**3GPP TSG-RAN WG4 Meeting # 96-e R4-2012048**

**Electronic Meeting, August 17-28, 2020**

**Agenda item:** 7.7.2

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [96e][217] NR\_pos\_RRM\_Part\_3

**Document for:** Information

# Introduction

The documents in agenda items 7.7.2.2, 7.7.2.3 and 7.7.2.4 contains the following main topics and sub-topics under each main topic:

* Topic #1: New measurement gap patterns for positioning measurements (AI 7.7.2.2)
  + Sub-topic 1-1: Measurement gaps for positioning measurements
  + Sub-topic 1-2: Gap sharing
  + Sub-topic 1-3: CRs on gaps
* Topic #2: gNB requirements (AI 7.7.2.3)
  + Sub-topic 2-1: Selection of option for gNB measurement accuracy requirements
  + Sub-topic 2-2: Optionality of gNB measurement accuracy requirements
  + Sub-topic 2-3: Basic scenario/condition for gNB measurement accuracy requirements
* Topic #3: Other requirements (AI 7.7.2.4)
  + Sub-topic 3-1: CRs on report mapping for gNB positioning measurements
  + Sub-topic 3-2: SRS transmission during DRX inactive

# Topic #1: New measurement gap patterns for positioning measurements

## Companies’ contributions summary

|  |  |  |
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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2009741**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009741.zip) | ZTE | ***Proposal 10: For RSTD measurement with gap, the measurement delay extension with the similar gap sharing scaling factor as NR SA measurements for the equal splitting gap scheme shall be considered, e.g.***   * ***CSSFRSTD = CSSFwithin\_gap,i which is defined in clause 9.1.5.2.2 of TS38.133 [6] for the inter-frequency SSB measurements with equal splitting gap sharing scheme*** |
| [**R4-2009881**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009881.zip) | Qualcomm | CR to 38.133 update CSSF within gap to include NR positioning measurements with gap sharing. The proposed changes are independent of whether new MG patterns are adopted for positioning or not. |
| [**R4-2009674**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009674.zip) | ZTE | **Proposal 1: New gap patterns for PRS measurements shall use only current MGRP.**  **Proposal 2: Add two new gap patterns as listed below:**   |  |  |  | | --- | --- | --- | | **Gap Pattern Id** | **Measurement Gap Length (MGL, ms)** | **Measurement Gap Repetition Period**  **(MGRP, ms)** | | 24 | 20 | 160 | | 25 | 40 | 160 |   **Proposal 3: When a UE is configured a gap pattern different than it requested, it shall still measure PRS and meet all the requirements (RRM and positioning related requirements).**  **Observation 1:** The current signaling supported by RAN2 doesn’t support indication of new MGL.  **Proposal 4: Send LS to RAN2 cc RAN1 on the new gap patterns and new configurations.**  **Proposal 5: Active BWP switching is prioritized over PRS measurement in a gap where active BWP switching is triggered.**  **Proposal 6: The UE is not required to meet PRS measurement requirements if Option 1 (prioritize BWP switch over PRS measurements) is adopted.** |
| [**R4-2009740**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009740.zip) | Intel | **Observation 1: For NR new gap patterns in [1], the more complicated scenarios of collision between the measurement gap and SMTC need to be analyzed carefully.**  **Observation 2: The separated new gap pattern can’t be used for PRS measurement only in Rel16.**  ***Proposal 1: The new measurement gap for PRS measurement can be FFS beyond Rel16.*** |
| [**R4-2009849**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009849.zip) | CATT | **Proposal 1: The combination of MGL and MGRP is {10, 80}ms and {10, 160}ms if introduced in Rel-16.**  **Proposal 2: The new gap patterns are applied for positioning measurement only.**  **Proposal 3: The PRS measurement and RRM measurement will impact each other by gap overlapping.**  **Proposal 4: When positioning measurement is performed using existing gap, the PRS and RRM measurement will impact each other by gap sharing defined as CSSF.**  **Proposal 5: When positioning measurement is performed in new gap pattern, since the gap cannot be used for RRM, one of measurement will be dropped due to gap collision.**  **Proposal 6: PRS measurement is performed in a gap even if active BWP switching is triggered in that gap i.e. PRS measurement is prioritized in gaps.** |
| [**R4-2009879**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009879.zip) | Qualcomm | **Observation 1. The useable portion of MGL for PRS is significantly reduced in typical deployments (TSMTC < TPRS) given that one MG pattern must cover both SMTC and PRS and the fact that PRS cannot be transmitted in SSB symbols.**  **Proposal 1. RAN4 to adopt new measurement gap patterns as in Table 1 for NR positioning.**  Table 1 New measurement gap patterns for NR positioning   |  |  |  | | --- | --- | --- | | New gap pattern ID | MG length (ms) | MG period (ms) | | 24 | **20** | **160** | | 25 | **40** | **160** |   **Proposal 2. New MG patterns for positioning shall be defined per-UE and per-FR similar to R15 MG patterns.**  **Proposal 3. RAN4 to introduce capability signaling for each of the two new measurement gap patterns.**  **Proposal 4. When UE is in a positioning session and new MG patterns are configured, RRM measurements also share the same MG pattern.**  **Proposal 5. Tables 9.1.2-2 and 9.1.2-3 in TS 38.133 are updated to include new MG patterns and their applicability when measurement purpose is NR.**  **Proposal 6a. In synchronous EN-DC, NR standalone operation, and NE-DC, and on all serving cells in MCG for NR standalone operation with per-UE and per-FR measurement gaps for FR1, the total number of interrupted slots on serving cells are:**   * **20 slots when MGTA = 0 and 21 slots when MGTA = 0.5ms for 15 kHz SCS if MGL = 20ms** * **40 slots when MGTA = 0 and 41 slots when MGTA = 0.5ms for 15 kHz SCS if MGL = 40ms** * **40 slots for 30 kHz SCS if MGL = 20 ms** * **80 slots for 30 kHz SCS if MGL = 40 ms** * **80 slots for 60 kHz SCS if MGL = 20 ms** * **160 slots for 60 kHz SCS if MGL = 40 ms** * **160 slots for 120 kHz SCS if MGL = 20 ms** * **320 slots for 120 kHz SCS if MGL = 40 ms**   **Proposal 6b. In asynchronous EN-DC, and on all serving cells in SCG for NR standalone operation with per-UE and per-FR measurement gaps for FR1, the total number of interrupted slots on serving cells are:**   * **21 slots for 15 kHz SCS if MGL = 20ms** * **41 slots for 15 kHz SCS if MGL = 40ms** * **41 slots for 30 kHz SCS if MGL = 20ms** * **81 slots for 30 kHz SCS if MGL = 40ms** * **81 slots for 60 kHz SCS if MGL = 20ms** * **161 slots for 60 kHz SCS if MGL = 40ms** * **161 slots for 120 kHz SCS if MGL = 20ms** * **321 slots for 120 kHz SCS if MGL = 40ms**   **Proposal 6c. Total number of interrupted slots on FR2 serving cells during MGL for EN-DC, NR SA, and NE-DC with per-UE and per-FR measurement gap are:**   * **80 slots for 60 kHz SCS if MGL = 20ms** * **160 slots for 60 kHz SCS if MGL = 40ms** * **160 slots for 120 kHz SCS if MGL = 20ms** * **320 slots for 120 kHz SCS if MGL = 40ms**   **Observation 2. For NR positioning measurements with MG, maximum PRS periodicity can be 10.24s. Moreover,**   * **For TPRS  10ms, excluding TPRS = 8ms, the effective MGRP is 20ms** * **For TPRS = 8ms, the effective MGRP is 40ms** * **For TPRS = 16ms, the effective MGRP is 80ms** * **For TPRS = 32ms, the effective MGRP is 160ms**   Table 2 Scenarios with CSSFwithin\_gap,i=1 for NR positioning measurements   |  |  | | --- | --- | | Max DL-PRS-Periodicity in positioning frequency layer *i* (TPRS) (ms) | Max bitmap size of DL-PRS-MutingPattern in positioning frequency layer *i* | | 64, 320, 640, … ,10240 | **With or without muting** | | 32, 160 | **With muting of any bitmap size** | | 16, 80 | **With muting of bitmap size ≥ 4 bits** | | 8, 40 | **With muting of bitmap size 8 bits** |   **Proposal 7. Use CSSFwithin\_gap,i=1 for NR positioning configurations outlined in Table 2.**  **Proposal 8. An NR positioning frequency layer is a candidate to be measured in a gap if there is at least one DL PRS resource from that frequency layer that is fully contained (including the time duration spanned by its unmuted slots as configured by *DL-PRS-ResourceRepetitionFactor* ± its corresponding *DL-PRS-expectedRSTD-uncertainty*) by the gap.** |
| [**R4-2009882**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009882.zip) | Qualcomm | **CR to 38.133 on new MG patterns ID 24 and 25** |
| [**R4-2009913**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009913.zip) | Apple | ***Proposal 1: the new positioning MGs can only be requested by UE or configured by network when UE has PRS measurement.***  ***Proposal 2: the new NR positioning MG cannot be used when any 2G/3G MO is configured or when LTE RSTD measurement is configured.***  ***Observation1: the UE capability for concurrent RRM/PRS processing/measurement is still open and therefore how to use the legacy independent MG capability for new positioning MG is unclear.***  ***Proposal 3: RAN4 needs more discussion on the applicability of legacy independent MG capability indication to the new positioning MG patterns.***  ***Observation2: the UE capability for concurrent RRM/PRS processing/measurement is still open and therefore how to use the legacy effective MG assumption for new positioning MG is unclear.***  ***Proposal 4: RAN4 needs more discussion on the applicability of legacy effective MG when the new positioning MG patterns is used for legacy RRM measurement.***  ***Proposal 5: RAN4 needs more discussion on whether the legacy CSSF design could be reused when new positioning MG is used for both RRM measurement and positioning measurement.***  ***Proposal 6: In Rel-16, the legacy RRM requirements shall not applied during the period when UE is configured with new positioning MG patterns for PRS measurement.*** |
| [**R4-2010205**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010205.zip) | MediaTek | **Proposal 1**: Introduce the following MGL for POS  - MGL: 10ms, 18ms, 34ms, 66 ms  **Proposal 2**: Introduce the following MGRP for MGL in proposal 1:  - MGRP: 40ms, 80ms, 160ms, 320ms, 640ms, where  - MGRP 40ms is applicable for MGL 10ms  - MGRP 80ms is applicable for MGL 10ms, 18ms  - MGRP 160ms is applicable for MGL 10ms, 18ms, 34m  - MGRP 320ms is applicable for MGL 18ms, 34ms  - MGRP 640ms is applicable for MGL 34ms, 66ms  **Proposal 3**: If active BWP switching overlaps/collides with gaps used for PRS measurements, then UE performs active BWP switch after the current gap occasion, i.e., UE prioritizes PRS measurement in gap |
| [**R4-2010709**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010709.zip) | OPPO | **Proposal 1: Define new gap patterns with 10ms MGL and {80, and 120}ms MGRP.**   |  |  |  | | --- | --- | --- | | New gap pattern ID | MG length (ms) | MG period (ms) | | X | 10 | 80 | | Y | 10 | 160 |   **Observation 1: Try to reduce the impact on existing RRM measurements by introducing new gap patterns for positioning measurement in Rel-16.**  **Proposal 3: No extra impact on existing RRM measurements is introduced by new gap patterns with 10ms MGL and {80, and 120}ms MGRP.**  **Proposal 4: Active BWP switching should be prioritized over PRS measurement in a gap where active BWP switching is triggered. If active BWP switching interrupts any PRS/SRS then the UE is not required to meet positioning measurement requirements** |
| [**R4-2010756**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010756.zip) | NEC | **Proposal 1: RAN4 to introduce new MG pattern with MGL=10 and MGRP=80ms and newly introduced MG pattern shall be only applicable for PRS measurements in Rel-16.**  **Proposal 2: RAN4 to study further enhancement of newly introduced MG pattern to make it applicable for both PRS and RRM measurements in Rel-17.** |
| [**R4-2011162**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011162.zip) | Huawei, Hisilicon | **Proposal 1: Performing PRS measurement in successive MG occasions is subject to signaled UE capability {N,T}.**  **Proposal 2: Introduce the following two new MG patterns in Rel-16**   * **MGL = 10ms, MGRP = 80ms** * **MGL = 20ms, MGRP = 160ms**   **Proposal 3: New MG patterns are applicable for PRS measurement as well as RRM measurement for NR/LTE.**  **Proposal 4: Per UE gap and per FR gap apply for PRS and PRS+RRM measurement.**   * **Applicability of Rel-15 MG patterns as per UE and per FR gap remains unchanged** * **New MG patterns can also be used as per UE gap and per FR gap for both FR1 and FR2**   **Proposal 5: Configuration of MG for PRS measurement does not impact the existing rule for gapless RRM measurement** **in case of per FR gap configuration.**  **Proposal 6: MG is half-half shared between RRM and PRS measurement. The measurement period of both PRS and RRM measurements are scaled by a factor of 2 in case MG sharing applies.**  **Draft LS**:  RAN4 agreed to introduce the following 2 new measurement gap patterns in Rel-16:   * Gap pattern #24: MGL = 10ms, MGRP = 80ms * Gap pattern #25: MGL = 20ms, MGRP = 160ms   UE can optionally support one or both of the 2 new measurement gap patterns.  The 2 new measurement gap patterns can be used for measurement of   * NR PRS only, or * NR PRS and RRM measurement (for NR and/or E-UTRA measurement objects).   The 2 new measurement gap patterns can also be used as per UE gap and per FR gap for both FR1 and FR2. Existing capability independentGapConfig also applies for the 2 new measurement gap patterns. |
| [**R4-2011163**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011163.zip) | Huawei, Hisilicon | CR to 38.133 on CSSF and measurement gap related requirements for positioning |
| [**R4-2011164**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011164.zip) | Huawei, Hisilicon | CR to 36.133 on measurement gap related requirements for positioning |
| [**R4-2011360**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011360.zip) | Ericsson | * ***Observation****: Among the agreed in [1] candidate patterns, the following measurement gap configurations satisfy MGL/MGRP≤0.3 and MGRP≤160 ms:*   + *MGL=10 ms, MGRP=80 ms*   + *MGL=10 ms, MGRP=160 ms*   + *MGL=20 ms, MGRP=80 ms*   + *MGL=20 ms, MGRP=160 ms* * ***Proposal 1****: Introduce the following two new measurement gap patterns*   + *Gap pattern ID 24: MGL=10 ms, MGRP=80 ms*   + *Gap pattern ID 25: MGL=20 ms, MGRP=160 ms* * ***Proposal 2****: The new measurement gap patterns can be requested for FDD and TDD NR positioning measurements.* * ***Proposal 3****: The new measurement gap patterns are configured as per-UE measurement gap patterns if the UE does not support per-FR measurement gaps, otherwise the new measurement gap patterns are configured for the FR in which the positioning measurements are to be performed.* * ***Proposal 4****: The new measurement gap patterns can be requested only when the UE is configured with NR positioning measurements requiring such gaps via LPP and can only be used during the corresponding positioning measurement period.* * ***Proposal 5****: If configured, any of the two new measurement gap patterns shall be used also for RRM measurements if the UE needs to perform RRM measurements requiring measurement gaps during the positioning measurement period. This applies for:*    + *RRM measurements in any FR with per-UE measurement gaps, and*   + *For RRM measurements in the same FR as positioning measurements when the UE supports per-FR measurement gaps.* * ***Proposal 6****: Reuse for PRS-based positioning measurements the same approach as for other gap-based measurements. New sections need to be added in 9.1.5.2 for all PRS-based positioning measurements in any gaps, including the new gaps.* * ***Proposal 7****: In the definition of CSSF, NR positioning measurements are counted together with inter-frequency and inter-RAT measurement objects.* * ***Proposal 8****: No need to differentiate between the new and legacy measurement gaps in the definition CSSF.*   **Draft LS:**   * The two new measurement gap patterns:   + Gap pattern ID 24: MGL=10 ms, MGRP=80 ms   + Gap pattern ID 25: MGL=20 ms, MGRP=160 ms * The new measurement gap patterns can be requested for FDD and TDD NR positioning measurements. * The new measurement gap patterns are configured as per-UE measurement gap patterns if the UE does not support per-FR measurement gaps, otherwise the new measurement gap patterns are configured for the FR in which the positioning measurements are to be performed. * The new measurement gap patterns can be requested only when the UE is configured with NR positioning measurements requiring such gaps via LPP and can only be used during the corresponding positioning measurement period. * If configured, any of the two new measurement gap patterns shall be used also for RRM measurements if the UE needs to perform RRM measurements requiring measurement gaps during the positioning measurement period. This applies for:   + RRM measurements in any FR with per-UE measurement gaps, and   + For RRM measurements in the same FR as positioning measurements when the UE supports per-FR measurement gaps. |
| [**R4-2011361**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011361.zip) | Ericsson | CR to 38.133 on measurement gaps for PRS-based measurements |
| [**R4-2011506**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011506.zip) | Nokia, Nokia Shanghai Bell | 1. Specify following two new MG patterns for NR positioning, optional for UE, in Rel-16: 2. **MGL=10 ms and MGRP=80 ms** 3. **MGL=40 ms and MGRP=160 ms** 4. Define the two new MG patterns for performing combined RRM/NR positioning measurements. |

