**3GPP TSG-RAN WG4 Meeting # 109 R4-2318167**

**Chicago, US, 13th – 17th November 2023**

**Agenda item:** 8.9.6

**Source:** Moderator (Intel Corporation)

**Title:** Topic summary for [109][211] NR\_MG\_enh2\_part2

**Document for:** Information

# Introduction

This document is the TDocs summary for [109][211] NR\_MG\_enh2\_part2 with the following topics covered.

* Topic 1: Measurement without gaps for UEs reporting *NeedForGapInfoNR* (AI 8.9.3.1)
* Topic 2: Inter-RAT measurement without gap (AI 8.9.3.2)
* Topic 3: Performance part requirements for measurements without gaps (AI 8.9.5)

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 having 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.

This is the last meeting for core part of this work item. The group is supposed to complete the work item core part on time. We are very much close to completion due to all the hard works and efforts from each of you and we just need one more step. Hope all of you have a successful meeting about this work item.

# Topic #1: Measurement without gaps for UEs reporting *NeedForGapInfoNR*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318593 | Apple | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: as agreed in RAN4#108bis issue 1-2-2, RAN4 needs to sum among all possible maximum interruptions caused on applicable carriers. It is proposed to define an effective Tcycle across multiple MO/frequency layers so that the total interruption ratio can be reflected:**   * + **, where**     - **N is number of carriers which are measured with interruption,**     - **M is total number of carriers which are measured outside MG, including carriers that are measured with and without interruption,**     - **Tcyclei is the interruption cycle of the ith carrier which is measured with interruption:**        * **When no DRX is used: Tcyclei = max{80ms, SMTC} \* Kp**       * **When DRX cycle ≤ 320ms, Tcyclei = max{1.5 \* max(80ms, SMTC, DRX) \* Kp }**       * **When DRX cycle > 320ms, Tcyclei = DRX cycle \* Kp**   **Proposal 2: when measurement gap is not configured Use CSSF outside gap to scale SMTC period.**  **Observation 1: allowing UE to perform interruption-based measurement outside MG can facilitate RRM measurement.**  **Proposal 3: to make sure total interruption ratio is acceptable, network can control whether UE shall perform interruption-based measurement outside** MG.  **Proposal 4: number of measurement sample under similar scenarios in existing RRM requirement can be reused, as well as the lower bounds and applicability condition of additional samples due to AGC.**  **Proposal 5: even when DRX is larger than 320ms, interruption is still allowed, and it is according to Tcycle.**  **Observation 2: interruption ratio being discussed is already much lower than measurement gap overhead and VIL overhead in NCSG. It is NOT agreeable to introduce restriction on UE measurement behaviour to further lower interruption ratio.**  **Proposal 6: even when DRX is smaller than 320ms, interruption is allowed, and it is according to Tcycle.**  **Proposal 7: scaling factor 1.5, which was introduced to address frequent measurements in legacy releases when DRX cycle length is smaller than 320ms, shall NOT be removed.** |
| R4-2318863 | Xiaomi | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: For multiple MO/frequency layers case, no need to define an effective Tcycle across multiple MO/frequency layers, and the total interruption ratio is derived from the sum of interruption of individual frequency layers that need interruption.**  **Proposal 2: Use CSSFoutside\_gap to scale SMTC period when MG is not configured.**  **Proposal 3: Apply Kp to Tcycle,i / measurement period.**  **Proposal 4: Interruption is allowed when DRX cycle is configured equal or smaller than 320ms, or larger than 320ms, and it is according to Tcycle.**  **Proposal 5:** **Total interruption ratio for multiple MO/frequency layers case is the sum of interruption ratio of each configured MO that needs interruption.** |
| R4-2319090 | CMCC | Discussion on measurements without gaps for UEs reporting NeedForGapsInfoNR  ***Proposal 1: when MG is not configured, it is proposed to use CSSF outside gap to derive UE measurement period.***  ***Proposal 2: for NFG with interruption, Kp is always 1 when MG is configured, no matter MG and SMTC are partially overlapped or fully overlapped.***  ***Proposal 3: 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 4: for intra-frequency measurement without gap with or without interuption, AGC is not needed, the number of samples for measurement period is 5.***  ***Proposal 5: 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 6: for inter-frequency measurement without gap with or without interuption, the number of samples for measurement period is 8 if AGC is needed.***  ***Proposal 7: for both intra-frequency and inter-frequency measurement without gap with or without interuption, the number of samples for SSB index detection is 3.***  ***Observation 1: as shown in Table 1, Rel 16 inter-frequency measurement without MG and NFG are different feature. NFG cannot fully cover Rel 16 inter-frequency measurement without MG.***  Table 1 difference between Rel 16 inter-frequency measurement without MG and NFG   |  |  |  | | --- | --- | --- | |  | **Rel 16 inter-frequency measurement without MG** | **NFG** | | **Scenario** | Inter-frequency measurement without gap is support when SSB is completely contained in the active BWP of the UE | Inter-frequency measurement without gap is support when there is spare RF chain | | **UE capability** | Per-UE capability: *interFrequencyMeas-NoGap-r16*   * According TS 38.306, this capability indicates whether the UE can perform inter-frequency SSB based measurements without measurement gaps if the SSB is completely contained in the active BWP of the UE | Per-band capability: *NeedForGap*   * Indicates whether the UE supports reporting the measurement gap requirement information for NR target in the UE response to a network configuration RRC message. | | **Interruption** | No interruption, since SSB is within active BWP | Based on UE capability:   * NFG without interruption * NFG with interruption | | **Delay requirements** | Taking PSS/SSS detection as an example, the number of sample is 5, AGC is not needed | Taking PSS/SSS detection as an example, even the number of sample is FFS, but the number may be larger than 5, since AGC is needed when SSB is not in the active BWP |   ***Proposal 8: it is proposed to follow the similar approach as for Rel-15 intra-frequency measurement: when the target SSB is completely contained in active BWP of UE, apply the requirements on Rel-16 inter-frequency measurement without gap without interruption when UE supports interFrequencyMeas-NoGap-r16, regardless of the NeedForGaps’ status reporting.*** |
| R4-2319144 | Ericsson | Discussion on measurement for NeedForGaps  ***Observation 1: The detail interruption length in each measurement is useless to network since the interruption occasion is undefined.***  ***Observation 3: In Rel-15, RAN4 had already solved the power consumption issue for short DRX measurement by introducing scaling factor 1.5.***  ***Observation 4: The benefits of 1-to-1 mapping between NeedForGaps and NCSG is to avoid the frequent large signalling interaction.***  ***Proposal 1: RAN4 to define two sets of interruption length without UE capability reporting when UE reports ‘nogap with interruption’ in NeedForGaps.***   * ***Set 1: L= 0.5ms in FR1 and 0.25 in FR2*** * ***Set 2: L= 1ms in FR1 and 0.75 in FR2***   ***Proposal 2: When MG isn’t configured, Tcycle,i for each layer is CSSF\*max(80ms, SMTC).***  ***Proposal 3: When MG is configured, Tcycle,i for each layer is CSSF\*max(80ms, SMTC\*Kp).***  ***Proposal 4: RAN4 to define interruption ratio of single frequency layer equals 2\*L/Tcycle instead of interruption table.***  ***Proposal 5: When MG isn’t configured, CSSF outside gap shall be used including both the layers of NFG measurement with and without interruption.***  ***Proposal 6: The interruption ratio shall be 1-to-1 mapping with the measurement delay for NeedForGaps.***   * ***The interruption ratio of single frequency layer #i equals 2\*L/Tcycle,i.*** * ***Total interruption ratio is the sum of interruption ratio of individual frequency layers with interruption.***   ***Proposal 7: RAN4 to define the interruption ratio when DRX is configured as follow,***   * ***When DRX cycle is equal or smaller than 320ms,***    + ***no interruption is expected when configured SMTC occasions are misalignment with DRX ON duration;***   + ***Otherwise, single layer’s interruption equals to 2\*L/(1.5\*max(80ms, SMTC, DRX cycle) x CSSF)*** * ***When DRX cycle is larger than 320ms, no interruption is expected.***   ***Proposal 8: When UE supports NFG and Con-MGs, and NW configures the Con-MGs, NFG MO will be performed within the associated MG in the following scenarios***   * ***when the MO belongs to a band in which UE reports ‘nogap-nointerruption’ and all of the SMTC occasions of this MO are overlapped by the associated measurement gap*** * ***when the MO belongs to a band in which UE reports ‘nogap-interruption’ and part or all of the SMTC occasions of this MO are overlapped by the associated measurement gap***   ***Proposal 9: RAN4 to postpone the 1-to-1 mapping between NeedForGaps and NCSG capabilities until RAN4 has a clear understanding on NeedForGaps requirement.***  ***Proposal 10: RAN4 to send LS to RAN2 to clarify whether NW can enable NCSG and NFG at the same time.*** |
| R4-2319250 | Vivo | Further consideration on remaining issues for measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: Tcycle definition on a certain configured carrier I, prefer option 2, i.e., Tcycle,i = max (80ms, scaling factors \* SMTC period)**  **Proposal 2: Use CSSF outside gap to scale SMTC period when MG is not configured.**  **Proposal 3: For the scaling factor when MG is configured, option 2 (apply kp to Tcycle,i) is preferred.**  **Proposal 4: Regarding DRX based interruption ratio, when DRX cycle is equal or smaller than 320ms, interruption will still be expected. Support option 2 of issue 1-4-1 and option 2 of issue 1-4-2.** |
| R4-2319478 | OPPO | On measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: Support option 3: Tcycle = max(80ms, SMTCmin), where SMTCmin is smallest SMTC among multiple MO/frequency layers.**  **Proposal 2: CSSF outside gap could be used when MG is not configured.**  **Proposal 3: Do not apply Kp to Tcycle,i**.  **Proposal 4: No interruption is expected when DRX is configured larger than 320ms.**  **Proposal 5: When DRX is configured smaller than 320ms, support option 1, no interruption is expected when SMTC is during DRX-off and UE use such SMTC to measure NFG measurements with interruption on a certain MO.**  **Proposal 6: Consider Rel-17 concurrent gaps with Rel-18 NFG measurements.** |
