**3GPP TSG-RAN4 Meeting #102-eR4-22x**

**Online, 21 February – 3 March, 2022**

**Agenda item:** 10.11.2.3

**Source:** Apple

**Title:** Email discussion summary for [102-e][219] NR\_MG\_enh\_3

**Document for:** Information

# Introduction

This email discussion includes agenda item 10.11.2.3 for NCSG in R17 measurement gap enhancement.

# Topic #1: NCSG design

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

## Companies’ contributions summary

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| **TDoc** | **Source** | **Proposals / Observations** |
| [**R4-2203715**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203715.zip) | Qualcomm, Inc. | **Proposal 1: Capture the scheduling restriction as the following text proposal:****When multiple MOs are configured, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of SSB symbols to be measured from all MOs, and on 1 data symbol before each consecutive SSB symbols to be measured in the union and 1 data symbol after each consecutive SSB symbols to be measured in the union within SMTC window duration. When the boundary of the union doesn’t align with the serving carrier slot/symbol boundary, the partial overlapping symbol is counted towards the overlapping to the union as a whole symbol.****Observation 1: Spare chain power consumption in NCSG is dominated by on/off and configuration, and shorter ML brings negligible power benefit.****Proposal 2: No additional mandatory NCSG patterns besides agreed GP 0, 1, 13 and 14.****Proposal 3: Add a new separated UE capability for per-UE or per-FR NCSG support signaling, and a separated set of NCSG pattern support capabilities.**

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| X-Y | Network controlled small gap (NCSG) | Support of per-FR NCSG (independentGapConfig) |  | yes | no | UE cannot signal per-FR NCSG capability | per-UE | No | No |  |  | Optional with capability signalling |
| X-Y+1 | Network controlled small gap (NCSG) | Supported NCSG patterns |  | yes | no | Network does not know whether some NCSG patterns can be configured to UE | per-UE | No | No |  |  | Optional with capability signallingNCSGpatterns #0, #1, [x1, y1, …] are conditional mandatory if UE support X-1 |
| X-Y+2 | Network controlled small gap (NCSG) | Supported NR-only NCSG patterns |  | yes | no | Network does not know whether some NR-only NCSG patterns can be configured to UE | per-UE | No | No |  |  | Optional with capability signallingNCSGpatterns #0, #1, [x2, y2, …] are conditional mandatory if UE support X-1 |

**Proposal 4: The offset of NCSG refers to the starting point of VIL1.****Observation 2: RAN4 specification 38.133 9.1.2 clause only specifies legacy MG interruption for MGTA=0ms and MGTA=0.5ms cases, not MGTA=0.25ms cases.****Proposal 5: Remove 0.25ms MGTA column from per-UE NCSG VIL table.****Observation 3: UE may not have two dedicated measurement processing resources for L1 and L3 running simultaneously when measured by separated RF chains.****Proposal 6: For L1 measurement in an FR1 serving cell, NCSG should be considered in P factor NCSG, including VILs and ML, are overlapped with any of the RS for L1 measurement.****Proposal 7: Count ‘no-gap-no-ncsg’ into CSSF calculation by following R16 inter-f w/o gap measurement enhancement as the agreements on different SMTC and MG/NCSG overlapping cases align for the two use cases. No additional agreement is needed beyond this one and the previous agreements for CSSF calculation.****Proposal 8: Do not consider CSI-RS measurement use cases in R17 NCSG.****Observation 4: The supports for the following configurations for neighboring cell measurement is are infeasible, or not beneficial:*** + - * 1. **One legacy perUE gap + one NCSG perUE gap (4): contradict to agreement from RAN4#100e WF[3]**
				2. **One legacy perUE gap + NCSG FR1 gap (5), One legacy perUE gap + NCSG FR2 gap (6): infeasible to support running per-UE type of gap and per-FR type of gap simultaneously from UE implementation perspective, and RAN4 already agreed not to support such combination without concurrent gaps.**
				3. **Legacy FR1 gap + NCSG FR2 gap (2), Legacy FR2 gap + NCSG FR1 gap (3): complicated for UE implementation and offering minor throughput gain**

**Proposal 9: Reply the following to RAN2 questions on NCSG configuration combinations (captured in Appendix):****Considering only neighboring cell measurement as use cases, RAN4 finds the following configuration is feasible:****1) NCSG FR1 gap + NCSG FR2 gap****But the following configuration inconsistent with RAN4 agreement:****4) One legacy perUE gap + one NCSG perUE gap****And the following configurations infeasible or with significant complexity from UE implementation perspective and with limited system throughput gain:****2) Legacy FR1 gap + NCSG FR2 gap****3) Legacy FR2 gap + NCSG FR1 gap****5) One legacy perUE gap + NCSG FR1 gap****6) One legacy perUE gap + NCSG FR2 gap****Note that use cases besides neighboring cell measurement, e.g., positioning, are not covered in this response.** |
| [**R4-2203739**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203739.zip) | Apple | **Proposal 1: regarding NCSG for CSI-RS based inter-frequency measurement with gap, RAN4 confirms either 1) NCSG for CSI-RS based inter-frequency measurement with gap is NOT supported in R17. Or 2) NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17. However, corresponding requirements will not be defined in R17.****Proposal 2: no additional mandatory NCSG patterns on top of the ones agreed in previous RAN4 meetings.****Proposal 3: introduce a new signaling, e.g. *supportedNCSGPattern-Nronly* to allow UE to indicate support of some NCSG patterns which can only be used for NR-only measurement.****Proposal 4: The offset of NCSG refers to the starting point of VIL1.****Proposal 5: RAN4 either concludes no additional UE capability is needed for per-UE and per-FR differentiation for NCSG on top of that defined for legacy gap, or define a new one bit NCSG per-UE and per-FR capability, e.g. independentNCSGConfig.****Proposal 6: similar with *deriveSSB-IndexFromCell*, RAN4 shall introduce tolerance requirement for *deriveSSB-IndexFromCell-inter* such as:*** **When *deriveSSB-IndexFromCell-inter* is enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the target carrier and reference carrier is within a tolerance not worse than 2 SSB symbols of target carrier and the SFNs of all cells on the target carrier and reference carrier are the same.**

**Proposal 7: with △tless then 2 SSB symbol of target carrier, *deriveSSB-IndexFromCell-inter* can also be configured if the SCS of SSB is different between target cell and the serving cell which is used for SSB indexes derivation.****Proposal 8: scheduling restriction agreed on single CC case with *deriveSSB-IndexFromCell-inter* is true can also apply for multiple CCs. Restriction applies for the merged Measurement window in time domain among MOs.****Proposal 9: no need to introduce a mapping table between legacy measurement gap patterns and corresponding NCSG patterns.****Proposal 10: in UE feature list discussed in RAN4#101-e-bis, X-2 shall be introduced while X-3 is unnecessary.****Proposal 11: answer to question from RAN2:*** **Independent of whether the UE supports concurrent measurement gaps, the following operations are supported:**
	+ **NCSG FR1 gap + NCSG FR2 gap**
	+ **Legacy FR1 gap + NCSG FR2 gap**
	+ **Legacy FR2 gap + NCSG FR1 gap**
* **Without considering concurrent gap, the following operations are not supported:**
	+ **One legacy perUE gap + one NCSG perUE gap**
	+ **One legacy perUE gap + NCSG FR1 gap**
	+ **One legacy perUE gap + NCSG FR2 gap**
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| [**R4-2203881**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203881.zip) | CATT | **Proposal 1: NCSG for CSI-RS based inter-frequency measurement with gap should be supported in R17.** **Proposal 2: For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.** **Proposal 3: For the support of NCSG pattern, prefer to introduce a new signalling and it is also fine to leave it to RAN2.** **Proposal 4: The offset of NCSG refers to the starting point of ML.** **Proposal 5: No additional per BC indication is needed on top of per FR NCSG.** **Proposal 6: It is up to RAN2 to define the UE capability indicating the support of per FR NCSG.** **Proposal 7: Do not introduce mapping table between legacy measurement gap patterns and corresponding NCSG patterns.** **Proposal 8: Combination 1), 2) and 3) can be supported, and combination 4), 5) and 6) cannot be supported without considering concurrent gaps.**  |
| [**R4-2204059**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204059.zip) | MediaTek inc. | **Proposal 1: RAN4 not to work on CSI-RS based inter-frequency measurement requirement via NCSG In Rel-17.****Proposal 2: For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.****Proposal 3: Introduce a new UE capability similar to supportedGapPattern for UE to report which NCSG patterns are supported.****Proposal 4: Introduce a new UE capability similar to supportedGapPattern-Nronly for UE to report which NCSG patterns are supported for NR only measurement.****Proposal 5: The offset of NCSG refers to the starting point of VIL1.****Proposal 6: When UE reports the NCSG capability (‘no-gap-no-ncsg’, ’ncsg’ and ‘gap’) on a target band to network, the reported capability applies to all measurement types agreed by RAN4.****Proposal 7: Do not introduce per BC UE capability indication for per-UE and per-FR differentiation for NCSG on top of per-UE indication in Rel-17.****Proposal 8: On the scheduling restriction during ML of NCSG, scheduling restriction on SSB symbols and 1 symbol before and after SSB symbols apply only if all following additional conditions are met:*** **All NR MOs are indicated with deriveSSB-IndexFromCell-inter**
* **All NR MOs have the aligned SMTC offset during NCSG and the same SMTC duration.**
* **All NR MOs have the same SSB SCS with the serving cells**
* **The frequency layers indicated in all NR MOs have the same time-domain SSB mapping pattern.**