## Open issues summary

Scope of RAN4 core work according to the approved exception sheet in [RP-201343](http://3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_88e/Docs/RP-201343.zip):

1. PRS RSTD measurement requirements:

* Measurement period requirement
* Measurement capability

1. UE Rx-Tx time difference measurement requirements:

* Measurement period requirement
* Measurement capability

1. PRS RSRP measurement requirements

* Measurement delay requirement
* Measurement capability

1. Other RRM impacts

* New measurement gap patterns for positioning measurements and impacts on existing RRM measurements

Note: In case RRM requirements for new MG are not finalized in RAN4#96-e then no new MG will be introduced in Rel-16.

### Sub-topic 1-1: Measurement gaps for positioning measurements

**Issue 1-1-1: New MG patterns**

In RAN4#95-e according to the approved WI in [R4-2009266](http://3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_95_e/Docs/R4-2009266.zip) the following was agreed:

“*Introduce 2 new MG patterns with MGL ≥ 10 ms and MGRP ≥ 80 ms…New MG patterns shall be UE capability.*”

* **Proposals on new MG patterns:**
  + Option 1: ZTE, QC

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| --- | --- | --- |
| Gap pattern ID | MG length (ms) | MG period (ms) |
| 24 | 20 | 160 |
| 25 | 40 | 160 |

* + Option 2: CATT, OPPO

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| --- | --- | --- |
| Gap pattern ID | MG length (ms) | MG period (ms) |
| 24 | 10 | 80 |
| 25 | 10 | 160 |

* + Option 3: MTK
    - * MGRP 40ms is applicable for MGL 10ms
      * MGRP 80ms is applicable for MGL 10ms, 18ms
      * MGRP 160ms is applicable for MGL 10ms, 18ms, 34m
      * MGRP 320ms is applicable for MGL 18ms, 34ms
      * MGRP 640ms is applicable for MGL 34ms, 66ms
  + Option 4: NEC

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| --- | --- | --- |
| Gap pattern ID | MG length (ms) | MG period (ms) |
| 24 | 10 | 80 |

* + Option 5: HW, E///

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| --- | --- | --- |
| Gap pattern ID | MG length (ms) | MG period (ms) |
| 24 | 10 | 80 |
| 25 | 20 | 160 |

* + Option 6: Nokia

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| --- | --- | --- |
| Gap pattern ID | MG length (ms) | MG period (ms) |
| 24 | 10 | 80 |
| 25 | 40 | 160 |

* Recommended WF:
  + Need further discussion

**Issue 1-1-2: New MG patterns are used only when UE is configured with at least PRS measurements i.e. cannot be used for only RRM**

* Proposals
  + Option 1: CATT, Apple, Oppo, QC, E///, HW, Nokia
    - Yes
* Recommended WF:
  + New MG patterns can only be configured when the UE is configured with PRS measurements.

**Issue 1-1-3: Whether new MG patterns is applicable for only PRS measurements or for both PRS and RRM measurements?**

* Proposals
  + Option 1: CATT, Oppo, NEC, Apple
    - New MG patterns are applicable only for PRS measurements i.e. new gaps cannot be shared with RRM measurements.
  + Option 2: QC, ZTE, HW, E///, Nokia
    - New MG patterns are applicable for PRS and all RRM measurements i.e. new gaps can be shared between PRS and RRM measurements.
  + Option 3: HW
    - New MG patterns are applicable for PRS and NR/LTE RRM measurements i.e. new gaps are not shared between PRS and 2G/3G RRM measurements.
* Recommended WF:
  + Collect companies’ view.

**Issue 1-1-4: New MG patterns defined as per-UE or per-UE and per-FR capabilities for both FR1 and FR2?**

* Proposals
  + Option 1: QC, HW, E///
    - Defined as per-UE and per-FR capabilities for both FR1 and FR2
  + Option 2. Apple
    - Defined as only per-UE capability for both FR1 and FR2
* Recommended WF:
  + Collect companies’ view.

### Sub-topic 1-2: Gap sharing rules for new MG gaps

**Issue 1-2-1: Whether performing PRS measurement in successive MG occasions subject to signalled UE capability {N, T}? N = duration of DL PRS symbols in ms processed every T ms?**

* Proposals
  + Option 1: QC, HW
    - Yes.
  + Option 2:
    - No
* Recommended WF:
  + - Collect companies’ view.

**Issue 1-2-2: Use existing CSSF for sharing new MG pattern between RRM and PRS measurements?**

* Proposals
  + Option 1: ZTE, QC, HW, E///
    - Yes.
  + Option 2: Apple
    - No
* Recommended WF:
  + - Collect companies’ view.

**Issue 1-2-3: If existing CSSF is used then rules for new MG sharing between RRM and PRS measurements**

* Proposals
  + Option 1: ZTE, HW
    - Equal split of gaps between PRS and all RRM measurements
  + Option 2: E///
    - NR positioning measurements are counted together with inter-frequency and inter-RAT measurement objects
  + Option 3: QC
    - gap sharing of NR positioning should be based on the same principle of LTE-PRS, i.e., scarce PRS (corresponding to long periodicities) should be prioritized over other candidates for measurement in the same gap instance.
  + Other option not precluded
* Recommended WF:
  + - Collect companies’ view.