| R4-2319979 | Huawei | Discussion on requirements for NeedForGaps  **Proposal 1: Tcycle,i = scaling factors \* max (80ms, SMTC period).**  **Proposal 2: Use CSSF outside gap to scale SMTC period when MG is not configured.**  **Proposal 3: Do not apply Kp to Tcycle,i / measurement period for MO #i when MG is configured.**  **Proposal 4: RAN4 not to use pre-defined window to define total interruption ratio for multiple MOs.**  **Proposal 5: RAN4 not to define further optimization of interruption ratio based on DRX.**  **Proposal 6: Re-use number of samples and lower bounds from existing measurement period requirements for measurement with interruption (adopt option 1 for Issues 1-3-1 to 1-3-5).**  **Proposal 7: Apply scaling factor 1.5 for DRX cycle <= 320ms also for measurement that causes interruption.**  **Proposal 8: RAN4 not to define default SMTC pattern or dedicated measurement pattern to restrict the scheduling restriction occasions.**  **Proposal 9: NeedForGaps and NCSG are not expected to be enabled for the same UE at the same time.**  **Proposal 10: No need to establish the mapping between UE’s indication for NeedForGaps and NCSG.** |
| R4-2320422 | ZTE Corporation | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: The Tcycle definition on a certain configured carrier i is scaling factor \* max (80ms, SMTC period/MGRP).**  **Proposal 2: When measurement gap is not configured, use CSSF outside gap to scale the configured SMTC period.**  **Proposal 3: When measurement gap is configured and the SMTC is total or partial overlapped with MG, Kp is needed.**  **Proposal 4: If DRX cycle is larger than 320ms, no interruption is expected.**  **Proposal 5: If DRX cycle is smaller than 320ms, the UE shall perform measurement during DRX OFF duration as much as possible.** |
| R4-2320487 | Qualcomm | Remaining issues on Measurement without gaps for NFG  **Observation**: RAN4 has not discussed about how/what to specify the window length and how to calculate the exact maximum interruption length. Taking a smallest Tcycle among multiple frequency layers as the effective Tcycle already work as minimum requirements and simple. Due to limited timeline, we suggest RAN4 complete the interruption requirements based on the effective Tcycle.  **Proposal: RAN4 conclude total interruption requirement for multiple frequency layers based on smallest Tcycle among multiple frequency. (option2)**   * **Definition of effective Tcycle is min(Tcyclei­) among multiple frequency layers.** * **Tcyclei is a measurement periodicity for the certain freuqency layer i.**   **Observation:** Kp is about relation between SMTC and MGRP. Same Kp is applied for nogap-nointerruption. But for nogap-interruption, UE is not following SMTC periodicity but following max(80ms, SMTC) instead. Therefore, kp is calculated based on max(80ms,SMTC) and MGRP, where MGRP > max(80ms, SMTC).  **Proposal: For nogap-nointerruption, legacy Kp is reused.**  **Proposal: For nogap-interruption, Kp = 1-max(80ms,SMTC)/MGRP, where max(80ms, SMTC) < MGRP. If MGRP is smaller or equal to max(80ms, SMTC), Kp is not applicable.**  **Proposal: Add guidance in introduction of inter/intra frequency measurement without gap (clause 9.2.1, clause 9.3.1) to handle nogap-with interruption when MG is configured and it is partially or fully overlapped. Details are directly discussed in CR.**  **Proposal : Depending on whether SSB is completely contains in active BWP or not, different number of samples are applied for Mpss/sss\_sync\_inter, MSSB\_index\_inter, Mmeas\_period\_inter  - If SSB is completely contained in active BWP, number of samples for legacy inter-frequency measurements without gap is reused.  - If SSB is not completely contained in active BWP, number of samples for nogap-noncsg for inter-frequency measurement is reused.**  **Observation :** When NW configured DRX but UE is not in DRX, interruption is still introduced for frequency layer that UE indicate nogap-interruption.  **Observation** : When UE is in DRX, UE perform measurement at DRX on duration and there is no active traffic when DRX on duration.  **Proposal : When DRX is configured, interruption is allowed according to Tcycle, where Tcycle can be defined as max(80ms, SMTCmin, DRX cycle).** |
| R4-2320731 | Nokia | Discussion on measurements without gaps  **Proposal 1: Discuss the definition of measurements without gaps for the cases below:**  **a. Case 1: Intra frequency with SSB contained within active BWP**  **b. Case 2: Intra frequency with SSB not contained withing the active BWP**  **c. Case 3: Inter frequency with SSB contained within active BWP**  **d. Case 4: Inter frequency with SSB not contained within active BWP**  **Proposal 2: A measurement is only defined as measurement outside gap if the SMTC does not overlap with GAP, otherwise the requirements with measurement gap apply and no interruptions are allowed**.  **Proposal 3: For Case 1, measurements are always performed without gaps, and no interruptions are allowed, if**  **a. the SMTC does not overlap with GAP.**  **Proposal 4: For Case 2, measurements are always performed without gaps if**  **a. the SMTC does not overlap with GAP, and**  **b. the UE indicates ‘no-gap’ via intraFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR**  **Proposal 5: For case 3, measurements are always performed without gaps, and no interruptions are allowed, if**  **a. the SMTC does not overlap with GAP, and**  **b. the UE supports interFrequencyMeas-Nogap-r16, or the UE indicates ‘no-gap’ via interFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR**  **Proposal 6: For case 4, measurements are always performed without gaps if**  **a. the SMTC does not overlap with GAP, and**  **b. the UE indicates ‘no-gap’ via interFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR**  Observation 1: Depending on the SMTC configuration and overlap with gaps the total interruption ratio would differ between 2 frequency layers.  **Proposal 7: Interruption ratio is defined for a single frequency layer, and total interruption ratio is the sum of interruption ratio of individual frequency layers.**  **Proposal 8: Tcycle,i = CSSF x max( 80, max(TSMTC, DRX cycle)), for the ith frequency layer.**  **Proposal 9: Define interruption ratio per layer based on the formula**  **a. ratio,i = 2 \* L \* 100 / Tcycle,i, where L is the interruption length**  Observation 2: Kp is used in gapless measurements to take into account the SMTC overlap with measurement gaps.  Observation 3: It was agreed in RAN4 #108 that when GAP overlaps with SMTC, CSSF inside gap is used.  **Proposal 10: Do not consider measurement delay extension when GAP overlaps with SMTC.**  **Proposal 11: Do not apply Kp to Tcycle or measurement period.**  Observation 4: Additional ACG samples are considered in existing requirements only for inter-frequency measurements when SSB is not contained in the active BWP.  **Proposal 12: Additional ACG samples are only needed for inter-frequency measurement requirements if the SSB is not completely contained in the active BWP of the UE.**  Observation 5: drx-onDurationTimer can be as small as 1/32 ms  Observation 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.  Observation 7: Interruptions on PDCCH on the DRX cycle can cause the UE to experience delay in UL and DL grants as long as the drx-longcycle.  Observation 8: The impact of interruption is more severe on PDCCH than for PDSCH during DRX activity time.  **Proposal 13: No interruption is expected during DRX activity time, including DRX ON duration extended by inactivity-timer after each PDCCH reception.**  **Proposal 14: Update clauses 9.2.1 and 9.3.1 to determine the cases where measurements without gaps apply, including:**  **a. Measurement is performed within gap, if SMTC partially or fully overlaps with GAP.** |
| R4-2320925 | MediaTek Inc. | Discussion on measurement without gaps for UEs reporting NeedForGapsInfoNR  **Proposal 1: RAN4 shall define the requirements of Tcycle,i = scaling factors \* max (80ms, SMTC period), scaling factor is CSSFoutside\_gap.**  **Proposal 2: RAN4 shall define the requirements of multiple frequency layers scaling factor for measurement delay to include all the frequency layers without MG and with or without interruption in the same scaling factor.**  **Proposal 3: RAN4 shall include the following frequency layers in the calculation of multiple frequency layers scaling factor outside gap (CSSFoutside\_gap) in the UE requirements: (i) Rel-15/Rel-16 Intra-/inter-frequency without gap; (ii) Rel-18 Intra-/inter-frequency NFG with interruption; and (iii) Rel-18 Intra-/inter-frequency NFG without interruption.**  **Proposal 4: Use CSSF outside gap to scale SMTC period when MG is not configured.**  **Proposal 5: Do not apply Kp to Tcycle,i / measurement period.**  **Proposal 6: For inter-frequency case 1: RAN4 shall take requirements of ‘nogap-noncsg’ for lower bound and # of samples for inter-frequency measurement without interruption in Section 9.3.9 of TS38.133 as a starting point.**  **Proposal 7: For inter-frequency and intra-frequency case 2: RAN4 shall reuse existing requirements of ‘ncsg’ for lower bound and number of samples for intra-frequency and inter-frequency measurement with interruption as baseline.**  **Proposal 8: The number of sample number for PSS/SSS detection without AGC is equal to 5 samples.**  **Proposal 9: The number of sample number for measurements without AGC is equal to 5 samples.**  **Proposal 10: The number of sample number for SBI index detection without AGC is equal to 3 samples.**  **Proposal 11: The number of sample number when AGC is needed is equal to additional 3 samples.**  **Proposal 12: RAN4 shall reuse all existing values for lowers bound for NFG new requirements.**  **Proposal 13: For DRX based interruption ratio when DRX is configured larger than 320ms, RAN4 shall follow the existing requirements of NCSG or MG as baseline.**  **Proposal 14: For DRX based interruption ratio when DRX is configured smaller than 320ms, RAN4 shall follow the existing requirements of NCSG or MG as baseline.**  **Proposal 15: Consider 1.5 is to address frequent measurements in legacy releases when DRX cycle length is smaller than 320ms.** |
| R4-2319087 | CMCC | DraftCR on intra-frequency measurement delay for NFG |
| R4-2319128 | Intel Corporation | draftCR on interruption requirements for UE reporting NFG |
| R4-2319147 | Ericsson | Draft CR on NeedForGaps interruption |
| R4-2320488 | Qualcomm | Draft CR for inter-frequency measurement without gap |
| R4-2319477  Moved here from 8.9.3 | OPPO | Draft CR on CSSF for R18 measurement without gap |
| (Missing draftCR?) | ZTE | Draft CR on L1 measurement impact of R18 NFG |
| R4-2318333  (withdrawn) | CATT | Discussion on RRM requirements for measurement without gaps for UEs reporting NeedForGapsInfoNR |

