**3GPP TSG RAN WG4 Meeting #99-e R4-21xxxxx**

**Electronic Meeting, May 19-27, 2021**

**Agenda item:** 9.10.2.1 & 9.10.2.3

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for [99-e][228] NR\_MG\_Part\_2

**Document for:** Information

# Introduction

The scope of this email discussion is UE RRM requirements for NR positioning from the following agenda items:

* AI 9.10.2.1 Pre-configured MG pattern
* AI 9.10.2.3 Network Controlled Small Gap

In providing comments, companies are encouraged to:

* Be concise
* Provide comments on all topics/sub-topics of interest
* Ensure that comments are inserted in the latest version of the document by checking the folder before uploading
* Use “Track changes” to help identify added comments/changes

# Topic #1: Pre-configured MG pattern(s)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2109098**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109098.zip) | CATT | **Proposal 1: Define the abbreviation of pre-configured measurement gap as Pre-MG.**  **Proposal 2: The pre-configured MG can be configured for CSI-RS L3 measurement and PRS measurement.**  **Proposal 3: The pre-configured MGs are not additionally configured per BWP.**  **Proposal 4: No additional ON/OFF bit is needed for the configuration of pre-configured MG.**  **Proposal 5: The initial status of pre-configured MGs is not fixed after it is configured.**  **Proposal 6: MG configuration can be changed after BWP switching but this case is not considered in pre-configured MG pattern requirements.**  **Proposal 7: The pre-configured MG is the same as RRC configured MG after it is activated.**  **Proposal 8: Whether the deactivated pre-configured MG and the RRC configured MG can be configured simultaneously needs to be studied.**  **Proposal 9: The pre-configured MG can be activated/deactivated autonomously triggered by condition change.**  **Proposal 10: The pre-configured MG being activated/deactivated is also controlled by NW.**  **Proposal 11: No separated activation/deactivation delay is needed for the pre-configured MG.**  **Proposal 12: The measurement period for the measurement with pre-configured MG can reuse the current requirement with measurement gap in R16.**  **Proposal 13: No need to define the maximum number of transition between gapless and gap-based measurement procedures during ongoing measurements.**  **Proposal 14: UE can be scheduled during the pre-configured gaps while meeting existing scheduling restriction requirements defined in TS 38.133 if the pre-configured MG is not activated.**  **Proposal 15: The joint discussion with multiple gap patterns should be considered after each item is stable.**  **Proposal 16: The existing gap patterns (0~25) in Rel16 can be reused for the pre-configured MG.** |
| [**R4-2109180**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109180.zip) | MediaTek inc. | **Proposal 1: When pre-configured gap is used for PRS measurement, UE assumes the pre-configured gap is always activated (ON). In other words, the pre-configured gap falls back to the legacy gap**  **Proposal 2: When pre-configured gap is configured together with CSI-RS based L3 measurement, UE assumes the pre-configured gap is always activated (ON). In other words, the pre-configured gap falls back to the legacy gap**  **Proposal 3: Do not consider BWP-specific pre-configured MG. The gap configuration is unchanged after BWP switching.**  **Proposal 4: Introduce a single bit for existing MeasGapConfig to transform the legacy gap into pre-configured gap (detail to be left to RAN2).**  **Proposal 5: Do not introduce any default value nor any additional network indication for the initial state of pre-configured gap. Whether pre-configured MG activated or not depends on whether SSB to be measured is within the active BWP or not.**  **Proposal 6: The pre-configured gap should be active (ON) if UE is configured with any MO that needs to be measured with gap, including inter-frequency MO, inter-RAT MO or any intra-freq MO with SSB not within UE’s active BWP. Only if none of the above conditions is fulfilled, the pre-configured gap should be de-active (OFF).**  **Proposal 7: UE should autonomously re-check whether to switch the status of pre-configured gap right upon finishing the following network commands and procedures: BWP switching, adding/removing any measurement object(s), activating/de-activating any SCell(s).**  **Proposal 8: Additional validation time [20ms] is needed after BWP switch for UE to activate or de-activate the pre-configured gap.**  **Proposal 9: Re-start the measurement period after each activation/de-activation of the pre-configured gap. It is up to UE whether to reuse any measurement samples prior to activation/de-activation to trigger a measurement event.**  **Proposal 10: Gap patterns #24 and #25 are not used for pre-configured gap.** |
| [**R4-2109228**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109228.zip) | Intel Corporation | **Observation 1**: **The gap for PRS measurement shall be activated after being configurated no matter where UE active BWP is. That is the pre-configured MG for PRS measurement is unnecessary.**  **Observation 2:** **The pre-MG for PRS measurement is infeasible because it is independent with BWP switching.**  **Observation 3**. **The pre-MG can be helpful to reduce MG configuration delay for CSI-RS measurement significantly.**  ***Proposal 1: The pre-MGs can be applied to SSB, CSI-RS measurement only in Rel17.***  **Observation 4:**  **If we defined the per-UE or per-BWP MGs based on the applicability of MGs (assuming these MGs being activated) same as we did in Rel16, the pre-MG shall be per-UE or per-FR instead of per-BWP.**  **Observation 5: There are much higher standardazation works loading increased if the pre-MG is based on per-BWP**.  ***Proposal 2: The pre-MGs shall be per-UE or per-FR.***  **Observation 6: It is feasible to include both common and specific parameters for the pre-MG in the legacy MG configuration IE which can minimize standardization impacts.**  **Observation 7**. **MG configuration changed after BWP switching will extend the initial WI objects.**  ***Proposal 3: RAN4 shall only focus on the case of MG unchanged after BWP switching in Rel17.***  **Observation 8: BWP switching is one of necessary conditions for pre-configured MG’s activation.**  **Observation 9: Both UE and NW have the same understanding on the needs on the measurement gap for the measurements after BWP switching**.  ***Proposal 4***: ***It is feasible and efficient with autonomously/implicitly activation for preconfigured MG triggered by DCI/Timer based BWP switching.***  ***Proposal 4a***: ***It is feasible and efficient with autonomously/implicitly activation for preconfigured MG triggered by DCI/Timer based BWP switching and under NW preconfigured indications.***  **Observation 10:** **The activation delay for pre-configured MGs shall include the BWP switching delay at least**.  ***Proposal 5: RAN4 needs NOT to define the separated activation delay requirements for the pre-configured MG activation unless the BWP switching time is shorter than “gap transition time”.***  ***Proposal 6a: The RAN4 minimum requirements for intra-frequency SSB measurement can follow that of intra-frequency SSB measurement requirements with gap specified in*** *9.2.6* ***of TS38.133 [3].***  ***Proposal 6b: The RAN4 minimum requirements for intra-frequency SSB measurement and CSI-RS measurement with pre-configured MG can follow that of intra-frequency SSB measurement requirements with gap specified in*** *9.2.6* ***of TS38.133 [3] and inter-frequency CSI-RS measurement requirements specified in*** *9.10.3* ***of TS38.133 [3] respectively.***  ***Proposal 7: The same scheduling restriction in Rel16 [4] when preconfigured MG configured can be appliable.***  **Observation 11: The same RF switching time when considering pre-configured gap pattern as the legacy gap patterns in NR [3] can be reused.**  **Observation 12: MGL of the pre-configured gap patterns can also rely on the measurement type (e.g.** SSB or CSI-RS).  **Observation 13: The shorter MGL can be considered because of the perfect synchronization of measured BWP.**  ***Proposal 8 :* *The existing gap patterns in Rel16 [3] can be reused for the pre-configured MG depending on the configuration of the targeted measurements reference signal.*** |
| [**R4-2109252**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109252.zip) | Xiaomi | **Proposal 1: The pre-configured MG shall be configured for CSI-RS L3 measurement.**  **Proposal 2: The pre-configured MG shall not be configured for PRS measurement.**  **Proposal 3: it is not expected the pre-configured MGs can be configured per BWP.**  **Proposal 4: UE is indicated the gap-required MO group and gap-less MO group per BWP.**  **Proposal 5: For the active BWP, the pre-configured MG should be activated by default to the MO(s) required pre-configured MG and should be deactivated by default to the MO(s) without pre-configured MG.**  **Proposal 6: The pre-configured MG configuration shall be the same after the active BWP switching.**  **Proposal 7: The pre-configured MG can be activated/deactivated autonomously triggered by DCI/Timer based BWP switching.**  **Proposal 8: No need to define separate activation/deactivation delay requirement for pre-configured MG activation/deactivation.**  **Proposal 9: If there is one or more transitions between gap-based and gapless measurement during one measurement period, the relaxed measurement requirement shall be applied.** |
| [**R4-2109313**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109313.zip) | Apple | **Proposal 1: the assumption in R16 that PRS shall be measured within MG shall not be changed in this WI.**  **Proposal 2: as long as the Pre-MG is active, it can be used for PRS measurement. If the Pre-MG becomes deactivated due to BWP switch, UE is not required to meet PRS measurement requirements.**  **Observation 1: as long as the Pre-MG is active, it can be used for inter-frequency CSI-RS measurement. However, under R16 CSI-RS L3 measurement structure it is unlikely that CSI-RS measurement would become inter-frequency measurement from intra-frequency measurement (vice versa) after DCI or timer-based BWP switching.**  **Proposal 3: RAN4 can consider per-BWP MG configuration in the 2nd phase.**  **Proposal 4: introduce a flag to indicate whether the pre-configured MG is ON or OFF when that BWP becomes active.**  **Proposal 5: if the flag is ON, then the Pre-MG shall be considered as activated without additional activation delay after configuration. Otherwise, it is deactivated.**  **Proposal 6: NW can fully control the pre-configured MG being activated/deactivated.**  **Proposal 7: pre-configured MGs can be activated/deactivated autonomously triggered by BWP switching DCI/timer but explicitly directed according to the pre-configured ON/OFF state/bit for the target BWP.**  **Proposal 8: if similar minimum requirement at transitions is agreed, i.e. measurement period follows the longer one before and after BWP switching, then it may not be necessary to define N1,max and N2,max.**  **Proposal 9: it is feasible to consider MG pattern #24 and #25 for Pre-MG pattern. The use case can be once UE needs to perform PRS measurement, NW shall switch the UE to the BWP configured with MG pattern #24 or #25. After PRS measurement is done, NW can switch the UE back to the BWP configured with no MG.** |
