**3GPP TSG-RAN WG4 Meeting # 107 R4-23xxxxx**

**Incheon, Korea, 22nd – 26th May 2023**

**Agenda item:** 8.10.4

**Source:** Moderator (Intel Corporation)

**Title:** Topic summary for [107][212] NR\_MG\_enh2\_part2

**Document for:** Information

# Introduction

This document is the TDocs summary for [107][212] NR\_MG\_enh2\_part2 with the following topics covered

* Topic 1: Measurement without gaps for UEs reporting NeedForGapsInfoNR (AI 8.10.3.1)
* Topic 2: Inter-RAT measurement without gap (AI 8.10.3.2)

The moderator decides to choose the issues listed in this document for discussions in this meeting. The untouched issues raised in contributions are very much appreciated either but due to limited time in the meeting the moderator suggest to have certain priority. If the time is allowed in this meeting according to the session chair’s guidance we could discuss the mentioned issues in addition.

# Topic #1: Measurement without gaps for UEs reporting NeedForGaps

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307191 | Nokia | Discussion on measurements without gapsObservation 1: The network needs information of the measurement interruption to make scheduling decisions.Observation 2: Network KPIs might be affected if interruptions are placed in random locations, since the network cannot distinguish among lost ACK/NACK or DTX due to interruption or due to interference.**Proposal 1: The UE is only allowed to cause interruptions on PCell or activated Scell(s) immediately before and after an SMTC. The UE is not expected to cause interruption on each SMTC occasion.****Proposal 2: The UE is only allowed to cause interruptions on Pcell or activated Scell(s) in the certain time window before and after an SMTC.**Observation 3: If the interruptions used for no-gaps with interruption is the same as the ones with NCSG, there is no advantage of using the no-gap Case 2.**Proposal 3: Smaller interruption than NCSG is expected for UE signaling no-gap type 2.****Proposal 4: When UE signals “no-gap Case 2”, the interruption length can be specified based on the same RRT assumption as for NCSG (0.5ms in FR1 and 0.25ms in FR2) interruption occasion.**Observation 4: Existing requirements for measurements without gaps consider that the UE is not performing gap-less measurements on a SMTC occasion that is overlapping with a measurement gap, and Kp is used to extend the measurement delay.**Proposal 5: RAN4 to consider Kp as part of the calculation for the measurement cycle.****Proposal 6: RAN4 to consider Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSF x Kp) for FR1, where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.****Proposal 7: RAN4 to consider Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSF x Kp x KFR x Klayer1\_measurement) for FR2, where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps, and KFR is the scaling factor depending on the frequency range and SSB SCS.**Observation 5: drx-onDurationTimer can be as small as 1/32 msObservation 6: Interruption lengths of 0.25 to 1 ms during DRX ON duration would have extremely large impact on UE throughput, since it could cover the whole DRX ON duration.**Proposal 8: No interruption is expected when configured SMTC occasions are misalignment with DRX ON duration****Proposal 9: When DRX cycle is larger than 320ms, no interruption is expected****Proposal 10: When DRX is configured and interruption is allowed, the interruption ratio is determined considering the measurement cycle as agreed in Issue 1-1-5, where Tcyle is calculated considering DRX cycle.**Observation 7: 38.133 already have requirements for inter/intra frequency without measurement gaps in 9.2.5 and 9.3.9.**Proposal 11: RAN4 can reuse measurement delay requirements in 9.2.5 and 9.3.9 for measurement without gaps and without interruption.****Proposal 12: Consider the formulas for calculating intra-frequency measurement without gaps with interruption for FR1 as in the table below:**

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra | TSSB\_time\_index\_intra | T SSB\_measurement\_period\_intra  |
| No DRXNote 1 | max( 600ms x CSSFintra, 5 x Tcycle ) | max(120ms x CSSFintra, 3 x Tcycle)  | max(200ms x CSSFintra, 5 x Tcycle) |
| DRX cycle≤ 320ms Note 2, Note 3 | max( 600ms x CSSFintra, ceil(M2 x 5) x Tcycle)  | max(120ms x CSSFintra, ceil (M2x 3) x Tcycle)  | max(200ms x CSSFintra, ceil(1.5x 5) x Tcycle)  |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFintra | Ceil(3 x Kp) x DRX cycle x CSSFintra | ceil( 5 x Kp ) x DRX cycle x CSSFintra |
| NOTE 1: Tcycle = max( 80, TSMTC x CSSFintra x Kp), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 2: Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSFintra x Kp), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 3: Requirements considered only if SMTC overlaps with DRX ON, otherwise requirements without gaps without interruption apply. |

**Proposal 13: Consider the formulas for calculating intra-frequency measurement without gaps with interruption for FR2 as in the table below:**

|  |  |  |
| --- | --- | --- |
| DRX cycle | TPSS/SSS\_sync\_intra | T SSB\_measurement\_period\_intra  |
| No DRXNote 1 | max(600ms x CSSFintra, Mpss/sss\_sync\_w/o\_gaps x Tcycle)  | max(400ms x CSSFintra, Mmeas\_period\_w/o\_gaps Tcycle) |
| DRX cycle≤ 320ms Note 2, Note 3 | max(600ms x CSSFintra, ceil(1.5 x Mpss/sss\_sync\_w/o\_gaps)x Tcycle)  | max(400ms x CSSFintra, ceil(1.5x Mmeas\_period\_w/o\_gaps) Tcycle) |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps x KFR x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra | ceil(Mmeas\_period\_w/o\_gaps xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: Tcycle = max( 80, TSMTC x CSSFintra x Kp x KFR x Klayer1\_measurement), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 2: Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSFintra x Kp x KFR x Klayer1\_measurement), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps, and KFR is the scaling factor depending on the frequency range and SSB SCS.NOTE 3: Requirements considered only if SMTC overlaps with DRX ON, otherwise requirements without gaps without interruption apply. |

**Proposal 14: Consider the formulas for calculating inter-frequency measurement without gaps with interruption for FR1 as in the table below:**

|  |  |  |  |
| --- | --- | --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter | TSSB\_time\_index\_inter | T SSB\_measurement\_period\_inter  |
| No DRXNote 1 | max( 600ms x CSSFinter, 5 x Tcycle) | max(120ms x CSSFinter, 3 x Tcycle) | max(200ms x CSSFinter, 5 x Tcycle) |
| DRX cycle≤ 320ms Note 2, Note 3 | max( 600ms x CSSFinter, ceil(M2x 5) x Tcycle) | max(120ms x CSSFinter, ceil (M2 x 3) x Tcycle)  | max(200ms x CSSFinter, ceil(1.5x 5) x Tcycle)  |
| DRX cycle>320ms | ceil(5 x Kp) x DRX cycle x CSSFinter | Ceil(3 x Kp) x DRX cycle x CSSFinter | ceil( 5 x Kp ) x DRX cycle x CSSFinter |
| NOTE 1: Tcycle = max( 80, TSMTC x CSSFinter x Kp), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 2: Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSFinter x Kp), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 3: Requirements considered only if SMTC overlaps with DRX ON, otherwise requirements without gaps without interruption apply. |

**Proposal 15: Consider the formulas for calculating intra-frequency measurement without gaps with interruption for FR2 as in the table below:**

|  |  |  |
| --- | --- | --- |
| DRX cycle | TPSS/SSS\_sync\_inter | T SSB\_measurement\_period\_inter  |
| No DRXNote 1 | max(600ms x CSSFinter, Mpss/sss\_sync\_inter x Tcycle)  | max(400ms x CSSFinter, Mmeas\_period\_inter x Tcycle) |
| DRX cycle≤ 320ms Note 2, Note 3 | max(600ms x CSSFinter, ceil(1.5 x Mpss/sss\_sync\_inter )x Tcycle)  | max(400ms x CSSFinter, ceil(1.5x Mmeas\_period\_inter) x Tcycle)  |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_inter x Kp x Klayer1\_measurement) x DRX cycle x CSSFinter | ceil(Mmeas\_period\_inter xKp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: Tcycle = max( 80, TSMTC x CSSFinter x Kp x KFR x Klayer1\_measurement), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps.NOTE 2: Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSFinter x Kp x KFR x Klayer1\_measurement), where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps, and KFR is the scaling factor depending on the frequency range and SSB SCS.NOTE 3: Requirements considered only if SMTC overlaps with DRX ON, otherwise requirements without gaps without interruption apply. |