## Open issues summary

### Sub-topic 1-1 General definitions

**Issue 1-1-1: Tcycle definition on a certain configured carrier i: lower bound 80ms.**

* ***Background***
  + ***Tcycle is used for interruption requirements specification implementation.***
  + ***The UE is allowed to cause a certain interruption length every Tcycle period.***
  + ***Interruption requirements are specified per serving cell/per UE not per MO or per frequency layer.***
  + Agreements
    - Tcycle per MO/frequency layer is the same as UE measurement cycle.
  + Previous agreement: When MG is configured and overlapped with some of the SMTC occasions on carrier i, interruption is not allowed and all the measurements with interruptions are carried out within the configured MG.
* Proposals
  + Option 1: Tcycle,i = scaling factors \* max (80ms, SMTC period).
  + Option 2: Tcycle,i = max (80ms, scaling factors \* SMTC period).
  + Option 3: Tcycle = max(80ms, SMTCmin), where SMTCmin is smallest SMTC among multiple MO/frequency layers.
* Recommended WF
  + Discuss on following options:
  + Option 1
    - Tcycle,i = (CSSFintra or CSSFinter) \* max (80ms, SMTC period).
      * This applies to the interruption cycle when MG is either not configured or not overlapped with any SMTC occasions on carrier i.
      * This applies when DRX is not configured.
    - Tcycle,i = (CSSFintra or CSSFinter) \* max (80ms, SMTC period, DRX cycle).
      * This applies to the interruption cycle when MG is either not configured or not overlapped with any SMTC occasions on carrier i.
      * This applies when DRX is configured and DRX cycle is applied when interruption is allowed according to RAN4 conclusions.
  + Option 2
    - Tcycle = max(80ms, SMTCmin), where SMTCmin is smallest SMTC among multiple MO/frequency layers
      * This applies when DRX is not configured.
    - Tcycle = max(80ms, SMTCmin, DRXcycle)
      * This applies when DRX is configured and DRX cycle is applied when interruption is allowed according to RAN4 conclusions.
  + Option 3
    - Tcycle,i = (CSSFintra or CSSFinter) \* max (80ms, max(SMTC period, MGRP)).
      * This applies to the interruption cycle when MG is configured and partially or fully overlapped with SMTC occasions on carrier i.
      * This applies when DRX is not configured.

**Issue 1-1-2: Kp definition for interruption requirements**

* ***Background***
  + ***Kp is the scaling factor introduced in legacy releases, applied to the cases where the target SSB is within the UE active bandwidth part and measurement gap is not needed in nature, but since measurement gap is configured the measurements only happen outside gap occasions; Kp is calculated by dividing the total number of SMTCs by available SMTC number outside gap during window length max(SMTC, MGRP); Kp = 1 when SMTC occasion is always overlapped with gap.***
  + ***For interruption requirements, since either the measurements with interruptions are carried out within measurement gap or SMTC is not overlapped with any gap occasions, Kp is not needed.***
* Recommended WF
  + Continue discussion.

**Issue 1-1-3: Kp definition for measurement periods when measurement gap is configured**

* ***Background***
  + ***Kp is the scaling factor introduced in legacy releases, applied to the cases where the target SSB is within the UE active bandwidth part and measurement gap is not needed in nature, but since measurement gap is configured the measurements only happen outside gap occasions; Kp is calculated by dividing the total number of SMTCs by available SMTC number outside gap during window length max(SMTC, MGRP); Kp = 1 when SMTC occasion is always overlapped with gap.***
* Proposals
  + ***Option 1:*** 
    - **A measurement is only defined as measurement outside gap if the SMTC does not overlap with GAP, otherwise the requirements with measurement gap apply and no interruptions are allowed**.
    - **Do not consider measurement delay extension when GAP overlaps with SMTC.**
    - ***Do not apply Kp to Tcycle or measurement period.***
  + ***Option 2:*** 
    - Apply Kp in general to measurement period requirements.
    - Kp = 1 when any one/set of the below conditions is met
      * Measurement gap is not configured.
      * Measurement gap is configured, and measurement gaps are fully overlapped with the SMTC occasions.
      * Measurement gap is configured, and measurement gaps are not fully overlapped with SMTC occasions, and measurements are with interruption, and all measurements are carried out within measurement gaps.
    - Otherwise Kp = (total number of SMTC periods) / (number of available SMTC periods outside gap) within time period (max (SMTC period, MGRP)).
* Recommended WF
  + - More discussion needed.

### Sub-topic 1-2 Interruption requirements

**Issue 1-2-1: Specify total interruption ratio requirements in equation format to replace the texts below in the spec:**

**‘** UE is allowed to cause interruption on a certain frequency layer i:

- up to [2.50%] probability of missed ACK/NACK when 80ms ≤ Tcycle,i < 160ms, or

- up to [1.25%] probability of missed ACK/NACK when 160ms ≤ Tcycle,i < 320ms, or

- up to [0.625%] probability of missed ACK/NACK when 320ms ≤ Tcycle,i. ’

* ***Background***
  + ***The texts were part of agreements reached in one of the early meetings of discussions. The idea was to replace the bullets with equation format requirements.***
    - ***‘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***
      * ***FFS if the interruption rate can be captured in equation format’.***
  + ***Equation format interruption ratio was agreed to be implemented in the spec if possible, but the interruption ratio function was not endorsed in the last meeting.***
* Proposals
  + Option 1: Remove the texts after accurate equation format total interruption ratio is specified.
    - Option 1a: interruption ratio of single frequency layer equals 2\*L/Tcycle,i
* Recommended WF
  + Agree on option 1.

**Issue 1-2-2: Total interruption ratio considering maximum 2L interruption caused every time UE carries out measurements**

* ***Background***
  + Proposals in the last meetings
    - Option 1: Sum among all possible maximum interruptions caused on applicable carriers during a pre-defined window, and
      * Specify the window length and calculate the exact maximum interruption length.
      * Total interruption ratio is the total sum divided by window length.
    - Option 2: Do not sum up but to consider the smallest Tcycle,i among all applicable carriers, and
    - Total interruption ratio is 2L divided by smallest Tcycle,i among all applicable carriers.
  + Agreement:
    - Take option 1 as baseline for CR drafting and go with option 2 if option 1 is not feasible from CR draft perspective.
* Proposals
  + Option 1: Total interruption ratio = where N is number of layers and L is single interruption length
  + Option 2: Total interruption ratio = , where
    - N is number of carriers which are measured with interruption,
    - M is total number of carriers which are measured outside MG, including carriers that are measured with and without interruption,
  + Option 3: Total interruption ratio is the sum of interruption ratio of individual frequency layers with interruption.
* Recommended WF
  + Discuss the candidate options.

**Issue 1-2-3: Definition of measurements without gaps and cases with interruptions:**

* Proposals
  + Proposal 1: Discuss the definition of measurements without gaps for the cases below:
    - Case 1: Intra frequency with SSB contained within active BWP
    - Case 2: Intra frequency with SSB not contained withing the active BWP
    - Case 3: Inter frequency with SSB contained within active BWP
    - Case 4: Inter frequency with SSB not contained within active BWP
  + Proposal 2: A measurement is only defined as measurement outside gap if the SMTC does not overlap with GAP, otherwise the requirements with measurement gap apply and no interruptions are allowed.
  + Proposal 3: For Case 1, measurements are always performed without gaps, and no interruptions are allowed, if the SMTC does not overlap with GAP.
  + Proposal 4: For Case 2, measurements are always performed without gaps if
    - the SMTC does not overlap with GAP, and
    - the UE indicates ‘no-gap’ via intraFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR
  + Proposal 5: For case 3, measurements are always performed without gaps, and no interruptions are allowed, if
    - the SMTC does not overlap with GAP, and
    - the UE supports interFrequencyMeas-Nogap-r16, or the UE indicates ‘no-gap’ via interFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR
  + Proposal 6: For case 4, measurements are always performed without gaps if
    - the SMTC does not overlap with GAP, and
    - the UE indicates ‘no-gap’ via interFreq-needForGap, or the UE indicates ‘nogap-noncsg’ via NeedForGapNCSG-InfoNR

### Sub-topic 1-3 Measurement reporting delay requirements

* **Case 1:** without gap and no interruption
* **Case 2:** without gap but interruption allowed

**Issue 1-3-1: Measurement sample number for PSS/SSS detection without AGC**

* Proposals
  + Option 1: 5.
* Recommended WF
  + Agree on 5.

**Issue 1-3-2: Measurement sample number for Measurements without AGC**

* Proposals
  + Option 1: 5.
* Recommended WF
  + Agree on 5.

**Issue 1-3-3: Measurement sample number for SSB index detection without AGC**

* Proposals
  + Option 1: 3.
* Recommended WF
  + Agree on 3.

**Issue 1-3-4: Measurement sample number when AGC is needed**

* Proposals
  + Option 1: 3 samples are added.
* Recommended WF
  + Agree on additional 3.

**Issue 1-3-5: Lower bounds**

* Proposals
  + Option 1: reuse all existing values.
  + Option 2: other values.
* Recommended WF
  + Agree on option 1.