### Sub-topic 1-3: CRs on measurement gaps/CSSF

Directly provide comments on the following CRs in section 1.3.2:

* R4-2009881
* R4-2009882
* R4-2011163
* R4-2011164
* R4-2011361

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1-1: New MG patterns**

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| **Company** | **Comments** |
| ZTE | Prefer Option 1. It was agreed to define 2 new gap patterns so option 3 needs to be more specific. |
| E/// | MGL = 40 ms with MGRP = 160 ms will have considerable impact on scheduling so we want to avoid this combination. MGRP = 80 ms is preferable over 160 ms as former gives more flexibility because with muting 160 ms can be achieved. Therefore at least MGL = 10 ms and MGRP = 80 ms should be supported. |
| NEC | In last meeting GTW session, there was tentative agreement to introduce only one MG pattern. That is MGL=10ms and MGRP=80ms. There was proposals to introduce MGL=10 or larger and MGRP=160ms. However it was not agreed. Considering that tentative agreement reached after lot of discussion, we feel it is better to start from that point.  Based on above reasoning we prefer option 4. |
| Qualcomm | In response to NEC comment, there was no agreement to limit the number of new MG patterns to one. In fact, the current MAC specification has already reserved two spots for new MG patterns for positioning so we think RAN4 should move forward accordingly. Our preference is on option 1 and we think at least MGL=20ms and MGRP = 160ms should be one of the new MG patterns. MGL = 10ms does not create much differentiation from the current MGL limit of 6ms. Additionally, we note that these new MG patterns are only used for when UE is in a positioning session so the scheduling restriction only applies in these not-so-often cases. We further note that MG patterns in option 1 still keep the overhead below the recommended value by RAN1. |
| Intel | So far, there are still huge gap to converge these options for the new gap pattern. Don’t see the possibility to complete the whole new gap pattern design including the necessary RAN2 works in this meeting.  And it shall also be noted, the relevant discussion below (e.g. Sub topic 1-1-2/3/4) need wait the conclusion of this issue.  On the other hand, with the current MGP, there are still many feasible PRS deployment scenarios, which are quite enough to cover majority positioning using scenarios(>75%).  Also, from QC’s discussion[[**R4-2009879**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009879.zip)], one arguments to require a longer MGL is both SMTC and PRS shall be covered by a same MG. In our views, the problem of overlapping between PRS and SSB within a same MG can be address by CSSF also. |
| Huawei | We support option 5.  For MGRP we suggest the maximum is 160ms, which is same as today, and we believe this can help to save a lot of specification efforts in defining CSSF and RRM requirements.  For MGL, we believe 40ms may have considerable impact on scheduling and maintaining serving cell link. Also, it means even when the PRS occasion length is a little longer than 10ms, NW has to use a 40ms MGL, which may cause a lot of resource waste. |
| OPPO | Support option 2 and are also fine with option 5. We have the same concern as Huawei that 40ms MGL is too long and may lead to resource waste.  We also share the concern from Intel that regarding the diverse views, it seems difficult to introduce new gap in Rel-16. |

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| MTK | Reply to ZTE: Yes it is true that it was agreed to define 2 new gap patterns in last meeting.  We update our proposal as follows:   * MGL 10ms with MGRP 80ms * MGL 18ms with MGRP 160ms   We agree with Intel’s view that the problem of overlapping between PRS and SSB within a same MG can be address by CSSF.  On the other hand, if we need to consider SSB in new MG design, then we should design MGs based on considering possible SSB configuration and PRS configuration so that MGLs can accommodate non-overlapping SSB and PRS.  Currently there is no such analysis. What we have done is to design MG by considering possible PRS configuration. An MG should be designed with some expected PRS configuration, instead of just naming a longer MGL. |

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| Nokia | MGL = 10 ms with MGRP = 80 ms should be supported in our view as contained in most proposals. To reduce the impact to RRM measurements regarding the potential collision between PRS measurements and RRM measurements in SMTC windows, we can agree to proceed with a lower MCL = 20 ms (rather than 40 ms), i.e. to proceed with option 5. |
| CATT | Prefer Option 2. If two gap patterns need to be defined in R16, we prefer option 2. Much longer gap length which will have big impact on existing RRM measurement is not preferred in R16.  If no consensus is reached in this meeting, we are also fine that no new gap is defined in R16. |

**Issue 1-1-2: New MG patterns are used only when UE is configured with at least PRS measurements i.e. cannot be used for only RRM**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Support recommended WF. |
| E/// | Support option 2. If new MG pattern is configured then it is important that the UE is able to use it also for RRM measurements. |
| NEC | Support recommended WF that is “New MG patterns can only be configured when the UE is configured with PRS measurements”. |
| Qualcomm | Support recommended WF. |
| Apple | Support the recommended WF. |
| Intel | Firstly we can’t agree the recommend WF because RAN4 needs achieve the consensus on the new gap pattern(Issue 1-1-1) before such discussion. If there is not any consensus on this new gap pattern, these discussion will be meaningless.  From the technical point view, iIf the separated new gap pattern is need for NR Pos, the simultaneous two gap configuration is required. But according to “measGapConfig” perUE, such functionality is not supported in Rel16.  On the other hand, in the previous RAN4 agreements [R4-2005379] the following agreements was achieved.  *“Independent MG patterns for positioning and RRM measurements is deferred to future release.”* .  That is Option 1 will revoke our agreements before. |
| Huawei | Support the recommended WF. |
| OPPO | Support the recommended WF. |
| MTK | Support the recommended WF. |
| Nokia | We support the recommended WF, |
| CATT | Fine with the recommended WF |

**Issue 1-1-3: Whether new MG patterns is applicable for only PRS measurements or for both PRS and RRM measurements?**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Support Option 2. |
| E/// | Support option 1. |
| NEC | Support option 1 |
| Qualcomm | We support option 3 which is actually the way we have reflected it in our CR R4-2009882. The new MG patterns are not shared between positioning measurements and 2G/3G measurements (similar to applicability rules of MG patterns in NR that are new compared to LTE). |
| Apple | Support option 1. To share the new MG for RRM measurement, it means we need to accommodate this new MG to all concepts of the legacy RRM MG, but as we discussed in our paper, some parts are still unclear, e.g. applicability of legacy independent MG capability, applicability of legacy effective MG, or applicability of the legacy CSSF design with new MG. |
| Intel | Firstly we need discuss this issue after achieving the consensus on the new gap pattern (Issue 1-1-1) before such discussion.  Both Option 1 and Option 2 will introduce new issue which can impact the current Rel16 spec. e.g. Opt1 needs new IE or capability to support more than 2 gap configuration per UE. Opt 2 needs reinvestigate current RAN4 requirements (e.g. CSSF, requirements applicability ) |
| Huawei | We support option 3.  If the new MG patterns are only used for PRS measurement, it will significantly restrict the usage of the new MG patterns. We have discussed the issues in applying the new MG patterns for RRM measurement, and we do not see any big issue.  On the other hand, we do not see the need to apply the new MG patterns for 2G/3G measurement. |
| OPPO | Prefer option 1. We understand the rationales behind sharing new MG patterns between PRS and RRM but have some concerns to apply new MG patterns without extensive discussion at the very late stage of this topic. |
| MTK | Support option 3 |
| Nokia | We support option 2. This has best measurement efficiency, as the UE can make use of the entire measurement gap, even if there is only partial overlap with PRS resources. |
| CATT | Support option 1. We think the new gap patterns should only be applied for positioning measurement. Since the existing gap pattern is enough for RRM measurement, if the new gap pattern with longer gap length is used, then the remaining 4ms will be spare. It is a severe resource waste and will reduce the system throughput. |

**Issue 1-1-4: New MG patterns defined as per-UE or per-UE and per-FR capabilities for both FR1 and FR2?**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Support Option 1. There should be both per-UE and per-FR MGs. |
| NEC | Support option 1 |
| Qualcomm | Support option 1 and we don’t see why new MG patterns should be treated any differently compared to existing ones. In fact, option 1 is consistent with use of MG patterns for RRM and also provides more flexibility to the NW. |
| Apple | Support option 2, the new positioning MG cannot fit the concept of independent MG and more discussion is needed. As discussed in our paper, the capability of *independentGapConfig* means UE can support two RF chains for FR1 and FR2 reception and the UE activity on one FR would not impact any UE activity on the other FR. However, in last RANP meeting we precluded the concurrent PRS/SSB measurement from the Rel-16 scope. Without capability of concurrent reception of PRS+RRM, the legacy independent MG concept cannot be directly used for new positioning MG. |
| Intel | perUE capability can’t support two independent gap pattern. |
| Huawei | We support option 1. In our view, there should be no difference in applying the new MG patterns as per UE and per FR gap, compared to the legacy MG patterns. We are open to discuss if separate per FR gap capability needs to be defined for PRS measurement or for new MG patterns, but so far we understand the existing 1-bit capability can be used for all measurement types (RRM, PRS, PRS+RRM) and all MG patterns. |
| OPPO | Slightly prefer per UE. But if option 1 in issue 1-1-3 was agreed that new MG patterns are applicable only for PRS measurements and cannot be shared with RRM measurements, a new type of MG could be better other than per UE or per FR. |
| MTK | Support option 1. Same view as HW |
| Nokia | We support option 1. Per-UE and per-FR capabilities are both required, as PRS resources may just be allocated within one FR. |
| CATT | Support option 1. But the wording should be modified. The new gap patterns is defined as per-UE and per FR capabilities. ‘for both FR1 and FR2’ can make confusion and shall be deleted |

**Issue 1-2-1: Whether performing PRS measurement in successive MG occasions subject to signalled UE capability {N, T}?**

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| **Company** | **Comments** |
| E/// | This should be discussed together with the measurement period if that is the case. For new measurements gaps, it also depends on whether some gaps are used for RRM measurements or not, and for gaps in general it depends on whether the gaps are used for measurements on multiple frequencies, etc. LMF is not aware of gap configuration, number of carriers, etc. so this capability can at most impact UE measurement period requirement and not the NW configuration. This means there is no need for this the rule on successive MG occasions. We therefore support option 2. But if needed this should be discussed with measurement period. |
| NEC | Option 1 is fine with us |
| Qualcomm | We support option 1. Option 2 does not even make sense. Where and how to capture this in the specification is a different topic. |
| Intel | Regardless new or legacy gap, the answer is Yes. So if UE can’t complete PRS processing within a MGRP, the next PRS covered by MGRP may not be handled by UE. |
| Huawei | We support option 1.  This should be reflected in measurement period requirements and thus discussed in email 215. |
| OPPO | Support option 1. |
| MTK | Support option 1 |
| Nokia | The condition in option 1 is not exhaustive in our view. The PRS processing capability has impact on the minimum configurable MGRP. But this considers only PRS measurements, seen from this UE, not RRM measurements. If the NW configures UE to use gap sharing for PRS and RRM measurements, then the condition in option 1 is not exhaustive, as the availability of the next MG occasion for PRS measurements needs to be confirmed by the gap sharing rule as well, hence it may also be related to any prioritization of PRS measurements over RRM measurements. We agree with Ericsson’s comment that this capability is for UE measurement purposes and should not have an impact on the actual PRS configuration, because the network has to serve UEs with different PRS processing capabilities at the same time. |