Observation 8: If a UE signals no-gap as part of needForGaps or needForGapNCSG no interruption is expected by Rel-15 to Rel-17 gNBs.**Proposal 16: Indication of “no-gap” as part of needForGaps or needForGapsNCSG means no-gap Case 1 (no gap without interruption).****Proposal 17: No impact on Rel-18 NFG requirements because of mismatch scenarios where either UE or NW support Rel-17 or earlier release.**Observation 9: RRC messages configuring NFG or NCSG include overhead of RRC processing delay.**Proposal 18: [Rel 18 NeedForGapsInfoNR] and NeedForGapNCSG-InfoNR may be enabled for the same UE at the same time** |
| R4-2307408 | CATT | Discussion on RRM requirements for measurement without gaps for UEs reporting NeedForGapsInfoNR **Proposal 1: The UE is only allowed to cause interruptions on PCell or activated Scell(s) immediately before and after an SMTC. The UE is not expected to cause interruption on each SMTC occasion.****Proposal 2: For the case when UE reporting “no gap with interruption”, each interruption length should be defined as the number of interrupted slots corresponding to the RRT (0.5ms in FR1 and 0.25ms in FR2).** **Proposal 3: No** **need to capture the interruption ratio in equation format.** **Proposal 4: Tcycle is the available measurement interval in the measurement period requirements after considering the resource collision.**  |
| R4-2307445 | Vivo | Consideration on issues on measurement without gaps for UEs reporting NeedForGapsInfoNR **Proposal 1: For possible restrictions for interruptions, suggest that no more further restrictions are considered for interruptions.** **Proposal 2: For requirements on the interruption length, support option 1.** **Proposal 3: The interruption ratios agreed apply for a signal frequency layer. It is expected that the same interruption ratio will apply for all related frequency layer as well.** **SMTC and Kp should be included in the Tcycle.** |
| R4-2307554 | CMCC | Discussion on measurements without gap for UE supporting NeedForGapsInfoNR***Proposal 1: for the case without gap but interruption allowed, the interruption length can be specified based on RF retuning/retuning time, which is 0.5ms for FR1 and 0.25ms for FR2.*** ***Proposal 2: Measurement cycle length (Tcycle) = Kp \* number of measurment samples \* Max(SMTC period, DRX cycle)) \* CSSF.******Proposal 3: it is proposed to update the definition of inter-frequency SSB based measurements without measurement gaps in 9.3.1, 38.133 to include the case when UE indicates ‘no-gap’ via interFreq-needForGap.*** ***Proposal 4: for intra-frequency measurement without gap with or without interuption, AGC is not needed, the number of samples for PSS/SSS detection is 5.******Proposal 5: for intra-frequency measurement without gap with or without interuption, AGC is not needed, the number of samples for measurement period is 5.******Proposal 6: for inter-frequency measurement without gap with or without interuption, the number of samples for PSS/SSS detection is 8 if AGC is needed.******Proposal 7: for inter-frequency measurement without gap with or without interuption, the number of samples for measurement period is 8 if AGC is needed.******Proposal 8: for both intra-frequency and inter-frequency measurement without gap with or without interuption, the number of samples for SSB index detection is 3.***  |
| R4-2307638 | Apple | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR **Observation 1: restriction such as ‘interruptions immediately before and after an SMTC’ cannot benefit the system considering 1) SMTC configuration of different MO can be different. 2) It is up to UE on which MO to measure during each SMTC occasion.****Observation 2: restriction such as ‘UE is only allowed to cause interruptions on Pcell or activated Scell(s) in the certain time window before and after an SMTC’ needs more study. If the window is specified in RAN4 interruption requirement, then RAN4 needs to discuss how to design it so that it could cover all the cases, including scenario wherein SMTC offset, periodicity and duration are different among different MOs. If it is configured by NW, e.g. NW indicates interruption periodicity and starting time offset, it would be become something similar to NCSG, which has already been supported in R17.****Proposal 1: not define any restriction on interruption location in this release. Any enhancement can be considered in future release.****Proposal 2: interruption length shall be same as VIL defined for NCSG, e.g.*** **When UE reporting “[no-gap,TBD]” in [*NeedForGapInfoNR, TBD]* the interruption length can be VIL=1ms in FR1 and VIL=0.75ms in FR2.**
* **When UE reporting “[others,TBD]” in [*NeedForGapInfoNR, TBD]* no interruption allowed**

**Observation 3: whether interruption ratio applies to a single frequency layer or all frequency layers depends on how Tcycle is defined.****Proposal 3: define Tcycle based on sampling interval on all MOs which would cause interruption. With this, the interruption ratio is the total ratio, i.e., it shall apply for all frequency layers.****Observation 4: total interruption ratio shall reflect that some MOs need interruption while other do not.****Proposal 4: Tcycle = SMTC x CSSF x Kp x Kinterruption, where is the number of carriers on which the measurement may cause interruption.****Proposal 5: RAN4 shall not spend time to further clarify the meaning of value ‘no-gap’ in Rel-16 NeedForGap signalling.** |
| R4-2307805 | Intel Corporation | Discussion on measurements without gaps for UE reporting NFG**Proposal 1: Do not specify the interruption locations.****Proposal 2: As a starting point, the interruption length can be same as these defined for NCSG, e.g.*** **When UE reporting “no-gap[TBD]” in [NeedForGapInfoNR] the interruption length can be VIL=1ms in FR1 and VIL=0.75ms in FR2.**
* **When UE reporting “others[TBD]” in [NeedForGapInfoNR] no interruption allowed**

**Proposal 3: The measurement period requirements of intra-freq measurements without gap when interruption allowed (case 2) in Rel18 can be defined as****Table 9.x.y.z-1: Measurement period for intra-frequency measurements without gaps (FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra**  |
| No DRX | Max(200ms, Ceil(5 x Kp) x measCycleNFG) x CSSFintra |
| DRX cycle≤ 320ms | Max(200ms, Ceil(5 x Kp) x max(measCycleNFG, 1.5xDRX cycle)) x CSSFintra |
| DRX cycle> 320ms | Max(200ms, Ceil(5 x Kp) x max(measCycleNFG, DRX cycle)) x CSSFintra |
| NOTE 1: measCycleNFG is the measurement cycle when UE supported [no-gap-with-interruption] |

**Table 9.x.y.z-2: Measurement period for intra-frequency measurements without gaps (FR2)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra**  |
| No DRX | Max(400ms, Ceil(Mmeas\_period\_w/o\_gaps x Kp) x measCycleNFG ) x CSSFintra |
| DRX cycle≤ 320ms | Max(400ms, Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleNFG, 1.5xDRX cycle)) x CSSFintra |
| DRX cycle> 320ms | Ceil(Mmeas\_period\_w/o\_gaps x Kp) x max(measCycleNFG, DRX cycle) x CSSFintra |
| NOTE 1: measCycleNFG is the measurement cycle when UE supported [no-gap-with-interruption] |

**Proposal 4:** **The measurement period requirements of inter-freq measurements without gap when interruption allowed (case 2) in Rel18 can be defined as****Table 9. x.y.zz-1: Measurement period for inter-frequency measurements without gaps ((FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter**  |
| No DRX | max(200ms, ceil( 5 x Kp) x measCycleNFG)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 5 x Kp) x max(measCycleNFG,DRX cycle)) x CSSFinter |
| DRX cycle>320ms | ceil( 5 x Kp ) x DRX cycle x CSSFinter |
| NOTE 1: measCycleNFG is the measurement cycle when UE supported [no-gap-with-interruption] |

**Table 9. x.y.zz-2: Measurement period for inter-frequency measurements without gaps (FR2)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_inter**  |
| No DRX | max(400ms, ceil(Mmeas\_period\_inter x Kp x Klayer1\_measurement) x measCycleNFG)Note 1 x CSSFinter |
| DRX cycle≤ 320ms | max(400ms, ceil(1.5x Mmeas\_period\_inter x Kp x Klayer1\_measurement) x max(measCycleNFG,DRX cycle)) x CSSFinter  |
| DRX cycle>320ms | ceil(Mmeas\_period\_inter xKp x Klayer1\_measurement) x DRX cycle x CSSFinter |
| NOTE 1: measCycleNFG is the measurement cycle when UE supported [no-gap-with-interruption] |

**Proposal 5: The measurement period requirements of intra/inter-freq measurements without gap and no interruption (case 1) in Rel18 can be defined by reusing the existing requirements in Section 9.2.5 / 9.3.9 of TS38.133 respectively with the necessary updates on CSSFoutside\_gap in 9.1.5.1 of TS38.133.****Proposal 6: No need to establish the mapping between UE’s indication for NeedForGaps and NCSG.** |
| R4-2307958 | Xiaomi | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR **Proposal 1:** **For the issue of requirements on the interruption length, we support option 1 to define the interruption length same as VIL defined for NCSG.****Proposal 2: RAN4 to remove the square brackets of the interruption ratio agreed in last meeting:*** **80ms ≤ Tcycle < 160ms: up to 2.50% probability of interruption**
* **160ms ≤ Tcycle < 320ms: up to 1.25% probability of interruption**
* **320ms ≤ Tcycle: up to 0.625% probability of interruption**

**Proposal 3: RAN4 to define the interruption ratio requirement applies to all frequency layers.****Proposal 4: The Tcycle definition is as follow:*** **When no DRX is used: Tcycle = SMTC x Kp;**
* **When DRX is in use:**
	+ **When DRX cycle ≤ 320ms, Tcycle = 1.5 x max(SMTC, DRX) x Kp;**
	+ **When DRX cycle > 320ms, Tcycle = DRX cycle x Kp;**

**Proposal 5: The measurement requirements for inter-frequency case 1 can be defined by reusing 9.3.9 framework in TS38.133, and the update is only needed for the definition part.****Proposal 6: The measurement requirements for intra/inter-freq measurement without gap when interruption allowed (case 2) can be defined with the following aspects:*** **Update the definition part**
* **Take the low bound and measurement samples needed for the procedure of PSS/SSS detection, measurement and SSB index detection for NCSG in 9.3.10 as baseline**
* **Measurement cycle, Kp, Klayer1\_measurement, and CSSFoutside\_gap depends on the Tcycle definition discussed in issue 1-1-1.**
 |
| R4-2308443 | Ericsson | Discussion on measurement for NeedForGaps ***Observation 1: In Rel-15, RAN4 had already solved the power consumption issue for short DRX measurement by further scaling factor*** *1.5.****Observation 2: The benefits of 1-to-1 mapping between NeedForGaps and NCSG is to avoid the frequent large signalling interaction.******Proposal 1: The interruption length equals 0.5ms in FR1 and 0.25 in FR2 when UE reports ‘interruption’ in NeedForGaps.******Proposal 2: RAN4 to agree that the UE is only allowed to cause interruptions on PCell or activated Scell(s) immediately before and after an SMTC. The UE is not expected to cause interruption on each SMTC occasion.******Proposal 3: RAN4 to define the interruption ratio for NeedForGaps based on a general equation other than listing all the possible combinations.******Proposal 4: RAN4 to introduce a NW indicator to reduce the total interruption ratio.**** ***Option 1: Use a scaling factor KNeedForGaps,i to extend SMTC measurement delay***
* ***Option 2: Use MeasCycleNFGi to replace SMTC to define measurement delay***

