions with Standalone NR Carrier Aggregation** **Add SCS (e.g., 480 kHz and 960 kHz)** **• NR-DC: Interruptions** **Add SCS (e.g., 480 kHz and 960 kHz)** |
| R4-2114144 | Huawei | **Observation 1: The interruption requirements are derived based on absolute time durations for certain UE actions.****Proposal 1: Define the interruption requirements for FR2-2 based on the same assumptions as in legacy FR2.****Observation 2: The interruption requirements for FR2-2 shall consider the MRTD between CCs where additional slot may be allowed when the MRTD is non-negligible considering the slot length of 480 kHz and 960 kHz.** |
| R4-2114190 | Intel | **Proposal 1: For new SCSs RAN4 to define interruption length at transition between active and non-active during DRX (Table 8.2.1.2.1-1 in TS38.133) as shown in Table 1****Proposal 2: For new SCSs RAN4 to define interruption length at SCell addition/release for EN-DC (Tables 8.2.1.2.3-1, 8.2.1.2.3-1 in TS38.133) as shown in Tables 2-3 and for SA (Tables 8.2.2.2.1-1, 8.2.2.2.1-1 in TS38.133) as shown in Tables 4-5****Proposal 3: For new SCSs RAN4 to define interruption length at SCell activation/deactivation for EN-DC (Tables 8.2.1.2.4-1, 8.2.1.2.4-2) as shown in Tables 6-7 and for SA (Tables 8.2.2.2.2-1, 8.2.2.2.2-2) as shown in Tables 8-9****Proposal 4: For new SCSs RAN4 to define interruption length at measurements on deactivated E-UTRA SCC (Table 8.2.1.2.5.2-1) as shown in Table 10.****Proposal 5: For new SCSs RAN4 to define interruption length at Active BWP switching for EN-DC (Table 8.2.1.2.7-1) and SA (Table 8.2.2.2.5-1) as shown in Table 11.****Proposal 6: For new SCSs RAN4 to define interruption length due to UE-specific CBW change (Table 8.2.1.2.11-1) as shown in Table 12.****Proposal 7: For new SCSs RAN4 to define interruption length at NR SRS carrier based switching (Tables 8.2.1.2.12-1, 8.2.1.2.12-2 for EN-DC and Tables 8.2.2.2.9-1, 8.2.2.2.9-2 for SA) as shown in Table 12-13.** |
| R4-2114572 | Qualcomm | **Proposal 1: Given the limited number of RAN4 meetings for this WI, propose that RAN4 prioritize specifying interruption requirements for FR2-2 in the following order:**1. **NR-SA**
2. **NR-DC**
3. **EN-DC and NE-DC (if time permits or during maintenance phase)**

**Observation 1: RAN4 specifies the UE transmit timing based on the SSB bandwidth.****Observation 2: An additional margin in the timing error is specified to account for UE artifacts related to DL to UL switching.****Observation 3: The upper limit on the timing error is half CP length on the uplink transmission.****Observation 4: Reduction in CP length of the UL transmission for higher SCS of 480/960kHz leaves the UE with very little timing estimation error margin which does not scales down linearly with wider DL SSB bandwidth.** **Proposal 2: For UL SCS of 480/960 kHz, the UE shall use a Te corresponding to half CP length of the UL transmission.*** **For UL SCS of 480 kHz, Te = 4.5\*32\*Tc**
* **For UL SCS of 960 kHz, Te = 4.5\*16\*Tc**

**Proposal 3: Propose to update Table 8.2.2.2.1-1 and 8.2.2.2.1-2 with 480/960 kHz subcarrier spacing as below:****Proposal 4: Propose to update Table 8.2.2.2.2-1 and 8.2.2.2.2-2 with 480/960 kHz subcarrier spacing as below:****Proposal 5: Propose to update Table 8.2.2.2.3-1 with 480/960 kHz subcarrier spacing as below:** |

## Open issues summary

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

### Sub-topic 3-1: Requirement prioritization

*Sub-topic description:*

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

**Issue 3-1-1: Prioritization of interruption requirements**

* Proposal 1 (Ericsson): Below three interruptions are prioritised as follows, taking possible application scenarios into account we proposed:
	+ EN-DC Interruption
		1. Add SCS (e.g., 480 kHz and 960 kHz)
	+ SA: Interruptions with Standalone NR Carrier Aggregation
		1. Add SCS (e.g., 480 kHz and 960 kHz)
	+ NR-DC: Interruptions
		1. Add SCS (e.g., 480 kHz and 960 kHz)
* Proposal 2 (Qualcomm): RAN4 prioritize specifying interruption requirements for FR2-2 in the following order:
	+ SA: Interruptions with Standalone NR Carrier Aggregation (Vivo)
	+ NR-DC: Interruptions
	+ EN-DC and NE-DC Interruptions (if time permits or during maintenance phase)
* Recommended WF
	+ Discuss the proposals along with the deployment scenarios being discussed under Sub-topic 1-1.

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| **Company** | **Comments** |
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### Sub-topic 3-2: General principles

*Sub-topic description:*

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

**Issue 3-2-1: Applicability of FR2-1 interruption durations**

* Proposal 1 (Huawei, Vivo, Nokia, Intel, Qualcomm): Define the interruption requirements for FR2-2 based on the same assumptions (RF retunings, AGC etc) as in legacy FR2 (FR2-1).
	+ The baseline interruption time (Ti) in FR2-2 to be same as FR2-1
		1. Nslot,interrupted = ⌈ Ti/Tslot ⌉ for synchronous scenario
		2. Nslot,interrupted = ⌈ Ti/Tslot ⌉ + 1, for asynchronous scenario
* Recommended WF
	+ Agree on proposal 1.

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| **Company** | **Comments** |
| XXX |  |

**Issue 3-2-2: Impact of MRTD**

* Proposal 1a (Huawei, Vivo): The interruption requirements for FR2-2 shall consider the MRTD between CCs where additional slot may be allowed (asynchronous scenarios) when the MRTD is non-negligible considering the slot length of 480 kHz and 960 kHz.
* Proposal 1b (Intel): The symbol length for 480/960kHz SCS is very short and CP length is shorter than MRTD (considering that legacy FR2 MRTD requirements can be applied both for FR2-1 and FR2-2) implying that FR2-2 will always have asynchronous scenario. Always allow an additional slot, wherever applicable.
* Recommended WF
	+ Discuss proposal 1a and 1b.

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| **Company** | **Comments** |
| XXX |  |

### Sub-topic 3-3: Interruption requirements

*Sub-topic description: The exact interruption tables will be updated here in the second round once we have some agreements on the deployment scenarios and/or general principles.*

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

**Issue 3-3-1: TBD**

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| **Company** | **Comments** |
| XXX |  |

## Summary for 1st round

### Open issues

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

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
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**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

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** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | 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