**Issue 1-2-2: Use existing CSSF for sharing new MG pattern between RRM and PRS measurements?**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Support Option 1. Re-using existing CSSF would be enough and time saving. |
| E/// | Support option 1. It is unrealistic to start another mechanism to share gaps between RRM and PRS measurements. |
| Qualcomm | Support option 1. |
| Apple | It’s up to issue 1-1-3. Support option 2, as we clarified in our paper, the legacy CSSF with MG only assumes that one carrier could be measured in one MGL, but in this new positioning MGs, the situation might be completely different. If all the positioning MOs are on the different carriers from the existing inter-frequency RRM MOs, then one RRM MO carrier and one positioning MO carrier might be measured within one long MGL, and therefore the CSSF with MG shall be redesigned for this case. If even in this case we still use the legacy CSSF, then what’s the benefit to have this new MG to cover RRM measurement here? |
| Intel | Firstly we need discuss this issue after achieving the consensus on the new gap pattern (Issue 1-1-1) before such discussion.  From the issue itself, we can spport Option 2.  If there were new gap pattern whose MGL is larger than current one(6ms), there are multiple issues not addressed in Rel15 for CSSF. For an example,  **in Rel15 only 5 scenarios below for MG collision with other RRM are anlaysised and define the corresponding requiremnents. However, for the longer MGL there must be more complicated scenarios not covered before.** |
| Huawei | We support option 1, but the detailed CSSF design needs to discussed in 1-2-3. |
| MTK | We support option 1. Same view as HW. |
| Nokia | We support option 1. Reusing existing CSSF is sufficient, which is also used for gap sharing with LTE PRS measurements. |
| CATT | If new gap patterns are only used for positioning measurement, then the gap sharing is not needed. |

**Issue 1-2-3: If existing CSSF is used then rules for new MG sharing between RRM and PRS measurements**

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| --- | --- |
| **Company** | **Comments** |
| ZTE | We prefer Option 1 here. |
| E/// | Currently there are two groups of measurements – intra- and inter-frequency in the definition of CSSF. What does the equal split (Option 1) actually means – 50% to positioning and 50% to intra & inter RRM measurements? If so, the impact on RRM can be rather big. What is proposed in Ericsson’s CR is that positioning measurements are included in the group with inter-frequency and inter-RAT RRM measurements (note that there are no intra- or inter-frequency PRS measurements so we need to explicitly mention positioning measurements in the CSSF definition) and have the same split between the two groups (RRM intra-frequency and RRM inter-frequency/inter-RAT+positioning) as in Rel-15. Alternatively, one could introduce a third group for positioning measurements only but then the definition of CSSF becomes much more complicated with the three groups.  As of the PRS measurements with long periodicity, they have to be prioritized, similar to Rel-15 but considering the PRS-based configurations instead of LTE PRS configurations. So we support combination of both options 2 and 3. |
| Qualcomm | We agree with Ericsson’s comment above and think a combination of option 2 and option 3 makes sense and is consistent with how LTE-PRS measurement was supported in CSSF. |
| Intel | Up to issue 1-2-2 |
| Huawei | We support option 1.  There are two issues with option 2 and/or option 3:  1) it does not consider the processing time T, during which UE cannot take another PRS measurement, we have discussed this issue in our paper R4-2011162  2) it does not consider multiple PRS frequency layers, e.g. if measurement period for multiple PRS layers are sum of the measurement periods of each individual layer, it would be counted twice if multiple PRS layer competes MG in CSSF calculation.  Due to different natures of RRM (periodic and short processing time) and PRS measurement (single measurement and long processing time), we see it difficult to reuse the current CSSF design for LTE PRS. Our proposal with option 1 is 50% MG to positioning and 50% MG to RRM measurements, which could at least make Rel-16 requirements work. We can consider further optimizing the CSSF in future releases. |
| MTK | We have the following proposal:   * If PRS periodicity >= 80 ms, then PRS measurement is prioritized over other candidates for measurement in the same gap instance. * Otherwise, Equal split of gaps between PRS and all RRM measurements |
| Nokia | We support option 3. PRS measurements must be given priority over RRM measurements due to longer PRS periodicity and also due to applied PRS muting pattern. We think, that in case of conflicting requirements for PRS and RRM measurements, existing intra-/inter-frequency/inter-RAT RRM requirements should be relaxed when UE is configured to perform PRS measurements during positioning sessions. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| [**R4-2009881**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009881.zip) | Intel: same issue(CSSF) as [**R4-2011163**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011163.zip)**, which can be updated after the discussion** |
| Huawei: the CSSF part needs to be based on agreement. Besides, we understand NR PRS measurement is not supported in EN-DC, so changes related to EN-DC are not needed. |
| Nokia: In general, we agree with changes in this CR, which is based on option 3 in issue 1-2-3 but deals with legacy MGPs. In clause 9.1.5.2, reference to LMF [31] should be 37.355 or 38.305. In the enumeration below Table 9.1.5.2.1-1, which refers to gap sharing case, the NR positioning frequency layer is added to this enumeration and hence to the counting procedure. However, in the phrase before the enumeration, only MO’s are mentioned, so positioning frequency layers should be added as well in this phrase (ending within the gap j). |
| [**R4-2009882**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009882.zip) | Intel : shall be updated according to the final conclusion on the new gap pattern for Rel16 . |
| Huawei: In general OK. However, we have different approach for the gap applicability table as in our CR 1163, where we consider positioning measurement also as NR measurement, this should make the table simpler. |
| Nokia; We principally agree with changes in this CR, which is based on option 1 in issue 1-1-1. In clause 9.1.2, reference to LPP should be 37.355 [34]. In our view, the term “positioning frequency layer” should be added to the definitions clause. |
| [**R4-2011163**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011163.zip) | Nokia: In our understanding, gap sharing between PRS and RRM measurements in this proposed CR is based on option 1 of issue 1-2-3, i.e. equal split of gaps between PRS and RRM measurements, which is done without distinction of PRS configurations, either used for legacy or new MGPs. This could lead in some cases to too frequent MG use for PRS measurements against RRM measurements. |
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| [**R4-2011164**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011164.zip) | Qualcomm: we don’t understand why this CR is needed. This is for 36.133 and RAN4 seems to converge on the agreement that new MG patterns are only used when UE is in an NR positioning session. |
| Huawei: Response to QC comment, in NE-DC case the new MG patterns will be applied to LTE serving cells, and can be used by LTE PSCell to measure LTE inter-freq carriers, so they cannot be totally invisible in 36.133. |
| Nokia: Table 8.1.2.1-1 lists both MGP with MGL=10 ms. This is not aligned to the latest proposal for 20,ms MGL. According notes 10 and 11, GP24 (10 ms / 80 ms) is only configurable by NR PCell, (i.e. NR standalone, NR-DC and NE-DC) and GP25 (20 ms/160 ms) only applicable for NE-DC. On what basis this latter restriction is defined?. |
| [**R4-2011361**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011361.zip) | Qualcomm: the definition of long PRS period is not accurate in this CR and lacks the specifics that we have provided in our CR. |
| Intel : shall be updated according to the final conclusion on the new gap pattern for Rel16 |
| Huawei: the changes to measurement capability 9.1.3 is not agreeable. We do not see the need to define measurement capability in RAN4. |
| Nokia: Note 2 in Table 9.1.2-3 contains a duplicated phrase on measurement purpose for E-CID. In our understanding, E-UTRA measurements are inter-RAT type in case of NR standalone. Table 9.1.2-4b: Why the numbers for interrupted slots are lower than in Table 9.1.2-4 for same SCS for same MGL? |

## Summary for 1st round

### Open issues

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

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| --- | --- |
| **Sub-topic** | **Status summary** |
| **Sub-topic 1-1** | **Issue 1-1-1: New MG patterns**  Agreements from GTW session on 20th August:   * Agreements   + Introduce 2 new MG patterns for PRS measurements  |  |  | | --- | --- | | MG length (ms) | MG period (ms) | | 20 | 160 | | 10 | 80 | |
| **Sub-topic 1-1** | **Issue 1-1-2: New MG patterns are used only when UE is configured with at least PRS measurements i.e. cannot be used for only RRM**  Agreements from GTW session on 20th August:   * Agreement: New MG patterns can only be configured when the UE is configured with PRS measurements |
| **Sub-topic 1-1** | **Issue 1-1-3: Whether new MG patterns is applicable for only PRS measurements or for both PRS and RRM measurements?**  Tentative agreements: None  *Candidate options:*   * Option 1: CATT, Oppo, NEC, Apple   + New MG patterns are applicable only for PRS measurements i.e. new gaps cannot be shared with RRM measurements. * Option 2: QC, ZTE, HW, E///, Nokia, CMCC   + New MG patterns are applicable for PRS and all RRM measurements i.e. new gaps can be shared between PRS and RRM measurements. * Option 3: HW, MTK, E///, QC   + New MG patterns are applicable for PRS and NR/LTE RRM measurements i.e. new gaps are not shared between PRS and 2G/3G RRM measurements. * Option 4: Apple   + New MG patterns are applicable for PRS and RRM measurements;   + the UE is required to meet requirements for PRS measurements performed in the new MG gap pattern; and   + while the new MG pattern is configured for the PRS measurements the UE is not required to meet requirements for RRM measurements which need gaps.   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 1-1** | **Issue 1-1-4: New MG patterns is defined as per-UE or per-UE and per-FR capabilities?**  *Tentative agreements:* None  *Candidate options:*   * + Option 1: QC, HW, E///, NEC, ZTE, MTK, Nokia, CATT     - Defined as per-UE and per-FR capabilities   + Option 2. Apple     - Defined as only per-UE capability   *Recommendations for 2nd round:* |
| **Sub-topic 1-2** | **Issue 1-2-1: Whether performing PRS measurement in successive MG occasions subject to signalled UE capability {N, T}? N = duration of DL PRS symbols in ms processed every T ms?**  *Tentative agreements: None*  *Candidate options:*   * + Option 1: QC, HW, NEC, OPPO, MTK,     - Yes.   + Option 2: E///, Nokia     - No   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 1-2** | **Issue 1-2-2: If new gaps are shared between PRS and RRM measurements then the use existing CSSF for sharing new MG pattern between RRM and PRS measurements?**  *Tentative agreements:* None  *Candidate options:*   * + Option 1: ZTE, QC, HW, E///, Nokia, MTK     - Yes.   + Option 2: Apple, Intel     - No   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 1-2** | **Issue 1-2-3: If existing CSSF is used then rules for new MG sharing between RRM and PRS measurements?**  *Tentative agreements:* None  *Candidate options:*   * + Option 1: ZTE, HW     - Equal split of gaps between PRS and all RRM measurements   + Option 2: E///, QC, Nokia     - NR positioning measurements are counted together with inter-frequency and inter-RAT measurement objects and     - gap sharing of NR positioning should be based on the same principle of LTE-PRS, i.e., scarce PRS (corresponding to long periodicities) should be prioritized over other candidates for measurement in the same gap instance.   + Option 3: MTK     - If PRS periodicity >= 80 ms, then PRS measurement is prioritized over other candidates for measurement in the same gap instance;     - Otherwise, Equal split of gaps between PRS and all RRM measurements   *Recommendations for 2nd round:* Need further discussion |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on impact of NR positioning measurements on RRM | Ericsson |
| #2 | LS on new measurement gap patterns | Ericsson |

### CRs/TPs

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

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2009881 | Revised |
| R4-2009882 | Revised |
| R4-2011163 | Noted |
| R4-2011164 | Revised |
| R4-2011361 | Noted |

## Discussion on 2nd round (if applicable)

### Open issues

**Issue 1-1-3: Whether new MG patterns is applicable for only PRS measurements or for both PRS and RRM measurements?**

*Candidate options:*

* Option 1: CATT, Oppo, NEC, Apple
  + New MG patterns are applicable only for PRS measurements i.e. new gaps cannot be shared with RRM measurements.
* Option 2: QC, ZTE, HW, E///, Nokia, CMCC
  + New MG patterns are applicable for PRS and all RRM measurements i.e. new gaps can be shared between PRS and RRM measurements.
* Option 3: HW, MTK, E///, QC
  + New MG patterns are applicable for PRS and NR/LTE RRM measurements i.e. new gaps are not shared between PRS and 2G/3G RRM measurements.
* Option 4: Apple
  + New MG patterns are applicable for PRS and RRM measurements;
  + the UE is required to meet requirements for PRS measurements performed in the new MG gap pattern; and
  + while the new MG pattern is configured for the PRS measurements the UE is not required to meet requirements for RRM measurements which need gaps.