| [**R4-2109517**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109517.zip) | CMCC | Using scenarios  *Observation 1: In Rel-16 CSI-RS based L3 measurement, only intra-frequency without MG and inter-frequency with MG is considered.*  ***Proposal 1: if pre-configured MG is used for CSI-RS L3 measurement, the pre-configured MG will remain activated when there is CSI-RS based inter-frequency measurement.***  ***Proposal 2: if pre-configured MG is used for CSI-RS L3 measurement, the pre-configured MG will remain deactivated when there is only CSI-RS based intra-frequency measurement.***  *Observation 2: PRS is assumed to be measured in measurement gap in Rel-16.*  ***Proposal 3: if pre-configured MG is used for PRS measurement, the pre-configured MG will remain activated when there is PRS measurement.***  Activation/deactivation of pre-configured MG  ***Proposal 4: if the use case of MG pattern change following BWP switch is not considered, this autonomously/implicitly triggered way is a good way to move forward. But considering that whether MG is needed or not is also related with the MOs, it is better to specify a clear rule on the activation/deactivation of MG so that NW and UE share the same understanding on the usage of pre-configured MG.***  ***Proposal 5: If the use case of MG pattern change following BWP switch is considered, since the selection of MG pattern depends on the SMTC (or CSI-RS) of measurement objects measured in MG and different UE may have different implementation, the autonomously/implicitly triggered way may be not suitable. The better way is to activate/deactivate the pre-configured MG by the network indication.*** |
| [**R4-2109614**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109614.zip) | vivo | **Proposal 1: For each individual BWP, when it is active, whether the pre-configured MG should be activated or deactivated, i.e., the activated/deactivated status of the pre-configured gap, is fully determined by the network and could be forward to UE through corresponding signalling.**  **Proposal 2: It is not necessary to configure pre-configured MGs for each BWP.**  **Proposal 3: The pre-configured MG is deactivated when the bandwidth of all MOs are within the bandwidth of this BWP. The pre-configured MG is activated for this BWP when the bandwidth of any one MO are out of the bandwidth of this BWP.**  **Proposal 4: Suggests to use one bit or few bits per BWP to indicate whether the pre-configured MG is ON or OFF when that BWP is active. When that BWP is inactive, the indication through bits is neglected.**  **Proposal 5: The initial status of a pre-configured MG for a particular BWP should be jointly determined by the active/inactive status of that BWP and the ON/OFF indication carried by bits/signallings during pre-configured MG configuration.**  **Proposal 6: the pre-configured MG configuration is changed through RRC reconfiguration procedure and will not be changed after a BWP switching.**  **Proposal 7: the condition to activate/de-activate the Pre-configured MG is BWP switch, use option 1a to determine on how pre-configured MGs can be activated/deactivated** |
| [**R4-2109730**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109730.zip) | Qualcomm CDMA Technologies | **Proposal1: RAN4 shall strive to agree on a basic version of configuration and (de)activation mechanism for pre-configured MG.**  **Proposal2: A basic pre-configured MG’s configuration features one MG pattern which can be per-UE or per FR.**  **Proposal2.1: A basic pre-configured MG’s pattern may optionally be the same as the pattern of the legacy MG.**  **Proposal2.2: A basic pre-configured MG’s configuration shall also include a per BWP level status/state indication on whether the MG pattern is enabled by default for a candidate BWP.**  **Proposal3: whether pre-configured MG is active for the current BWP is pre-determined to UE upon the completion of RRC configuration by the network.**  **Proposal4: Only the gap status can change between active and in-active for a basic version of the pre-configured MG.**  **Proposal5: A basic pre-configured MG doesnot support changing the gap status in an implicit way.**  **Proposal5.1: RAN4 may not need to discuss the conditions of (de)activation for the basic pre-configure GAP and how UE uses it can follow the existing RAN4 spec.**  **Proposal5.2: The change of the pre-configured MG status is triggered by the BWP switch and pre-configured under the control by the NW via RRC configuration.** |
| [**R4-2109759**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109759.zip) | ZTE Corporation | **Observation 1: How to deal with the relation of pre-configured MG with current legacy MG, which can be de-prioritized by other important issues.**  **Proposal 1: It’s unnecessary to configure pre-configured MGs per BWP.**  **Proposal 2: It is reasonable that Whether pre-configured MG activated or not depends on whether reference signal to measure is within the active BWP or not.**  **Proposal 3: Option 2 can be a starting point, but whether and how to transform an legacy MG into pre-configured MG should be further studied.**  **Proposal 4: The existing gap pattern #0~23 in Rel 16 can be reused for pre-configured MG.** |
| [**R4-2109894**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109894.zip) | NEC | **Proposal 1: RAN4 to agree “Pre-MG” as the unified abbreviation of pre-configured measurement gap.**  **Proposal 2: Pre-configured MG shall not be configured for PRS measurement and CSI-RS L3 measurement.**  **Proposal 3: RAN4 to agree that Pre-configured MGs are additionally configured per BWP.**  **Proposal 4: RAN4 to agree that pre-configured MG is activated/deactivated autonomously/implicitly with BWP switching**  **Proposal 5: RAN4 to agree that delay of MG (de)activation is same as that of BWP switching.** |
| [**R4-2110064**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110064.zip) | OPPO | **Proposal 1: Pre-configured MG shall be also allowed to be configured for CSI-RS L3 measurement.**  **Observation 1: Assuming pre-configured MGs can be configured per BWP, two options are suggested:**   * **Option 1: all BWPs in one CC are associated with 1 set of MG configuration (i.e., 1 MG pattern), when per-configured MG is not considered for multiple concurrent gaps.** * **Option 2: each or subset of BWPs in one CC are associated with 1 set of MG configuration (i.e., 1 MG pattern), when per-configured MG is considered as part of multiple concurrent gaps.**   **Observation 2: MG configuration can be changed after BWP switching, if per-configured MG is considered as part of multiple concurrent gaps.**  **Proposal 2：Pre-configured MGs can be additionally configured per BWP.**  **Observation 3: If per-configured MG is not considered for multiple concurrent gaps, prefer whether per-configured MG is activated or not for one BWP can be implicitly triggered by BWP switching,**   * **e.g., per-configured MG is “not activated by default” until being activated along with BWP switch/activation.**   **Proposal 3: Prefer default status of ‘Not activated’ for pre-configured MG.**  Observation 4: UE behavior should be clarified after deactivation of pre-configured MG and switching to a new BWP without any per-configured gap.  Proposal 4: For UE behavior after deactivation of pre-configured MG,   * **Option 1: UE shall perform measurement without gap.** * **Option 2: UE shall perform measurement with legacy gaps.** * **Option 3: UE shall perform measurement with a default gap through immediate activation.**   **Proposal 5: The existing gap patterns (0~23) in Rel16 can be reused for the pre-configured MG.**  **Proposal 6: No separated activation delay for the pre-configured MG activation/deactivation.** |
| [**R4-2110269**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110269.zip) | Nokia, Nokia Shanghai Bell | 1. In NR Rel-15, RRC signalling for configuring and activating measurement gaps has been used due to signalling robustness. 2. Errors in measurement gap configuration can have significant negative UE and system impact. 3. It is important that changes in the measurement gaps are signalled in a robust way. 4. DCI formats 0-1, 0-2, 1-1 and 1-2 need to be investigated for inclusion of information bits related to (de-)activation of pre-configured MGs and for associated signalling robustness.   Following proposals are made, which we see necessary to be considered in the discussion to ensure that a practically usable feature will be developed:   1. a) The use case scenarios for pre-configured MGP include measuring intra-/inter-frequency SSB and additionally at least measuring PRS and CSI-RS L3.   b) It may even include inter-RAT measurements.   1. The procedures for configuration and (de-)activation of pre-configured MG patterns are designed such to support both single MGP and multiple concurrent MGPs. 2. Existing RRC signalling message (i.e. RRC reconfiguration command) shall be extended to configure a single or multiple pre-configured MGPs per BWP used for per-UE or per-FR gap support. 3. Pre-configured MG(s), configurable per-UE and per-FR, can additionally be configured per BWP. 4. When pre-configured MG patterns are configured via RRC signalling, they are not activated at the same time of configuration, hence remain inactive. 5. Signalling for activation / deactivation of a pre-configured MG pattern is based on explicit activation/deactivation command. 6. RAN4 to consider the robustness of the mechanisms for activation and deactivation of MG pattern when they do not use RRC signalling. 7. RAN4 need to account for robustness of the measurement gap changes when evaluating and agreeing on explicit activation/deactivation of MG pattern(s) without using RRC signalling. 8. MGP change delay shall be evaluated based on realistic latencies. 9. No additional separate delay is needed for activating a preconfigured MGP. 10. No separate additional delay is needed for deactivating a preconfigured MGP. 11. Robustness shall be evaluated including the final signal loss probability. 12. Analyse and evaluate, under realistic assumption, the possible impact on ongoing cell detection from a change in MGP. 13. Analyse and evaluate, under realistic assumption, the possible impact on the latency of ongoing measurements from a change in MGP. 14. RAN 4 to define procedures for pre-configured MG pattern support, which provide flexibility and full network control related to MG pattern usage. 15. Consider sharing of MG patterns using a MG pattern pool for specifying the configuration of pre-defined MG patterns. 16. RAN4 to consider MG patterns #0-#25 for use as pre-configured MG pattern. 17. RAN4 not to specify maximum number of transitions between gapless and gap-based measurement procedures for ongoing measurements. 18. Scheduling restrictions in TS 38.133, clause 9.2.5.3 apply in case the UE does not require pre-configured or legacy measurement gaps. 19. RAN4 to use the abbreviation Pre-MG for pre-configured measurement gaps in TS 38.133. |