***Proposal 5: When no DRX is configured, the measurement cycle for frequency layer #i in which UE reports ‘interruption needed’ is max(80ms, KNeedForGaps,i\*SMTCi\*CSSFi) in NeedForGaps.******Where,*** ***KNeedForGaps,i is the interruption ratio controller indicator for frequency layer #i;******SMTCi is the SMTC periodicity for frequency layer #i;******CSSFi is the CSSF for frequency layer #i.******Proposal 6: RAN4 to define the interruption ratio when DRX is configured**** ***When DRX cycle is equal or smaller than 320ms,***
	+ ***no interruption is expected when configured SMTC occasions are misalignment with DRX ON duration;***
	+ ***otherwise, the interruption ratio is min(K, 2\*L/(KNeedForGaps \*1.5\* max(DRX cycle, SMTCi) \*CSSFi)).***
* ***When DRX cycle is larger than 320ms, no interruption is expected.***

***Proposal 7: RAN4 to define UE measurement requirements with different UE capabilities and NW configurations as in Table below.******Table: UE measurement requirements with different UE capabilities and NW configurations***

|  |  |  |
| --- | --- | --- |
|  NW configUE capability | Case a: No gap  | Case b:MG |
| Case 1: gap | No requirement | Measurement with MG |
| Case 2: no-gap-with-interruption | NeedForGaps requirement | FFS |
| Case 3: no-gap-no-interruption | Measurement without MG | Measurement outside MG |

***Proposal 8: When UE reports ‘no-gap-with-interruption’ in NeedForGaps, and NW configures the MG, RAN4 to further study UE’s behaviour**** ***Scenario 1: There is no band UE reporting ‘gap’ in NeedForGaps, but NW configures the MG***
* ***Scenario 2: There are other band(s) UE reporting ‘gap’ in NeedForGaps, and NW configures the MG***

***Proposal 9: RAN4 to agree the measurement requirement for NeedForGaps case 1 in FR1 as follow.*****Table. Measurement period when UE reports ‘no gap no interruption’ in NeedForGaps for inter-frequency measurements (FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_NeedForGaps\_wo\_interuption**  |
| No DRX | max(200ms, ceil( 8 x Kp) x SMTC period) x CSSFNeedForGaps\_no\_interrupt |
| DRX cycle≤ 320ms | max(200ms, ceil(1.5x 8 x Kp) x max(SMTC period, DRX cycle)) x CSSFNeedForGaps\_no\_interrupt |
| DRX cycle>320ms | ceil( 8 x Kp ) x DRX cycle x CSSFNeedForGaps\_no\_interrupt |

***Proposal 10: In case 1, RAN4 to agree the following bullets CSSFNeedForGaps\_no\_interrupt as follow.**** ***CSSFNeedForGaps\_no\_interrupt is determined according to CSSFoutside\_gap,i for measurement conducted outside MG/NCSG or according to CSSFwithin\_gap,i for measurement conducted within measurement gaps.***

***Proposal 11: In case 1, RAN4 to update the CSSFoutside\_gap,i to add additional factor NNeedForGaps\_no\_interrupt, where NNeedForGaps\_no\_interrupt is the number of configured MOs in the bands which UE reports ‘no gap no interruption’ in NeedForGaps and not fully overlapping with the MG; otherwise, it is 0.******Proposal 12: In case 2, RAN4 to update the CSSFoutside\_gap,i to add additional factor NNeedForGaps\_with\_interrupt , where NNeedForGaps\_with\_interrupt is the number of configured MOs in the bands which UE reports ‘no gap with interruption’ in NeedForGaps and not fully overlapping with the MG; otherwise, it is 0.******Proposal 13: RAN4 to agree the measurement requirement for NeedForGaps case 2 outside gap in FR1 as follow.*****Table: Measurement period when UE reports ‘no gap with interruption’ in NeedForGaps for inter-frequency measurements (FR1)**

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_NeedForGaps\_with\_interuption**  |
| No DRX | max([640ms], ceil(8 × Kp) × KNeedForGaps × SMTC period) × CSSFoutside\_gap |
| DRX cycle≤ 320ms | max([640ms], ceil(1.5x 8 x Kp) x KNeedForGaps × max(SMTC period, DRX cycle)) x CSSFoutside\_gap |
| DRX cycle>320ms | ceil(8 x Kp ) x DRX cycle x CSSFoutside\_gap |

***Proposal 14: RAN4 to agree the measurement requirement for NeedForGaps case 2 within gap the same as legacy measurement within gap.******Proposal 15: RAN4 to postpone the 1-to-1 mapping between NeedForGaps and NCSG capabilities until RAN4 has a clear understanding on NeedForGaps requirement.*** |
| R4-2308463 | OPPO | On measurement without gaps for UEs reporting NeedForGapsInfoNR **Proposal 1: Introduce restrictions for interruptions, and interruptions are only allowed on PCell or activated Scell(s) immediately before and after an SMTC.****Proposal 2: Support option 1, the interruption length can be same as VIL defined for NCSG, e.g.*** **When UE reporting “[no-gap, TBD]” in [*NeedForGapInfoNR, TBD*], the interruption length can be VIL=1ms in FR1 and VIL=0.75ms in FR2.**
* **When UE reporting “[other, TBD]” in [*NeedForGapInfoNR, TBD*], no interruption allowed**

**Proposal 3: When defining Tcycle, consider SMTC period and Kp, and in addition consider Klayer1\_measurement for FR2.****Proposal 4: CSSF should not be considered in Tcycle and the agreed interruption ratio should only apply to single frequency layer.****Proposal 5: In case of multiple frequency layers with different measurement cycle, the interruption ratio with the shortest measurement cycle should apply.** **Proposal 6: When defining delay for measurement without gap with interruption, the [meas\_cycle] should be SMTC period in case of non-DRX and max(SMTC period, DRX cycle) in case of DRX.****Proposal 7a: When defining delay for measurement without gap with interruption, the sample number within NCSG in Rel-17 (i.e. 8-sample including AGC) should be used.****Proposal 7b: When defining delay for inter-frequency measurement without gap without interruption, the sample number for measurement without gap in Rel-16 (i.e. 5-sample) should be used.** |
| R4-2308660 | Huawei | Discussion on requirements for NeedForGaps**Proposal 1: No additional restriction on interruption location is defined.** **Proposal 2: The length of each interruption is defined as 1ms for FR1 and 0.75ms for FR2.****Proposal 3: Adopt the following updates to the interruption ratio requirements.*** **Interruption ratio is defined for a single frequency layer, and total interruption ratio is the sum of interruption ratio of individual frequency layers.**
* **Tcycle is defined as max(80ms, TmeasCycle \* CSSF \* Kp), where TmeasCycle equals to SMTC period or a NW configured value (similar to measCycleSCell).**

**Proposal 4: RAN4 not to define further optimization of interruption ratio based on DRX.****Proposal 5: For measurement with interruption, adopt the following updates based on existing requirements for measurement without gap.*** **SMTC period is changed to TmeasCycle as in Proposal 3**
* **CSSF outside MG is updated to account for MOs measured outside MG**

**Proposal 6: For inter-frequency measurement without interruption, existing requirements in cl. 9.3.9 (for the case where UE reports ‘nogap-noncsg’ with NeedForGapNCSG-InfoNR) can be re-used.****Proposal 7: RAN4 not to define default SMTC pattern or dedicated measurement pattern to restrict the scheduling restriction occasions.****Proposal 8: Agree on the following principles for NeedForGap and NCSG reporting** * **[NeedForGapsInfoNR] and NeedForGapNCSG-InfoNR are not expected to be enabled for the same UE at the same time.**
* **No need to establish the mapping between UE’s indication for NeedForGaps and NCSG**

**Proposal 9: RAN4 not to further discuss UE behaviours in mismatch scenarios.****Proposal 10: RAN4 not to further discuss the assumption on whether interruption is needed or not for a UE reporting ‘no-gap’ in Rel-16 NeedForGapsInfoNR.** |
| R4-2308723 | ZTE Corporation | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR**Proposal 1: The UE is only allowed to cause interruptions immediately before and after an SMTC occasion.****Proposal 2: For the requirements on interruption length, apply the RTT assumption, i.e. the interruption length can be 0.5ms in FR1 or 0.25ms in FR2.****Proposal 3: We are open for whether to define interruption ratio in equation form or not, but we suggest to discuss frequency layer issue and the definition of Tcycle first.****Proposal 4: We are fine to consider SMTC, CSSF and Kp in the definition of Tcycle.** **Proposal 5: UE is expected to perform measurement during DRX off duration.****Proposal 6: The definition of inter-freq no-gap measurement needs to be updated in the TS 38.133 clause 9.3.1.****Proposal 7: Existing scheduling restriction requirements in the TS38133 clause 9.3.10 can be reused for no-gap measurement with interruption. And there is no scheduling restriction for no-gap measurement without interruption.** **Proposal 8: We are fine to introduce the default SMTC pattern.** |
| R4-2309423 | Qualcomm | Discussion on requirements for measurement without gap**Proposal: Definition of Tcycle = max(80ms, SMTC period, DRX cycle).****Proposal: CSSF and other scaling factor need to be included at measurement requirements similar to existing measurement requirements.** **Proposal: interruption length is same as VIL defined for NCSG, 1ms in FR1 and 0.75ms in FR2.** **Observation** : As measurement period are scaled from CSSF for multiple frequency layers, total interruption ratio is not larger than interruption ratio for single layer. Same upper bound of interruption ratio can be used for multiple frequency layers. $$Total interruption ratio for multiple layers =\frac{Total interruption length}{Measurement period}≅\frac{2\*Interruption length \*N\_{freqlayer}}{Tcycle \*CSSF \*scaling factors}\leq \frac{2\*interruption length}{Tcycle }=Interruption ratio for single layer$$**Proposal 2: No need to define separate interruption ratio for multiple frequency layers or DRX. The following interruption requirement are applied for both single frequency layer and multiple frequency layers, and both non-DRX and DRX.** * **80ms ≤ Tcycle < 160ms: up to [2.50%] probability of interruption**
* **160ms ≤ Tcycle < 320ms: up to [1.25%] probability of interruption**
* **320ms ≤ Tcycle: up to [0.625%] probability of interruption**