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| **Company** | **Comments** |
| Apple | We support option 1 and can compromise to option 4. Because whether/how to apply the new MG pattern to RRM is also related with the concurrent PRS/RRM measurement capability and that concurrent PRS/RRM issue has been delayed to R17, so we cannot determine in R16 whether or how new MG pattern could be used for RRM. |
| MTK | We support option 2.  On the other hand, if option 1 is agreed, then we would like to revert the agreement to introduce 20ms MGL since reasonable PRS deployment would only require 18ms MGL, i.e., 20ms MGL is too long if new gaps are not shared by SSB and PRS.  Another option is that both 18ms MGL and 20ms MGL are introduced in Rel-16, the network can choose to configure short-duration MGL if SSB and PRS are not transmitted simultaneously in an MG.  We can’t agree on option 4 since it means that there are no requirements on RRM if UE is measuring PRS in new MGs. The impact to RRM is too much. |
| Ericsson | We support option 2 but can also compromise with option 3. The new gaps can be shared for positioning and RRM measurements, when configured for UE performing positioning measurements. |
| Qualcomm | We support option 3. There is no reason to avoid using new MG patterns for RRM in a positioning session. We cannot understand the arguments from Apple on how MGL = 6 ms with MGRP = 80ms can be share for RRM and PRS measurements but MGL = 10ms with MGRP = 80ms cannot. The extra 4ms in gap length introduces far less waste compared to leaving regular gap instances completely unused (imagine T\_PRS = 160ms with MGRP = 80 and MGL = 10ms). Then 50% of the gap instances are completely wasted because UE cannot use it for RRM or PRS. This is far more impactful compared to the extra 4ms that may be wasted. The impact of option 1 is that NW will never grant UE any of the new MG patterns. |
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**Issue 1-1-4: New MG patterns is defined as per-UE or per-UE and per-FR capabilities?**

*Candidate options:*

* + Option 1: QC, HW, E///, NEC, ZTE, MTK, Nokia, CATT
    - Defined as per-UE and per-FR capabilities
  + Option 2. Apple
    - Defined as only per-UE capability

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| **Company** | **Comments** |
| Apple | It’s up to issue 1-1-3, if this MG is dedicated for positioning purpose, we can also agree on option 1. |
| MTK | Option 1 |
| Ericsson | Support option 1.  Is Option 2 perceived as more advantageous over Option 1 by Apple, what is the justification for Option 1? |
| Qualcomm | Support option 1. For a UE capable of per-FR gap, this is very beneficial as new MG with higher scheduling blackout will only impact the FR in which positioning is being performed while not impacting the other FR at all. |
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**Issue 1-2-1: Whether performing PRS measurement in successive MG occasions subject to signalled UE capability {N, T}? N = duration of DL PRS symbols in ms processed every T ms?**

*Candidate options:*

* + Option 1: QC, HW, NEC, OPPO, MTK,
    - Yes.
  + Option 2: E///, Nokia
    - No

**Issue 1-2-2: If new gaps are shared between PRS and RRM measurements then use the existing CSSF for sharing new MG pattern between RRM and PRS measurements?**

*Candidate options:*

* + Option 1: ZTE, QC, HW, E///, Nokia, MTK
    - Yes.
  + Option 2: Apple, Intel
    - No

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| **Company** | **Comments** |
| Apple | Up to issue 1-1-3. |
| MTK | Issue 1-2-1: option 1  Issue 1-2-2: Our proposal on CSSF design is given in option 3 in Issue 1-2-3 |
| Ericsson | Issue 1-2-1: Option 2. This issue is also related to the PRS measurement period, and some agreements related to capability were reached there, so the issue is not so relevant anymore. Also, we do not specify how the UE uses the gaps, for PRS or other measurements. It’s UE implementation on which gap to choose for one or another carrier frequency or for one or another measurement type. Furthermore, Option 1 can even impact the gap sharing rules and the legacy implementation for NR RRM measurements.  Issue 1-2-2: Support option 1, and agree that the CSSF approach shall be reused, perhaps with some clarification in the CSSF definition |
| Qualcomm | Issue 1-2-1: Support option 1 but we have already agreed to this in a way by agreeing on T\_effect formulation in email thread Part 1. So in our view, this no longer needs to be discussed.  Issue 1-2-2: We support option 1. |
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**Issue 1-2-3: If existing CSSF is used then rules for new MG sharing between RRM and PRS measurements?**

*Candidate options:*

* + Option 1: ZTE, HW
    - Equal split of gaps between PRS and all RRM measurements
  + Option 2: E///, QC, Nokia
    - NR positioning measurements are counted together with inter-frequency and inter-RAT measurement objects and
    - gap sharing of NR positioning should be based on the same principle of LTE-PRS, i.e., scarce PRS (corresponding to long periodicities) should be prioritized over other candidates for measurement in the same gap instance.
  + Option 3: MTK
    - If PRS periodicity >= 80 ms, then PRS measurement is prioritized over other candidates for measurement in the same gap instance;
    - Otherwise, Equal split of gaps between PRS and all RRM measurements

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| **Company** | **Comments** |
| MTK | Option 3 |
| Ericsson | Option 2. It is unrealistic and complicated to have big changes to CSSF definition/concept compared to that in Rel-15. Furthermore, equal split between RRM and positioning means 50% for positioning and 50% for all RRM (including intra-, inter-frequency, and inter-RAT), i.e., for each of intra-/inter-frequency and inter-RAT it is remaining 17% in average which is not acceptable due to the big impact on RRM measurements. |
| Qualcomm | We support option 2. Option 3 from MTK is not complete. PRS periodicity can be 20ms but there can be heavy muting resulting in very scarce opportunities for PRS measurements (effectively making it appear once every 80 or every 160ms). Equal split of gaps also ignores that PRS presence can be subject to its periodicity and muting pattern and may be quite scarce. |
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### CRs/TPs comments collection

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| --- | --- |
| **CR/TP/LS number** | **Comments collection** |
| R4-2012136 (LS) |  |
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| R4-2012137 (CR revision of R4-2009881) |  |
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| R4-2012138 (CR revision of R4-2009882) |  |
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| R4-20012139 (CR revision of R4-2011164) |  |
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## Summary on 2nd round (if applicable)

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

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| R4-2012135 (WF) |  |
| R4-2012136 (LS) |  |
| R4-2012137 (CR) |  |
| R4-2012138 (CR) |  |
| R4-2012139 (CR) |  |

# Topic #2: gNB requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2009672**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009672.zip) | ZTE | **Proposal 1: Once a gNB supports one particular method, it has to meet the accuracy requirements to guarantee the positioning accuracy.**  **Proposal 2: Have different accuracy requirements for different types of BS.** |
| [**R4-2009850**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009850.zip) | CATT | **Proposal 1: Define accuracy for SRS-RSRP, gNB Rx-Tx time difference and UL RTOA.**  **Proposal 2: Mandatory for gNB to meet accuracy for supported positioning measurement.**  **Proposal 3: One set of side conditions is defined to meet accuracy for UE’s serving as well as neighbor cell, and the value in clause 7.2 in 36.111 can be reused.**  **Proposal 4: gNB measurement accuracy requirement is applied when gNB receives in beam direction which UL signal is transmitted.**  **Proposal 5: Accuracy requirement is defined based on a subset of SRS configuration.** |
| [**R4-2009878**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009878.zip) | Qualcomm | **Proposal 1. gNB positioning measurement accuracy requirements are NOT optional if supported by a gNB.**  **Proposal 2. One set of side conditions applicable to both serving and neighbor gNB to derive the gNB Rx-Tx time difference measurement accuracy requirements.**  **Proposal 3. Select side conditions to meet accuracy for UE’s serving as well as neighbor cells; SINR value is FFS (side conditions in TS 36.111 can be used as a baseline).**  **Proposal 4. Performance requirements shall not limit the applicability to fixed antenna beams. Performance test setting can be further discussed to use fixed antenna beam.**  **Proposal 5. RAN4 to consider defining accuracy requirements in a tiered model (i.e., different accuracy requirements for different SRS BW).**  **Proposal 6. RAN4 to agree on link-level simulation assumptions for gNB Rx-Tx time difference measurement to determine the suitable SRS configurations and their corresponding accuracy requirements.** |
| [**R4-2011165**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011165.zip) | Huawei, Hisilicon, CMCC | **Observation 1: gNB measurement requirements are necessary to guarantee the minimum performance of UL-based positioning techniques and UL-and-DL-based positioning techniques.**  **Observation 2: Defining requirements for a measurement type does not mandate every gNB to implement the measurement; whereas not defining requirements for a measurement type means the measurement performance cannot be tested even the measurement is implemented.**  **Observation 3: UL-based positioning is an important use case, and it will not be supported by RAN4 requirements if RAN4 only defines gNB requirements for Rx-Tx time difference and SRS-RSRP.**  **Observation 4: The measurement requirements for UL-RTOA are already defined in LTE.**  **Observation 5: In NR, UL-ROTA measurement is taken by gNB, same as Rx-Tx time difference and SRS-RSRP measurement.**  **Observation 6: From gNB measurement performance point of view, UL-RTOA is quite similar as Rx-Tx time difference, so RAN4 effort to introduce requirements for UL-RTOA is not an issue.**  **Proposal 1: RAN4 to define gNB measurement accuracy requirements for UL-RTOA in the Perf part of the WI. The requirements and side conditions for gNB Rx-Tx time difference are re-used.** |
| [**R4-2011166**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011166.zip) | Huawei, Hisilicon | **Proposal 1: If a gNB declares support of a positioning technique, it should be able to meet the accuracy requirements defined for the corresponding measurement.**  **Proposal 2: Define one set of side condition for gNB accuracy requirements for UEs in both serving cell and neighbor cell. The side conditions defined in 36.111 are used as starting point but can be revisited based on simulations.**  **Proposal 3: gNB accuracy requirements does not depend on antenna beam configuration in gNB.**  **Proposal 4: gNB accuracy requirements are defined for subset of SRS configurations. The accuracy requirements to be met for a certain gNB may be depending on gNB declaration.**  Proposal 5: gNB accuracy requirements are defined depending on gNB types. |
| [**R4-2011303**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011303.zip) | Ericsson | **Proposal 1: Divide the requirements for the Rx-Tx timing measurements in a PRS/SRS detection requirement (38.104) and timing requirements (38.133).**  **Proposal 2: Take the decision about the optionality on the end of the WI and concentrate the work on SRS-RSRP, Rx-Tx time difference.** |
| [**R4-2011507**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011507.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1: No RTOA minimum accuracy requirements will be defined.**  **Proposal 2: It is optional for gNB to meet accuracy for supported positioning measurement. Which requirements are met for each measurement type, will be declared by the BS manufacturer.**  **Proposal 3: a) Side conditions for gNB Rx-Tx time difference and SRS-RSRP will be separately specified for UE’s serving gNB and for UE’s neighbor gNBs (Issue-1, Option 2).**  **b) Side conditions for UE’s serving gNB and for UE’s neighbor gNBs are FFS and need to be derived from system level simulations (Issue-2, new Option 3).**  **c) Scenarios are based on those in the NR positioning study item [5], i.e. UMi and UMa for FR1, and UMi for FR2, similar as done for defining side conditions for RSTD and UE Rx-Tx time difference.**  **d) UL SINR figures for UMi and UMa in FR1 and for UMi in FR2 are to be collected for UE’s strongest cell and at least 4 weaker cells and ratios are derived from the CDF percentile of 5%.**  **Proposal 4: For deriving accuracy requirements and for defining requirements for conformance testing, fixed gNB antenna beams will be assumed for FR1 and FR2.**  **Proposal 5: Accuracy requirements are defined for all SRS configurations but is met only for subset of SRS configurations declared by the manufacturer (Issue-2, Option 2).**  **Proposal 6: RAN4 to discuss the suitability of candidate SRS configurations, as depicted in Table 2 and 3, as starting point for deriving gNB minimum accuracy requirements for gNB Rx-Tx time difference and SRS-RSRP.**  **Proposal 7: Accuracy requirements for SRS-RSRP and gNB Rx-Tx time difference depend on BS type (1-C, 1-H, 1-O and 2-O).** |