| [**R4-2110911**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110911.zip) | Huawei, HiSilicon | **Proposal 1: No need to restrict the use of pre-configured MG with PRS or CSI-RS measurements. How to handle PRS and CSI-RS measurements with pre-configured MG can be left to NW and/or UE implementation.**  **Proposal 2: Pre-configured MGs is not additionally configured per BWP.**  **Proposal 3: On top of common configuration parameters as Rel-16 MG configuration, NW also configures the following new parameters for pre-configured MG**   * **A flag to indicate whether the MG is used as pre-configured MG or not** * **Status (activated or deactivated) of the pre-configured MG**   **Proposal 4: Status (activated or deactivated) of pre-configured MG is not fixed after configuration.** **NW configures the status when pre-configured MG is configured.**  **Proposal 5: RAN4 to support ON/OFF of the pre-configured MG. Changing of MG configuration following a BWP switching is not considered.**  **Proposal 6: Network can transform a pre-configured MG into legacy MG or vice versa with same MG configuration.**  **Proposal 7a: RRC reconfigurations of MO or serving cell are not considered as triggering event for activation or deactivation of pre-configured MG, but the status of pre-configured MG should be configured by the NW.**  **Proposal 7b: For SCell activation and deactivation, FFS**   * **Option A: SCell activation and deactivation is considered as triggering event for activation or deactivation of pre-configured MG** * **Option B: NW indicates the status of pre-configured MG after SCell activation and deactivation**   **Proposal 8: Pre-configured MG is implicitly activated and deactivated based on the triggering events.**  **Proposal 9: Adopt the following criteria for activation and deactivation of pre-configured MG:**   * **If MG is not required by any of the configured measurements, the MG is deactivated.** * **If MG is required by one or more of the configured measurements, the MG is activated.**   **Proposal 10: The delay of activation and deactivation of pre-configured MG is defined as BWP switching delay plus *Delta*.** **The value of *Delta* can be FFS.**  **Proposal 11: Activation and deactivation of pre-configured MG takes effect from the first MG occasion after the activation and deactivation delay.**  **Proposal 12: The transition requirements defined in clause 9.1.6 apply also with pre-configured MG.**  **Proposal 13: RAN4 not to define limit on the maximum number of transitions (between MG based and MG-less measurement) during the measurement period.**  **Proposal 14: Existing scheduling restriction for RRM measurement without MG applies when pre-configured MG is deactivated.**  **Proposal 15: Defer the discussion on multiple pre-configured MGs with concurrent MGs when requirements for pre-configured MG and concurrent MGs are stabilized.**  **Proposal 16: The existing gap patterns (0~25) in Rel-16 can be reused for the pre-configured MG.** |
| [**R4-2111311**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2111311.zip) | Ericsson | **Pre-configured MG terminology:**   * **Observation # 1**: P-MG is more compact abbreviation than Pre-MG for the pre-configured measurement gap pattern. * **Proposal # 1**: P-MG is used as an abbreviation for the pre-configured measurement gap pattern.   **Measurement scenarios for P-MG:**   * **Observation # 2**: PRS measurements are always done in measurement gaps. * **Proposal # 2**: In the first phase of the WI the pre-configured gap pattern is configured ONLY for SSB based measurements. * **Proposal # 3**: The pre-configured gap pattern for CSI-RS based L3 measurements can be considered during the second phase of the WI.   **P-MG configuration procedure:**   * **Proposal # 4**: Status of the P-MG can be changed between activation and deactivation by any configured BWP. * **Proposal # 5**: Do not define any flag per BWP to indicate whether the pre-configured MG is ON or OFF when that BWP becomes active.   **P-MG status upon and after RRC configuration:**   * **Observation # 3**: Default or fixed pre-configured measurement gap pattern (P-MG) status (activated or deactivated) is not efficient. * **Observation # 4**: There is no benefit of changing MG configuration after BWP switching and change in MG configuration will even adversely affect the scheduling in the network. * **Observation # 5**: There is no benefit of changing MG configuration after BWP switching and change in MG configuration will even adversely affect the scheduling in the network. * **Proposal # 6**: Support options 3, 3a and 3b i.e.   + Status of pre-configured MG is not fixed (no default status):   + Whether pre-configured MG activated or not depends on whether reference signal to measure is within the active BWP or not.   + Network signals the status (activated or deactivated) when pre-configured MG is configured * **Proposal # 7**: P-MG configuration cannot be changed after the BWP switching. * **Proposal # 8**: On relation of P-MG and with the current RRC configured MG we support all the following possibilities:   + The already configured P-MGP is transformed into legacy MGP (with same MGL/MGRP) if the UE is configured to measure on any carrier (e.g. inter-RAT) which always need gaps for performing the measurement.   + Network can transform an already configured P-MGP into legacy MGP with same MGL/MGRP or vice versa without deconfiguring the P-MGP   + Deconfigure P-MG and reconfigure legacy pattern if P-MG is not suitable for MO configuration e.g. inter-RAT, PRS etc.   **P-MG activation/deactivation procedure:**   * **Observation # 6**: The UE needs gaps to measure SSBs when the measured SSB is not fully within the BW of the active BWP. Otherwise the UE can measure the SSBs without gaps. This change between gap based and gapless measurement is triggered by active BWP switching. * **Proposal # 9**: P-MG is autonomously/implicitly triggered by DCI/Timer based BWP switching. * **Proposal # 10**: The P-MG is considered as activated by the UE and gNB if the BW of the active BWP (after the switching) does not fully contain the BW of the SSB(s) to measure. * **Proposal # 11**: The P-MG is considered as deactivated by the UE and gNB if the BW of the active BWP (after the switching) fully contains the BW of the SSB(s) to measure.   **RRM requirements: activation/deactivation delay:**   * **Observation # 7**: Transition time for switching between gap-based measurement (activated state) and gapless measurement (deactivated state) is needed by the UE to adapt to the new measurement procedure after the active BWP switching e.g. since measurement sampling may be different in the two procedures * **Observation # 8**: Transition time for switching between gap-based measurement (activated state) and gapless measurement (deactivated state) is needed the gNB to adapt to scheduling after the active BWP switching e.g. complete on going scheduling in gaps or start scheduling in gaps. * **Observation # 9**: The need for the activation/deactivation delay becomes even more critical when BWP switching occurs shortly before the occurrence of the gap e.g. for shorter MGRP. * **Proposal # 12**: The activation/deactivation of the P-MG needs activation/deactivation delay, which needs to be specified. Actual value of the delay is FFS.   **RRM requirements: measurement period:**   * **Observation # 10**: The delay requirements in section 9.1.6, TS 38.133 for transitions from measurements performed outside gaps to measurements performed within gaps or vice versa does not account for any time to configure the measurement gaps e.g. when switching from gapless to gap-based measurement. * **Observation # 11**: The requirements in section 9.1.6, TS 38.133 apply when the UE is already configured with gaps for certain measurement but after the BWP switching the UE starts using the same gaps also for measurement which was being performed without gaps before the BWP switching. * **Proposal # 13**: The total measurement period Tmeasure, total) to account for transition between activation and deactivation of the P-MG during the measurement needs to be specified. * **Proposal # 14**: Total measurement period (Tmeasure, total) can be expressed in terms of basic measurement period (Tmeasure, basic) and aggregated time consumed due to total number of transitions between gapless measurement procedure and gap-based measurement procedure during the ongoing measurement. * **Proposal # 15**: In proposal 8, Tmeasure, basic can be expressed as: Tmeasure, basic = MAX(TBWP, TG); where:   + TBWP= It is the measurement period when the measurement is fully performed without measurement gap   + TG= It is the measurement period when the measurement is fully performed with measurement gap.   **RRM requirements: Number of transitions during measurement period:**   * **Observation # 12**: Too frequently switching between activation and deactivation of P-MG may lead to measurement instability and may also not give gNB enough opportunity to adapt scheduling. * **Proposal # 16**: Prefer to define maximum number of transitions but no limit on the transition is also acceptable.   **RRM requirements: scheduling restriction requirements:**   * **Proposal # 17**: We support options 1 and 1a on scheduling restriction i.e.   + If the UE is measuring without pre-configured gaps and no other frequency layer, which needs gaps is configured, then the UE can be scheduled during the pre-configured gaps while meeting existing scheduling restriction requirements defined in TS 38.133.   + Existing scheduling restriction for RRM measurement without MG applies when pre-configured MG is deactivated.   **RRM requirements: UE behavior after deactivation:**   * **Proposal # 18:** After P-MG is deactivated the UE shall measure without causing any interruption and shall be able to receive and transmit in the serving cell in all the slots even within MGL of P-MG.   **Gap patterns for P-MG:**   * **Observation # 13**: The MGP # 24 and # 25 are used when the UE is configured with positioning measurements, which always need gaps. * **Proposal # 19**: The existing gap patterns (0~23) in Rel16 can be reused for the pre-configured MGP. |