**Issue 1-3-6: Conditions when ACG is needed.**

* Proposals
  + Option 1: Additional ACG samples are only needed for inter-frequency measurement requirements if the SSB is not completely contained in the active BWP of the UE.
* Recommended WF
  + Discussion needed.

### Sub-topic 1-4 DRX specific issues

**Issue 1-4-1: Interruption caused when DRX is configured larger than 320ms**

* Proposals
  + Option 1: No interruption is expected when DRX is configured larger than 320ms on the serving cell.
  + Option 2: Interruption is allowed, and it is according to Tcycle,i.
  + Option 3: No interruption is expected during DRX activity time, including DRX ON duration extended by inactivity-timer after each PDCCH reception.
* Recommended WF
  + Discussion needed.

**Issue 1-4-2: Interruption caused when DRX is configured smaller than 320ms**

* Proposals
  + Option 1: No interruption is expected when SMTC is during DRX-off and UE uses such SMTC to measure NFG measurements with interruption on a certain MO; otherwise interruption is allowed.
  + Option 2: Interruption is always allowed, and it is according to Tcycle,i.
  + Option 3: No interruption is expected during DRX activity time, including DRX ON duration extended by inactivity-timer after each PDCCH reception.
* Recommended WF
  + Discussion needed.

**Issue 1-4-3: Scaling factor 1.5**

* ***Background***
  + ***1.5 is to address frequent measurements in legacy releases when DRX cycle length is smaller than 320ms.***
* Proposals
  + Option 1: Apply 1.5.
* Recommended WF
  + Discussion needed.

### Sub-topic 1-5 Others

**Issue 1-5-1: 1-to-1 mapping between NeedForGaps and NCSG capabilities**

* Proposals
  + Option 1: NeedForGaps and NCSG are not expected to be enabled for the same UE at the same time and there is No need to establish the mapping between UE’s indication for NeedForGaps and NCSG.
* Recommended WF
  + Agree on option 1.
  + Send an LS to RAN2 about RAN4 agreements.

**Issue 1-5-2: NFG with concurrent gaps**

* Proposals
  + Option 1: When UE supports NFG and Con-MGs, and NW configures the Con-MGs, NFG MO will be performed within the associated MG in the following scenarios:
    - when the MO belongs to a band in which UE reports ‘nogap-nointerruption’ and all of the SMTC occasions of this MO are overlapped by the associated measurement gap
    - when the MO belongs to a band in which UE reports ‘nogap-interruption’ and part or all of the SMTC occasions of this MO are overlapped by the associated measurement gap
* Recommended WF
  + Not to reflect the discussions in the spec.

**Issue 1-5-3: Difference between R16** **inter-frequency measurement without MG and NFG**

* ***Background***

Table 1 difference between Rel 16 inter-frequency measurement without MG and NFG

|  |  |  |
| --- | --- | --- |
|  | **Rel 16 inter-frequency measurement without MG** | **NFG** |
| **Scenario** | Inter-frequency measurement without gap is support when SSB is completely contained in the active BWP of the UE | Inter-frequency measurement without gap is support when there is spare RF chain |
| **UE capability** | Per-UE capability: *interFrequencyMeas-NoGap-r16*   * According TS 38.306, this capability indicates whether the UE can perform inter-frequency SSB based measurements without measurement gaps if the SSB is completely contained in the active BWP of the UE | Per-band capability: *NeedForGap*   * Indicates whether the UE supports reporting the measurement gap requirement information for NR target in the UE response to a network configuration RRC message. |
| **Interruption** | No interruption, since SSB is within active BWP | Based on UE capability:   * NFG without interruption * NFG with interruption |
| **Delay requirements** | Taking PSS/SSS detection as an example, the number of sample is 5, AGC is not needed | Taking PSS/SSS detection as an example, even the number of sample is FFS, but the number may be larger than 5, since AGC is needed when SSB is not in the active BWP |

* Proposals
  + Option 1: it is proposed to follow the similar approach as for Rel-15 intra-frequency measurement: when the target SSB is completely contained in active BWP of UE, apply the requirements on Rel-16 inter-frequency measurement without gap without interruption when UE supports interFrequencyMeas-NoGap-r16, regardless of the NeedForGaps’ status reporting.
* Recommended WF
  + Discuss if there is impact on the spec from this issue.
  + The moderator’s observation is that the differences are clear to the group in technical aspects.

**Issue 1-5-4: Specification structure**

* Proposals
  + Update clauses 9.2.1 and 9.3.1 to determine the cases where measurements without gaps apply, including:
    - Measurement is performed within gap, if SMTC partially or fully overlaps with GAP.
* Recommended WF
  + Discussion needed

### Sub-topic 1-6 CR list

|  |  |  |
| --- | --- | --- |
| R4-2319087 | CMCC | DraftCR on intra-frequency measurement delay for NFG |
| R4-2319128 | Intel Corporation | draftCR on interruption requirements for UE reporting NFG |
| R4-2319147  (overlap with R4-2319128) | Ericsson | Draft CR on NeedForGaps interruption |
| R4-2320488 | Qualcomm | Draft CR for inter-frequency measurement without gap |
| R4-2319477  Moved here from 8.9.3 | OPPO | Draft CR on CSSF for R18 measurement without gap |
| (Missing draftCR?) | ZTE | Draft CR on L1 measurement impact of R18 NFG |

**Issue 1-6-1: R4-2319147**

* Recommended WF
  + Merge to R4-2319128.

**Issue 1-6-2: Missing draftCR on L1 measurement impact of R18 NFG**

* Recommended WF
  + Allocate a number to capture conclusions in the meeting in order to close the work item.