**Proposal 3: Do not introduce additional scheduling restriction before or after SMTC. Do not introduce SMTC pattern.** **Proposal : replace measurement period component to Tcycle. General measurement period format is Max(lower\_bound, Number of Samples \* scaling factors\* Tcycle \* CSSFinter/intra ), where Tcycle = max (80ms, SMTC period, DRX cycle).****Proposal : For no-gap with or without interruption, measurement samples are 5 for intra-frequency measurement, 8 for inter-frequency measurement.****Intra frequency measurements without gap with interruption*** PSS/SSS detection for FR1
	+ No DRX : max (600ms, ceil(5 x Kp) x Tcycle x CSSFintra )
	+ DRX cycle < 320ms : max (600ms, ceil(5 x M2 x Kp) x Tcycle x CSSFintra )
	+ DRX cycle >=320ms : ceil(5 x Kp) x Tcycle x CSSFintra
* Time period for time index detection
	+ No DRX : max (120ms, 3 x Tcycle x CSSFintra)
	+ DRX cycle < 320ms : max (120ms, ceil(M2 x 3 x Kp) x Tcycle x CSSFintra )
	+ DRX cycle >=320ms : Ceil(3 x Kp) x Tcycle x CSSFintra
* Measurement period
	+ No DRX : max (200ms, ceil(5 x Kp) x Tcycle x CSSFintra)
	+ DRX cycle < 320ms : max (200ms, ceil(1.5 x 5 x Kp) x Tcycle x CSSFintra )
	+ DRX cycle >=320ms : ceil(5 x Kp) x Tcycle x CSSFintra

**Inter frequency measurements without gap with interruption*** PSS/SSS detection for FR1
	+ No DRX : max (600ms, ceil(8 x Kp) x Tcycle x CSSFinter )
	+ DRX cycle < 320ms : max (600ms, ceil(8 x 1.5 x Kp) x Tcycle x CSSFinter )
	+ DRX cycle >=320ms : ceil(8 x Kp) x Tcycle x CSSFinter
* Time period for time index detection
	+ No DRX : max (120ms, 3 x Tcycle) x CSSFinter
	+ DRX cycle < 320ms : max (120ms, ceil(M2 x 3 x Kp) x Tcycle) x CSSFinter
	+ DRX cycle >=320ms : Ceil(3 x Kp) x Tcycle x CSSFinter
* Measurement period
	+ No DRX : max (200ms, ceil(8 x Kp) x Tcycle )x CSSFinter
	+ DRX cycle < 320ms : max (200ms, ceil(8 x 1.5 x Kp) x Tcycle ) x CSSFinter
	+ DRX cycle >=320ms : ceil(8x Kp) x Tcycle x CSSFinter

For requirements for inter-frequency measurement without gap, without interruption, 5 measurement samples are used for PSS/SSS and measurement period. **Inter frequency measurements without gap without interruption*** PSS/SSS detection for FR1
	+ No DRX : max (600ms, ceil(5 x Kp) x Tcycle x CSSFinter )
	+ DRX cycle < 320ms : max (600ms, ceil(5 x M2 x Kp) x Tcycle x CSSFinter )
	+ DRX cycle >=320ms : ceil(5 x Kp) x Tcycle x CSSFinter
* Time period for time index detection
	+ No DRX : max (120ms, ceil (3 x Kp) x Tcycle) x CSSFinter
	+ DRX cycle < 320ms : max (120ms, ceil(M2 x 3 x Kp) x Tcycle) x CSSFinter
	+ DRX cycle >=320ms : Ceil(3 x Kp) x Tcycle x CSSFinter
* Measurement period
	+ No DRX : max (200ms, ceil(5 x Kp) x Tcycle )x CSSFinter
	+ DRX cycle < 320ms : max (200ms, ceil(5 x 1.5 x Kp) x Tcycle ) x CSSFinter
	+ DRX cycle >=320ms : ceil(5 x Kp) x Tcycle x CSSFinter
 |
| R4-2309565 | MediaTek Inc. | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR **Proposal 1:** **The UE is only allowed to cause interruptions on Pcell or activated Scell(s) equal to interruption length before and after an SMTC in the certain time window (measurement cycle window).****Proposal 2:** **RAN4 shall define the interruption length requirements the same as these defined for NCSG in Rel-17, (i.e. VIL=1 ms in FR1 and VIL=0.75 ms in FR2).****Proposal 3: When single inter-freq carrier is configured for measurement, introduce a concept of measurement cycle (measCycleNFG), during which, UE is expected to measure a target frequency once.****Proposal 4: The interruption ratio for each MO requiring interruption is defined as 2\*(L/T)\*100%, where L is the interruption length, T is the measurement cycle of the MO, both in ms. FFS the Kp scaling factor.****Proposal 5: Same interruption ratio can be kept for multiple layers by defining the measurement cycle length as: Tcycle = measCycleNFG x CSSF, provided that at least an SMTC occasion is available per measCycleNFG per frequency layer.****Proposal 6: For the scenario of intra- and inter-frequency without gap when interruption is allowed, RAN4 shall reuse the existing number of samples and lower bound from Rel-17 NCSG requirements to define the new interruption requirements for NeedForGap.****Proposal 7: For the scenario of intra- and inter-frequency without gap when interruption is allowed, RAN4 shall leverage the existing Rel-17 NCSG requirements to define the new interruption requirements for NeedForGap after replacing the ‘max (VIRP, SMTC)’ in the measurement period requirement from NCSG with ‘measCycleNFG’ for NFG.****Proposal 8: The CSSF should be designed taking the requirements from clause 9.1.5.3 for NCSG as a baseline with update that at least one SMTC per measCycleNFG per frequency layer should be available.****Proposal 9: For DRX based interruption ratio, RAN4 shall follow the existing requirements of NCSG as baseline or it can be kept FFS until RAN4 reaches conclusion on the requirements for no DRX.****Proposal 10: For intra-frequency case 1: RAN4 shall take requirements in Section 9.2.5 of TS38.133 (intra-frequency without gap) as a starting point.****Proposal 11: For the scenario of intra- and inter-frequency without gap when interruption is not allowed (case 1), RAN4 shall reuse the existing number of samples and lower bound from ‘nogap-noncsg’ requirements** **of intra-frequency and inter-frequency without gap in clauses 9.2.5 and 9.3.9, respectively to define the new interruption requirements for NeedForGap.****Proposal 12: For intra-frequency case 1, RAN4 shall add the following line in Clause 9.2.5.1: ‘When intra-frequency SMTC is partially overlapping with interruption occasion, Kp = 1/(1- (SMTC period /measurement cycle length)), where SMTC period < measurement cycle length’.****Proposal 13: For inter-frequency case 1, RAN4 shall add the following line in Clause 9.3.9.1: ‘When inter-frequency SMTC is partially overlapping with interruption occasion, Kp = 1/(1- (SMTC period / measurement cycle length)), where SMTC period < measurement cycle length’.****Proposal 14: CSSFoutside\_gap, for measurement conducted outside measurement gaps, i.e. when intra/inter-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps or NCSG or NFG occasion.****Proposal 15: For CSSFwithin\_nfg, for measurement conducted within NFG, i.e. when intra/inter-frequency SMTC is fully occupied with NFG and there is no available SMTC in the measurement cycle window.****Proposal 16: No need to establish the mapping between UE’s indication for NeedForGaps and NCSG.****Proposal 17: [NeedForGapsInfoNR] and NeedForGapNCSG-InfoNR are not expected to be enabled for the same UE at the same time.****Proposal 18: When there is a mismatch between the no-gap capability supported by the NW and the UE then the existing requirements are not applicable and RAN4 should not define new requirements for such mismatch cases.****Proposal 19: When both the NW and UE support NFG and NCSG then which requirements shall be applied is left to the NW configuration.****Proposal 20: RAN4 doesn’t need to further clarify the meaning of value ‘no-gap’ in NeedForGap Rel-16 signalling.****Proposal 21: RAN4 to use requirements of NCSG as baseline to define scheduling availability. Yet, default SMTC pattern can be defined to restrict the scheduling restriction occasions or scheduling restriction shall be applied to the available SMTC within the measCycleNFG.** |

## Open issues summary

### Sub-topic 1-1 Interruption

**Issue 1-1-1: Framework of the interruption requirements**

* Proposals
	+ Option 1: The UE is only allowed to cause interruptions on PCell or activated Scell(s) immediately before and after an SMTC. The UE is not expected to cause interruption on each SMTC occasion.
		- Option 1a: The UE is only allowed to cause interruptions on Pcell or activated Scell(s) in the certain time window before and after an SMTC.
	+ Option 2: Do not define any restriction on interruption location in this release
* Recommended WF
	+ This issue is controversial. Try to clarify first that the interruption in Option 1 is about interruptions on all the carriers.
	+ Second could we confirm that the network does not avoid scheduling anyway?