## Open issues summary and companies views’ collection for 1st round

**[***Moderator Notes: In the last meeting, the basic procedures to use the preconfigured MG for UE measurement was agreed as:*

*Therefore, in this meeting we can focus on the issues of using scenario and configuration/activation procedures of pre-configured MG below.]*

### Sub-topic 1-0 Definition and using scenarios for Pre-configured measurement gap

#### **Issue#1-0-1-1 Whether is the pre-configured MG needed for PRS measurement?**

* Option 1 (CATT, Apple, Huawei, Nokia): Yes
* Option 2(Intel, Ericsson, xiaomi, , NEC): No
* Option 3(MTK): When pre-configured gap is used for PRS measurement, UE assumes the pre-configured gap is always activated (ON). In other words, the pre-configured gap falls back to the legacy gap

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| **Company** | **Comments** |
| Huawei | Option 1.  When UE is configured with PRS measurement, pre-configured MG can be always activated, or be transformed to legacy MG. We do not the reason to define any restriction in the spec. |
| CMCC | Option 1. Different from SSB based measurement, as mentioned in our contribution, if pre-configured MG is used for PRS measurement, the pre-configured MG will remain activated when there is PRS measurement. |

#### **Issue#1-0-1-2 Whether is the pre-configured MG needed for CSI-RS L3 measurement?**

* Option 1 (CATT, Intel, Apple, Huawei, Nokia, xiaomi, OPPO): Yes
* Option 2 (Ericsson, ,NEC): No
* Option 3 (MTK): When pre-configured gap is configured together with CSI-RS based L3 measurement, UE assumes the pre-configured gap is always activated (ON). In other words, the pre-configured gap falls back to the legacy gap

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| **Company** | **Comments** |
| Huawei | Option 1.  Similar as above issue, when UE is configured with inter-freq CSI-RS measurement, pre-configured MG can be always activated, or be transformed to legacy MG. We do not the reason to define any restriction in the spec. |
| CMCC | Option 1. Different from SSB based measurement, as mentioned in our contribution, if pre-configured MG is used for CSI-RS L3 measurement, the pre-configured MG will remain activated when there is CSI-RS based inter-frequency measurement. If pre-configured MG is used for CSI-RS L3 measurement, the pre-configured MG will remain deactivated when there is only CSI-RS based intra-frequency measurement. |

### Sub-topic 1-1 Configuration for Pre-configured measurement gap

#### **Issue 1-1-1: Whether can pre-configured MGs be additionally configured per BWP**

* Option 1 (Nokia, NEC, OPPO). Yes.
* Option 2 (Intel, CATT,MTK, Huawei, vivo,xiaomi, ZTE). No
* Option 2a (Apple): RAN4 can consider per-BWP MG configuration in the 2nd phase.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2.  Configuring pre-configured MG per BWP will cause unnecessary complexity for NW, and it may not work when UE is configured with CA. |
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#### **Issue 1-1-2: Specific parameters needed for pre-configured MG when being configured**

**[***Moderator Notes: In the last meeting, the basic procedures to use the preconfigured MG for UE measurement was agreed as:*

* + The common configuration parameters of pre-configured MG (e.g. MGRP, MGL, etc) which are same as these of Rel16 legacy MG can be configured by the similar way as the Rel16 legacy MGs
  + FFS on the specific configuration parameters for the new aspects of pre-configured MG to be introduced,
    - One single bit (or flag) per BWP to indicate whether the pre-configured MG is ON or OFF when that BWP becomes active
    - Others are not precluded.

*Therefore, in this meeting we can focus on the question below.*

* *What the specific parameters shall be introduced into configurations message for the pre-configured MG ?*

*Companies can provide your views on this question. And multiple parameters can be needed.]*

* Option 1 (Qualcomm, Apple, MTK, Intel, vivo). One single bit (or flag) per BWP to indicate whether the pre-configured MG is ON or OFF when that BWP becomes active
* Option 1a(Huawei) One single bit (or flag) per UE or per FR to indicate whether the pre-configured MG is ON or OFF
* Option 2 (MTK, Huawei, Intel): A single bit for existing MeasGapConfig to indicate the pre-configured gap
* Option 3(Xiaomi) UE is indicated the gap-required MO group and gap-less MO group per BWP
* Option 3(CATT, Ericsson): No any specific configuration parameters

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2 and optionally option 1a.  Option 2 is needed because NW and UE need to have common understanding on whether a configured MG is used as pre-configured MG (can be activated and deactivated) or as legacy MG (always activated).  Option 1a may also be needed, or alternatively RRC reconfiguration of pre-configured MG is considered as a condition to trigger activation and deactivation. |
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#### **Issue 1-1-3 Whether is the pre-configured MG activated or not after configuration completed?**

* Option 1 (Nokia, OPPO) : Not activated by default until being activated.
* Option 2 (CATT, Ericsson): Status of pre-configured MG is not fixed (no default status):
* Option 3a (MTK, Ericsson, xiaomi, ZTE): Whether pre-configured MG activated or not depends on whether reference signal to measure is within the active BWP or not.
* Option 3b(Intel, Apple, Qualcomm, Huawei, Ericsson, vivo): upon the RRC configuration by the network.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 3a or option 3b. |
| CMCC | Option 2, no need to specify the default status. In our understanding, option 3a and option 3b can also be understood that there is no default status.  Option 3a follow the approach of implicitly indication of activation/deactivation, whether the pre-configured MG activated or not depends on whether reference signal to measure is within the active BWP or not, which means there is no default status.  Option 3b follow the approach of explicitly indication of activation/deactivation from network, whether the pre-configured MG activated or not depends on network indication, which means there is no default status. |
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#### **Issue 1-1-4 Whether can MG configuration be changed after BWP switching?**

* Option 1 (MTK, Intel, Qualcomm, Huawei, Ericsson, vivo, xiaomi) : No
* Option 2(CATT): Yes

Recommended WF: Check whether Option 1 can be agreed.