**Where the SSB considered above are indicated by the union set of SSB-ToMeasure from all MOs if SSB-ToMeasure is configured in all MOs; otherwise all SSBs are considered.****Proposal 9: In the case that scheduling restriction on SSB symbols and 1 symbol before and after SSB symbols does not apply, the scheduling restriction is on all OFDM symbols during ML of NCSG.****Proposal 10: UE reports the capability of ncsg or no-gap-no-ncsg on a band for EUTRAN measurements only if no scheduling restriction is expected.****Proposal 11: The frequency layers to be considered in the CSSF calculation of NCSG are the frequency layers that are in the band that UE can measure with NCSG and configured with the SMTC occasions fully or partially overlapped by NCSG.****Proposal 12: On the L1 measurement impact due to NCSG in FR2, additionally consider the overlapping with the SSB of the inter-frequency measurement objects to be measured within NCSG with common beamforming as serving cell(s).****Proposal 13: Consider the following 2 UE capabilities in Rel-17.**

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Consequence if the feature is not supported by the UE** | **Type** | **Note** | **Mandatory/Optional** |
| X-2 | NCSG pattern  | Supported NCSG patterns for both EUTRAN and NR measurements | X-1 | Network does not know whether some NCSG patterns can be configured to UE | per-UE |  | Optional with capability signallingNCSG patterns #0, #1, #13 and #14 are conditional mandatory if UE support X-1 |
| X-y | NCSG pattern for NR-only measurement | Supported NCSG patterns for NR-only measurements | X-1 | Network does not know whether some NCSG patterns can be configured to UE | per-UE |  | Optional with capability signallingNCSG patterns #2, #3, #11, #17, #18 and #19 are conditional mandatory if UE support X-1 |

**Proposal 14: Reply to the RAN2 LS that case 1), 2) and 3) are supported if UE supports both per-FR gap and NCSG.****Proposal 15: Reply to the RAN2 LS that case 4), 5) and 6) are not considered in Rel-17 RAN4 requirements, but it is up to RAN2 whether to introduce the corresponding signalling.** |
| [**R4-2204258**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204258.zip) | CMCC | ***Proposal 1: it is proposed that NCSG for CSI-RS based inter-frequency measurement with gap is supported******Proposal 2: for NR-only measurement, NCSG patterns corresponding to the mandatory legacy gap patterns #2, #3, #11, #17, #18, #19 are proposed to be mandatory for UEs supporting NCSG.******Proposal 3: for the indication of support of some NCSG patterns, it is proposed to introduce a new UE capability, or leave this issue up to RAN2 design.******Proposal 4: for L1 measurement in FR1 , P = 1 provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement.*** ***Proposal 5: for L1 measurement in FR2 , P is proposed as following:**** ***For the case that the target carrier is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP.***
* ***For the case that the target carrier is inter-frequency carrier in different band as the serving cell, and UE is not capable of IBM, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP.***
* ***For the case that the target carrier is inter-frequency carrier in different band as the serving cell, and UE is capable of IBM, P = 1 provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement.***

***Proposal 6: it is proposed to consider following combinations:**** ***FR1 NCSG + FR2 NCSG***
* ***legacy FR1 gap + FR2 NCSG***
* ***legacy FR2 gap + FR1 NCSG***
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| [**R4-2204293**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204293.zip) | OPPO | **Proposal 1a: NCSG for CSI-RS based inter-frequency measurement with gap is not supported in Rel-17.****Proposal 1b: RAN4 to work on CSI-RS based inter-frequency measurement requirement via NCSG after stabilizing the SSB-based requirements.****Proposal 2: NCSG patterns #2, #3, #11, #17, #18, #19 are mandatory for NR-only measurement.****Proposal 3: To indicate the support of NCSG patterns for NR-only measurement, prefer option 2: to introduce a new signalling, and can also compromise to option 3: up to RAN2.****Proposal 4: The time offset of NCSG refers to the starting point of ML-RRT.****Proposal 5: When NCSG timing advance of 0ms is applied, the number of interrupted slots for 15kHz SCS should be revised to 2.****Proposal 6: Not introduce additional per BC indication for NCSG.****Proposal 7: For RRC signalling design in RAN2, all the 6 gap/NCSG combinations could be considered.****Proposal 8: For RRM requirements in RAN4, only the first 3 combinations will be considered in Rel-17.****Observation 1: The UE behaviour and corresponding requirements were solved in the last meeting and it is not necessary to discuss the meaning of “measurement within gap”.** |
| [**R4-2204406**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204406.zip) | Intel Corporation | ***Proposal 1: CSI-RS based inter-frequency measurement with NR NCSG can be deprioritized in Rel17.*** ***Proposal 2: NO additional mandatory NCSG patterns beside #0 , #1, #13,#14(for FR2).*** ***Proposal 3: How to indicate support of NR-only NCSG pattern is up to RAN2.******Proposal 4: The offset of NCSG refers to the starting point of VIL1.******Proposal 5: NO additional UE capability is needed for per-UE and per-FR differentiation for NCSG on top of that defined for legacy gap.******Proposal 6:* *It is unnecessary to introduce any transformation mapping table between the legacy MG and NCSG.******Proposal 7: RAN4’s reply on LS R2-2201935 can be:*****“Q:** **Whether to support simultaneous configurations on the following combinations?*** 1. **NCSG FR1 gap + NCSG FR2 gap**