**Issue 1-1-2: Requirements on the interruption length, if allowed**

* Proposals
	+ Option 1: As a starting point, the interruption length can be same as VIL defined for NCSG,e.g,
		- When UE reporting “[no-gap,TBD]” in [NeedForGapInfoNR, TBD] the interruption length can be VIL=1ms in FR1 and VIL=0.75ms in FR2.
		- When UE reporting “[others,TBD]” in [NeedForGapInfoNR, TBD] no interruption allowed
	+ Option 2: As a starting point,
		- when UE reporting “no-gap [TBD]” in [NeedForGapInfoNR, TBD], the interruption length can be specified based on the same RTT assumption as for NCSG (0.5ms in FR1 and 0.25ms in FR2) interruption occasion.
		- Otherwise, no interruption is allowed
* Recommended WF
	+ Discuss about {1.0ms FR1, 0.75ms FR2} vs. {0.5ms FR1, 0.25ms FR2}

**Issue 1-1-5a: Requirements on the interruption ratio, if allowed - whether ratios are for individual frequency layer or in total**

* Previous agreements
	+ Interruption ratio is defined as follows:
		- 80ms ≤ Tcycle < 160ms: up to [2.50%] probability of interruption
		- 160ms ≤ Tcycle < 320ms: up to [1.25%] probability of interruption
		- 320ms ≤ Tcycle: up to [0.625%] probability of interruption
		- Do not define requirement for the case Tcycle < 80ms
* Proposals
	+ Option 1: Interruption ratio is defined for a single frequency layer, and total interruption ratio is the sum of interruption ratio of individual frequency layers
	+ Option 2: The agreed interruption ratio should only apply to single frequency layer. In case of multiple frequency layers with different measurement cycle, the interruption ratio with the shortest measurement cycle should apply
	+ Option 3: The interruption ratios agreed apply for a single frequency layer. It is expected that the same interruption ratio will apply for all related frequency layers
	+ Option 4: Define Tcycle based on sampling interval on all MOs which would cause interruption. With this, the interruption ratio is the total ratio, i.e., it shall apply for all frequency layers.
* Recommended WF
	+ Discuss upon options.

**Issue 1-1-5b: Requirements on the interruption ratio, if allowed - how Tcycle is specified**

* Proposals
	+ Option 1: Tcycle is the available measurement interval in the measurement period requirements after considering the resource collision
	+ Option 1a:
		- Tcycle = Max(SMTC period, DRX cycle) x CSSF x Kp
	+ Option 1b:
		- When no DRX is used: Tcycle = SMTC x Kp;
		- When DRX cycle ≤ 320ms, Tcycle = 1.5 x max(SMTC, DRX) x Kp;
		- When DRX cycle > 320ms, Tcycle = DRX cycle x Kp;
	+ Option 1c:
		- Tcycle = measCycleNFG x CSSF, provided that at least an SMTC occasion is available per measCycleNFG per frequency layer
	+ Option 1d:
		- Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSF x Kp) for FR1, where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps
		- Tcycle = max( 80, max(TSMTC, DRX cycle) x CSSF x Kp x KFR x Klayer1\_measurement) for FR2, where Kp is the scaling factor for an SSB frequency layer to be measured without measurement gaps, and KFR is the scaling factor depending on the frequency range and SSB SCS
	+ Option 2a:
		- Tcycle = SMTC x CSSF x Kp x Kinterruption, where is the number of carriers on which the measurement may cause interruption
	+ Option 3: replace measurement period component to Tcycle. General measurement period format is Max(lower\_bound, Number of Samples \* scaling factors\* Tcycle \* CSSFinter/intra ), where Tcycle = max (80ms, SMTC period, DRX cycle).
* Recommended WF
	+ Discuss upon the options.

**Issue 1-1-7: Trade-off between interruption ratio and measurement delay**

* Proposals
	+ Option 1: RAN4 to introduce a NW indicator KNeedForGaps to reduce the total interruption ratio
	+ Option 2: RAN4 to introduce measCycleNFG to reduce the total interruption ratio
* Recommended WF
	+ Discuss upon the options.

### Sub-topic 1-2 Measurement reporting delay requirements

* **Case 1:** without gap and no interruption (e.g. ’nogap’ or ’nogap-nointerruption[TBD]’ indicated in [**NeedForGapInfoNR-r18: TBD])**
* **Case 2:** without gap but interruption allowed (e.g. ’nogap-with interruption[TBD]’ indicated in [**NeedForGapInfoNR-r18:TBD])**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sub-issues** | **Proposals on** | **Candidate Options** | **Company’s view** |
| **Sub-issue 1: Framework of requirements** |
| Framework of requirements | FFS: Definition updated | Option 1: If UE indicate *’nogap-withinterruption[TBD] via* ***NeedForGapInfoNR-r18[TBD]***, UE shall be able to identify a new detectable intra/inter frequency cell within….Option 2: in the introduction part, the definition for intra/inter-freuqency measuremen without gap can be updated as: “A measurement is defined as inter-frequency measurement without gaps if the UE indicates ‘no-gap’ via interFreq-needForGap for inter-frequency measurement.**“** |  |
| Requirements for both index is known and unknow | Tidentify\_inter\_without\_index if UE is not indicated to report SSB based RRM measurement result with the associated SSB index (*reportQuantityRsIndexes* or *maxNrofRSIndexesToReport* is not configured) or *deriveSSB-IndexFromCellInter-r17* is configured for the FR1 and FR2-1 target frequency layers and and UE supporting [recognition of *deriveSSB-IndexFromCellInter*]. Otherwise UE shall be able to identify a new detectable intra/inter frequency cell within Tidentify\_intra/inter\_with\_index. |  |
| Main components within the requirements | Tidentify\_intra/inter\_without\_index = (TPSS/SSS\_sync + T SSB\_measurement\_period) msTidentify\_intra/inter\_with\_index = (TPSS/SSS\_sync + T SSB\_measurement\_period + TSSB\_time\_index) ms |  |
| **Sub-issue 2: Common parameters among** **{TPSS/SSS , T SSB\_measurement , TSSB\_time\_index}** |
| Common parameters among {TPSS/SSS , T SSB\_measurement , TSSB\_time\_index***}*** | FFS: scaling\_factor1:M2 depending on DRX | Option 1: M2=1.5 when DRX cycle ≤ 320ms |  |
| FFS: scaling\_factor 2:Scale factor for SMTC overlapping with measurement gap | Option 1: Update Kp factors in 9.2.5 or 9.3.9 |  |
| FFS: scaling\_factor 3: Klayer1\_measurementScale factor for L1 measurements RS non-overlapping with measurement gap |  |  |
| Option 1: Meas\_cycle | Option 1: replace “measCycleSCell” wih Tcycle ( depending on issue 1-1-5)Option 2: Depending on Tcycle definition in issue 1-1-1 |  |
| CCSFintra/inter | Option 1: Reuse CSSFintra/inter in TS38.133 |  |
| FFS:Additional samples for AGC | P1: Needs to include additional AGC in the requirements for PSS/SSS detection because of other sequential procedures.P2: AGC sample needed for inter-frequency only |  |
|  |  |  |
| **Sub-issue 3-1: Time period for PSS/SSS** |
| Time period for PSS/SSS detection for FR1:***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]) x [scaling\_factor 2]x [meas\_cycle] ) x [CSSF]*** | Low bound | 600ms when no DRX or DRX cycle≤ 320ms |  |
| FFS: meas\_samples without AGC | Option 1: 5 Option 2: 5 for intra-f and 8 for inter-f measurement. Option 3: 8 |  |
| Time period for PSS/SSS detection for FR2:***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]x [scaling\_factor 2] x [scaling\_factor 3])) x [meas\_cycle] ) x [CSSF]*** | Low bound | 600ms when no DRX or DRX cycle≤ 320ms |  |
| FFS: meas\_samples without AGC | Option 1: Mpss/sss\_sync\_w/o\_gapsO defined in TS38.133 9.2.5. or Mpss/sss\_sync\_inter defined in TS38.133 9.3.9 |  |
| **Sub-issue 3-2: Measurement period** |
| Measurement period for FR1: ***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]) x [scaling\_factor 2]x [meas\_cycle] ) x [CSSF]*** | FFS: Low bound | Option 1: 200ms when no DRX or DRX cycle≤ 320msOption 2: 400ms when no DRX or DRX cycle≤ 320ms |  |
| meas\_samples without AGC | Option 1: 5 |  |
| Measurement period for FR2: ***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]x [scaling\_factor 2] x [scaling\_factor 3])) x [meas\_cycle] ) x [CSSF]*** | FFS: Low bound | Option 1: 400ms when no DRX or DRX cycle≤ 320ms |  |
| meas\_samples without AGC | Option 1: Mmeas\_period\_w/o\_gaps  defined in TS38.133 9.2.5. for intra-f or Mmeas\_period\_inter defined in TS38.133 9.3.9 for inter-f |  |
| **Sub-issue 3-3: Time period for time index detection** |
| Time period for time index detection (FR1)***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]) x [scaling\_factor 2]x [meas\_cycle] ) x [CSSF]*** | FFS: Low bound | Option 1: 120ms when no DRX or DRX cycle≤ 320msOption 2: 200msOption 3: 240ms |  |
| FFS: meas\_samples without AGC | Option 1: 3 |  |
| Time period for time index detection (FR2):***max( [low\_bound], ceil( [meas\_samples] x [scaling\_factor 1]x [scaling\_factor 2] x [scaling\_factor 3])) x [meas\_cycle] ) x [CSSF]*** | FFS: Low bound | Option 1: 200ms when no DRX or DRX cycle≤ 320msOption 2: 240ms |  |
| meas\_samples without AGC | Option 1: Mssb\_index\_intra  defined in TS38.133 9.2.5. for intra-f  |  |
|  |  |  |  |

**Issue 1-2-1: Requirement for intra/inter-freq measurement without gap when interruption allowed (case 2)**

* Previous agreements
	+ When RAN4 defining the measurement requirements for intra/inter-freq measurement without gap when interruption allowed (case 2), the following key aspects needs to be updated at least.
		- Updated the definition of intra/inter-frequency SSB based measurements without measurement gaps to include the case when UE indicates ‘nogap-withinterruption[TBD]’ via ‘needForGap-r18[TBD]’
		- Updated the scaling factor because of the measurement gap overlapping (Kp )
		- Updates on CSSFoutside\_gap
		- Updates on Klayer1\_measurement
* Proposals
	+ Option 1: The measurement requirements for intra/inter-freq measurement without gap when interruption allowed (case 2) can be defined with the following aspects:
		- Update the definition part
		- Take the low bound and measurement samples needed for the procedure of PSS/SSS detection, measurement and SSB index detection for NCSG in 9.3.10 as baseline
		- Measurement cycle, Kp, Klayer1\_measurement, and CSSFoutside\_gap depends on the Tcycle definition discussed in issue 1-1-1Option 2: Do not define any restriction on interruption location in this release
	+ Option 2: For measurement with interruption, adopt the following updates based on existing requirements for measurement without gap.
		- SMTC period is changed to TCycle as in Issue 1-1-5b
		- CSSF outside MG is updated to account for MOs measured outside MG
	+ Option 3: For the scenario of intra- and inter-frequency without gap when interruption is allowed, RAN4 shall leverage the existing Rel-17 NCSG requirements to define the new interruption requirements for NeedForGap after
		- replacing the ‘max (VIRP, SMTC)’ in the measurement period requirement from NCSG with ‘measCycleNFG’ for NFG
		- The CSSF should be designed taking the requirements from clause 9.1.5.3 for NCSG as a baseline with update that at least one SMTC per measCycleNFG per frequency layer should be available
* Recommended WF
	+ Discuss upon the options in the table