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| **Company** | **Comments** |
| Huawei | Option 1. |
| CMCC | We do not have strong preference. Just suggest companies can reach consensus on whether to consider MG pattern change after BWP switching, since it may have impact on other issues, i.e. the mechanism of activation/deactivation of P-MG. |

#### **Issue 1-1-5 Relation of pre-configured MG and with the current legacy MG**

* Option 1. (CATT):
  + The pre-configured MG is the same as RRC configured MG after it is activated.
  + Whether the deactivated pre-configured MG and the RRC configured MG can be configured simultaneously needs to be studied
* Option 2a (Ericsson, ZTE)
  + The already configured P-MGP is transformed into legacy MGP (with same MGL/MGRP) if the UE is configured to measure on any carrier (e.g. inter-RAT) which always need gaps for performing the measurement.
  + Network can transform an already configured P-MGP into legacy MGP with same MGL/MGRP or vice versa without deconfiguring the P-MGP
  + Deconfigure P-MG and reconfigure legacy pattern if P-MG is not suitable for MO configuration e.g. inter-RAT, PRS etc.
* Option 2b (Huawei):
  + Network can transform a pre-configured MG into legacy MG or vice versa with same MG configuration.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2b.  The issue is related to issue 1-1-2. We understand whether a configured MG is used as pre-configured MG or as legacy MG should be controlled by the NW. |
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### Sub-topic 1-2 Pre-configured MG activation/deactivation

[*Moderator notes: the agreements in the last meeting are:*

* *FFS on whether NW can fully control the pre-configured MG being activated/deactivated*
* *FFS on how pre-configured MGs can be activated/deactivated:*
  + *Option 1 Autonomously/implicitly triggered by condition change*
  + *Option1a Autonomously triggered by BWP switching DCI/timer but explicitly directed according to the pre-configured ON/OFF state/bit for the target BWP*
  + *Option 2: If the use case of MG pattern change following BWP switch is considered, to activate/deactivate the pre-configured MG by the network indication*
* *FFS on evaluation on MG activation/deactivation mechanism*

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#### **Issue 1-2-1 Whether NW can fully control the pre-configured MG being activated/deactivated**

* Option 1(CATT, Apple, Intel): Yes

Recommend WF: Option 1 can be agreed.

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| **Company** | **Comments** |
| Huawei | Option 1 is not clear. Does it mean activation and deactivation of pre-configured MG is explicitly triggered by the NW? |

#### **Issue 1-2-2 Criteria of activation/deactivation pre-configured MG**

* Option 1 (Huawei, MTK,vivo) :
  + If MG is not required by any of the configured measurements, the MG is deactivated.
  + If MG is required by one or more of the configured measurements, the MG is activated.
* Option 2 (Ericsson):
  + The UE needs gaps to measure SSBs when the measured SSB is not fully within the BW of the active BWP. Otherwise the UE can measure the SSBs without gaps. This change between gap based and gapless measurement is triggered by active BWP switching.
* Option 3() : No need to define such criteria in the spec if the NW indication was included in pre-configured MG configuration.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 1.  This criteria is needed at least for BWP switch triggered activation and deactivation. |
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#### **Issue 1-2-3 Pre-configured MG activation/deactivation mechanism**

* Option 1 (CATT, Ericsson, Intel, xiaomi, CMCC, NEC, OPPO, Huawei) Autonomously/implicitly triggered by BWP switching DCI/Timer.
  + Option 1a (Nokia): RAN4 need to account for robustness of the measurement gap changes when evaluating and agreeing on activation/deactivation of MG pattern(s) without using RRC signaling.
* Option 2 (Intel, Apple, Qualcomm, vivo, CMCC) the pre-configured MG activation/deactivation is triggered by the BWP switch and pre-configured under the control by the NW via its RRC configuration message.
  + Option 2a (CMCC): If the use case of MG pattern change following BWP switch is considered, to activate/deactivate the pre-configured MG by the network indication
* Option 3 (Huawei, MTK) : Besides BWP switching, there could be also other RRC and MAC procedures that could trigger a change in need for MG and thus activation and deactivation of pre-configured MG, e.g.
  + RRC (re)configuration of MO
  + RRC (re)configuration of serving cells
  + SCell activation and deactivation
* Option 3a : Besides BWP switching, there could be also other RRC procedures that could trigger a change in need for MG and thus activation and deactivation of pre-configured MG. MAC procedures such as SCell (de)activation shall be further discussed as FFS.
* Option 3b (Huawei) : RRC reconfigurations of MO or serving cell are not considered as triggering event for activation or deactivation of pre-configured MG, but the status of pre-configured MG should be configured by the NW. For SCell activation and deactivation, FFS

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | For BWP switch triggered activation and deactivation, support implicit activation and deactivation.  For RRC reconfiguration triggered activation and deactivation (e.g. MO change, serving cell change or configuration of pre-configured MG), prefer explicit configuration but implicit activation and deactivation is also fine for us (this relates to issue 1-1-2).  For SCell activation and deactivation triggered activation and deactivation, FFS |
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#### **Issue 1-2-3 Whether the status of activation/deactivation (e.g. ON/OFF) is needed?**

* Option 1 (Ericsson, CATT) : No.
  + e.g. P-MGP shall not have a fixed status (activated or deactivated) upon RRC configuration
* Option 1a (OPPO):
  + Set pre-configured MG inactive as default after the RRC configuration, with no additional signalling.
* Option 2 (Qualcomm, Intel,ZTE): Yes

[*Moderator notes: this issue is relevant with issue 1-2-2*.]

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We understand this is same as issue 1-1-3. |
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### Sub-topic 1-3 RRM requirements

#### **Issue 1-3-1 Activation/Deactivation Delay**

* Option 1(CATT, xiaomi, NEC, OPPO): No separated activation delay for the pre-configured MG activation/deactivation
* Option 1a(Intel): RAN4 needs NOT to define the separated activation delay requirements for the pre-configured MG activation unless the BWP switching time is shorter than “gap transition time”.
* Option 2a(Huawei): some transition time (ΔT) shall be included in the pre-configured MG activation/deactivation time on top of the BWP switching delay. Activation and deactivation of pre-configured MG takes effect from the first MG occasion after the activation and deactivation delay.
* Option 2b (MTK): Additional validation time [20ms] is needed after BWP switch for UE to activate or de-activate the pre-configured gap.
* Option 3 (Ericsson): The activation/deactivation of the P-MG needs activation/deactivation delay, which needs to be specified. Actual value of the delay is FFS.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2a.  Both UE and NW may need extra time than BWP switch delay to adapt the scheduling. |
| CMCC | In our understanding, this issue is about the transition time (T\_delta). One general question is how to capture the transition time. Does is captured in BWP switching delay, or does it captured in measurement period, or do we introduce a new requirement, e.g. P-MG activation/deactivation delay to capture T\_delta? It is better to firstly align on this general question. |
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#### **Issue 1-3-2 Interruption requirements**

* Option 1. (Apple, Intel,): No

Recommended WF: Companies to check Option 1 is agreeable.

* No interruption requirements will be introduced due to pre-configured MG activation/deactivation.