**🡪**Yes. * 1. **Legacy FR1 gap + NCSG FR2 gap**

**🡪Yes*** 1. **Legacy FR2 gap + NCSG FR1 gap**

**🡪Yes*** 1. **One legacy perUE gap + one NCSG perUE gap**

**🡪This is postponed to joint discussion(NCSG + concurrent MG).*** 1. **One legacy perUE gap + NCSG FR1 gap**

**🡪This is postponed to joint discussion(NCSG + concurrent MG).*** 1. **One legacy perUE gap + NCSG FR2 gap**

**🡪This is postponed to joint discussion (NCSG + concurrent MG).”** |
| [**R4-2205012**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205012.zip) | ZTE Corporation | **Proposal 1: De-prioritize the CSI-RS based inter-f measurement, until the discussion of applying of NCSG to SSB-based measurement finished. Or considering the NCSG for CSI-RS based measurement in Rel-18 MG enhancement.****Proposal 2: Considering the urgen timeline of Rel-17, Option 2 and Option 4 are possible choices and we prefer Option 2.****Proposal 3: For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.** **Proposal 4: we support re-using *supportedGapPattern-NRonly-r16* to indicate optionally supported NCSG patterns to NW, not need new signalling.** **Proposal 5: Prefer Option 2 since is can guarantee the effective ML location/length consistent between legacy gap pattern and the corresponding NCSG pattern.****Proposal 6: Introducing a mapping table would help to define the applicability and capability related to NCSG patterns by referring to the corresponding NCSG patterns.** **Proposal 7: Support Option 1, i.e. re-using the per-UE/per-FR differentiation defined for legacy gap.** **Proposal 8: For the frequency layer with NCSG capability reported by UE has the SMTC which is fully non-overlapped with ML of NCSG, this frequency layer should be removed from the CSSF within NCSG.****Proposal 9: The sub-bullet about FR1 above can be supported.****Proposal 10: The sub-bullets about FR2 above need some further revision.****Proposal 11: For FR2, two factors should be considered when determine whether L1 measurement impacted or not by RRM measurement within ML of NCSG:*** + **Whether L1 RS overlaps with VIL of NCSG**
	+ **Whether UE is capable of IBM**
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| [**R4-2205372**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205372.zip) | Huawei, HiSilicon | **Proposal 1: NCSG can be used for CSI-RS inter-frequency measurement. UE reports supported CSI-RS BW for each band.****Proposal 2: For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.****Proposal 3: Re-use *supportedGapPattern-NRonly* for UE to indicate supported NCSG patterns for NR-only measurement.** **Proposal 4: The offset of NCSG refers to the starting point of ML – RRT. Allow 2 slots interruption for 15kHz, sync, mgta=0.****Proposal 5: RAN4 not to further discuss the meaning of “measurement within gap” since UE behaviour are already clear based on existing agreement.****Proposal 6: The reported capability (‘no-gap-no-ncsg’, ’ncsg’ and ‘gap’) does not apply to all measurement types on the same band.****Proposal 7: Define a per BC indication for per FR NCSG.****Proposal 8:** **On each serving cell *i*, the scheduling restriction should apply on the union of the restricted symbols due to measurement on each MO *j*, *j=1…J*, where J is the number of MOs to be measured with NCSG.** **For measurement on each MO *j*, the restricted symbols on serving cell *i*, if applicable, include*** **the symbols that fully or partially overlap with the measured SSB symbols plus 1 symbol before and after based on the timing of the time reference cell, if *deriveSSB-IndexFromCell-inter* is configured;**
* **all the symbols in the SMTC window, if *deriveSSB-IndexFromCell-inter* is not configured.**

**Proposal 9: For defining CSSF within NCSG, re-use the same way as in CSSF within legacy MG for handling the overlapping between SMTC and NCSG.****Proposal 10: When NCSG is configured, an L1 RS occasion is considered as overlapped with NCSG if** * **it overlaps the VIL1 or VIL2 of NCSG, or**
* **it overlaps the ML of NCSG, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell.**

**Proposal 11: Define the mapping between legacy MGPs and their corresponding NCSG patterns.****Proposal 12: Reply to RAN2 that configuration 1), 2) and 3) are supported, and configuration 4), 5) and 6) are not supported from RAN4 requirements point of view.** |
| [**R4-2205937**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205937.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1: RAN4 to consider application of NCSG for measuring CSI-RS L3 based inter-frequency measurement with gap for Rel-18 as a residual of Rel-17 NR measurement gap enhancements.****Proposal 2: No additional mandatory NCSG pattern beyond NCSG patterns #0 and #1 and NCSG patterns corresponding to legacy patterns #13 and #14 in FR2 for per-FR capable UE will be specified.****Proposal 3: How to indicate support of NR-only NCSG patterns, is up to RAN2. RAN4 to include this aspect in the reply LS on NCSG to RAN2.** **Proposal 4: The offset of NCSG refers to the starting point of VIL1.****Proposal 5: The assumption "When UE reports the NCSG capability ('no-gap-no-ncsg', 'ncsg' and 'gap') on a target band to network, the reported capability applies to all measurement types agreed by RAN4 on that target band." is not applicable and hence can be removed.** **Proposal 6: No further clarification on the meaning of “measurement within gap” is needed, since the agreement on issue 3-1-2 in WF[2] already provides this clarification.****Proposal 7: RAN4 not to consider any additional NCSG capability other than per-UE gap and per-FR gap in Rel-17. How to specify UE capability signalling support for NCSG, is up to RAN2.****Proposal 8: No mapping table between legacy measurement gap patterns and corresponding NCSG patterns is needed.****Proposal 9: RAN4 to confirm to RAN2, that simultaneous configuration of NCSG for FR1 and NCSG for FR2 is supported, while other listed combinations are not supported, in the scope of Rel-17 NCSG requirements. Hence those combinations are subject to be considered in the work on joint requirements for Rel-17 MG enhancements.****Proposal 10: RAN4 to take into account RAN2’s prioritization of the NR SA scenario and to inform RAN2 on latest agreements regarding mandatory NCSG patterns and the support of both per-UE and per-FR NCSG patterns.** |
| [**R4-2206019**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206019.zip) | Ericsson | **Scenarios/use cases for NCSG patterns:*** **Observation # 1**: Existing CSI-RS based inter-frequency measurements are done with measurement gaps.
* **Observation # 2**: Impact on scheduling restriction and other related issues for CSI-RS based inter-frequency measurement using NCSG will require substantial work
* **Proposal # 1**: NCSG for CSI-RS based inter-frequency measurement with gap is not supported in R17.

**NCSG patterns:*** **Observation # 3**: Network is expected to use the same or similar framework for legacy gap patterns and NCSG patterns.
* **Observation # 4**: Limiting mandatory NCSG patterns corresponding to only legacy patterns #0 and #1 will have significant implementation constrain on the existing network e.g. based on Rel-16.
* **Proposal # 2**: NCSG patterns, which correspond to all the mandatory legacy gap patterns in Rel-16, should be mandatory:
	+ For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory
* **Observation # 5**: How the UE indicates the support of NR-only NCSG pattern is related to RAN2 signaling design.
* **Proposal # 3**: How to indicate support of NR-only NCSG pattern is left for RAN2 to decide.
* **Observation # 6**: Offset of NCSG should allow alignment between the NCSG and legacy measurement gaps for future profness and transformation.
* **Proposal # 4**: Support option 2 i.e. offset of NCSG refers to RRT before the start of the ML.

**NCSG capability:*** **Observation # 7**: Additional NCSG capability for per-UE and per-FR differentiation on top of existing per-UE and per-FR capability creates unnecessary complexity in handling different UEs for NCSG configuration.
* **Observation # 8**: New NCSG per-UE and per-FR capability may result in that the UE indicates different type capabilities (per FR or per UE) for legacy gaps and for NCSG making transformation between legacy gaps and NCSG difficult.
* **Proposal # 5**: No additional NCSG capability for per-UE and per-FR differentiation is needed on top of existing per-UE and per-FR capability.