**Issue 1-2-2: Requirement for inter-freq measurement without gap (Inter-f case 1)**

* Previous agreements
	+ The requirements for inter-frequency case 1 can be defined by reusing 9.3.9 framework in TS38.133.
	+ The following updates needed can be FFS:
		- Updated the definition of inter-frequency SSB based measurements without measurement gaps to include the case when UE indicates ‘no-gap’ via interFreq-needForGap.
		- Measurement samples needed for the induvial process (PSS/SSS detection, measurement and SSB index detection
		- Measurement cycles definition
		- Updated the scaling factor because of the measurement gap overlapping (Kp )
		- Updates on CSSFoutside\_gap
* Proposals
	+ Option 1: The measurement requirements for inter-frequency case 1 can be defined by reusing 9.3.9 framework in TS38.133, and the update is only needed for the definition part.
	+ Option 2: The measurement period requirements of intra/inter-freq measurements without gap and no interruption (case 1) in Rel18 can be defined by reusing the existing requirements in Section 9.2.5 / 9.3.9 of TS38.133 respectively with the necessary updates on CSSFoutside\_gap in 9.1.5.1 of TS38.133
	+ Option 3: For inter-frequency case 1, RAN4 shall add the following line in Clause 9.3.9.1: ‘When inter-frequency SMTC is partially overlapping with interruption occasion, Kp = 1/(1- (SMTC period / measurement cycle length)), where SMTC period < measurement cycle length’
* Recommended WF
	+ Discuss about {1.0ms FR1, 0.75ms FR2} vs. {0.5ms FR1, 0.25ms FR2}

### Sub-topic 1-3 UE behaviours

**Issue 1-3-1a: Mapping between NeedForGap and NCSG capabilities when UE supports both of them**

* Proposals
	+ Option 1: Indication of “no-gap” as part of needForGaps or needForGapsNCSG means no-gap Case 1 (no gap without interruption)
	+ Option 2: No need to establish the mapping between UE’s indication for NeedForGaps and NCSG
	+ Option 3: RAN4 to postpone the 1-to-1 mapping between NeedForGaps and NCSG capabilities until RAN4 has a clear understanding on NeedForGaps requirement
* Recommended WF
	+ Discuss upon the options

**Issue 1-3-1b: enabling NCSG and NFG at the same time**

* Proposals
	+ Option 1: *NeedForGapsInfoNR* and *NeedForGapNCSG-InfoNR* are not expected to be enabled for the same UE
	+ Option 2: [Rel 18 NeedForGapsInfoNR] and NeedForGapNCSG-InfoNR may be enabled for the same UE at the same time
	+ Option 3: NeedForGaps and NCSG are not expected to be enabled for the same UE at the same time, but NW can alternatively switch between NeedForGaps and NCSG once both UE and NW support NeedForGaps and NCSG
* Recommended WF
	+ Discuss upon the options.

# Topic #2: Inter-RAT measurement without gap

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307192 | Nokia | Discussion on interRAT measurements without gaps**Proposal 1: RAN4 to discuss among the following options for case b-2:****a. Option 1: Both CRS rate matching and CRS-IM have the same requirements****b. Option 2: Gapless measurements for Case b-2 are only allowed with CRS rate matching**Observation 1: In case b-2 the LTE CRS are fully contained within UE’s active BWP.Observation 2: No interruption is expected for measurements within the UE’s active BWP since retuning is not needed.**Proposal 2: Do not consider interruption for case b-2**Observation 3: Measurement period requirements for case a-1 have relationship to measurement period discussed for NR measurements without gaps.**Proposal 3: Wait for further progress on measurement requirements for NR measurements without gaps before discussing measurement period requirements for case a-1.**Observation 5: Scheduling restrictions around CRS would be applicable entire radio frame, and would results in only 2 out of the 14 symbols of a subframe to be available for scheduling.Observation 7: For cases b1 and b2 the UEs are already expected to be using either rate matching or CRS-IM in order to mitigate LTE CRS interference.**Proposal 4: RAN4 to consider that UEs reporting no-gap for cases b1 and b2 support simultaneousRxTxInterBandCA and simultaneousRxDataSSB-DiffNumerology/ simultaneousRxDataSSB-DiffNumerology-inter.****Proposal 5: RAN4 to define requirements for cases b1 and b2 support with no scheduling restrictions.** |
| R4-2307409 | CATT | Discussion on RRM requirements for Inter-RAT measurement without gap**Proposal 1: No need to differentiate the two scenarios for case b-2.** **Proposal 2: No need to introduce additional indication of “no gap with interruption” for case b-2.** **Proposal 3: No interruption is assumed for case b-2.** **Proposal 4: Inter-RAT LTE measurement without gap (case b-1 and b-2) can be performed in parallel with NR measurement without searcher limitation.** **Proposal 5: The scaling factor for inter-RAT LTE measurement without gap (case b-1 and b-2) can be defined separately based on the total number of LTE frequency layers.** **Proposal 6: For the inter-RAT NR measurements without gap (case a-1), the requirements of inter-frequency measurement without gap based on *NeedForGapsInfoNR* in TS 38.133 can be reused including with and without interruption.**  |
| R4-2307446 | Vivo | Consideration on issues on inter-RAT measurement without gap **Proposal 1: Do not further differentiate user scenarios for the case b-2.** **Proposal 2: For case b-2 it is not necessary to consider “no gap with interruption”.** **Proposal 3: For case b-2, regarding whether to consider parallel measurement without searcher limitation or not, support option 2.** **Proposal 4: For issue 2-4-3, it could follow the requirements from NR inter-frequency requirements without, i.e., section 9.3.9 of TS38.133 to define inter-RAT NR measurement without gap without interruption.****Proposal 5: For issue 2-4-9, support to define effective measurement window for inter-RAT LTE measurement, i.e., option 1.** **Proposal 6: For issue 2-5-2, for the detailed scheduling restriction requirements, section 9.4.3.5 could be used as a baseline.** **Proposal 7: For issue 2-6-1, interruption requirements should be defined for case a-1 and b-1, i.e., option 1.**  |
| R4-2307555 | CMCC | Discussion on inter-RAT measurements without gaps***Proposal 1: for inter-RAT E-UTRAN measurement without gap for case b-2 (LTE CRS to be measured is contained in UE’s active BWP), no need to introduce indication of “no gap with interruption” because of AGC,T/F offset issue.******Proposal 2: for inter-RAT NR measurements without gap (case a-1), the requirements framework of existing inter-frequency measurement without gap (9.3.9, 38.133) can be used as baseline. But the number of samples need to be updated from 5 to 8.*** |
| R4-2307639 | Apple | Discussion on R18 inter-RAT measurement without gap**Proposal 1: no need to differentiate the following two scenarios in RRM requirements:*** **Scenario 1: Inter-RAT LTE measurement for LTE CRS rate-matching feature**
* **Scenario 2: Inter-RAT LTE measurement for CRS-IM receiver**

**Proposal 2: A new per-UE capability to support Case b-2 should be defined. Indication such as “no gap with interruption” is not necessary unless well justified. Potential issues such as AGC can be reflected in applicability conditions for case b-2.****Proposal 3: Performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported. The fundamental goal of this objective is to reduce measurement gap overhead by enabling inter-RAT measurement w/o gap, rather than facilitate the RRM measurement.****Proposal 4: RAN4 to introduce an effective measurement window for inter-RAT E-UTRAN measurement without gap.****Proposal 5: Scheduling restriction due to inter-RAT LTE measurement is needed when serving cell and target MO have mixed SCS and they are in the same band.** |
| R4-2307806 | Intel Corporation | Discussion on inter-RAT measurement without gaps**Observation 1: For the inter-RAT NR measurement case a-1 the requirements can be different when UE reports different capabilities among the two (nogap-withint and nogap-noint).****Proposal 1: Prioritize the requirement for case a-1 without gap and no allowed interruption.****Proposal 2: For the inter-RAT NR measurements without gap (case a-1), the requirements can be defined as:** * **The requirements shall be differentiated for TDD and FDD.**
* **And the requirements can be**
	+ **Tidentify\_irat\_without\_index = (TPSS/SSS\_sync\_irat + TSSB\_measurement\_period\_irat) ms**
	+ **Tidentify\_irat\_with\_index = (TPSS/SSS\_sync\_irat + TSSB\_measurement\_period\_irat + TSSB\_time\_index\_irat) ms**
* **For the specific the requirement, e.g.**

**Table x-1: Time period for PSS/SSS detection (Frequency range FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TPSS/SSS\_sync\_irat** |
| No DRX | Max(600ms, 8 × SMTC period) × Nfreq |
| DRX cycle ≤ 320ms | Max(600ms, Ceil(8×1.5) × Max(SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | 8 × DRX cycle × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