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| **Company** | **Comments** |
| Huawei | Option 1. This was already agreed in R4-2103677. |
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#### **Issue 1-3-3 Measurement period**

* Option 1. (Ericsson):
  + The total measurement period Tmeasure, total) to account for transition between activated and deactivated P-MGP during the measurement needs to be specified
  + Total measurement period (Tmeasure, total) can be expressed in terms of basic measurement period (Tmeasure, basic) and aggregated time consumed due to total number of transitions between gapless measurement procedure and gap-based measurement procedure during the ongoing measurement.
  + Tmeasure, basic can be expressed as: Tmeasure, basic = MAX(TBWP, TG); where:
    - TBWP= It is the measurement period when the measurement is fully performed without measurement gap
    - TG= It is the measurement period when the measurement is fully performed with measurement gap~~.~~
* Option 2a (Intel)
  + The RAN4 minimum requirements for intra-frequency SSB measurement can follow that of intra-frequency SSB measurement requirements with gap specified in 9.2.6 of TS38.133 [3].
  + The RAN4 minimum requirements for intra-frequency SSB measurement and CSI-RS measurement with pre-configured MG can follow that of intra-frequency SSB measurement requirements with gap specified in 9.2.6 of TS38.133 [3] and inter-frequency CSI-RS measurement requirements specified in 9.10.3 of TS38.133 [3] respectively.
* Option 2b (CATT) The measurement period for the measurement with pre-configured MG can reuse the current requirement with measurement gap in R16
* Option 3 (Huawei) The transition requirements defined in clause 9.1.6 apply also with pre-configured MG.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 3.  It is noted that the switching between MG based and MG-less measurement is not new and already exists in Rel-15. The new aspect is that the pre-configured MG can be activated and deactivated. However, this mainly impacts the availability of resources for data scheduling, but from measurement perspective there is no difference compared to Rel-15. |
| CMCC | In our understanding, there are two cases:  Case 1: When pre-configured MG is activated/deactivated, and there is no status change of pre-configured MG during the measurement period (i.e. pre-configured MG remain activation/deactivation during the measurement period),   * The legacy measurement delay requirements for both intra-frequency measurement and inter-frequency measurement can be reused   Case 2: When pre-configured MG is activated/deactivated, and there is status change of pre-configured MG during the measurement period (i.e. change from activation to deactivation, or vise verse during the measurement period), there are two possible options to specify the requirements   * Option 1: reuse transition requirements defined in clause 9.1.6. * Option 2: do not reuse the transition requirements defined in clause 9.1.6. the measurement delay requirements are specified based on the samples measured without MG and the samples measured with MG   We slightly prefer option 2. |
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#### **Issue 1-3-4 Transitions between gapless and gap-based measurement procedures during ongoing measurements**

* Option 1(Ericsson):
  + define maximum number of transitions but no limit on the transition is also acceptable.
* Option 2 (CATT, Huawei, Intel, MTK, Nokia). Not needed.
* Option 2a(Apple): if similar minimum requirement at transitions is agreed, i.e. measurement period follows the longer one before and after BWP switching, then it may not be necessary to define N1,max and N2,max
* Option 2b (MTK): UE re-starts a new measurement period after each activation/de-activation of the pre-configured gap.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2. |
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#### **Issue 1-3-5 Whether there is scheduling restriction during pre-configured MGs when not used.**

* Option 1 (Ericsson, Nokia, MTK): If the UE is measuring without pre-configured gaps and no other frequency layer which needs gaps is configured then the UE can be scheduled during the pre-configured gaps while meeting existing scheduling restriction requirements defined in TS 38.133.
* Option 1a(Ericsson,Huawei) Existing scheduling restriction for RRM measurement without MG applies when pre-configured MG is deactivated.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | In our view, option 1 and option 1a are rather similar, so we can support both them. We slightly prefer to use the wording in option 1a for more precise and accurate wording. |
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#### **Issue 1-3-6 UE behavior after deactivation of pre-configured MG**

* Option 1 (OPPO): After deactivation of pre-configured MG and switching to a new BWP without any per-configured gap,
  + option 1: UE shall perform measurement without gap until switching away from this BWP.
  + option 2: Immediate activation of default gap. UE shall perform measurement with default gap.
  + option 3: UE shall perform measurement with legacy per UE or per FR gaps.
* Option 2 (Ericsson)
  + After P-MG is deactivated the UE shall measure without causing any interruption and shall be able to receive and transmit in the serving cell in all the slots even within MGL of P-MG.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2 is fine, but it is too strong to say “without causing any interruption” becasue the existing interruption and scheduling restriction requirements should apply. |
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### Sub-topic 1-4 MG pattern configurations

#### **Issue 1-4-1 Number of pre-configured MG patterns**

* Option 1 (CATT) : Defer this discussion until the joint discussion with multiple concurrent MG.

[*Moderator notes: in the last meeting the agreements below were achieved:*

* + *A single pre-configured MG is considered for the case of non-concurrent MG scenarios.*
  + *FFS if more pre-configured MGs shall be considered for the multiple concurrent MG scenarios*

*Therefore, Option 1 above can be agreed.* ]

Recommended WF: Further discussion needed.

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| **Company** | **Comments** |
| Huawei | Support option 1. |
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#### **Issue 1-4-2 MG patterns used for the pre-configured MG mechanism**

* Option 1. (Intel, MTK,OPPO, Ericsson, ZTE): The existing gap patterns (0~23) in Rel16 can be reused for the pre-configured MG, which can be activated or deactivated when being configurated.
* Option 2. (Apple, CATT, Huawei): All existing MG patterns #0~25 in Rel-16 are applicable for the pre-configured MG

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2.  As commented in issue 1-0-1, NW can disable pre-configured MG when it configures MG pattern #24 or #25. This is effectively same as excluding MG pattern #24 and #25 from being used for pre-configured MG, but it is more future proof e.g. considering that MG-less PRS measurement might be introduced. |
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### Sub-topic 1-6 Other

#### **Issue 1-5-1 unified abbreviation of pre-configured measurement gap**

* Option 1 (Ericsson): P-MG
* Option 2(CATT, Nokia, Intel, NEC): Pre-MG

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Support option 1.  This is anyway for discussion rather than for specification. |

## CRs/TPs comments collection

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

### Open issues

## Discussion on 2nd round (TBD)

Please only comment on topics that are selected for discussion in 2nd round.

*[Moderator notes: all 2nd round discussions are moved to a dedicated Email thread for WF on the Email reflector.*

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## Summary on 2nd round

No further agreement was reached in the 2nd round.