## Open issues summary

Companies are requested to provide comments on the test case CRs in the table in section 3.3.2.

### Sub-topic 2-1

**Issue 2-1-1: Selection of option for gNB measurement accuracy requirements**

* Option 1: E///, Nokia
  + Define accuracy for SRS-RSRP and gNB Rx-Tx time difference
* Option 2: CATT, HW, CMCC
  + Define accuracy for SRS-RSRP, gNB Rx-Tx time difference and UL RTOA
* Recommended WF
  + Need further discussion

### Sub-topic 2-2

**Issue 2-2-1: Optionality of gNB measurement accuracy requirements**

Question: Is gNB positioning measurement accuracy requirement optional for a gNB if it is supported by the gNB?

* Proposals
  + Option 1: QC, CATT, ZTE, HW
    - No
  + Option 2: E///, Nokia
    - Declared by manufacturer
  + Recommended WF
    - Need further discussion

### Sub-topic 2-3

**Issue 2-3-1: Side conditions (e.g. SINR) for applicability of accuracy**

* Proposals
  + Option 1: QC, CATT, HW
    - One set of side conditions to meet accuracy for UE in serving as well as in neighbour cells
  + Option 2: Nokia, E///
    - Separate side conditions to meet accuracy for UE in serving and for UE in neighbour cells
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals

**Issue 2-3-2: How to derive side conditions (e.g. SINR)**

* Proposals
  + Option 1: QC, CATT, HW
    - Based on TS 36.111 clause 7.2
  + Option 2: Nokia, E///
    - Based on system simulations
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals

**Issue 2-3-3: Antenna configuration in accuracy requirement**

* Proposals
  + Option 1: Nokia, E///
    - Assume fixed gNB antenna beams
  + Option 2: QC, CATT, HW
    - Do not assume fixed gNB antenna beams
  + Other options not precluded (differentiation between test and application)
* Recommended WF
  + Collect companies’ feedback on the above proposals

**Issue 2-3-4: SRS configurations for accuracy requirements**

* Proposals
  + Option 1: QC
    - Accuracy is defined and met for all SRS configurations
  + Option 2: Nokia
    - Accuracy is defined for all SRS configurations but is met only for subset of SRS configurations declared by manufacturer
  + Option 3: CATT, HW
    - Accuracy is defined and met for only subset of SRS configurations
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals’

**Issue 2-3-5: If accuracy defined or met for subset of SRS configurations, how to derive such configurations?**

* Proposals
  + Option 1: QC
    - Derive SRS configurations based on link simulations for the suitable SRS configurations and their corresponding accuracy requirements.
  + Option 2: Nokia
    - SRS configurations are declared by manufacturer
  + Option 3: HW
    - SRS configurations for defining accuracy requirements are derived from link level simulations.
    - SRS configurations for which accuracy requirements to be met are declared by the manufacturer.
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals

**Issue 2-3-6: Accuracy dependency on SRS BW**

* Proposals
  + Option 1: QC, Nokia
    - Define accuracy based on SRS BW
  + Option 2:
    - Define same accuracy regardless of SRS BW
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals

**Issue 2-3-7: Accuracy requirements for different BS types (1-C, 1-H, 1-O, 2-O)**

* Proposals
  + Option 1: ZTE, Nokia, HW
    - Accuracy requirement depends on BS type
  + Option 2: E///
    - Agree accuracy requirement depends on BS type as current working assumption but prove at the end if this is needed or not.
  + Option 3: CATT
    - Same accuracy requirement applies to all BS types but side condition depends on BS type
  + Other options not precluded
* Recommended WF
  + Collect companies’ feedback on the above proposals

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1-1: Selection of option for gNB measurement accuracy requirements**

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| --- | --- |
| **Company** | **Comments** |
| E/// | Support option 1 |
| Qualcomm | No strong view. We support either options but would like to draw the companies’ attention to the fact that this issue has been discussed for many meetings without any conclusion. Maybe it’s best to start discussing “how” accuracy requirements are going to be defined (e.g., simulation assumptions, …). |
| Intel | Slightly prefer Option 2 because the UL RTOA requirements can reuse these of gNB time difference in principle, which will not increase limited efforts. |
| Huawei | We support option 2. We still do not see valid technical reasons why UL-RTOA requirements should not be defined.  In Ericsson paper R4-2011303, the main concern is the gNB sync. However, accuracy for UL-RTOA is a measurement performance requirement, and it does not mandate any NW synchronization requirements. We do not understand why NW synchronization is a concern particularly for UL-RTOA, because it is the same thing for DL part. If we follow the logic, RAN4 should just not define UE requirements for RSTD.  In Nokia paper R4-2011507, the main concern is that use of UL-RTOA is different from that of gNB Rx-Tx. Here we are only defining accuracy requirements for the gNB measurement, and how the measurements are used in the positioning method is not relevant for RAN4. Also, the two measurements are used for different positioning methods, so only gNB supporting UL-TDOA needs to meet the accuracy requirements for UL-RTOA.  The timeline and efforts for introducing UL-RTOA requirements is also not issue, as the requirements can be reused from those defined for gNB Rx-Tx.  On the other hand, we believe UL-TDOA, which is an UL-based positioning method, is important feature with clear use cases. We have already compromised to not define requirements for AoA/ZoA in Rel-16, and if UL-RTOA requirements are not defined, there would be nothing in RAN4 requirements to support UL-based positioning. |

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| OPPO | Support option 2 |

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| MTK | Option 2 |
| CMCC | Prefer option 2. As we mentioned in previous meetings, UL RTOA only rely on gNB, it is an important positioning type and will be widely used. It is necessary to define requirements for this positioning type. |
| Nokia | We support option 1 and provide reasoning in our contribution. |
| CATT | Support option 2. Since there is no more effort for UL RTOA requirements if gNB Rx-Tx accuracy is defined. |

**Issue 2-2-1: Optionality of gNB measurement accuracy requirements**

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| **Company** | **Comments** |
| ZTE | Our opinion remains the same as in the last meeting, the gNB must meet accuracy requirements once it claims to support a certain positioning method. |
| E/// | Support option 2 (declared by the vendor) |
| Qualcomm | Support option 1. |
| Intel | Support Option 1. |
| Huawei | We support option 1. |
| OPPO | Support option 1. |
| MTK | Option 1 |
| Nokia | We support option 2. A gNB may not support all accuracy requirements defined for a certain positioning measurement type, i.e. not all requirements for each and every specified SRS configuration. |
| CATT | Support option 1. |

**Issue 2-3-1: Side conditions (e.g. SINR) for applicability of accuracy**

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| **Company** | **Comments** |
| E/// | Support option 2. There can be a BS implementation, which measured only for UEs in the serving cell. |
| Qualcomm | Support option 1. Option 2 is not constructive as it segments the BS implementations to two groups: those who support single-RTT and those who support multi-RTT. However, single-RTT positioning technique is not a RAN1 method. |
| Intel | In our view, non-serving cell is enough for gNB based positioning. No need to define the side condition for the serving cell.  Support Option 1. |
| Huawei | We support option 1 with same reason as mentioned by QC above. |
| OPPO | Support option 1. |
| Nokia | We support option 2. We agree to the case mentioned by Ericsson. Separate side conditions will also better take into account achievable accuracies for UE in serving cell and UE in neighbor cell, as seen in the PRS link simulations for RSTD and UE Rx-Tx time, where SINR ratio has a large impact on accuracy level, especially for timing measurements. |
| CATT | Support option 1. |

**Issue 2-3-2: How to derive side conditions (e.g. SINR)**

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| **Company** | **Comments** |
| ZTE | Prefer option 1. |
| E/// | We prefer system simulation. |
| Qualcomm | Support option 1. To companies who are proposing option 2, when do you plan to do this? There are only two meetings left after this meeting and there are not even simulation assumptions put forward. So how is option 2 even possible with the present situation? |
| Intel | Support Option 1. The system level simulation works can’t be finished before the target timeline. |
| Huawei | We support option 1. Of course, if the conditions prove to be improper in the coming link level simulations, we are also open to revisit based on simulation results. |
| OPPO | Support option 1 at this moment. We are also fine to revisit if any problem is identified based on link level simulation. |
| Nokia | We support option 2. As done for PRS link simulations, we prefer to derive SINR ratios from system simulations, both for UE in serving and UE in neighbour cell. To this purpose we propose in our contribution i) to base the system simulation scenarios on those in the NR positioning study item, i.e. UMi and UMa for FR1, and UMi for FR2, similar as done for defining side conditions for RSTD and UE Rx-Tx time difference and ii) to collect UL SINR figures for UMi and UMa in FR1 and for UMi in FR2 for UE’s strongest cell and at least 4 weaker cells and ratios are derived from the CDF percentile of 5%. |
| CATT | Support option 1. |

**Issue 2-3-3: Antenna configuration in accuracy requirement**

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| **Company** | **Comments** |
| E/// | Support option 1. Beam capabilities are declared by the BS (see TS 38.141-2, section 4.6: Manufacturer's declarations, Table 4.6-1: Manufacturers declarations for BS type 1-H, BS type 1-O and BS type 2-O radiated test requirements). |
| Qualcomm | Support option 2. |
| Intel | Option 2 can be taken as the first phase. |
| Huawei | We support option 2. This has been discussed in many meetings, but we still do not get clear understanding from proponent of option 1 on how “fixed beam” assumption would impact the requirements. |
| OPPO | Support option 2. |
| MTK | Option 2 |
| Nokia | We support option 1. As pointed out in our contribution, accuracy requirements should not be based on use of dynamic RX beamforming. Main peak direction of gNB beam pattern should be aligned with main peak direction of UE in serving cell. For conformance testing, we agree with Ericsson, beam configurations, as declared by the manufacturer, according to TS 38.141-2, can be used. |
| CATT | Support option 2. Again the meaning of fixed beam is needed to be clarified. |