**Table x-5: Measurement period for inter-RAT measurements (Frequency range FR1)**

|  |  |
| --- | --- |
| **Condition NOTE1,2** | **TSSB\_measurement\_period\_irat** |
| No DRX | Max(200ms, 8 × SMTC period) × Nfreq |
| DRX cycle ≤ 320ms | Max(200ms, Ceil(8 × 1.5) × Max(SMTC period, DRX cycle)) × Nfreq |
| DRX cycle > 320ms | 8 × DRX cycle × Nfreq |
| NOTE 1: DRX or non DRX requirements apply according to the conditions described in section 5. |

**Proposal 3: Send an LS to RAN2 about signalling design for inter-RAT measurement without gap case a-1, b-1 and b-2.** |
| R4-2307959 | Xiaomi | Discussion on inter-RAT measurement without gap**Proposal 1: UE capability to support the inter-RAT LTE measurement without gap in case b-1 can take the framework of NeedForNCSG-InfoEUTRA as baseline, i.e. the gap information could be indicated per NR serving cell.****Proposal 2: The measurement period requirements for case a-1 could take the requirements for NR intra- and inter-frequency requirements based on NeedForGaps as baseline.****Proposal 3: RAN4 to define same measurement period requirements for inter-RAT LTE without gap and no interruption allowed for case b-1 and case b-2.****Proposal 4: RAN4 to update parameter TInter1 with fixed value and CSSFinterRAT = CSSFoutside\_gap,i to include the inter-RAT LTE without gap measurement object(s).**  |
| R4-2308444 | Ericsson | Discussion on Inter-RAT measurement without gap***Observation 1: There is no searcher limitation for LTE intra-frequency measurement together with NR measurement in EN-DC.******Proposal 1: No interruption is expected for case b-2.******Proposal 2: RAN4 send LS to RAN2 to introduce a new capability for case b-2 similar as Rel-16 inter-frequency measurement without gap.******Proposal 3: For case a-1, RAN4 to follow the NeedForGaps requirement when UE reports ‘no gap with interruption’ in NeedForGaps.******Proposal 4: For case a-1, RAN4 to follow the inter-RAT NR measurement in LTE to introduce the multiple frequency layers scaling factor Nfreq,NeedForGaps\_interrupt and Nfreq,NeedForGaps\_no\_interrupt.**** ***Nfreq,NeedForGaps\_interrupt is the total number of monitored inter-RAT NR carriers which belongs to the bands where UE reports ‘no gap with interruption’ in NeedForGaps;***
* ***Nfreq,NeedForGaps\_no\_interrupt is the total number of monitored inter-RAT NR carriers which belongs to the bands where UE reports ‘no gap no interruption’ in NeedForGaps.***

***Proposal 5: For case a-1, RAN4 to update Nfreq in LTE inter-RAT NR measurement when UE supports NeedForGaps.******Proposal 6: RAN4 to send the LS to introduce the effective measurement window configuration (case b-1 and case b-2) with the inter-RAT LTE measurement duration, periodicity and offset.*****Table. Effective measurement window configuration and minimum available time**

|  |  |  |  |
| --- | --- | --- | --- |
| **Effective measurement window (EMW) Id** | **Measurement Duration (MD, ms)** | **Measurement Period****(MP, ms)** | **Minimum available time for inter-RAT LTE measurements during 480 ms period****(Tinter1, ms)** |
| 0 | 5 | 40 | 60 |
| 1 | 5 | 80 | 30 |
| 2 | 2 | 40 | 24Note 1 |
| 3 | 2 | 80 | 12Note 1 |
| Note 1: When determining UE requirements using Tinter1 for EMW IDs 2, 3, Tinter1 = 60 for pattern ID 2, and Tinter1 = 30 for pattern ID 3. |

***Proposal 7:***  ***Inter-RAT LTE measurement without gap(case b-2) can be performed in parallel with NR measurement without searcher limitation.******Proposal 8: RAN4 not to differentiate the following scenarios for case b-2.**** ***Scenario 1: Inter-RAT LTE measurement for LTE CRS rate-matching feature***
* ***Scenario 2: Inter-RAT LTE measurement for CRS-IM receiver***

***Proposal 9: In case b-1, RAN4 to define*** $CSSF\_{interRAT,gapless}$ ***equaling*** $CSSF\_{outside\\_gap}$ ***which additionally includes the number of inter-RAT LTE gapless measurement MOs.******Proposal 10: In case b-2, RAN4 to define*** $CSSF\_{interRAT,gapless}$ ***which equals the number of configured inter-RAT LTE MOs within the active NR BWP.******Proposal 11:In case b-1 and b-2 ‘no gap no interruption’,*** $T\_{BasicIdentify}=480ms$***, and*** $T\_{Inter1}$ ***can be derived by the periodicity and duration of the effective measurement window(EMW).***$$T\_{Inter1}=\frac{480}{T\_{EMW,period}}∙T\_{EMW,duration}$$***Proposal 12: When the target inter-RAT LTE frequency layers belong to an intra-band with the serving cells, scheduling restriction is expected due to mix-numerology.******Proposal 13: RAN4 to study the following scheduling restriction principles based on LTE measurement RSs,**** ***How to apply the restriction symbols before and after the CRS symbols for inter-RAT LTE measurement without gap.***
* ***Whether to introduce new UE capability to support inter-RAT LTE measurement and NR data reception***
 |
| R4-2308464 | OPPO | Discussion on RRM requirements for inter-RAT measurements without gaps**Proposal 1: Introduce a new per-UE capability to support case b-2, similar as *interFrequencyMeas-Nogap-r16* for inter-frequency SSB based measurement.****Proposal 2: AGC issue can be handled by introducing additional samples.****Proposal 3: Timing offset issue can be handled by scheduling restrictions, e.g. the restricted serving cell symbols includes K symbols before and after the effective measurement window or LTE CRS resources.****Proposal 4: No interruption requirement should be defined for inter-RAT LTE case b-1 and case b-2.****Proposal 5: Performing inter-RAT LTE measurement and NR measurements in parallel without searcher limitation is NOT supported.****Proposal 6: Introduce the effective measurement window for inter-RAT LTE measurement, including offset, duration and periodicity.** * **The ML for NCSG can be reused as the duration for effective measurement window**
* **The VIRP for NCSG can be reused as the periodicity for effective measurement window**

**Proposal 7: For both case b-1 and case b-2 without DRX, the delay requirements could be based on** $T\_{identify}=T\_{basic\\_identify}\*\frac{480}{T\_{Inter1}}\*CSSF\_{InterRAT}$**, and** $T\_{Inter1}$ **should be updated by replacing MGRP or VIRP with the periodicity of effective measurement window.****Proposal 8: For both case b-1 and case b-2 with DRX, use the delay requirements within MG as the baseline and FFS whether and how to update the numbers of DRX cycles considering the newly introduced effective measurement window.****Proposal 9: Define interruption requirements for inter-RAT NR measurement case a-1, consider 1ms as the interruption length and FFS interruption location/ratio.****Proposal 10: For case a-1, NR inter-frequency measurement without gap in TS38.133 could be used as the starting point.** |
| R4-2308661 | Huawei | Discussion on inter-RAT MG-less measurement**Proposal 1: RAN4 not to differentiate sub-scenarios in Case b-2.****Proposal 2: Measurement with interruption is not considered for Case b-2.****Proposal 3: Performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported.****Proposal 4: For Case a-1, adopt the following updates based on the existing requirements for inter-RAT NR measurement*** **Max(MGRP, SMTC period) is changed to TmeasCycle for “no gap but interruption allowed”, and changed to SMTC period for “no gap no interruption”**
* **Nfreq is defined as the total number of LTE and NR MOs measured outside MG**
* **Kp is defined to account for SMTC occasions punctured by MG.**

**Proposal 5: For case b-1 and b-2,** * **TBasicIdentify = 480ms**
* **Tinter1 = 60ms, derived based on 40ms effective MGRP**
* **CSSFinterRAT = total number of LTE and NR MOs measured outside MG**

**Proposal 6: Define scheduling restriction for Case b-1 and b-2 when*** **serving cell and target MO have mixed SCS and they are in the same band, and**
* **UE does not support mixed SCS between serving cell and target MO**

**Proposal 7: Define effective measurement window to restrict the location of scheduling restriction due to inter-RAT LTE measurement.** |
| R4-2308724 | ZTE Corporation | Discussion on inter-RAT measurement without gaps**Proposal 1: No need to further differentiate the scenario for case b-2.****Proposal 2: For UE capability to support case b-2, we prefer to follow similar capability as Rel-16 inter-freq without gap capability.****Proposal 3: Inter-RAT LTE measurement without gap can be performed in parallel with NR measurement without searcher limitation.****Proposal 4: For measurement period requirement for case a-1 with ‘no gap but interruption allowed’, we could take the measurement period requirements for inter-freq no-gap measurement with interruption as base line.** **Proposal 5: For measurement period requirement for case a-1 with‘no gap no interruption’, we could take the measurement period requirements for inter-freq no-gap measurement without interruption as base line.****Proposal 6: For measurement requirement for case b-1 and case b-2, TBasicIdentify keeps 480 ms.****Proposal 7: For** $CSSF\_{interRAT}$**, take gap-less LTE MO into consideration.****Proposal 8: Postpone the issue 2-4-6 after we conclude issue 2-2-2.** |
| R4-2309424 | Qualcomm | Discussion on requirements of inter-RAT measurement without gaps**Proposal 1: RAN4 does not differentiate scenarios under case b-2.** **Proposal 2: if RAN4 agree to define per-UE capability to support case b-2 similar to interFrequencyMeas-Nogap-r16, UE does not need to indicate ‘no-gap with/without interruption’ for case b-2.****Proposal 3: Performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported****Proposal 4: if RAN4 adopt Tcycle = max (80ms, SMTC, DRX), the requirements for inter-frequency measurement without gap with/without interruption can be reused for inter-RAT NR measurement without gap with/without interruption.** **Proposal 5: The effective measurement window can be defined with including window periodicity, offset, and duration.** **Proposal 6: The effective measurement window should not be overlapped with SSB, SMTC, and other gaps.** **Proposal 7: Multiple patterns of effective measurement window can be defined such as** * **Pattern #1 : effective measurement window periodicity 40ms, EFW duration 6ms,**
* **Pattern #2 : effective measurement window periodicity 80ms, EFW duration 6ms**
* **Other patterns,**