# Topic #2: Inter-RAT measurement without gap

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318594 | Apple | Discussion on R18 inter-RAT measurement without gap  **Observation 1: existing UE capabilities regarding support of mixed SCS are only for intra and inter-frequency MO.**  **Proposal 1: introduce a new UE capability to indicate support of mixed SCS between NR serving cell and inter-RAT LTE MO.**  **Proposal 2: The scheduling restriction shall be defined for inter-RAT LTE measurement with mixed numerology, i.e., 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 3: specify scheduling restriction when UE does not support simultaneous Tx and Rx on the serving cell and target band.**  **Proposal 4: 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 to facilitate RRM measurement.**  **Proposal 5: if EMW is configured and fully overlapped with MG, but the periodicity of MG is smaller than EMW,** **apply legacy gap-based measurement requirements, i.e. RAN4 requirements should NOT be defined based on EMW.**  **Proposal 6: RAN4 to introduce the effective measurement window duration 5.5ms with periodicity 40ms and 80ms.**  **Proposal 7: if EMW with 2ms duration is introduced, RAN4 shall NOT assume legacy LTE capability for MGL=3ms can be reused.**  **Proposal 8: Scaling factor for case b-1 and b-2: Update CSSFinterRAT = CSSFouside\_gap,i to take the inter-RAT LTE MOs with no measurement gap in to consideration.** |
| R4-2318864 | Xiaomi | Discussion on inter-RAT measurement without gap  **Proposal 1: The scheduling restriction shall be defined for inter-RAT LTE measurement case b-1 and b-2 with mixed numerology.**  **Proposal 2: For case b-1, performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported in Rel-18 WI.**  **Observation 1: For these inter-RAT LTE cells that already have sufficient timing synchronization information, the EMW duration of 2ms is feasible for conducting CRS based measurement for LTE.**  **Proposal 3: The EMW duration= 2ms could be configured under the condition that the target inter-RAT LTE cell is already known.**  **Observation 2: With the agreed the UE capability to support case b-1, EMW functionality will be invalid. The**  **new UE capability to support case b-1 and EMW is needed.**  **Proposal 4: For the EMW configuration in case b-1,**   * **Alt1: RAN4 to introduce a new per-UE capability to support the EMW configuration on top of *NeedForNCSG-InfoEUTRA-r17*, and define corresponding requirements;** * **Alt2: RAN4 to confirm that EMW is only expected to be introduced to case b-2 other than both case b-1 and case b-2 and send a LS to RAN2 to clarify.**   **Proposal 5: Propose to update the feature list for NR\_MG\_enh2 as below if it was agreed to introduce a new per-UE capability to support the EMW configuration on top of *NeedForNCSG-InfoEUTRA-r17.***  *(Table refers to tdoc.)*  **Proposal 6: Use scaling factor Nfreq to derive measurement period requirements for UE indicating nogap-nointerruption and indicating nogap-withinterruption in case a-1.**  **Proposal 7: The measurement period requirements for case b-1 and case b-2 can be defined with the following updates:**   * **TBasicIdentify = 480ms;** * **TInter1=30 ms for EMWRP=80 ms, and TInter1=60 ms for EMWRP=40 ms;** |
| R4-2319091 | CMCC | Discussion on inter-RAT measurements without gaps  ***Proposal 1: for inter-RAT measurement without gap with mixed numerology, it is proposed to follow previous agreements that no additional UE capability is needed, and scheduling restriction is specified.*** |
| R4-2319127 | Intel Corporation | Remaining issues from inter-RAT measurement without gap  **Proposal 1: For case b-1 and b-2, when EMW periodicity is larger than MGRP and all EMW are covered by measurement gaps, inter-RAT LTE measurement will be dropped.**  **Proposal 2: No additional dropping is applied when none of the EMW overlaps with any of the measurement gap occasions, and existing scheduling/measurement restrictions apply.**  **Proposal 3: RAN4 agrees on table 1, 2, 3 and 4 in this section.**  **Table 1: Minimum available time for inter-RAT measurements when effective measurement window is configured**   |  |  |  |  | | --- | --- | --- | --- | | **EMW Pattern Id** | **EMW Length (EMWL, ms)** | **EMW Repetition Period**  **(EMWRP, ms)** | **Minimum available time for inter-RAT measurements during 480 ms period**  **(Tinter1, ms)** | | 0 | 5 | 40 | 60 | | 1 | 5 | 80 | 30 | | 2 | 2 | 40 | 24 | | 3 | 2 | 80 | 12 | | 4 | 5.5 | 40 | 36 | | 5 | 5.5 | 80 | 18 |   **Table 2: Measurement period and measurement bandwidth when no DRX is configured**   |  |  |  | | --- | --- | --- | | **Configuration** | **Physical Layer Measurement period: TMeasure, E-UTRAN FDD(or TDD) [ms]** | **Measurement bandwidth [RB]** | | 0 | Max(480, TEMW) x Ceil(CSSFinterRAT) | 6 | | 1 (Note 1) | Max(240, TEMW) x Ceil(CSSFinterRAT) | 50 | | NOTE 1: This configuration is optional. | | |   **Table 3: Requirement to identify a newly detectable E-UTRAN FDD or TDD cell when DRX is configured**   |  |  |  | | --- | --- | --- | | **DRX cycle length (s)** | **TIdentify, E-UTRAN FDD or TDD (s) (DRX cycles)** | | |  | EMW period = 40 ms | EMW period = 80 ms | | ≤0.16 | Non-DRX requirements apply | Non-DRX requirements apply | | 0.256 | 5.12\* Ceil(CSSFinterRAT)  (20\* Ceil(CSSFinterRAT)) | 7.68\* Ceil(CSSFinterRAT) (30\* Ceil(CSSFinterRAT)) | | 0.32 | 6.4\* Ceil(CSSFinterRAT)  (20\* Ceil(CSSFinterRAT)) | 7.68\* Ceil(CSSFinterRAT) (24\* Ceil(CSSFinterRAT)) | | 0.32< DRX-cycle ≤10.24 | Note1 (20\* Ceil(CSSFinterRAT)) | Note1 (20\* Ceil(CSSFinterRAT)) | | NOTE 1: The time depends on the DRX cycle length. | | |   **Table 4: Requirement to measure E-UTRAN FDD or TDD cells when DRX is configured**   |  |  | | --- | --- | | **DRX cycle length (s)** | **Tmeasure, E-UTRAN FDD or TDD (s) (DRX cycles)** | | ≤0.08 | Non-DRX requirements apply | | 0.08< DRX-cycle ≤10.24 | Note1 (5\* Ceil(CSSFinterRAT)) | | NOTE 1: The time depends on the DRX cycle length. | | |
| R4-2319145 | Ericsson | Discussion on inter-RAT measurement without gap  ***Proposal 1: RAN4 to additionally introduce the effective measurement window duration 2ms and 5.5ms with periodicity 40ms, 80ms.***  ***Proposal 2: As a compromise, additional UE capability to support 2ms EMW can be introduced.***  ***Proposal 3: When EMW is fully overlapped with MG, but the periodicity of MG is smaller than EMW, the measurement period shall base on the max(EMW, MGRP).***  ***Proposal 4: No scheduling restriction due to mix-numerology in case b-1.***  ***Proposal 5: In case b-2, a new UE capability to support mix-numerology scheduling restriction between inter-RAT LTE measurement and NR data reception with 30KHz can be introduced.***  ***Proposal 6: The scheduling restriction will be applied to the whole EMW if UE doesn’t support mix-numerology between LTE measurement and NR data reception.*** |
| R4-2319150 | Ericsson | LS on inter-RAT measurement without gap  In R18 measurement gap enhancement WI (NR\_MG\_enh2-Core), RAN4 discussed RRM requirements for inter-RAT measurement without gaps and reached the following agreements below.   |  | | --- | | Agreement:   * For the effective measurement window(EMW), RAN4 further introduce the candidate values for EMW duration: 5.5ms and 2ms   + Introduce a new per-UE capability to support 2ms | |
| R4-2319251 | Vivo | Further consideration on remaining issues for inter-RAT measurement without gap  **Proposal 1: For Scheduling restriction due to mixed numerology for case b-2, ok with option 1 and 1a.**  **Proposal 2: For issue 2-2-2 and 2-2-3, Support defining scheduling restriction**  **Proposal 3: For scaling factor for case b -1 and b-2, support option 3.**  **Proposal 4: For issue 2-5-1, support option 2.**  **Proposal 5: Introduction of new UE capabilities for supporting EMW for case b-1** |
| R4-2319479 | OPPO | On RRM requirements for Inter-RAT measurement without gap  **Proposal 1: For case b-1, performing inter-RAT LTE measurement and NR measurements in parallel without searcher limitation is NOT supported either.**  **Proposal 2: Introduce the effective measurement window duration: 2ms with periodicity 40ms, 80ms.**  **Proposal 3: The effective measurement window with 2ms duration can be subject to UE capability.**  **Proposal 4: For case b-1 and case b-2, update CSSFinterRAT=CSSFoutside\_gap to additional include the number of inter-RAT LTE MOs without gap.**  **Proposal 5: At least some EMW patterns should be supported by default if UE supports inter-RAT LTE measurement without gap, and no new UE capabilities for supporting EMW is needed.** |
| R4-2319980 | Huawei | Discussion on inter-RAT MG-less measurement  **Proposal 1: For Case b-2, define scheduling restriction when serving cell and target MO have mixed SCS, and UE does not support any of** ***crs-IM-nonDSS-30kHzSCS-r17*, *crs-IM-nonDSS-NWA-30kHzSCS-r17* and the new UE capability for inter-RAT LTE measurement with mixed SCS.**  **Proposal 2: For both Case b-1 and b-2, define scheduling restriction when UE does not support simultaneous Tx and Rx on the serving cell and target band (as already agreed in RAN4#106-bis-e).**  **Proposal 3: For Case b-1, define scheduling restriction when serving cell and target MO have mixed SCS and they are in bands with overlapping frequency, and UE does not support the new UE capability for inter-RAT LTE measurement with mixed SCS.**  **Proposal 4: For Case b-1, performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported in Rel-18.**  **Proposal 5: For Case b-1 and b-2, for inter-RAT LTE measurement causing scheduling restriction, if EMW is configured and fully overlapped with MG, but the periodicity of MG is smaller than EMW, UE measurement requirements are based on EMW-RP.**  **Proposal 6: RAN4 to introduce additional effective measurement window duration: 2ms and 5.5ms with periodicity 40ms, 80ms. Introduce UE capability for window duration of 2ms in case of sync.**  **Proposal 7: For Case b-1 and b-2, CSSFinterRAT is defined as CSSF outside MG, which additionally accounts for inter-RAT carriers measured without MG.**  **Proposal 8: For Case b-1 and b-2, Tinter1 is calculated based on 40ms MGRP unless the EMW is with 80ms periodicity.**  **Proposal 9: For Case a-1, RAN4 to discuss the calculation of Nfreq**   * **Option 1: number of NR MOs that are measured outside MG (same principle as NR SA)** * **Option 2: total number of LTE and NR MOs (same principle as LTE SA)**   **Proposal 10: RAN4 not to further discuss reporting of UE capability interRAT-NeedForIntrNR-r18.**  **Proposal 11: RAN4 not to define new UE capability for supporting EMW.**  **Proposal 12: RAN4 to define new UE capability for scheduling restriction due to mixed SCS for both Case b-1 and b-2.** |
| R4-2320423 | ZTE Corporation | Discussion on inter-RAT measurement without gaps  **Proposal 1: Introduce a new UE capability to indicate whether the UE supports parallel inter-RAT LTE no-gap measurement and data reception from the serving cell with a mixed numerology.**  **Proposal 2: For case b-2, the scheduling restriction shall be defined for the UE not supporting the new capability and serving cell and target cell are in the same band with mixed SCS.**  **Proposal 3: Specify scheduling restriction when UE does not support simultaneous Tx and Rx on the serving cell and target cell.**  **Proposal 4: For case b-1, specify scheduling restrictions caused by mixed numerology.**  **Proposal 5: For case b-1 and case b-2, when MG is partially overlapped with EMW (EMW periodicity > MGRP), the inter-RAT LTE measurement with scheduling restriction is performed within MG, and the collided occasions are shared by inter-RAT LTE measurements and measurements with gap.**  **Proposal 6:**  **The definition of scaling factor for case b-1 and case b-2 is as follows:**   * **In the case that EMW is not configured or EMW is configured and fully overlapped with measurement gap, reuse the existing scaling factor CSSFwithin\_gap.** * **In the case that EMW is configured, and is partially overlapped with measurement gap (EMW periodicity< MGRP), introduce a new scaling factor Kp to handle the collision between EMW and MG, where Kp is calculated by dividing the total number of EMW by available EMW number outside gap. And to handle the collision between different inter-RAT LTE measurement, introduce a scaling factor, which is equal to the number of inter-RAT LTE gapless MOs.** * **In the case that EMW is configured, and is partially overlapped with measurement gap (EMW periodicity > MGRP), use the existing CSSF within gap.**   **Proposal 7: Do not further discuss how to report UE capability *interRAT-NeedForIntrNR-r18*.**  **Proposal 8: Introduce a new UE capability to indicate whether the UE supports EMW.** |
| R4-2320489 | Qualcomm | Discussion on Remaining issues on interRAT measurements without gaps.  **Observation** : simultaneousRxTxInterBandENDC is already defined in Rel 17 which can be applied for case b-1 DC scenario. Therefore, RAN4 does reuse this capability and 9.4.3.5 scheduling restriction for case b-1.  **Proposal: Existing scheduling restrictions on 9.4.3.5 can be reused for case b-1 for UE who does not support simultaneousRxTxInterBandENDC.**  **Observation** : For case b-2 (CRS in active BWP), there are two scenarios as   1. DSS scenario: no scheduling restriction is needed because CRS and serving cell is same SCS. Moreover, there is RM’ed around CRS. 2. CRS-IM scenario: CRS is not serving LTE for the UE. In this case, mixed SCS scenario can be possible. But it is questionable whether/how scheduling restriction is applied for CRS-IM purpose.   **Observation:** mixed numerology scenario is only considered for CRS-IM. UE to perform CRS-IM with different numerology, UE has to support a corresponding CRS-IM capability. Without supporting CRS-IM capability, there is no scenario that UE to perform LTE measurement without gap while NR SCS is 30KHz and CRS is completely contained in UE active BWP.  **Proposal: RAN4 does not need to define scheduling restrictions due to mixed numerology for case b-2.**  **Proposal: NW should not configure fully overlapped EMW and MG but MG periodicity is smaller than EMW. If NW configure such scenario, it is up to UE implementation whether follow EMW or MG configuration. RAN4 does not specify requirements for this scenario.**  **Proposal: No additional UE capability is introduced. RAN4 already made agreements that no additional UE capability is defined for mixed numerology at RAN4 #106 bis-e [2]**   |  | | --- | | **R4-2306331, RAN4 #106-bis-e** **Issue 2-2-3: Additional capability to support inter-RAT measurement without gap with mixed numerology**  **< Agreement >**:   * + No additional UE capability is defined for inter-RAT measurement with mixed numerology; instead it can be considered for scheduling restriction | |
| R4-2320732 | Nokia | Discussion on interRAT measurements without gaps   1. The UE is aware of the use case and configuration of the cells in an inter-RAT measurement scenario. 2. If the UE have any limitations in an inter-RAT measurement scenario, it shall ask for gaps. If not, it shall support gapless without scheduling restrictions, nor additional capabilities defined. 3. Always use the MG for Inter-RAT LTE measurements as long as the EMW and MG over 4. Not to introduce a new UE capability for 2ms EMW in issue 2.4.2. 5. Scaling factor for case b-1 and b-2    1. 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    2. 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 6. Reporting of interRAT-NeedForIntrNR-r18 capability should be done based on network request. 7. RAN4 not to introduce new UE capability for supporting of EMW. |
| R4-2320926 | MediaTek Inc. | Discussion on inter-RAT measurements  **Proposal 1: For scheduling restriction for inter-RAT LTE measurements case b-2, RAN4 should use the existing scheduling availability specified for inter-frequency measurements without a gap in TS 38.133 as a baseline for the inter-RAT LTE measurement without measurement gaps.**  **Proposal 2: For scheduling restriction for inter-RAT LTE measurements case b-1, 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 3: RAN4 to introduce additional effective measurement window duration: 2ms and 5.5ms with periodicity 40ms, 80ms, yet UE capability for window duration of 2ms shall be introduced in case of sync is needed.** |
| R4-2318865 | Xiaomi | CR on introduction of interruprion requirements for inter-RAT NR measurement without gap (case a-1) |
| R4-2319981 | Huawei | draftCR on measurement period and scheduling restriction for inter-RAT NR measurement without gap |
| R4-2318595 | Apple | CR for measurement delay for nogap-noncsg |
| R4-2320434 | ZTE | Draft CR for measurement delay for nogap-noncsg EUTRAN FDD |