**Issue 2-3-4: SRS configurations for accuracy requirements**

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| **Company** | **Comments** |
| E/// | Support option 2 |
| Qualcomm | We disagree with option 2. We can support option 3 only if simulation results show that some SRS configurations do not provide acceptable performance but until then, no SRS configuration should be excluded. |
| Intel | Option 1 and 3 are fine for us. Bur for time being, the Option 3 is more feasible. |
| Huawei | We support option 3. This should be same as UE requirements, where accuracy are not defined for every PRS configuration. |
| OPPO | Support option 3 to enable more flexibility for UE. And as mentioned by Huawei, PRS measurement at UE side does not define the accuracy for all PRS configurations. |
| Nokia | Option 2. A gNB may not support all specified SRS configurations, e.g. not all specified SRS bandwidths. Accuracy is to be met for supported SRS configurations as declared by the manufacturer. |
| CATT | Support option 3. |

**Issue 2-3-5: If accuracy defined or met for subset of SRS configurations, how to derive such configurations?**

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| **Company** | **Comments** |
| E/// | Support option 3. We agree to do link simulations |
| Qualcomm | We support link level simulations and it seems that this common part of option 1 and 3 should be the WF. |
| Intel | Support Option 3 |
| Huawei | We support option 3.  For requirements to be defined, this should be same as UE requirements, i.e. RAN4 selects the SRS configurations based on simulation results and also considering typical configurations.  For requirements to be met, we believe some gNB declarations may be considered, e.g. regarding the supported SRS BW. This should be similar as UE capability for PRS measurement. |
| OPPO | Support option 3. |
| Nokia | In our view, option 2 is not meaningful in this context (how to derive the SRS configurations). We have a preference for option 3. We consider option 1 and first bullet of option 3 as identical. |
| CATT | Support option 3. |

**Issue 2-3-6: Accuracy dependency on SRS BW**

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| **Company** | **Comments** |
| E/// | Support option 1 |
| Qualcomm | Support option 1. |
| Intel | Option 1 can be agreed. |
| Huawei | We support option 1. |
| OPPO | Support option 1. |
| Nokia | We support option 1. |
| CATT | Support option 1. |

**Issue 2-3-7: Accuracy requirements for different BS types (1-C, 1-H, 1-O, 2-O)**

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| **Company** | **Comments** |
| ZTE | Support Option 1. We are a bit puzzled by Option 2, when is the end? What option 2 suggests seems to be that we can change the agreements later on which is not very efficient. |
| E/// | As compromise we can support option 1. But we should also be open to review the decision in case any issue is identified. |
| Intel | Both Option 1 and 2 are fine for us. Prefer Option 2 slightly. |
| Huawei | We support option 1. At least the margin for calibration will need to be discussed when defining the accuracy numbers. |
| Nokia | We support option 1. Especially for the gNB Rx-Tx time difference measurement, this distinction is needed in our view. We don’t see how different side conditions, as mentioned in option 3, can lead to the same accuracy requirement related to this timing measurement in contrast to gNB SRS-RSRP measurement, where this approach might be possible. |
| CATT | Support option 3. It is needed to be clarified why different side condition cannot solve the problem and why using different accuracy requirements is better. |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
| **Sub-topic 2-1** | **Issue 2-1-1: Selection of option for gNB measurement accuracy requirements**  *Tentative agreements:* None  Candidate options:   * Option 1: E///, Nokia   + Define accuracy for SRS-RSRP and gNB Rx-Tx time difference * Option 2: CATT, HW, CMCC, Intel, MTK   + Define accuracy for SRS-RSRP, gNB Rx-Tx time difference and UL RTOA   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-2** | **Issue 2-2-1: Optionality of gNB measurement accuracy requirements**  *Tentative agreements:* None  *Candidate options:*   * Option 1: QC, CATT, ZTE, HW, MTK, OPPO, Intel   + No * Option 2: E///, Nokia   + Declared by manufacturer   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-3** | **Issue 2-3-1: Side conditions (e.g. SINR) for applicability of accuracy**  *Tentative agreements:* None  *Candidate options:*   * Option 1: QC, CATT, HW, Intel, OPPO   + One set of side conditions to meet accuracy for UE in serving as well as in neighbour cells * Option 2: Nokia, E///   + Separate side conditions to meet accuracy for UE in serving and for UE in neighbour cells   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-3** | **Issue 2-3-2: How to derive side conditions (e.g. SINR)**  *Tentative agreements:* None  *Candidate options:*   * Option 1: QC, CATT, HW, OPPO, Intel, ZTE   + Based on TS 36.111 clause 7.2 * Option 2: Nokia, E///   + Based on system simulations   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-3** | **Issue 2-3-3: Antenna configuration in accuracy requirement**  *Tentative agreements:* None  *Candidate options:*   * Option 1: Nokia, E///   + Assume fixed gNB antenna beams * Option 2: QC, CATT, HW, MTK, Intel   + Do not assume fixed gNB antenna beams   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-3** | **Issue 2-3-4: SRS configurations for accuracy requirements**  *Tentative agreements:* None  *Candidate options:*   * + Option 1: QC     - Accuracy is defined and met for all SRS configurations   + Option 2: Nokia, E///     - Accuracy is defined for all SRS configurations but is met only for subset of SRS configurations declared by manufacturer   + Option 3: CATT, HW, OPPO, Intel     - Accuracy is defined and met for only subset of SRS configurations   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 2-3** | **Issue 2-3-5: If accuracy defined or met for subset of SRS configurations, how to derive such configurations?**  *Tentative agreements:*   * SRS configurations for defining accuracy requirements are derived from link level simulations. * SRS configurations for which accuracy requirements are met are FFS.   *Recommendations for 2nd round:* Review link simulation assumptions |
| **Sub-topic 2-3** | **Issue 2-3-6: Accuracy dependency on SRS BW**  *Tentative agreements:*  gNB positioning measurement accuracy is defined based on the SRS BW.  *Recommendations for 2nd round:* N/A |
| **Sub-topic 2-3** | **Issue 2-3-7: Accuracy requirements for different BS types (1-C, 1-H, 1-O, 2-O)**  *Tentative agreements: None*  *Candidate options:*   * Option 1: ZTE, Nokia, HW, E///, Intel   + Accuracy requirement depends on BS type * Option 2: CATT   + Same accuracy requirement applies to all BS types but side condition depends on BS type   *Recommendations for 2nd round:* Need further discussion |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on gNB requirements for NR positioning (document for Approval) | Ericsson |
| #2 | System simulation assumptions for deriving side conditions (document for Approval) | Ericsson |
| #3 | Link simulation assumptions for deriving positioning SRS configurations (document for Approval) | Nokia |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

### Open issues

**Issue 2-1-1: Selection of option for gNB measurement accuracy requirements**

Candidate options:

* Option 1: E///, Nokia
  + Define accuracy for SRS-RSRP and gNB Rx-Tx time difference
* Option 2: CATT, HW, CMCC, Intel, MTK
  + Define accuracy for SRS-RSRP, gNB Rx-Tx time difference and UL RTOA

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| **Company** | **Comments** |
| MTK | Option 2 |
| E/// | Option 1 |
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**Issue 2-2-1: Optionality of gNB measurement accuracy requirements**

*Candidate options:*

* Option 1: QC, CATT, ZTE, HW, MTK, OPPO, Intel
  + No
* Option 2: E///, Nokia
  + Declared by manufacturer

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| **Company** | **Comments** |
| MTK | Option 1 |
| E/// | Option 2. Should be declared by the gNB. |
| Qualcomm | Option 1. |
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**Issue 2-3-1: Side conditions (e.g. SINR) for applicability of accuracy**

*Candidate options:*

* Option 1: QC, CATT, HW, Intel, OPPO
  + One set of side conditions to meet accuracy for UE in serving as well as in neighbour cells
* Option 2: Nokia, E///
  + Separate side conditions to meet accuracy for UE in serving and for UE in neighbour cells

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| **Company** | **Comments** |
| E/// | Support 2. |
| Qualcomm | Option 1. Multi-RTT side conditions should be generic and not based on serving or neighbor cell side conditions. |
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**Issue 2-3-2: How to derive side conditions (e.g. SINR)**

*Candidate options:*

* Option 1: QC, CATT, HW, OPPO, Intel, ZTE
  + Based on TS 36.111 clause 7.2
* Option 2: Nokia, E///
  + Based on system simulations

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| **Company** | **Comments** |
| E/// | Option 2. It is expected that the system simulation assumptions should be approved in this meeting and results are provided in the next meeting. |
| Qualcomm | We can support option 2 if simulation assumptions are agreed. |
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**Issue 2-3-3: Antenna configuration in accuracy requirement**

*Candidate options:*

* Option 1: Nokia, E///
  + Assume fixed gNB antenna beams
* Option 2: QC, CATT, HW, MTK, Intel
  + Do not assume fixed gNB antenna beams

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| **Company** | **Comments** |
| E/// | Support option 1. |
| Qualcomm | Option 2. |
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**Issue 2-3-4: SRS configurations for accuracy requirements**

*Candidate options:*

* + Option 1: QC
    - Accuracy is defined and met for all SRS configurations
  + Option 2: Nokia, E///
    - Accuracy is defined for all SRS configurations but is met only for subset of SRS configurations declared by manufacturer
  + Option 3: CATT, HW, OPPO, Intel
    - Accuracy is defined and met for only subset of SRS configurations

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| **Company** | **Comments** |
| E/// | Support 2. |
| Qualcomm | We can support option 3 depending on the outcome of link-level simulations. Suggest to postpone the discussion to that time. |
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**Issue 2-3-7: Accuracy requirements for different BS types (1-C, 1-H, 1-O, 2-O)**

*Candidate options:*

* Option 1: ZTE, Nokia, HW, E///, Intel
  + Accuracy requirement depends on BS type
* Option 2: CATT
  + Same accuracy requirement applies to all BS types but side condition depends on BS type

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| **Company** | **Comments** |
| E/// | Support option 1. Question to CATT: can you please elaborate which do you mean by the ‘side condition’. Do you mean SNR or anything else? |
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### CRs/TPs comments collection

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| **CR/TP/LS/Other number** | **Comments collection** |
| R4-2012141 (system simulation assumptions) |  |
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|  |
| R4-2012142 (Link simulation assumptions) |  |
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## Summary on 2nd round (if applicable)

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

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| R4-2012140 (WF) |  |
| R4-2012141 |  |
| R4-2012142 |  |