**Proposal 8: TbasicIdentify is 480ms, CSSFinterRAT is number of inter-RAT MOs measured outside of measurement gap. Tinter1 is defined based on configured effective measurement window patterns, such as*** **Tinter1 = 60ms for EFW pattern #1**
* **Tinter1 = 30ms for EFW pattern #2,**
* **Others**

**Observation** : mixed SCS between serving Cell and target MO implies EN-DC. The scheduling restriction for UE does not support simultaneousRxTxInterBandENDC in TDD band include the mixed SCS scenario. **Proposal 9: No need to define additional scheduling restriction for mixed SCS between serving Cell and target MO case.** **Proposal 10: If RAN4 adopt the effective measurement window, For UE who does not support [simultaneousRxTxInterBandENDC], the UE is not expected to transmit PUCCH/PUSCH/SRS on all symbols during the effective measurement window.**  |
| R4-2309566 | MediaTek Inc. | Discussion on inter-RAT measurements**Proposal 1: There is no need to differentiate scenarios for Case b-2.****Proposal 2: RAN4 shall agree on the following:  1) A new per-UE capability to support Case b-2 should be defined, 2) signalling levels can be: (i) ‘gap’, and (ii) ‘nogap-nointerruption’, 3) power imbalance between LTE neighbouring cell and NR serving cell is less than 6 dB, FFS additional AGC samples for measurements delay, 4) scheduling restriction shall be defined for inter-RAT LTE measurement case b-2 with mixed numerology.****Proposal 3: RAN4 shall request RAN2 to define a new UE signalling capability for case b-2, with the above details.****Proposal 4: RAN4 shall delay the discussion on searcher limitation requirement until RAN4 reaches conclusion on parallel measurements.****Proposal 5: RAN4 shall use the requirements from inter-frequency Rel-18 NeedForGap ‘when interruption is allowed’ as baseline to define inter-RAT NR measurement without gap but interruption is allowed.****Proposal 6: RAN4 shall use the requirements from inter-frequency Rel-18 NeedForGap ‘when interruption is not allowed’ as baseline to define inter-RAT NR measurement without gap and no interruption.****Proposal 7: RAN4 can use the existing inter-RAT LTE measurement framework in TS38.133 clause 9.4 to define the requirements for ‘nogap-noncsg’ Inter-RAT LTE measurements Case b-1 (provided in equation above).****Proposal 8: For case b-2, the general framework for case b-1 can be reused for case b-2, however, RAN4 shall consider the impact from AGC, time offset and frequency offset on measurement period requirements.****Proposal 9: For scheduling restriction for inter-RAT LTE measurements, RAN4 should define SMTC-like pattern for LTE or effective measurement window, yet FFS for the overlap between the SMTC in LTE and NR.****Proposal 10: For scheduling restriction for inter-RAT LTE measurements, RAN4 should use the existing scheduling availability specified for inter-RAT LTE measurements without a gap in TS 38.133 section 9.4.3.5 as a baseline for the inter-RAT LTE measurement without measurement gaps.****Proposal 11: RAN4 shall define interruption for case a-1 and case b-1, while FFS for case b-2 to address the AGC and timing and frequency offsets.****Proposal 12: RAN4 shall not discuss the release independent issue until sufficient progress has been achieved.** |

## Open issues summary

Up to this meeting, all agreed using scenarios for inter-RAT NR/LTE measurements without gap can summarized as:

1. the inter-RAT NR measurements without gap in Rel18 includes the two scenarios below.
	* **Case a-1**: UE performing the measurements without gap in NR carriers as there is vacant RF chains for UE measurements
	* **~~Case a-2~~**~~: NR reference signal to be measured are fully contained within UE’s LTE channel bandwidth~~
2. the inter-RAT LTE measurements without gap in Rel18 includes the two scenarios below.
	* **Case b-1**: UE performing the measurements without gap in LTE carriers as there is vacant RF chains for UE measurements
	* **Case b-2**: LTE CRS are fully contained within UE’s active BWP

### Sub-topic 2-1 Scenarios

**Issue 2-1-1: Differentiate scenarios for Case b-2**

* Proposals
	+ Option 1: Do not differentiate the cases. Both CRS rate matching and CRS-IM have the same requirements
	+ Option 2: Gapless measurements for Case b-2 are only allowed with CRS rate matching
* Recommended WF
	+ Agree on option 1

### Sub-topic 2-2 UE capabilities

It shall be noted that the main tasks related to RAN4 (listed in the table below) are to investigate how UE to support these features and define the necessary measurement requirements. Based on the general principles, we can also organize the discussion on UE capabilities in the several sub issues below, which are coupled with the using scenarios.

|  |  |
| --- | --- |
| Using scenarios  | Capability (sub-topic 2-2) |
| Case a-1: Inter-RAT NR wo gap because of the vacant RF chain available | < Agreement in R4#106>: * + Add the request on the additional signaling from UE to indicate the inter-RAT NR measurements without gap but interruption needed in the inter-RAT NR measurement without gap (case a-1) to the LS to RAN2
 |
| Case b-1: Inter-RAT LTE wo gapbecause of the vacant RF chain available | < Agreement in R4#106bis-e>:Reuse NeedForNCSG-InfoEUTRA-r17 to support Case b-1 and Define requirements for case when UE reports “nogap-noncsg” in NeedForNCSG-InfoEUTRA-r17 for indicating no-gap without interruption |
| Case b-2: Inter-RAT LTE wo gap because the measurement reference signal can be contained within UE’s active BWP | < Agreement in R4#106bis-e>:A new per-UE capability to support Case b-2 should be defined |

**Issue 2-2-2: UE capability to support the inter-RAT LTE measurement requirements when LTE CRS to be measured is contained in UE’s active BWP(Case b-2)**

* Proposals
	+ Option 1: Do not consider interruption for case b-2 and no need to introduce additional indication of “no gap with interruption” for case b-2
	+ Option 2: A new per-UE capability to support Case b-2 should be defined. Indication such as “no gap with interruption” is not necessary unless well justified. Potential issues such as AGC can be reflected in applicability conditions for case b-2
	+ Option 3: Introduce a new capability for case b-2 similar as Rel-16 inter-frequency measurement without gap
	+ Option 4: RAN4 shall agree on the following:
		- A new per-UE capability to support Case b-2 should be defined,
		- signalling levels can be: (i) ‘gap’, and (ii) ‘nogap-nointerruption’,
		- power imbalance between LTE neighbouring cell and NR serving cell is less than 6 dB, FFS additional AGC samples for measurements delay,
		- scheduling restriction shall be defined for inter-RAT LTE measurement case b-2 with mixed numerology.
* Recommended WF
	+ Agree on
		- Introduce a new per-UE capability to support case b-2 similar as Rel-16 inter-frequency measurement without gap
		- ‘No gap with interruption’ is not considered for case b-2
		- No interruption is considered for case b-2

### Sub-topic 2-3 Searcher limitation

**Issue 2-3-1: searcher limitation**

* Proposals
	+ Option 1: Inter-RAT LTE measurement without gap(case b-2) can be performed in parallel with NR measurement without searcher limitation
	+ Option 2: Performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported
	+ Option 3: RAN4 shall delay the discussion on searcher limitation requirement until RAN4 reaches conclusion on parallel measurements
* Recommended WF
	+ Discuss upon the options

### Sub-topic 2-4 Measurement reporting period requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Using scenarios  | Capability indications | New RRM requirements needed | Notes |
| Case a-1: Inter-RAT NR wo gap because of the vacant RF chain available | “gap” | No | The existing requirements in TS36.133 8.1.2.4.21&22 can be applied |
| “no gap but interruption allowed” | Yes  | To be defined in TS36.133 |
| “no gap no interruption” | Yes.  | To be defined in TS36.133 |
| Case b-1: Inter-RAT LTE wo gapbecause of the vacant RF chain available | “gap” | No | The existing requirements in TS38.133 9.4.2&9.4.3 can be applied  |
| “ncsg”  | No.  | the existing requirements in TS38.133 9.4.2&9.4.3 can be reused.  |
| “nogap-noncsg” | Yes | To be defined in TS38.133 |
| Case b-2: Inter-RAT LTE wo gap because the measurement reference signal can be contained within UE’s active BWP | “gap”[TBD]  | No | The existing requirements in TS38.133 9.4.2&9.4.3 can be applied |
| “no gap but interruption allowed” [TBD] | TBC(Depending on issue 2-2-2) |  |
| “no gap” [TBD] | Yes | To be defined in TS38.133 |

**Issue 2-4-9: Effective measurement window**

* Proposals
	+ Option 1: Introduce the effective measurement window for inter-RAT LTE measurement, including offset, duration and periodicity.
	+ Option 1a:
		- The ML for NCSG can be reused as the duration for effective measurement window
		- The VIRP for NCSG can be reused as the periodicity for effective measurement window
	+ Option 1b:

Table. Effective measurement window configuration and minimum available time

|  |  |  |  |
| --- | --- | --- | --- |
| Effective measurement window (EMW) Id | Measurement Duration (MD, ms) | Measurement Period(MP, ms) | Minimum available time for inter-RAT LTE measurements during 480 ms period(Tinter1, ms) |
| 0 | 5 | 40 | 60 |
| 1 | 5 | 80 | 30 |
| 2 | 2 | 40 | 24Note 1 |
| 3 | 2 | 80 | 12Note 1 |
| Note 1: When determining UE requirements using Tinter1 for EMW IDs 2, 3, Tinter1 = 60 for pattern ID 2, and Tinter1 = 30 for pattern ID 3. |

* + Option 2: Define effective measurement window to restrict the location of scheduling restriction due to inter-RAT LTE measurement
* Recommended WF
	+ Agree on Option 1