## 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
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 Power imbalance

### Sub-topic 2-2 Scheduling restriction

**Issue 2-2-1: Scheduling restriction due to mixed numerology for case b-2 when UE does not support crs-IM features**

* ***Background***
  + Companies claimed that there is no scenario for UE not supporting CRS-IM features to be configured for measurements on 15kHz LTE without gaps for case b-2.
  + Though even this is not correct configuration the UE is not guaranteed with undefined behaviour if no scheduling restriction is specified.
  + If this is not correct configuration, the UE is allowed to cause any interruption.
* Proposals
  + Option 1: The scheduling restriction shall be defined for inter-RAT LTE measurement case b-2 with mixed numerology, -- 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.
  + Option 2: RAN4 does not need to define scheduling restriction due to mixed numerology.
* Recommended WF
  + Reach consensus on whether it is correct configuration if network configures the UE to measure on 15kHz LTE for case b-2 if the UE does not support CRS-IM features.
  + If so RAN4 agrees on option 1.
  + If not the UE behaviour is not specified.

**Issue 2-2-1a: Scheduling restriction due to mixed numerology for case b-2: when UE supports crs-IM features**

* Proposals
  + Option 1: If UE supports *crs-IM-nonDSS-30kHzSCS-r17* or *crs-IM-nonDSS-NWA-30kHzSCS-r17*, there should be no scheduling restriction for case b-2.
* Recommended WF
  + Agree on option 1.

**Issue 2-2-2: Scheduling restriction when UE does not support simultaneous Tx and Rx on the serving cell and target band for both cases b-1 and b-2**

* Proposals
  + Option 1: Specify scheduling restriction.
  + Option 1a: Specify scheduling restriction for UE who does not support *simultaneousRxTxInterBandENDC.*
* Recommended WF
  + Agree on option 1.
  + Agree on option 1a.

**Issue 2-2-3: Scheduling restriction due to mixed numerology for case b-1**

* Proposals
  + Option 1: Not specify scheduling restriction similar as NCSG.
  + Option 2: specify scheduling restriction
* Recommended WF
  + Agree on option 1.

### Sub-topic 2-3 Searcher limitation

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

* Background
  + Agreements:
    - For Case b-2, performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported in Rel-18.
    - FFS whether to apply the same limitation to case b-1.
* Proposals
  + Option 1: For Case b-1, performing inter-RAT measurement and NR measurements in parallel without searcher limitation is NOT supported in Rel-18.
* Recommended WF
  + Agree on option 1.

### 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 gap  because 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 2-4-1: Overlap between Effective measurement window and SMTC/SSB**

* ***Background***
  + Agreements
    - For case b-2, when EMW is configured overlapped with SMTC/SSB/CSI-RS measurement with scheduling restrictions, inter-RAT LTE measurement will be dropped.

**Issue 2-4-1a: Overlap between Effective measurement window and MG**

* ***Background***
  + Agreements
    - For case b-1 and b-2, when EMW is partially overlapped with MG (EMW periodicity < MGRP), the EMW occasion colliding physically with MG will be dropped.
    - Note: The proximity rule in Rel-17 does not apply in this case.
* Proposals
  + Option 1: For case b-1 and b-2, when EMW periodicity is larger than MGRP and all EMW are covered by measurement gaps, inter-RAT LTE measurement will be dropped.
  + Option 2: No UE behaviour is specified.
  + Option 3: apply legacy gap-based measurement requirements, i.e. RAN4 requirements should NOT be defined based on EMW.
  + Option 4: UE measurement requirements are based on EMW-RP.
* Recommended WF
  + Discuss upon the options.

**Issue 2-4-1b: Where to perform Inter-RAT LTE measurement causing scheduling restriction**

**Issue 2-4-1c: EMW is not overlapped with any MG occasion**

* ***Background***
  + Due to the fact that the scheduling restrictions are common, it is good configuration for the network to configure the EMW not overlapped with MG occasion since CRS is in every LTE slot.
* Proposals
  + Option 1: No additional dropping is applied when none of the EMW overlaps with any of the measurement gap occasions, and existing scheduling/measurement restrictions apply.
* Recommended WF
  + Agree on option 1.

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

* Background
  + Agreement

Table 1: 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 |

**Issue 2-4-2a: New EMW configuration #2 and #3:**

Table 2

|  |  |  |  |
| --- | --- | --- | --- |
| **EMW Pattern Id** | **EMW Length (EMWL, ms)** | **EMW Repetition Period**  **(EMWRP, ms)** | **Minimum available time for inter-RAT measurements during 480 ms period**  **(Tinter1, ms)** |
| 2 | 2 | 40 | [24] |
| 3 | 2 | 80 | [12] |

* Proposals
  + Option 1: introduce the patterns in the table 2 and they are optional with UE capabilities.
    - Option 1a:introduce the patterns in the table 2 without UE capabilities.
  + Option 2: do not introduce any of them.
* Recommended WF
  + Agree on option 1.

**Issue 2-4-2b: New EMW configuration #4 and #5:**

Table 3

|  |  |  |  |
| --- | --- | --- | --- |
| **EMW Pattern Id** | **EMW Length (EMWL, ms)** | **EMW Repetition Period**  **(EMWRP, ms)** | **Minimum available time for inter-RAT measurements during 480 ms period**  **(Tinter1, ms)** |
| 4 | 5.5 | 40 | [60] |
| 5 | 5.5 | 80 | [30] |

* Proposals
  + Option 1: introduce the patterns in the table 2 and they are optional with UE capabilities.
    - Option 1a:introduce the patterns in the table 2 without UE capabilities.
  + Option 2: do not introduce any of them.
* Recommended WF
  + Agree on option 1.

**Issue 2-4-3: Scaling factor for case a-1: Nfreq definition**

* ***Background***
  + The principles are different between NR MO outside gap and LTE inter-frequency without MG, where all inter-frequency MOs, regardless if they are measured with or without MG, are counted in the same Nfreq.
* Proposals
  + Option 1: number of NR MOs that are measured outside MG (same principle as NR SA).
  + Option 2: total number of LTE and NR MOs (same principle as LTE SA).
* Recommended WF
  + Discuss upon options.

**Issue 2-4-4: Scaling factor for case b-1 and b-2**

* Proposals
  + Option 1: Update CSSFinterRAT = CSSFouside\_gap,i to take the inter-RAT LTE MOs with no measurement gap in to consideration.
  + Option 2:
    - 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
    - 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
  + Option 3: CSSFinterRAT is defined as CSSF outside MG, and inter-RAT carriers measured without MG are counted in CSSF outside MG
* Recommended WF
  + Agree on option 3.

### Sub-topic 2-5 UE capabilities

**Issue 2-5-1: Reporting of UE capability interRAT-NeedForIntrNR-r18**

* Proposals
  + Option 1: Reporting of interRAT-NeedForIntrNR-r18 capability should be done based on network request.
  + Option 2: Do not further discuss this issue.
* Recommended WF
  + Option 2. It is RAN2 work.

**Issue 2-5-2: Introduction of new UE capabilities for supporting EMW**

* Proposals
  + Option 1: Yes for case b-1.
  + Option 2: No.
* Recommended WF
  + Agree on:
    - It is mandatory for UE to support EMW patterns #0 and #1 if UE supports inter-RAT measurement without measurement gap case b-1 or case b-2.