# Topic #3: Other requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2009914**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009914.zip) | Apple | ***Proposal 1: reuse the same principle of legacy SRS transmission in CDRX for positioning SRS transmission in CDRX, that is,***   * ***Periodic and SP positioning SRS is not transmitted during DRX inactive time, while aperiodic positioning SRS is transmitted regardless of the active/inactive time for DRX***   ***Observation: without the DRX information or MG information, positioning TRPs may waste the resource or power to measurement all the positioning SRS occasion from target UE.***  ***Proposal 2: RAN4 continues the study to see if it’s necessary to let serving gNB report the DRX and MG information of target positioning UE to LMF.*** |
| [**R4-2011167**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011167.zip) | Huawei, Hisilicon | **Observation 1: It is feasible for UE to transmit positioning SRS during DRX inactive time.**  **Observation 2: Transmission of positioning SRS during DRX inactive time will cause additional power consumption and implementation complexity for UE.**  **Observation 3: Transmit timing, power and beam may be sub-optimal for positioning SRS during DRX inactive time.**  **Draft LS:**  RAN4 discussed the positioning SRS transmission during DRX inactive time, and reached the conclusion that it is feasible to allow positioning SRS transmission during DRX inactive time. However, it will cause additional power consumption and implementation complexity for UE, and the transmit timing, power and beam may be sub-optimal for positioning SRS transmission during DRX inactive time which may cause interference to other UEs in the serving cell, or degraded performance for the reception of the positioning SRS itself. |
| [**R4-2011168**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011168.zip) | Huawei, Hisilicon | CR to 38.133 to add CSI-RS related reporting criteria for ECID |
| [**R4-2011249**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011249.zip) | Ericsson | * **Observation 1:** UE needs to acquire DL synchronization before transmitting SRS during its DRX inactive time. * **Observation 2:** UE receiver activity due to synchronization and transmitter activity due to SRS in DRX inactive time increases UE power consumption. * **Observation 3:** Legacy BS implementation, which will also receive positioning SRS, does not support periodic/semi-persistent SRS reception during DRX inactive time. * **Observation 4:** Due to additional complexity, not all BS implementations are expected to process periodic/semi-persistent SRS reception during DRX inactive time. * **Proposal 1:** LMF should assume that by default the BS is unable to receive periodic/semi-persistent positioning SRS during the DRX inactive time. * **Proposal 2:** The UE can be allowed to transmit DRX during the DRX inactive time provided that the BS is able to receive periodic/semi-persistent positioning SRS during the DRX inactive time. |
| [**R4-2011363**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011363.zip) | Ericsson | CR to 38.133 on reporting criteria for NR positioning measurements |
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## Open issues summary

### Sub-topic 3-1: reporting criteria

**Issue 3-1-1: Reporting criteria for positioning measurements**

* Directly provide comments on the following CRs in section 3.3.2:
* R4-2011168
* R4-2011363

### Sub-topic 3-2: SRS transmission during DRX inactive

**Issue 3-2-1: Impact of SRS transmission during DRX inactive on UE**

* Is it feasible for UE to transmit SRS for positioning during the DRX inactive period from UE power consumption and UE complexity perspective?
  + Option 1: Huawei
    - Yes
  + Option 2: Apple, E///
    - No
* Recommended WF
  + Need further discussion

**Issue 3-2-2: Impact of SRS transmission during DRX inactive on BS/TRP**

* Is it feasible for every BS/TRP to receive and process positioning SRS transmitted SRS during the DRX inactive period from BS/TRP implementation/complexity perspective?
  + Option 1:
    - Yes
  + Option 2: E///
    - No
* Recommended WF
  + Need further discussion

**Issue 3-2-3: Is periodic and semi-persistent positioning SRS transmission allowed during DRX inactive time?**

* Option 1: HW
  + Yes
* Option 2: Apple
  + No
* Option 3: E///
  + Yes but only if the BS is capable of processing SRS during DRX inactive time.
* Recommended WF
  + Need further discussion

## Companies views’ collection for 1st round

### Open issues

**Issue 3-2-1: Impact of SRS transmission during DRX inactive on UE**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1. The LS question is asking about feasibility and the answer is certainly yes. However, in reply LS, we can mention that while feasible, it is precluded from R16. |
| Apple | Support option 2 |
| Intel | prefer keep the same SRS transmission approach as Rel15. So we can support Option 2 |
| Huawei | We support option 1 for the same reason as mentioned by QC above, and regarding the LS we also think QC suggestion is a good approach. We can add in the LS something like “RAN4 suggests to not allow positioning SRS Tx in DRX inactive time in Rel-16.” |
| MTK | Support HW’s view |
| Nokia | We support option 2. We agree with Apple and Ericsson, it is increasing UE power consumption, as it is based on periodic / semi-persistent SRS in contrast to aperiodic SRS and the impact on UE power consumption for this DRX inactive operation has not been quantitatively assessed. It is also increasing UE complexity, as DL synchronization must be achieved in short time before SRS can be transmitted with acceptable Tx timing accuracy. |

**Issue 3-2-2: Impact of SRS transmission during DRX inactive on BS/TRP**

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | We support option 1. The LS question is asking about feasibility and the answer is certainly yes. However, in reply LS, we can mention that while feasible, it is precluded from R16. |
| Huawei | We support option 1, and comments are same as for 3-2-1. We can also mention the negative impacts on gNB side in the LS. |
| MTK | Same view as HW. |
| Nokia | We support option 2. We agree with Ericsson that there is a considerable impact to legacy BS in order to search for / receive such periodic or semi-persistent SRS in DRX inactive periods, Further, as stated in Huawei’s contribution, we see that the potential impacts of transmit timing error, transmit power misalignment and suboptimum beam adjustment, which may cause increased periodic interference to uplink of other UEs in the serving cell and this requires further quantitative analysis. Altogether we think feasibility of SRS in DRX inactive periods for BS is not given. |
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**Issue 3-2-3: Is periodic and semi-persistent positioning SRS transmission allowed during DRX inactive time?**

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| --- | --- |
| **Company** | **Comments** |
| E/// | Option 2 or option 3 is ok. |
| Qualcomm | We need to clarify the question, are we talking about R16 or future releases? If R16, then we support option 2. |
| Apple | Support option 2. |
| Intel | To QC’s question, this is for Rel16. We support option 2. |
| Huawei | We have not actually proposed option 1. We are ok with option 2 at least for Rel-16. |
| OPPO | Support option 2. |
| MTK | Support option 2 |
| Nokia | Based on our comments to issue 3-2-2, we support option 2. A proper study of this enhancement in regard to UE/ BS complexity aspects and in regard to increased UL interference in case of suboptimum UE realization of transmit timing, transmit power and beam adjustment in RAN1 is required in our view. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2011168**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011168.zip) | Ericsson: For CSI-RS based E-CID measurements, separate reporting criteria (i.e., separate rows) would be needed, e.g., because not all UE may be capable of performing these measurements. Therefore CR needs to be revised. |
| Qualcomm: we agree that CSI-RS based E-CID measurement is a separate capability and cannot be clubbed with the SSB-based E-CID. |
| Huawei:  In 37.355 there is only a single signaling for ECID measurement reporting *NR-ECID-SignalMeasurementInformation-r16*, which includes both SSB and CSI-RS measurements, i.e. there is no separate reporting for SSB and CSI-RS, so we cannot define separate reporting criteria for SSB and CSI-RS.  On the other hand, we agree that SSB and CSI-RS for ECID are separate UE capabilities, so we can update the CR to reflect this, i.e. the SSB (CSI-RS) reporting is only applicable when UE supports reporting SSB (CSI-RS) for ECID. |
| [**R4-2011363**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011363.zip) | Qualcomm: we cannot agree to this CR. Putting the number [64] for number of TRPs is not agreeable as this is subject to UE capability. Also, as discussed many times in previous meetings, reporting per frequency layers is not supported in LMF so the corresponding language should not exist. |
| Intel: can’t agree. |
| Huawei:  we cannot agree to add per frequency layer. We have following agreement in RAN4#95-e R4-2008664 which is not based on per frequency layer. Also the reporting signaling as defined in 37.355 has nothing to do with frequency layer.   * RSTD reporting criteria: Ecat = 1, one report which includes RSTD measurements and PRS-RSRP measurements (if configured with RSTD and supported by UE).   We do not agree to add 64 TRPs in reporting criteria requirements. The number of TRPs should be up to UE reported capability. |
| Nokia: we agree with the changes. For the term “frequency layer” we prefer to use the term “positioning frequency layer” (TS 38.214). This term should be used for NR positioning throughout TS 38.133. |

## Summary for 1st round

### Open issues

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

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| --- | --- |
|  | **Status summary** |
| **Sub-topic 3-1** | **Issue 3-2-1: Impact of SRS transmission during DRX inactive on UE**  *Tentative agreements:* None  *Candidate options:*   * + Option 1: Huawei, QC, MTK     - Yes   + Option 2: Apple, E///, Nokia, Intel     - No   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 3-1** | **Issue 3-2-2: Impact of SRS transmission during DRX inactive on BS/TRP**  *Tentative agreements: None*  *Candidate options:*   * + Option 1: HW, QC, MTK     - Yes   + Option 2: E///, Nokia     - No   *Recommendations for 2nd round:* Need further discussion |
| **Sub-topic 3-1** | **Issue 3-2-3: Is periodic and semi-persistent positioning SRS transmission allowed during DRX inactive time in Rel-16?**  *Tentative agreements:*  Periodic and semi-persistent positioning SRS transmissions during DRX inactive time are NOT allowed in Rel-16.  *Recommendations for 2nd round:* None |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | LS response on positioning SRS during DRX inactive time (LS out to RAN2; response to R2-2003877) | Apple |
|  |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [R4-2011168](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011168.zip) | Revised |
| R4-2011363 | Revised |

## Discussion on 2nd round (if applicable)

### Open issues

**Issue 3-2-1: Impact of SRS transmission during DRX inactive on UE**

*Candidate options:*

* + Option 1: Huawei, QC, MTK
    - Yes
  + Option 2: Apple, E///, Nokia, Intel
    - No

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| --- | --- |
| **Company** | **Comments** |
| Apple | Suggest to skip this discussion since all companies agree UE shall not transmit P/SP positioning SRS during DRX inactive time. We propose to capture this key conclusion in the reply LS. |
| MTK | Support Apple’s view |
| E/// | Support option 2. But we agree with Apple that no need to conclude on this since it is agreed not to allow SRS in DRX inactive times in R16. |
| Qualcomm | We agree to Apple’s suggestion subject to explicitly mentioning the conclusion is applicable to R16. |
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**Issue 3-2-2: Impact of SRS transmission during DRX inactive on BS/TRP**

*Candidate options:*

* + Option 1: HW, QC, MTK
    - Yes
  + Option 2: E///, Nokia
    - No

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Suggest to skip this discussion since all companies agree UE shall not transmit P/SP positioning SRS during DRX inactive time. We propose to capture this key conclusion in the reply LS. |
| E/// | Support option 2. But on this issue we also agree with Apple that no need to conclude on this since it is agreed not to allow SRS in DRX inactive times in R16. |
| Qualcomm | Same as 3-2-1. |
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### CRs/TPs comments collection

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| --- | --- |
| **CR/TP/LS/Other number** | **Comments collection** |
| R4-2012143 (LS) |  |
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| R4-2012144 (CR revision of [R4-2011168](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011168.zip)) | Ericsson: separate reporting criteria (and corresponding rows in the table) are needed for CSI-RS based E-CID measurements. |
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| R4-2012145 (CR revision of R4-2011363) |  |
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## Summary on 2nd round (if applicable)

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

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| R4-2012143 (LS) |  |
| R4-2012144 (CR) |  |
| R4-2012145 (CR) |  |