**Mapping between legacy gaps and NCSG patterns:*** **Observation # 9**: The transformation between the NCSG pattern and the corresponding legacy measurement gap pattern can be performed by the network via RRC reconfiguration.
* **Observation # 10**: Bu transformation between legacy measurement gap pattern and NCSG pattern requires the network to know the relation between legacy measurement gap pattern and NCSG pattern.
* **Observation # 11**: Wgreed NCSG patterns corresponding to the legacy patterns #0 to #23.
* **Proposal # 6**: Define mapping between legacy measurement gap patterns and corresponding NCSG patterns for the gNB to determine the transform gap pattern.
* **Proposal # 7:** Mapping between legacy measurement gap patterns and corresponding NCSG is defined by relating their identifiers.
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## Open issues summary

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

### Sub-topic 1: Scenarios and use cases

**Issue 1-1: NCSG for CSI-RS based inter-frequency measurement with gap**

* Option 1: NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17. (CATT, CMCC)
* Option 1a: NCSG can be used for CSI-RS inter-frequency measurement. UE reports supported CSI-RS BW for each band. (HW)
* Option 2: NCSG for CSI-RS based inter-frequency measurement with gap is NOT supported in R17. (QC, Apple, MTK, OPPO, [Intel?], ZTE, E///)
* Option 2a: RAN4 to work on CSI-RS based inter-frequency measurement requirement via NCSG after stabilizing the SSB-based requirements. (OPPO, [Intel?], ZTE)
* Option 2b: RAN4 to consider application of NCSG for measuring CSI-RS L3 based inter-frequency measurement with gap for Rel-18 as a residual of Rel-17 NR measurement gap enhancements (Nokia)
* Option 3: NCSG for CSI-RS based inter-frequency measurement with gap is supported in R17. However, corresponding requirements will not be defined in R17. (Apple)

Recommended WF:

3 companies support option 1/1a. 8 companies support option 2/2a/2b. Based on majority’s view, please companies check if option 2 is agreeable:

NCSG for CSI-RS based inter-frequency measurement with gap is NOT supported in R17

1st round Comment collection:

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| **Company** | **Comments** |
| Apple | Support recommended WF.Some further study is needed to support NCSG for inter-frequency CSI-RS L3 measurement. For instance, how to address BW issue is unclear. Option 1a proposes to let UE report supported CSI-RS BW, which increases RRC signaling overhead. However it is unclear to us when UE shall report the supported BW. If UE reports it together with support of NCSG on different bands, which means the reporting may come earlier before MO configuration. NW may not even configure CSI-RS L3 measurement for the UE. Thus it increase RRC overhead w/o any gain. Considering this is the last meeting to complete core part, we suggest RAN4 deprioritize this in R17.  |
| QC | Support option 2 as moderator recommended |
| Intel | Support recommended WF. |
| OPPO | Support recommended WF. |
| vivo | Ok with the recommended WF |
| ZTE | Fine with the agreement achieved in GTW. |

### Sub-topic 2: NCSG patterns

**Issue 2-1: On top of agreed pattern #0, #1, #13 and #14, whether additional NCSG gap patterns shall be mandatorily supported if UE supports NCSG.**

* Option 1:For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory. (CATT, MTK, CMCC, OPPO, ZTE, HW, E///)
* Option 2: no additional mandatory NCSG patterns (QC, Apple, Intel, Nokia)

Recommended WF:

7 companies support option 1. 4 companies support option 2. Based on majority’s view, please companies check if option 1 is agreeable:

For NR-only measurement, NCSG GP#2, #3, #11, #17, #18, #19 are mandatory.

1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | For the sake of progress, we can compromise to option 1.However, we still don’t think mandating more NCSG pattern can benefit the system, mainly because the impact on throughput is the same (depending on VIL, rather than ML). Some company mentioned that pattern with shorter ML can save UE power. According to contributions in this meeting, seems not all companies share the same view. Even if this is true, it doesn’t mean this pattern needs to be mandated. Option 2 proposes to not make them mandatory, not to remove them. UE vendors who believe shorter ML is beneficial can optionally support them. Some company mentioned in last meeting that if not all UE support these patterns, NW may not implement they, which therefore makes the patterns useless. However, we are not convinced since there are quite a lot of optional features and even a lot of optional patterns in legacy MG design. |
| QC | We want to understand the motivation of supporting more gap patterns. Most of companies supports option 1 because it aligns with R16. But these mandatory legacy GPs can bring throughput gain, while the same NCSG patterns can’t enhance throughput.We understand Huawei’s argument on power saving, but as we explained in our contribution, the power saving is almost negligible, since most power is consumed in power up and setting up RF and baseband modules for such a short time usage. We are open to make compromise to reach agreement, but first we want to understand the motivation from option 1 proponents to figure out a way to compromise. |
| Intel | We can compromise to Option 2. One question is whether the separated capability to support these additional mandatory NCSG gap pattern is needed? |
| ZTE | Prefer Option 1. NCSG is an optimization with reduced interruption based on legacy MG, not introduce any new pattern, so re-using the same mandatory pattern rule as legacy MG is reasonable.  |
| MTK | We support Option 1.We see no problem to extend the Rel-16 concept to NCSG. UE who supports NCSG can already do measurement at the same time with data scheduling, and Rel-17 UE should already support mandatory legacy gap for NR-only measurement. Therefore, mandating the same set of gap patterns actually does not cause extra UE implementation effort much. We are also open to hear views from other companies. |

**Issue 2-2: UE can indicate support of some NCSG patterns which can only be used for NR-only measurement. FFS on how to indicate support of NR-only NCSG pattern:**

* Option 1: reuse *supportedGapPattern-Nronly* (ZTE)
* Option 2: introduce a new signaling, e.g. *supportedNCSGPattern-Nronly* (MTK, OPPO, Apple, QC)
* Option 3:up to RAN2 (OPPO, Intel, Nokia, E///)

Recommended WF:

Discussion is needed.

1st round Comment collection:

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| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 2. This is a new R17 feature. Having its own capability can increase UE and NW flexibility. Regarding option 3, we don’t think it is a good idea simply because core part is supposed to be finalized by March. There is no enough time to raise and resolve this in RAN2. |
| QC | We support option 2. Since UE may support different patterns for NCSG and legacy gap, new signaling is needed |
| Intel | Technically we support Option 3. For an example, if there is mapping between NCSG and legacy MG, the existing signaling may be reused. But this is up to RAN2 indeed. But in order to complete this WI on time, we can compromise to Option 2 also. |
| OPPO | Between option 1 and option 2, we prefer option 2 since it is more flexible. If no consensus can be reached, it can be determined by RAN2. |
| ZTE | According to the agreement achieved in GTW, the mapping would not be defined between legacy MG and NCSG, so we can compromise to Option 2 or 3. |
| MTK | We support Option 2. We think it is OK to leave some flexibility for UE to select which gap pattern to support, as long as we already have some mandatory gap patterns. |

**Issue 2-3: time offset for NCSG:**

* Option 1:The offset of NCSG refers to the starting point of VIL1. (QC, Apple, MTK, Intel, Nokia)
* Option 2: The offset of NCSG refers to the starting point of ML – RRT. Allow 2 slots interruption for 15kHz, sync, mgta=0. (OPPO, ZTE, HW, E///)
* Option 3: The offset of NCSG refers to the starting point of ML. (CATT)



Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We don’t have very strong view since all of the options can make it clear to both NW and UE when the gap starts. We slightly prefer option 1 over option 2 because it may be clearer to RAN2 since RAN2 may not even know what is RRT. Going with this logic, option 3 is also acceptable since RRC spec doesn’t need to know VIL as well since most likely only ML and VIRP will be captured in RRC signaling design. |
| QC | Option 1.As we explained in our contribution, the agreement on MGTA = 0.75ms made in the previous meeting assumes reference point for MGTA at the beginning of VIL1. If we choose option 2 or 3, there is a misalignment between reference point for MGTA and offset.  |
| Intel | Option 1 as explained in our TDoc. |
| OPPO | Option 2. As discussed in the last meeting, the length of RTT is defined in the unit of ms and fixed compared with VIL. Moreover, option 2 makes the transform between NCSG and legacy MG easier.  |
| vivo | No strong view, slightly prefer option 1 since it is more straightforward. |
| ZTE | Fine with the agreement achieved in GTW. |

**Issue 2-4: mgta for NCSG:**

Background: interruption requirement for 0.25ms mgta was added in per-UE NCSG and per-FR1 NCSG in Table 9.1.2c-1 with square brackets. Companies are encouraged to check if 0.25ms is needed for this case.