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
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# Topic #2: Network Controlled Small Gap (NCSG)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2109100**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109100.zip) | CATT | **Proposal 1: No need to further define whether the use cases of NCSG is intra-frequency, inter-frequency or inter-RAT measurement.**  **Proposal 2: Whether to define separate NCSG for synchronous and asynchronous DC can be discussed and decided directly in the NCSG pattern design part.**  **Proposal 3: Similarly as LTE, define NCSG for part of legacy gap pattern with long MGL.**  **Proposal 4: Define NCSG pattern for set or subset of the following legacy gap pattern:**   * **Gap pattern with ID 0, 1, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19.**   **Proposal 5: The VIL should be defined as the number of interrupted slots.**  **Proposal 6: The VIL are defined considering RF tuning time and slot boundary alignment between cells. And (VIL1+ML+VIL2) can be larger than MGL for asynchronous case.**  **Proposal 7: The current CSSF requirements can be reused except to exclude the candidate that will be measured in NCSG.**  **Proposal 8: No additional NCSG capability for per-UE and per-FR differentiation is needed.**  **Proposal 9: If UE doesn’t support per-FR gap and per-FR NCSG, NCSG cannot be configured with legacy gap pattern simultaneously. If UE support per-FR gap and per-FR NCSG, NCSG can be configured with legacy gap pattern in the different FR.**  **Proposal 10: Measurement requirement for NCSG is defined based on the assumption that only one layer can be monitored in one NCSG occasion.**  **Proposal 11: NCSG in FR2 can be deprioritized in current stage.**  **Proposal 12: When NCSG is configured then during the ML the existing scheduling restriction requirements defined in TS 38.133 shall also apply.**  **Proposal 13: Let RAN2 decide NCSG signaling details and any relation between NCSG and ‘NeedForGap’ based on RAN4 technical input on NCSG pattern design.** |
| [**R4-2109182**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109182.zip) | MediaTek inc. | ***Observation 1: The Rel-16 ‘NeedForGap’ mechanism allows UE to do a real time assessment on this current HW/SW capability to determine whether to support the ‘no gap’ for particular bands and also reduces the reporting overhead significantly, compared to LTE.***  ***Proposal 1: Rel-17 NCSG capability is reported on top of existing RAN2 ‘NeedForGap’ signalling with a new component ‘NCSG’.***  ***Proposal 2: No additional NCSG capability for per-UE and per-FR differentiation is needed.***   * ***When UE only supports per-UE gap, the NCSG interruption happens in all FRs.*** * ***When UE supports per-FR gap, the NCSG interruption is constrained in an FR***   ***Proposal 3: The use case for NCSG includes 1) de-activated or dormant SCell measurement, 2) intra-frequency measurement with SSB no within active BWP, and 3) inter-frequency measurements. FFS whether to consider inter-RAT EUTRAN measurements.***  ***Proposal 4: Extend the NR gap patterns #0~23 for NCSG, but not #24 and #25.***  ***Proposal 5: Introduce absolute RRT (RF retuning time) to replace VIL in NCSG pattern definition. RRT is [0.5ms] in FR1 and [0.25ms] in FR2, occurring in the beginning and the end of NCSG, i.e., ML=MGL-RRT1-RRT2***  ***Proposal 6: VIL on active victim serving cells is the number of interrupted slots calculated based on***   * + ***Aggressor reference cell RRT,***   + ***Victim cell SCS, and***   + ***Sync or async. operation***   ***Proposal 7: When UE supports NCSG, the supported gap pattern index shall be the same as its reported legacy MG pattern capability.***  ***Proposal 8: Existing gap applicability in Rel-16 for NR-only measurements and mandatory gap patterns is re-used for NCSG capable UEs.***  ***Proposal 9: Introduce a single bit for existing MeasGapConfig to transform the legacy gap into NCSG (detail to be left to RAN2).***  ***Proposal 10: Introduce a new CSSF dedicated for NCSG.***  ***Proposal 11: UE is only required to measure one frequency layer in each NCSG occasion.***  ***Observation 2: UE is not expected to perform data reception/transmission on serving cell together with the inter-frequency measurements during NCSG in an intra-band or inter-band with CBM scenario, but it’s possible for inter-band with IBM.***  ***Proposal 12: NW needs to be informed that the inter-frequency measurements with NCSG is CBM or IBM with serving cells in FR2.*** |
| [**R4-2109230**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109230.zip) | Intel Corporation | ***Proposal 1: The usage of NCSG on the general measurements below can be deprioritized in Rel17.***   * ***intra-frequency measurements with MG,*** * ***inter-frequency measurements with MG,*** * ***inter-RAT measurements***   ***Proposal 2: Reuse part of the legacy MG patterns in [2] only as the new NCSG patterns in NR.***  ***Proposal 3: In order to minimize RAN4 and other RAN group’s standardization efforts, RAN4 can define NR NCSG patterns based on existing NR legacy MG patterns in [2].***  ***Proposal 4: The interruption requirements during measurements on SCC defined in TS38.133 and TS36.133 shall be revisited because of NCSG is used.***  ***Proposal 5*: *The “NeeForGap” signaling structure can be reused for NR NCSG as a start point.*** |
| [**R4-2109315**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109315.zip) | Apple | **Proposal 1: RAN4 doesn’t need to revisit the assumption that PRS is always measured within MG in this work item.**  **Proposal 2: since UE is not expected to process PRS and data simultaneously, it is unnecessary to use NCSG for PRS measurement.**  **Proposal 3: according to proposal 1 and 2, RAN4 doesn’t need to define NCSG for existing pattern #24 and #25.**  **Proposal 4: existing RF retuning time (500us for FR1 and 250us for FR2) can be reused to determine the absolute RF retuning time for VIL1 and VIL2.**  **Proposal 5: the absolute time for VIL1 and VIL2 shall be translated into number of interrupted slots when capturing in RAN4 specification.**  **Proposal 6: ML=MGL-VIL1-VIL2.**  **Observation 1: *measCycleSCell* is much longer than MGRP. It is unlikely that NW would specifically configure NCSG for measurement.**  **Observation 2: existing interruption requirement for measurement on deactivated SCC is defined in the way that the impact on system is quite similar to NCSG, i.e. UE is only allowed to cause interruptions immediately before and immediately after an SMTC.**  **Proposal 7: RAN4 shall study whether and how much we can benefit from using NCSG for measurement on deactivated SCC before concluding the use case.**  **Proposal 8: No additional NCSG capability for per-UE and per-FR differentiation is needed.** |
| [**R4-2109512**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109512.zip) | CMCC | **Use cases of NR NCSG**  ***Proposal 1: except measurements on deactivated Scell, NCSG can be used for intra-frequency measurements with MG, inter-frequency measurements with MG, and inter-RAT measurements.***  **NCSG pattern**  ***Proposal 2: it is proposed to use NR gap patterns #0~23 to define NCSG pattern.***  *Observation 1: if VIL is defined as the equivalent time of the interrupted slots, and* *different NCSG pattern for synchronous and asynchronous operation is adopted, there may be too many NSCG patterns.*  *Observation 2: if VIL is defined as the equivalent time of the interrupted slots, and same NCSG pattern for synchronous and asynchronous operation is designed, the benefit of introducing NCSG in synchronous scenario will be sacrificed.*  ***Proposal 3: it is proposed to define VIL and interruption separately, and the VIL is the RF retuning time (RRT).***   |  |  |  |  |  | | --- | --- | --- | --- | --- | | ***SCS*** | ***Synchronous*** | | ***Asynchronous*** | | |  | ***interruption length before measurement*** | ***interruption length after measurement*** | ***interruption length before measurement*** | ***interruption length after measurement*** | | ***15KHz SCS*** | ***1 slot*** | ***1 slot*** | ***2 slots*** | ***2 slots*** | | ***30KHz SCS*** | ***2 slots*** | ***2 slots*** | ***3 slots*** | ***3 slots*** | | ***60KHz SCS*** | ***3 slots*** | ***3 slots*** | ***4 slots*** | ***4 slots*** | | ***120KHz SCS*** | ***6 slots*** | ***6 slots*** | ***7 slots*** | ***7 slots*** |   ***Proposal 4: it is proposed that VIL (RTT) equals to absolute RF retuning time defined in Rel-15, which is 0.5ms for FR1 and 0.25ms for FR2.***  ***Proposal 5: if VIL is agreed to be equal to RF tuning/retuning time (RTT),*** ***it is proposed that same NSCG pattern is applied for synchronous and asynchronous operation. And the interruption can be defined separately for synchronous and asynchronous.***  **Interruption**  ***Proposal 6: the interruption is proposed as following:***  **Relation between NCSG and ‘NeedForGap’**  *Observation 3: In LTE, for ‘NeedForGap’, no interruption is specified.*  *Observation 4: NCSG and ‘NeedForGap’ are different feature. ‘NeedForGap’ is the case that measurement is performed without gap and without interruption, but NCSG means measurement with network controlled small interruption.*  ***Proposal 6: it is not preferred to reuse Rel-16 ‘NeedForGap’ signalling for NCSG.*** |