**Issue 2-5-3: Introduction of new UE capabilities for supporting mixed numerologies between NR and LTE**

* ***Background***
  + Agreement
    - No additional UE capability is defined for inter-RAT measurement with mixed numerology; instead it can be considered for scheduling restriction
* Proposals
  + Option 1: Yes, a new UE capability to support mix-numerology scheduling restriction for inter-RAT LTE measurement and NR data reception with 30KHz is introduced.
    - Option 1a: apply the capability to both b-1 and b-2.
    - Option 2a: apply the capability only to b-2.
  + Option 2: RAN4 does not introduce any new capability for supporting mixed numerologies between NR and LTE.
* Recommended WF
  + Clarification is needed on the agreement in background:
    - It is not to specify the capability for supporting inter-RAT measurement or for supporting mixed numerologies without restriction.
  + Discuss the options.

### Sub-topic 2-6 CR handling

|  |  |  |
| --- | --- | --- |
| R4-2318865 | Xiaomi | CR on introduction of interruprion requirements for inter-RAT NR measurement without gap (case a-1) |
| R4-2319981 | Huawei | draftCR on measurement period and scheduling restriction for inter-RAT NR measurement without gap |
| R4-2318595 | Apple | CR for measurement delay for nogap-noncsg |
| R4-2320434 | ZTE | Draft CR for measurement delay for nogap-noncsg EUTRAN FDD |

**Issue 2-6-1: R4-2320434**

* Recommended WF
  + Merge to R4-2318595.

# Topic #3: Performance part requirements for measurements without gap

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2319093 | CMCC | Discussion on RRM performance requirements for measurements without gaps  ***Proposal 1: for measurements without gaps for UEs reporting NeedForGapsInfoNR, it is proposed to define tests for both intra-frequency measurement and inter-frequency measurement.***  ***Proposal 2: it is proposed to define test for both measurement without gap with interruption and measurement without gap without interruption.***  ***Proposal 3: for inter-RAT NR/LTE measurements without gap, it is proposed to define tests for following cases:***   * ***Case a-1: UE performing the measurements without gap in NR carriers as there is vacant RF chains for UE measurements*** * ***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*** |
| R4-2319129 | Intel | Test cases list for measurements without gap  **Proposal 1: Interruption requirements are only tested in case b-1 for inter-RAT measurement without gap.**  **Proposal 2: Measurements period requirements without interruption are only tested in case b-2 for inter-RAT measurement without gap.**  **Proposal 3: Endorse the test cases lists in table 1 and 2 in this paper.** |
| R4-2319149 | Ericsson | Discussion on measurement without gap test cases  **NeedForGaps**  **Proposal 1: RAN4 to define NeedForGaps test cases to verify both scenarios when UE reports to support ‘no gap no interruption’ and ‘no gap with interruption’ in different bands.**  **Proposal 2: RAN4 to define separate test cases for both MG configured and not configured scenarios for NeedForGaps.**  **Proposal 3: RAN4 to define separate test cases for single frequency layer and multiple frequency layers scenarios for NeedForGaps**.  **Proposal 4: RAN4 to define separate NeedForGaps test cases for different Tcycle configuration including the following cases:**  **Proposal 5: RAN4 to verify total interruption ratio and measurement period in the same test case for NeedForGaps.**  **Proposal 6: RAN4 to define separate test cases for non-DRX and DRX scenarios in NeedForGaps.**   |  |  |  |  | | --- | --- | --- | --- | | **No.** | **Test case** | **Test setup and scenario** | **Purpose of test** | | 1 | Event triggered reporting test on intra-frequency in FR1 without MG | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 * Both F1, F2 in FR1 * non-DRX, AWGN * SMTC: 40ms * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test * No MG configuration | * Intra-frequency cell search/measurement delay for Cell 2 is met, and * Single layer interruption ratio requirement is met, and * UE will not cause any interruption if reports ‘no gap no interruption’ in intra-frequency band | | 2 | Event triggered reporting test on intra-frequency in FR1 without MG with DRX | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 * Both F1, F2 in FR1 * AWGN * DRX: 320ms * SMTC: 40ms * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test * No MG configuration | * Intra-frequency cell search/measurement delay for Cell 2 is met, and * Single layer interruption ratio requirement is met, and * UE will not cause any interruption if reports ‘no gap no interruption’ in intra-frequency band | | 3 | Event triggered reporting test on inter-frequency in FR1 without MG | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown inter-frequency neighbor cell (Cell3) on F3 * Both F1, F2 in FR1 * non-DRX, AWGN * SMTC for cell 2: 40ms * SMTC for cell 3: 160ms * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test | * Intra-frequency cell search/measurement delay for Cell 2 is met, and * Inter-frequency cell search/measurement delay for Cell 3 is met, and * The total interruption ratio for multiple layers requirement is met based on UE reporting ‘no gap no interruption’ or ‘no gap with interruption’ in a band | | 4 | Event triggered reporting test on inter-frequency in FR1 with MG | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown inter-frequency neighbor cell (Cell3) on F3 * Both F1, F2 in FR1 * non-DRX, AWGN * SMTC for cell 2: 40ms * SMTC for cell 3: 80ms * MG pattern: #1 per-UE gap and #3 per-FR gap * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test | * Intra-frequency cell search/measurement delay for Cell 2 is met, and * Inter-frequency cell search/measurement delay for Cell 3 is met, and * UE will not cause any interruption outside MG | | 5 | Event triggered reporting test on intra-frequency in FR2 without MG | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 * Both F1, F2 in FR2 * non-DRX, AWGN * SMTC: 160ms * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test * No MG configuration | * Same as test case 1 | | 6 | Event triggered reporting test on inter-frequency in FR2 without MG with DRX | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown inter-frequency neighbor cell (Cell3) on F3 * Both F1, F2 in FR2 * AWGN * DRX: 320ms * SMTC for cell 2: 40ms * SMTC for cell 3: 160ms * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test | * Same as test case 3 | | 7 | Event triggered reporting test on inter-frequency in FR2 with MG | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown inter-frequency neighbor cell (Cell3) on F3 * Both F1, F2 in FR2 * non-DRX, AWGN * SMTC for cell 2: 80ms * SMTC for cell 3: 160ms * MG pattern: #1 per-UE gap and #19 per-FR gap * RS to measure: SSB w/o SBI reporting * Data scheduled during the whole test | * Same as test case 4 |   **Inter-RAT measurement without gaps**  **Proposal 7: RAN4 not to define test case for case a-1 in inter-RAT measurement without gap.**  **Proposal 8: RAN4 to define separate test cases for case b-1 and b-2 in inter-RAT measurement without gap.**  **Proposal 9: RAN4 to verify measurement period with no interruption together in inter-RAT measurement without gap.**  **Proposal 10: RAN4 to define separate test cases to verify the collision between EMW and NR measurement in inter-RAT measurement without gap.**  **Case b-1:**   |  |  |  |  | | --- | --- | --- | --- | | **No.** | **Test case** | **Test setup and scenario** | **Purpose of test** | | 1 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR1 | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 * F1 in FR1, F2 in LTE * non-DRX, AWGN * SMTC: 40ms * EMW pattern: measurement length 6ms, measurement period 40ms, offset 10ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Verify UE behaviour when UE supports NeedForNCSG-InfoEUTRA-r17 capability and * No interruption is expected, and * Scheduling restriction within EMW depends on UE capability | | 2 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR1 | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown neighbor cell (Cell3) on F3 * F1, F2 in FR1, F3 in LTE * non-DRX, AWGN * SMTC: 80ms * EMW pattern: measurement length 5ms, measurement period 40ms, offset 2ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Verify UE behaviour when UE supports NeedForNCSG-InfoEUTRA-r17 capability, and * UE behaviour when EMW collides with SMTC, and * No interruption is expected, and * Scheduling restriction within EMW depends on UE capability | | 3 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR2 | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F2 and unknown neighbor cell (Cell3) on F3 * F1 in FR2, F2 in FR1, F3 in LTE * non-DRX, AWGN * SMTC: 40ms * EMW pattern: measurement length 5ms, measurement period 40ms, offset 10ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Verify UE behaviour when UE supports NeedForNCSG-InfoEUTRA-r17 capability, and * No interruption is expected, and * Scheduling restriction within EMW depends on UE capability |   **Case b-2:**   |  |  |  |  | | --- | --- | --- | --- | | **No.** | **Test case** | **Test setup and scenario** | **Purpose of test** | | 1 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR1 | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F1 * Cell1 in FR1, Cell2 in LTE * non-DRX, AWGN * SMTC: 40ms * EMW pattern: measurement length 5ms, measurement period 40ms, offset 10ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Verify UE behaviour when UE supports inter-RAT measurement without gap capability and * The total interruption ratio requirement is met, and * UE will not cause any interruption if reports ‘no gap no interruption’ in intra-frequency band | | 2 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR1 | * Pcell (Cell1) on F1 and unknown neighbor cell (Cell2) on F1 * Cell1 in FR1, Cell2 in LTE * non-DRX, AWGN * SMTC: 40ms * EMW pattern: measurement length 2ms, measurement period 40ms, offset 10ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Same as case 1 | | 3 | Event triggered reporting test on inter-RAT LTE measurement without MG in FR2 | * CA with Pcell (Cell1) on F1 and serving cell (Cell2) on F2 and unknown neighbor cell (Cell3) on F3 * F1 in FR2, F2 in FR1, F3 in LTE * non-DRX, AWGN * SMTC: 40ms * EMW pattern: measurement length 5ms, measurement period 40ms, offset 10ms * RS to measure: CRS * Data scheduled during the whole test * No MG configuration | * Same as case 1 | |
| R4-2319983 | Huawei | Discussion on test cases for measurement without MG  **Proposal 1: Define the following test cases for NFG based inter-frequency measurements.**   * **TC1: with interruption, MG configured, FR1** * **TC2: with interruption, MG not configured, FR1** * **TC3: without interruption, MG not configured, FR1** * **TC4: with interruption, MG configured, FR2** * **TC5: with interruption, MG not configured, FR2** * **TC6: without interruption, MG not configured, FR2**   **Proposal 2: Define the following test cases for inter-RAT measurements without MG.**   * **TC1: Case a-1, with interruption, MG configured, target NR in FR1** * **TC2: Case a-1, with interruption, MG not configured, target NR in FR1** * **TC3: Case a-1, without interruption, MG not configured, target NR in FR1** * **TC4: Case a-1, with interruption, MG configured, target NR in FR2** * **TC5: Case a-1, with interruption, MG not configured, target NR in FR2** * **TC6: Case a-1, without interruption, MG not configured, target NR in FR2** * **TC7: Case b-1, with scheduling restriction and EMW, FR1** * **TC8: Case b-1, without scheduling restriction and no EMW, FR1** * **TC9: Case b-2, with scheduling restriction and EMW, FR1** * **TC10: Case b-2, without scheduling restriction and no EMW, FR1** |
| R4-2320490 | Qualcomm | Discussion on scope of performance requirement for FeMG part2  **Proposal: RAN4 introduce following RRM performance requirements**   * **Intra-frequency measurement w/o gap**   + **UE report nogap-interruption**   + **SSB outside active BWP**   + **MG is not configured.** * **Inter-frequency measurement w/o gap**   + **UE report nogap-interruption**   + **SSB outside active BWP**   + **MG is not configured.** * **InterRAT-LTE measurement without gap**    + **Either case b-1 or case b-2 with effective measurement window.**   + **MG is not configured.** |
| R4-2320733 | Nokia | Discussion on RRM performance requirements for measurements without gaps  **Proposal 1: Define test cases to verify interruption in for the following scenarios:**  **a. SA in FR1**  **b. SA in FR2**  **c. EN-DC E-UTRAN – NR FR1**  Observation 1: The UE interruption behaviour from core requirements is expected to be different depending on whether the SSB is contained within the active BWP or not.  **Proposal 2: Define test cases to verify interruption in for the following scenarios:**  **a. Case 1: Intra frequency with SSB contained within active BWP,**  **b. Case 2: Intra frequency with SSB not contained withing the active BWP,**  **c. Case 3: Inter frequency with SSB contained within active BWP,**  **d. Case 4: Inter frequency with SSB not contained within active BWP.**  **Proposal 3: Define test cases with DRX configured for**  **a. NR SA FR1 and FR2;**  **b. Intra frequency with SSB not contained within the active BWP**  **Proposal 4: Define test cases to verify measurement delay in for the following scenarios:**  **a. Case 1: Intra frequency with SSB contained within active BWP under non-DRX,**  **b. Case 2: Intra frequency with SSB not contained withing the active BWP under non-DRX,**  **c. Case 3: Inter frequency with SSB contained within active BWP under non-DRX,**  **d. Case 4: Inter frequency with SSB not contained within active BWP under non-DRX.**  **e. Case 5: Intra frequency with SSB not contained within active BWP under DRX.**  **Proposal 5: Discuss the list of test cases based on the following table:**   |  |  |  | | --- | --- | --- | | SA FR1 | Interruptions during measurements without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under DRX | | Measurement procedure:  event triggered reporting test without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | | FFS Intra frequency with SSB not contained within the active BWP under DRX | | SA FR2 | Interruptions during measurements without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under DRX | | Measurement procedure:  event triggered reporting test without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | | FFS Intra frequency with SSB not contained within the active BWP under DRX | | EN-DC E-UTRAN – NR FR1 | Interruptions during measurements without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | | Measurement procedure:  event triggered reporting test without gap | Intra frequency with SSB contained within active BWP under non-DRX | | Intra frequency with SSB not contained within the active BWP under non-DRX | | Inter frequency with SSB contained within active BWP under non-DRX | | Inter frequency with SSB not contained within active BWP under non-DRX | |
| R4-2320928 | MTK | RRM performance requirements for measurements without gaps  **Proposal 1: RAN4 shall take the following Rel-17 principles from MGE as starting point to define test cases for Rel-18 NeedForGap and inter-RAT gapless measurements and FFS what functionalities for Rel-18 MGE-2 part 2 need to be tested.**   * **Only define test case in NR SA in both FR1 and FR2** * **Do not introduce the test for L1 impact** * **Do not introduce test cases for intra-freq measurement without gap** * **Define a minimum set of test cases for SSB-based measurement** * **Only define test case under non-DRX** * **Define test case without SBI reporting.** * **On SSB-only test cases, RAN4 does not consider simultaneous per-UE gap and per-FR gap configurations** * **Do not define test cases with simultaneously FR1 and FR2 gaps configured.** * **Test cases are limited to single serving carrier** * **Only use mandatory gap patterns to define test cases** * **Focus on only fully non-overlp and partially partial overlap in the test case design** * **Verify gap dropping behaviour without introducing additional test cases**   **Proposal 2: RAN4 should consider defining test cases listed in Table 1 and 2 of this contribution.** |