* Option 1: remove 0.25ms from table 9.1.2c-1 (QC)
* Option 2: keep 0.25ms in table 9.1.2c-1

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We are fine with option 1. The reason we mentioned option 2 in last meeting is that we found no restriction in neither RAN4 nor RAN2 spec which precludes 0.25ms mgta in FR1, even though that was the assumption when RAN4 developing gap interruption requirements. The only restriction is TS38.331 explicitly says “For FR2, the network only configures 0 ms and 0.25 ms.”Since it is not considered in existing gap interruption requirement, we are fine to not consider it for NCSG as well. |
| QC | Option 1. Note that legacy gap doesn’t have MTGA = 0.25 for the corresponding table, and NCSG should follow. |
| Intel | Option 1 is fine for us. Draft CR on this is needed also. |
| OPPO | Fine with option 1 since MGTA=0.25ms is for FR2.  |
| MTK | We have no strong view with either options, but we want to clarify that RAN2 and RAN4 may take different actions based on Option 1.In RAN2 spec, how NCSG will be configured is still not clear at this moment. If NCSG is introduced by re-using the legacy gap IE with some modification, then probably all mgta values will still be there. Therefore, we suggest leave it to RAN2 to decide. For example, we can tell RAN2 that MGTA 0.25ms is useless for NCSG, but it is up to RAN2 to decide what to do in the RRC signaling. In RAN4 requirements, we are fine to directly go with Option 1. |

### Sub-topic 3: UE capability and NW configuration

**Issue 3-1: meaning of “measurement within gap”**

* Option 1: no need to further discuss (OPPO, HW, Nokia)

Recommended WF:

Since this has already been reflected in the agreement in previous RAN4 meeting, no need to further discuss.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support the recommended WF. |
| QC | Support the recommended WF. |
| Intel | Support the recommended WF. |
| OPPO | Support the recommended WF. |
| ZTE | Support the recommended WF. |
| MTK | Support the recommended WF. |

**Issue 3-2: When UE reports the NCSG capability (‘no-gap-no-ncsg’, ’ncsg’ and ‘gap’) on a target band to network, whether the reported capability applies to all measurement types agreed by RAN4:**

* + De-activated SCell measurement
	+ SSB based intra-frequency measurement with gap
	+ SSB based inter-frequency measurement with gap
	+ Inter-RAT E-UTRAN measurement
	+ Dormant SCell L3 measurement
	+ TBD: CSI-RS based inter-frequency measurement
* Option 1: yes (MTK)
* Option 2: no (HW, Nokia)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | RRM measurement on deactivated SCC or dormant SCell are exceptions, since legacy interruption based measurement is still possible.  |
| QC | Since we already have interruption specified and use cases (fully, partial, non-overlapping) agreed, do we still make further agreement on this? If it is for CSSF calculation, we suggest to discuss it directly in CR. |
| MTK | We support Option 1.We are fine to take this into CR discussion. The point to raise this is to avoid an extended UE capability discussion, e.g., a UE can support NCSG on a band only for NR measurement, but not for LTE measurement. If this is allowed, we need some new UE capability to inform network. (And we do not want it.) |

**Issue 3-3: other assumptions when discussing NW configuration and corresponding UE behaviour**

* Proposal 1: Count ‘no-gap-no-ncsg’ into CSSF calculation by following R16 inter-f w/o gap measurement enhancement as the agreements on different SMTC and MG/NCSG overlapping cases align for the two use cases. No additional agreement is needed beyond this one and the previous agreements for CSSF calculation. (QC)
* Proposal 2: UE reports the capability of ncsg or no-gap-no-ncsg on a band for EUTRAN measurements only if no scheduling restriction is expected. (MTK)

Recommended WF:

Discussion is needed. Please be kindly reminded that they are different proposals rather than options, which are not mutual exclusive. Companies are encouraged to provide comments on each of them.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Question on proposal 1 “following R16 inter-f w/o gap measurement enhancement”: are we going to reuse “*interFrequencyConfig-NoGap-r16*” or introduce a new one specifically for NCSG?Regarding proposal 2, is it correct understanding that if scheduling restriction applies, UE can only indicate “gap”? Even though we agree with analysis in MTK’s contribution, it doesn’t mean UE can only indicate “gap”. NCSG can still be used with scheduling restriction applying for the whole ML window. The two approaches have same consequence on this layer, i.e. measuring it within legacy gap or within NCSG with whole ML restricted. However, for other layers the second approach still allows NCSG which may bring beneficial.  |
| QC | Reply to Apple: our proposal is not about capability. We propose that calculating CSSF when ‘no-gap-no-ncsg’ is reported and NCSG or legacy gap is configured or not by following the CSSF calculation when UE supports inter-f w/o gap and legacy gap is configured or not. The proposal is based on the fact that the agreed measurement procedure for full/partial/non-overlapping cases is the same as inter-f w/o gap.Question to proposal 2: we expect that the proposal is captured in spec as: *For NCSG usage on inter-RAT measurement to LTE, no scheduling restriction when UE reports NCSG support and network configures NCSG.*This proposal is reasonable from simplifying spec perspective. But Apple’s comment seems feasible based on our understanding, too, and the potential benefit might be observed from other frequency layers.  |
| MTK | Proposal 1 are fine to us. If it is agreed, we need to add this into the CR.Regarding proposal 2, we raise this issue to simplify the requirement. We agree with Apple’s comment under the condition that there is only single band to be measured. The problem we have in mind is that if UE may have restriction on some EUTRAN bands but no restriction on other EUTRAN bands, how should network know this? Introducing a new UE capability could be one solution, but it is not feasible given this is the last meeting. A simple approach is to treat this band with restriction together with the band that needs ‘gap’.  |

**Issue 3-4: Whether additional UE capability is needed for per-UE and per-FR differentiation for NCSG on top of that defined for legacy gap**

* Option 1: No (Apple, MTK, Intel, ZTE, Nokia, E///)
* Option 2: Define a per BC indication for per FR NCSG. (HW)
* Option 3: do not rely on R15 capability independentGapConfig. Define a new NCSG per-UE and per-FR capability, e.g. independentNCSGConfig. (QC, Apple)
* Option 4: leave it to RAN2. (CATT, Nokia)

Recommended WF:

Considering 1) this issue has been discussed for many meetings. 2) this is the last meeting to complete core part. 3) option 1 got strong level of support, please companies check if option 1 is acceptable:

No additional UE capability is needed for per-UE and per-FR differentiation for NCSG on top of that defined for legacy gap, i.e. independentGapConfig.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We are fine with option 1 or 3. We believe reusing legacy capability is feasible as in option 1. Option 3 can gives more flexibility since it is a new R17 feature. Even though it is not that attractive, we are fine with it if this can be considered as compromise between option 1 and 2.  |
| QC | Per BC indication can be more flexible to UE, but we can compromise to not have it if NCSG per-FR gap capability can be reported separately from legacy gap per-FR capability.However, we observe that some companies consider this flexibility not necessary. Given that the original definition of legacy gap per-FR capability covers legacy gap only, and NCSG is a new type of gap, whether such definition extension is compatible to R15 original definition should be a RAN2 decision. We propose the following compromise option:Per-UE NCSG or per-FR NCSG capability is supported on per-UE basis. Whether to reuse *independentGapConfig* to indicate such capability is up to RAN2 decision.Note that it is part of feature list discussion and extending to the next meeting is expected. We don’t see this pending issue as a RAN4 obligation to wrap it up from closing core requirement discussion perspective. |
| Intel | The proposal in the recommended WF is fine for us. |
| OPPO | Support the recommended WF. |
| vivo | Ok with recommended WF |
| ZTE | Fine with the recommended WF. |
| MTK | We are fine with the recommended WF. |

### Sub-topic 4: measurement related requirements

**Issue 4-1: tolerance requirement for deriveSSB-IndexFromCell-inter (△t):**

* Option 1: (Apple)
	+ When deriveSSB-IndexFromCell-inter is enabled, the UE assumes frame boundary alignment (including half frame, subframe and slot boundary alignment) across cells on the target carrier and reference carrier is within a tolerance not worse than 2 SSB symbols of target carrier and the SFNs of all cells on the target carrier and reference carrier are the same.

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We support defining tolerance requirement for the new IE. We are also fine to use similar requirement such as “min{2 SSB symbols of target carrier, 1 PDSCH symbol of reference cell}”. However, this may reduce the use case, e.g. if NW can guarantee △t is smaller than 2 SSB symbols of target carrier but not 1 PDSCH symbol of reference cell. The drawback of using 2 SSB symbols for all cases is that scheduling restriction may need to be extended to 2 SSB symbols. So it has pros and cons. We would like to hear views from companies. |
| Intel | We are fine Option 1 in principle. But the exact number of this value can be bracketed for further checking. |
| ZTE | The discussion about tolerance requirement of the new IE **deriveSSB-IndexFromCell-inter** is make sense. But whether reusing the legacy requirement for **deriveSSB-IndexFromCell** or with some revision, which should be further discussed. |
| MTK | It is important to define the tolerance for the new indication. Since this indication will also be used in the scheduling restriction requirement, we also need to address how big the tolerance is in terms of the data SCS. Therefore, we think the legacy tolerance min(2 SSB symbols, 1 PDSCH symbol) can be considered. |

**Issue 4-2: requirements applicability of deriveSSB-IndexFromCell-inter**

Background: the following applicability was in RAN4#101-e-bis. However, for multiple CCs and/or multiple MOs cases are still open.

* *deriveSSB-IndexFromCell-inter* can only be configured if the SCS of SSB is the same between target cell and the serving cell which is used for SSB indexes derivation.
* *deriveSSB-IndexFromCell-inter* is applicable in both FR1 and FR2.

**Issue 4-2-1: whether deriveSSB-IndexFromCell-inter is applicable when multiple CCs are configured?**

* Option 1: yes. Restriction applies for the merged Measurement window in time domain among MOs. (Apple)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We think deriveSSB-IndexFromCell-inter is applicable when multiple CCs. This is similar with legacy gap interruption on different carriers.  |
| QC | Same view as Apple. |
| Intel | Yes |
| ZTE | Agree with Apple. |
| MTK | We think Option 1 is in the right direction but missing some details, e.g., how this affects to the serving CC with a different SCS. (Note that we limit the MO to have the same SCS to the reference CC, but not always the same to other CCs which are impacted.) Therefore, we suggest modifying Option 1 toRestriction applies to the serving cell symbols which partially or fully overlapped with the merged Measurement window in time domain among Mos. |

**Issue 4-2-2: whether deriveSSB-IndexFromCell-inter is applicable when multiple MOs are configured?**

* Option 1: yes. When multiple MOs are configured, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/TRS/CSI-RS for CQI on the union of SSB symbols to be measured from all MOs, and on 1 data symbol before each consecutive SSB symbols to be measured in the union and 1 data symbol after each consecutive SSB symbols to be measured in the union within SMTC window duration. When the boundary of the union doesn’t align with the serving carrier slot/symbol boundary, the partial overlapping symbol is counted towards the overlapping to the union as a whole symbol. (QC)
* Option 1a: yes. On each serving cell I, the scheduling restriction should apply on the union of the restricted symbols due to measurement on each MO j, j=1…J, where J is the number of MOs to be measured with NCSG. (HW)
	+ For measurement on each MO j, the restricted symbols on serving cell I, if applicable, include
	+ the symbols that fully or partially overlap with the measured SSB symbols plus 1 symbol before and after based on the timing of the time reference cell, if deriveSSB-IndexFromCell-inter is configured;
	+ all the symbols in the SMTC window, if deriveSSB-IndexFromCell-inter is not configured.

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Option 1 and 1a are similar in our view, which are both fine for us.  |
| QC | Same view as Apple, and could Huawei provides suggestions on capturing the updated scheduling restriction on our CR, if our proposed text missed anything from option 1a? |
| Intel | Both of them are fine. The exact wording can be done in CR. |
| ZTE | Fine with both of Option 1 and 1a. |
| MTK | Both Option 1 and 1a are fine, but it seems to assume that all MOs are indicated with deriveSSB-IndexFromCell-inter. We need to add a note for the case that there is an MO which is not indicated with deriveSSB-IndexFromCell-inter. The scheduling restriction of this MO will be all symbols in the SMTC. Therefore, after taking the union, the scheduling restriction is also all symbols in the SMTC. |

**Issue 4-2-3: whether deriveSSB-IndexFromCell-inter is applicable when SCS of SSB is different between target cell and the reference cell?**

* Option 1: yes, with △tless then 2 SSB symbol of target carrier (Apple)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | As elaborated in our contribution, we found deriveSSB-IndexFromCell-inter can also be used in diff SCS case, as long as △t can be guaranteed. Exact value can be discussed in issue 4-1.  |
| Intel | Same comments as 4-1 |
| ZTE | Same comments as 4-1 |
| MTK | Same comments as 4-1 |

**Issue 4-3: scheduling restriction regarding deriveSSB-IndexFromCell-inter**

* Option 1: (MTK)
	+ On the scheduling restriction during ML of NCSG, scheduling restriction on SSB symbols and 1 symbol before and after SSB symbols apply only if all following additional conditions are met, where the SSB considered above are indicated by the union set of SSB-ToMeasure from all MOs if SSB-ToMeasure is configured in all MOs; otherwise all SSBs are considered.
		- All NR MOs are indicated with deriveSSB-IndexFromCell-inter
		- All NR MOs have the aligned SMTC offset during NCSG and the same SMTC duration.
		- All NR MOs have the same SSB SCS with the serving cells
		- The frequency layers indicated in all NR MOs have the same time-domain SSB mapping pattern.
	+ In the case that scheduling restriction on SSB symbols and 1 symbol before and after SSB symbols does not apply, the scheduling restriction is on all OFDM symbols during ML of NCSG.

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We understand that these conditions can simply use case of deriveSSB-IndexFromCell-inter. However, not all conditions are necessary. For instance, SMTC duration, SCS and SSB mapping pattern don’t have to be the same, as long as restriction window is the union of SSB to measure from all MOs as under issue 4-2-2.  |
| Intel | Agree with Apple. The exact conditions can be FFS in the maintenance stage. |
| MTK | We are fine to postpone this to maintenance and try to work on how to merge the restricted symbols from different MOs.The thing we want to give everyone a heads-up is that spec allows a very flexible MO configurations, e.g., different SCS, SSB-ToMeasure, SSB mapping, SMTC offset and duration. |

**Issue 4-4: CSSF**

* Proposal 1: The frequency layers to be considered in the CSSF calculation of NCSG are the frequency layers that are in the band that UE can measure with NCSG and configured with the SMTC occasions fully or partially overlapped by NCSG. (MTK)
* Proposal 1a: For the frequency layer with NCSG capability reported by UE has the SMTC which is fully non-overlapped with ML of NCSG, this frequency layer should be removed from the CSSF within NCSG. (ZTE)
* Proposal 2: For defining CSSF within NCSG, re-use the same way as in CSSF within legacy MG for handling the overlapping between SMTC and NCSG. (HW)

Recommended WF:

Discussion is needed. Please be kindly reminded that they are different proposals rather than options, which are not mutual exclusive. Companies are encouraged to provide comments on each of them.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | All proposals are fine for us. Proposal 1 and 1a are similar in our view. Proposal 2 can cover proposal 1/1a but it seems quite high level. Companies can work on CR directly if companies have same understanding on the principle. |
| ZTE | All of them are similar, fine with them.  |
| MTK | All proposals are similar. We can handle this in the CR. |