## Open issues summary

### Sub-topic 3-1 General test cases principles

**Issue 3-1-1: Specify test cases not for EN-DC in A.4 and A.5**

* Proposals
  + Option 1: No and specify test cases only for NR SA sections A.6 and A.7 (A.8 is also considered if it is group consensus).
  + Option 2: Yes, specify test cases for EN-DC E-UTRAN – NR FR1
* Recommended WF
  + Agree on option 1.

**Issue 3-1-2: whether to introduce test cases for intra/inter/inter-RAT-frequency without gap**

* Proposals
  + Option 1: No.
  + Option 2: Yes.
* Recommended WF
  + Agree on option 1.

**Issue 3-1-3: Specify test cases for only non-DRX configuration**

* Proposals
  + Option 1: Only non-DRX configuration is considered.
  + Option 2: DRX test cases are necessary.
* Recommended WF
  + Discuss upon options.

**Issue 3-1-4: SSB index reading is not verified in the test cases defined**

* Proposals
  + Option 1: No SBI reading is verified in the test.
* Recommended WF
  + Agree on option 1.

**Issue 3-1-5: Do not consider per-FR gap configuration in the test cases defined**

* Proposals
  + Option 1: No per-FR gap is considered.
* Recommended WF
  + Agree on option 1.

**Issue 3-1-6: Single serving cell is considered in test setups**

* Proposals
  + Option 1: Only single serving cell is considered.
  + Option 2: CA is considered.
* Recommended WF
  + Agree on option 1.

**Issue 3-1-7: Verify dropping when measurement gap configuration collides with EMW**

* Proposals
  + Option 1: Yes and dedicated test case is introduced.
  + Option 2: Yes but no dedicated test case.
  + Option 3: No.
* Recommended WF
  + Discuss upon options.

### Sub-topic 3-2 Test cases list

The group shall strive to endorse the test cases list for measurements without gap based on the below suggest test cases list. Addition (for better test coverage) and down selection (for reduced test effort) subject to group consensus. The numbering of the test cases subjects to further arrangement during the meeting.

Table 1 Test cases list for UE reporting NFG

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No. #** | **Item of core requirements** | **Type of test cases** | **Frequency range of serving cell** | **MG configuration** | **TC is Needed** | **TC is NOT needed** | **Subclause** | **Test purpose and notes** |
| 1-1 | Interruptions | Interruptions at UE measurements without measurement gaps | FR1 |  |  |  | A.6.5.2.X |  |
| 1-2 | FR2 |  |  |  | A.7.5.2.X |  |
| 1-3 | Intra-frequency measurement period | Event triggered reporting tests for UE supporting NFG without interruptions non-DRX | FR1 |  |  |  | A.6.6.1.X |  |
| … | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG with interruptions non-DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG without interruptions with DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG with interruptions with DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Inter-frequency measurement period | Event triggered reporting tests for UE supporting NFG without interruptions non-DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG with interruptions non-DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG without interruptions with DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | Event triggered reporting tests for UE supporting NFG with interruptions with DRX | FR1 |  |  |  | A.6.6.1.X |  |
|  | FR2 |  |  |  | A.7.6.1.X |  |
|  | … |  |  |  |  |  |  |  |
|  | … |  |  |  |  |  |  |  |
|  | … |  |  |  |  |  |  |  |

Table 2 Test cases list for inter-RAT measurements without gaps

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Item of core requirements** | **Type of test cases** | **Frequency range of serving cell** | **MG configuration** | **TC is needed** | **TC is NOT needed** | **Subclause** | **Test purpose and notes** |
| 2-1 | Interruptions | Interruptions at UE EUTRAN measurements without measurement gaps | FR1 |  |  |  | A.6.5.2.X | Case b-1 only |
| 2-2 | FR2 |  |  |  | A.7.5.2.X |
| 2-3 | Inter-RAT EUTRAN measurement period non-DRX | NR – EUTRAN event triggered reporting test cases with interruptions | FR1 |  |  |  | A.6.6.3.X | Case b-1 |
| … | FR2 |  |  |  | A.7.6.3.X |
|  | NR – EUTRAN event triggered reporting test cases without interruptions | FR1 |  |  |  | A.6.6.3.X | Case b-2 |
|  | Inter-RAT EUTRAN measurement period with DRX | NR – EUTRAN event triggered reporting test cases with interruptions | FR1 |  |  |  | A.6.6.3.X | Case b-1 |
|  | FR2 |  |  |  | A.7.6.3.X |
|  | NR – EUTRAN event triggered reporting test cases without interruptions | FR1 |  |  |  | A.6.6.3.X | Case b-2 |
|  | Inter-RAT NR measurement period | E-UTRA – NR event triggered reporting test cases non-DRX | EUTRAN FR1 |  |  |  | A.8.4.2.X | Case a-1,  Target in both FR1 and FR2 |
|  | E-UTRA – NR event triggered reporting test cases with DRX |  |  |  |
|  | … |  |  |  |  |  |  |  |
|  | … |  |  |  |  |  |  |  |
|  | … |  |  |  |  |  |  |  |