**Issue 4-5: impact on L1 measurement in FR1**

* Option 1: For L1 measurement in an FR1 serving cell, NCSG should be considered in P factor NCSG, including VILs and ML, are overlapped with any of the RS for L1 measurement. (QC)
* Option 2: for L1 measurement in FR1, P = 1 provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement. (CMCC)
* Option 2a: For L1 measurement in an FR1 serving cell, NCSG is not to be considered in P factor provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement. (ZTE)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Analysis behind option 1 is valid for some UE implementation. However, it is different from the assumption when defining legacy requirements. Both option 2 and 2a are fine. We slightly prefer option 2 since the wording can be directly reused in the CR. |
| QC | We can compromise to option 2 or 2a. |
| Intel | Option 2 /2a |
| ZTE | Option 2/2a |
| MTK | Either Option 2 or 2a is fine. In our understanding, it is already endorsed in the CR in last meeting. The basic concept is to replace measurement gap in the legacy requirements by VIL for NCSG. Companies are encouraged to check and provide comments directly to CR. |

**Issue 4-6: impact on L1 measurement in FR2**

* Proposal 1: On the L1 measurement impact due to NCSG in FR2, additionally consider the overlapping with the SSB of the inter-frequency measurement objects to be measured within NCSG with common beamforming as serving cell(s). (MTK)
* Proposal 2: for L1 measurement in FR2, P is proposed as following: (CMCC)
	+ For the case that the target carrier is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP.
	+ For the case that the target carrier is inter-frequency carrier in different band as the serving cell, and UE is not capable of IBM, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP.
	+ For the case that the target carrier is inter-frequency carrier in different band as the serving cell, and UE is capable of IBM, P = 1 provided that VIL of NCSG is not overlapped with any of the RS for L1 measurement.
* Proposal 3: For FR2, two factors should be considered when determine whether L1 measurement impacted or not by RRM measurement within ML of NCSG: (ZTE)
	+ Whether L1 RS overlaps with VIL of NCSG
	+ Whether UE is capable of IBM
* Proposal 4: When NCSG is configured, an L1 RS occasion is considered as overlapped with NCSG if: (HW)
	+ it overlaps the VIL1 or VIL2 of NCSG, or
	+ it overlaps the ML of NCSG, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell.

Recommended WF:

Proposals are quite aligned. Moderator was trying to merge them. Please companies check if the following recommendation is agreeable:

When NCSG is configured and L1 RS occasion is NOT overlapped with NCSG, P = 1.

When NCSG is configured and L1 RS occasion is overlapped with NCSG, P is calculated in the same way as in Rel-15 with VIRP replacing legacy MGRP.

Note: An L1 RS occasion is considered as overlapped with NCSG if:

* it overlaps the VIL1 or VIL2 of NCSG, or
* it overlaps the ML of NCSG, and there exists a target carrier to be measured within NCSG that is intra-frequency carrier or inter-frequency carrier in the same band as the serving cell, or inter-frequency carrier in different band as the serving cell and UE does not support IBM between the target carrier and the serving cell.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | In our view proposals from companies are quite similar. We are fine with the recommended WF. |
| Intel | The recommended WF is fine for us. |
| ZTE | Generally fine with the recommended WF. |
| MTK | We are fine to take the recommended WF into the CR revision in 2nd round. |

### Sub-topic 5: others

**Issue 5-1: Whether to introduce a mapping table between legacy measurement gap patterns and corresponding NCSG patterns**

* Option 1: No (Apple, CATT, Intel, Nokia)
* Option 2: Yes (ZTE, HW, E///)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Maybe further clarification on the purpose of such mapping table can be helpful. According to offline discussion, some companies think the difference between option 1 and 2 is:For option 1, RAN4 needs to define a dedicated table for NCSG pattern (already captured in the endorsed CR in last meeting) and corresponding applicability (similar with Table 9.1.2-3). For option 2, existing gap pattern applicability can be reused with some modification, e.g. by adding some note to clarify it also applies to NCSG pattern with same index.If this is the case, we think both options can work. However, we still slightly prefer option 1 since RAN4 already endorsed a dedicated session for NCSG pattern and we think it is straightforward to capture NCSG pattern applicability in the same section.  |
| QC | To us option 1 and 2 as clarified by Apple seems very similar, and the only difference is the format of the description of the same requirement. Could proponents of option 1 and 2 clarify the difference? |
| Intel | Option 1. We are not sure the purpose of such mapping because they can be configured by NW independently. |
| vivo | Similar view with Apple’s clarification. We are ok with option 1 since option 2 can exist without any extra effort.  |
| ZTE | Fine with the agreements achieved in GTW. |

**Issue 5-2: if conclusion of issue 5-1 is “yes”, how to define the mapping table**

* Option 1: Mapping between legacy measurement gap patterns and corresponding NCSG is defined by relating their identifiers. (E///)
* Option 2: others

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | We prefer not to have such mapping. But if conclusion of issue 5-1 is “yes”, option 1 is OK. |

**Issue 5-3: UE feature list discussion on NCSG support**

* New capabilities proposed in this meeting

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between Ues (V2X WI only)”. | **Consequence if the feature is not onfigur by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| X-Y | Network controlled small gap (NCSG) | Support of per-FR NCSG  | X-1 | yes | no | UE cannot signal per-FR NCSG capability | per-UE | No | No |  |  | Optional with capability signalling |
| X-Y+1 | Network controlled small gap (NCSG) | Supported NCSG patterns | X-1 | yes | no | Network does not know whether some NCSG patterns can be onfigure to UE | per-UE | No | No |  |  | Optional with capability signallingNCSGpatterns #0, #1, [x, y, …] are conditional mandatory if UE support X-1 |
| X-Y+2 | Network controlled small gap (NCSG) | Supported NR-only NCSG patterns | X-1 | yes | no | Network does not know whether some NR-only NCSG patterns can be onfigure to UE | per-UE | No | No |  |  | Optional with capability signallingNCSGpatterns #0, #1, [x2, y2, …] are conditional mandatory if UE support X-1 |

* X-Y: Support of per-FR NCSG
	+ Option 1: support (QC)
	+ Option 2: not support

Recommended WF:

Moderator suggests companies discussing this under issue 3-2.

* X-Y+1: Supported NCSG patterns
	+ Option 1: support (CATT, QC, Apple, MTK)
	+ Option 2: not support
	+ Option 3: leave it to RAN2 (CATT)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1 considering this is a new R17 feature and having its own capability can increase flexibility. |
| QC | Support option 1. |
| Intel | Option 1 is fine for us. But we have a question: this feature is for NR UE only. What is the difference with X-Y+2 below. |
| OPPO | Option 1. |
| MTK | Support Option 1. |

* X-Y+2: Supported NR-only NCSG patterns
	+ Option 1: support (QC, MTK, Apple)
	+ Option 2: not support

Recommended WF:

Moderator suggests companies discussing this under issue 2-2.

**Issue 5-4: questions from RAN2 (R2-2201935)**

Whether to support simultaneous configurations on the following combinations?

* 1. NCSG FR1 gap + NCSG FR2 gap
		+ Option 1: yes (Apple, CATT, MTK, CMCC, OPPO, Intel, HW, Nokia)

Recommended WF:

RAN4 confirms NCSG FR1 gap + NCSG FR2 gap is supported.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support the recommended WF. |
| QC | Support the recommended WF. |
| Intel | Support the recommended WF. |
| OPPO | Support the recommended WF. |
| vivo | Support the recommended WF. |
| ZTE | Support the recommended WF. |
| MTK | Support the recommended WF. |

* 1. Legacy FR1 gap + NCSG FR2 gap
		+ Option 1: yes (Apple, CATT, MTK, CMCC, OPPO, Intel, HW)
		+ Option 2: not supported. (QC, Nokia)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support option 1. After reviewing proposals behind option 2, we think it may be misled by the wording in the endorsed CR:

|  |
| --- |
| 9.1.2C.2 Requirements applicabilityRequirements in clause 9.1.2C apply for UE capable of NCSG in standalone NR in both FR1 and FR2 (including FR1+FR2 CA), provided UE is configured with only NCSG and no other measurement gap is configured, and UE is configured with … |

If this is the case, we can update the wording in the CR. |
| QC | Can compromise to option 1 if it’s the majority from the first round discussion. |
| Intel | Option 1 |
| OPPO | Option 1 |
| vivo | Option 1 |
| ZTE | Option 1 |
| MTK | Option 1 |

* 1. Legacy FR2 gap + NCSG FR1 gap
		+ Option 1: yes (Apple, CATT, MTK, CMCC, OPPO, Intel, HW)
		+ Option 2: not supported. (QC, Nokia)

Recommended WF:

Discussion is needed.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Same comments as for 2) |
| QC | Can compromise to option 1 if it’s the majority from the first round discussion. |
| Intel | Option 1 |
| OPPO | Option 1 |
| vivo | Option 1 |
| ZTE | Option 1 |
| MTK | Option 1 |

* 1. One legacy perUE gap + one NCSG perUE gap
		+ Option 1: not supported without considering concurrent gaps. (QC, Apple, CATT, MTK, Intel, HW, Nokia)
		+ Option 1b: not considered in RAN4 requirement. But shall be supported in RRC design. (OPPO)
	2. One legacy perUE gap + NCSG FR1 gap
		+ Option 1: not supported without considering concurrent gaps. (QC, Apple, CATT, MTK, Intel, HW, Nokia)
		+ Option 1b: not considered in RAN4 requirement. But shall be supported in RRC design. (OPPO)
	3. One legacy perUE gap + NCSG FR2 gap
		+ Option 1: not supported without considering concurrent gaps. (QC, Apple, CATT, MTK, Intel, HW)
		+ Option 1b: not considered in RAN4 requirement. But shall be supported in RRC design. (OPPO)

Recommended WF:

Please companies check if both option 1 and option 1b are agreeable:

Regarding the following combinations:

* 1. One legacy perUE gap + one NCSG perUE gap
	2. One legacy perUE gap + NCSG FR1 gap
	3. One legacy perUE gap + NCSG FR2 gap

RAN4 confirms they are not supported from RAN4 requirement perspective. However, RAN4 will recommend RAN2 to support them in RRC design.

1st round Comment collection:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Support the recommended WF. |
| QC | If it’s not supported from RAN4 requirement perspective, we don’t think RRC signaling should support it. Suggest to keep the RAN4 requirement perspective part but don’t make recommendation for RRC design. |
| Intel | Support the recommended WF except the recommendation for RRC design which may mislead RAN2.  |
| OPPO | Firstly, we agree that these combinations are not supported from RAN4 RRM requirement perspective. For RRC design, the principle is that joint operation could be considered for forward compatibility. If companies have concerns on this part, we are also fine to leave it to RAN2, “the combinations (4)~(6) are not supported from RAN4 RRM requirement perspective. They may be considered in the next release. Whether these combinations are supported in RRC signaling design is up to RAN2” |
| vivo | Support “RAN4 confirms they are not supported from RAN4 requirement perspective”. Suggestion on RRC design seems unnecessary.  |
| ZTE | Fine with the recommended WF. |
| MTK | RAN4 can just mention the RAN4 requirement aspects to RAN2. Whether the RRC signaling should be introduced is already mentioned in a previous LS and it is already decided to be left to RAN2 |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2203716**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203716.zip)Qualcomm, Inc. | MTK: similar comment in the open issue. The CR seems to focus on only the case the all MOs are indicated with deriveSSB-IndexFromCell-inter. We also need to consider the case when some MO is not indicated with deriveSSB-IndexFromCell-inter. |
| [**R4-2203740**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203740.zip)Apple | QC: IE name should be TBD, and also pending sub-topic 4 discussionMTK: As commented in the open issue, we also need to know the tolerance in terms of the PDSCH SCS, which will be used as the foundation of scheduling restriction requirement. |
| [**R4-2203882**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203882.zip)CATT | QC: We noticed that requirement on inter-RAT NCSG is missing, and we added it to this version:<https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B219%5D%20NR_MG_enh_3/Round%201/R4-2203882%20Draft%20CR%20on%20measurement%20delay%20requirements%20with%20NCSG_QC.docx>Note that scheduling restriction is pending sub-topic 4 discussion and is not included.MTK: Question to QC. Could you remind us about the backgrounde for the following note in Table 9.4.1-2? “NOTE 3: This NCSG pattern is applicable for E-UTRA inter-frequency measurements only if NCSG based NR measurements are also configured.” And also which NCSG patterns are applicable to this NOTE 3 seems missing? |
| [**R4-2204060**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204060.zip)MediaTek inc. | QC: Pending issue 4-5,6 discussionMTK: We can update the CR according to the conclude in 4-5 and 4-6. |
| [**R4-2204294**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204294.zip)OPPO | QC:1. The ""UE can perform intra-….."" conditions should cover ""no-gap-with-no-interruption"", but not SMTC overlapping condition, and same for 9.3.1 change2. The NCSG and SMTC overlapping conditions are captured in subclauses like 9.2.5 and 9.3.9 as in R4-2203882, and no need to repeat in introductionMTK:Thanks for updating the CR. We think for intra-frequency, there are 3 measurement types that are considered in this NCSG work: deactivated SCell measurement, dormant SCell measurement and intra-frequency measurement with gap. Therefore, we suggest to use the following structure like below: (It is appreciated if company can help check whether there is any mistake below)

|  |
| --- |
| For intra-frequency measurements with gap,* if the UE indicates [‘no-gap’] via [TBD] for the band,
	+ if MG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped with the configured MG occasion, UE conducts the measurement within MG;
		- otherwise, UE conducts the measurement outside MG
	+ if NCSG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped with the configured NCSG occasion, UE conducts the measurement within NCSG;
		- otherwise, UE conducts the measurement outside NCSG
	+ If neither MG nor NCSG is configured by network
		- UE conducts the measurement without MG or NCSG
* if the UE indicates [‘ncsg’] via [TBD] for the band
	+ if MG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped or partially overlapped with the configured MG occasion, UE conducts the measurement within MG;
		- otherwise, UE does not conducts the measurement
	+ if NCSG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped or partially overlapped with the configured NCSG occasion, UE conducts the measurement within NCSG;
		- otherwise, UE does not conduct the measurement
	+ If neither MG nor NCSG is configured by network
		- UE does not conduct the measurement
* if the UE indicates [‘gap’] via [TBD] for the band
	+ if MG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped or partially overlapped with the configured MG occasion, UE conducts the measurement within MG;
		- otherwise, UE does not conduct the measurement
	+ otherwise, UE does not conduct the measurement

For deactivated SCell measurement and dormant SCell measurement,* + if MG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped with the configured MG occasion, UE conducts the measurement within MG;
		- otherwise, UE conducts the measurement outside MG
	+ if NCSG is configured by network,
		- if the SMTC occasions for the measurement are fully-overlapped with the configured NCSG occasion, UE conducts the measurement within NCSG;
		- otherwise, UE conducts the measurement outside NCSG
	+ If neither MG nor NCSG is configured by network
		- UE conducts the measurement without MG or NCSG
 |

The same structure of intra-frequency measurements with gap can be re-used for inter-frequency measurement with gap. Regarding some duplication with 9.2.5, we can handle this in the maintenance phase to figure out a cleaner way. We suggest to focus on the technical part in this meeting. |
| [**R4-2205373**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205373.zip)Huawei |  |
| [**R4-2206020**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206020.zip)Ericsson | QC: The highlighted part doesn't provide additional information, as it is obvious from the tables themselves. We suggest to remove it unless additional information is captured in the text.MTK: We do not see a very good motivation to add the highlighted part, either. As a compromise (in order to keep some record on how we agreed the patterns), maybe we can simply add a note in Table 9.1.2C-1 like “The NCSG patterns #0 to #23 in this table are derived from the gap patterns in Table 9.1.2-1 with the same repetition period and useful measurement time (MGL excluding RF switching time)”. Better wordings are welcomed. |
|  |  |
|  |  |
|  |  |

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **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)

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

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

Notes:

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

## 2nd round

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

Notes:

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

Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
|  |  |  |

Note:

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