| [**R4-2109616**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109616.zip) | vivo | **Proposal 1: Use option 2, “Define NCSG patterns for subset of the legacy MG patterns in [TS38.133 v16.5.0]” as the general NCSG design principle**  **Proposal 2: The following two rules can be used to define the subset of MGs where NCSG is defined**   * **Do not design NCSG for legacy NR measurement gap when the MGL of that legacy measurement gap is less than a particular threshold, for example 4ms for FR1 (3.5ms for FR2)** * **Do not design NCSG for legacy NR measurement gap when the percentage of (VIL1+VIL2)/ML is larger than a particular threshold, for example 2.** * **From UE power consumption point of view, it is suggested that NCSG for legacy NR measurement gap with MGRP = 20ms are not defined.**   **Proposal 3: confirm the expression of ML and either MGL= VIL1+ML+VIL2 or ML=MGL-VIL1-VIL2 (ML>0) according to NCSG’s structure. The concrete value of VIL could be discussed separately.**  **Proposal 4: For the robustness considerations, the VIL1 and VIL2 value are defined based on a generic interrupted duration, i.e., option 1.**  **Proposal 5: The value of VIL1 is 1ms for FR1 and 0.75ms for FR2 for DL synchronous case. For asynchronous case, 1 slot based on victim cell numerology should be added to the VIL1 value. For VIL2, as the starting point its value could be the same value as that of VIL1.** |
| [**R4-2109731**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109731.zip) | Qualcomm CDMA Technologies | **Proposal1: NCSG is viewed as a method of avoiding gaps with interruptions, so it can be employed to replace MG based measurements.**  **Proposal2: RAN4 NCSG design shall still assume the worst scenario of planned use cases as the baseline for defining the pattern and requirements.**  **Proposal3: VIL time isnot based on absolute RF retuning time. Rather, it shall be based on the existing interruption requirements for measuring deactiactived SCell.**  **Proposal4: RAN4 to discuss which principle to consider and determine the ML i.e. ML=MGL-VIL1-VIL2 v.s. ML=legacy MG window length.**  **Proposal5: RAN4 may directly agree on the number of interrupted slots for VIL1 and VIL2 and skip the discussions on choice of VIL time duration.**  **Proposal6: Translate 1ms(FR1) and 0.75ms(FR2) into the number of interrupted slots for defining the interruption requirements for the synchronous case and one more slot is needed for asychrnous case.**  **Proposal7: Support only one layer can be measured for each NCSG occasion, which is the assumption for deriving CSSF.**  **Proposal8: NCSG can be configured concurrently with legacy MG in the context of multiple concurrent and independent gaps.**  **Proposal9, RAN4 to discuss if existing scheduling restrictions of 9.2.5.3.3 for measurement on FR2 intra-frequency cell shall be extended for the use case of measurement on intra- or inter-frequency cell via NCSG instead of legacy MG.** |
| [**R4-2109761**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2109761.zip) | ZTE Corporation | **Proposal 1: Intra-frequency measurements with MG, inter-frequency measurements with MG or inter-RAT measurements may use NCSG instead of MG when UE supports the corresponding band combination and has additional RF chains for measurements.**  **Proposal 2: Define NCSG patterns corresponding to legacy gap patterns with ID # 0 to ID #23.**  **Proposal 3: There is no need to separate NCSG patterns needed for synchronous and asynchronous operations.**  **Proposal 4: NCSG capability can be reported on top of the existing ‘NeedForGap’ signaling structure with an additional component ‘NCSG’.** |
| [**R4-2110066**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110066.zip) | OPPO | ***Observation 1：If it is allowed to be used separately with ‘needforgap’, NCSG should be valid for intra-frequency measurements with MG,*** ***inter-frequency measurements with MG, inter-RAT measurements.***  ***Proposal 1: NCSG patterns should be shared for both sync and async scenarios.***  ***Proposal 2: Prefer to reuse part of the legacy MG patterns as reference for NR NCSG patterns, with long MGL, e.g., 6ms for FR1 or 5.5ms FR2.***  ***Proposal 3: NCSG pattern should be configured based on MG configuration, regarding NW explicit configuration for NCSG is considered in Rel17.***  ***Proposal 4: No additional NCSG capability for per-UE and per-FR differentiation is needed. NCSG pattern should follow the applicability of corresponding MG pattern.***  ***Proposal 5: NR NCSG signaling is introduced newly, independent from Rel-16 “Needforgap” signaling, e.g., NCSG, No-NCSG.*** |
| [**R4-2110270**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110270.zip) | Nokia, Nokia Shanghai Bell | 1. NSCG serve for intra-/inter-frequency measurements with gap and for inter-RAT measurements. 2. Separate NSCG patterns are defined for synchronous and asynchronous network operation. 3. Define VIL requirements based on absolute RF retuning times in FR1 and FR2. 4. Related to reuse of legacy gap patterns for NCSG usage, gap patterns with MGL=3 ms and lower and gap patterns defined for positioning measurements are excluded, i.e. 5. Gap patterns #24 and #25 are excluded. 6. Gap patterns #20 to #23 are excluded. 7. Gap patterns #2, #3 and #10, #11 are excluded. 8. Related to NCSG applicability and UE capability support: if UE supports NCSG, it is mandated to support actual mandatory MG patterns from per-UE gap patterns #0, #1, #4-9 for NCSG usage. In case UE supports NCSG and per-FR gap patterns, it is mandated to support also actual mandatory MG patterns gap #12-19 in FR2 for NCSG usage. 9. NCSG can be configured simultaneously with legacy MG pattern. 10. NCSG can be pre-configured and will reuse the activation/deactivation mechanism developed for pre-configured measurement gaps. 11. NCSG can be configured and activated together with concurrent measurement gaps. 12. The selection of the appropriate signalling structure for informing the network on UE’s capability support for NCSG can be discussed at a later point in time, when the NCSG pattern design as well as NCSG applicability and UE capability support are finalized. |
| [**R4-2110913**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2110913.zip) | Huawei, HiSilicon | **Proposal 1: Support NCSG for intra-frequency, inter-frequency and/or inter-RAT measurements which do not require MG but NCSG based on UE capability.**  **Proposal 2: Do not define NCSG patterns for legacy MGP #24 and #25. For other legacy MGPs, further evaluate if NCSG patterns should be defined after RAN4 decides on VIL and ML.**  **Proposal 3: Define VIL (or possible new name) and ML of NCSG in absolute time of ms.**  **Proposal 4: VIL for NCSG patterns is defined as 1ms for FR1 NCSG and 0.75ms for FR2 NCSG.**  **Proposal 5: Define ML for NCSG pattern as MGL of legacy MGP.**  **Proposal 6: Number of interrupted slots should be defined based on VIL in ms, considering the victim cell SCS, sync/async, with/without MGTA,** **RTD between serving cells and DL/DL.**  **Proposal 7: RAN4 to further discuss the condition, capability and impacts to measurement requirements for UE to use NCSG to control interruptions due to measurement on deactivated SCC or SCell in dormancy.**  **Proposal 8: NCSG is considered as MG for defining measurement requirements.**  **Proposal 9: Existing measurement mode requirements can be the baseline when NCSG is configured.**  **Proposal 10: Discuss simultaneous configuration of NCSG and legacy MG based on concurrent MG framework in a later phase.**  **Proposal 11: Scheduling restriction for NCSG is FFS, and check with RAN2 on the feasibility of informing NW the CBM or IBM between inter-frequency measurements and serving cells in FR2.**  **Proposal 12: Signalling supports for NCSG include at least**   * **NCSG configuration** * **UE capability related to NCSG patterns and per-UE/per-FR NCSG** * **UE capability related to need for NCSG for a target carrier** |
| [**R4-2111312**](file:///C:\Users\rhuang5\OneDrive%20-%20Intel%20Corporation\Documents\my_work\LTE_A\RAN4\99e\Docs\R4-2111312.zip) | Ericsson | **Scenarios for NCSG patterns:**   * **Observation # 1**: Intra-frequency and inter-frequency measurement scenarios are fundamental. * **Observation # 2**: Inter-RAT measurements are crucial for EN-DC and NE-DC operations. * **Proposal # 1**: If NCSG is used for the following measurement scenarios:   + - intra-frequency measurements with MG,     - inter-frequency measurements with MG,     - inter-RAT measurements   **NCSG patterns:**   * **Proposal # 2**: Define NCSG patterns for subset of the legacy MG patterns in TS 38.133. * **Proposal # 3**: Define selected NCSG patterns with larger MGL e.g. 5.5 ms-6 ms. * **Proposal # 4**: Define NCSG patterns for synchronous and asynchronous operations corresponding to legacy gap patterns with ID # 0, # 1, #13 and # 14. * **Proposal # 5**: VIL1 and VIL2 for FR1 and FR2 are defined agnostic to SCS to limit the NCSG patterns. * **Proposal # 6**: VIL1 and VIL2 for FR1 and FR2 are defined as follows:  |  |  |  |  |  | | --- | --- | --- | --- | --- | | **FR** | **VIL1** | | **VIL2** | | | **Sync** | **Async** | **Sync** | **Async** | | **FR1** | 1 ms | 2 ms | 1 ms | 2 ms | | **FR2** | 0.75 ms | | 0.75 ms | |  * **Proposal # 7**: Define different NCSG patterns for synchronous and asynchronous operations in FR1 and same NCSG patterns for synchronous and asynchronous operations in FR2. * **Proposal # 8:** ML should be sufficiently long enough to contain SMTC window. * **Proposal # 9:** ML is defined as follows:   + - * ML = Legacy MGL – 2\*RRT       * Where: RRT = 0.5 ms for FR1 and 0.25 ms for FR2   **Impact on RRM requirements due to NCSG:**   * **Proposal # 10**: Existing interruption requirements for SCell activation/deactivation can serve as starting point for the study of VIL requirements. * **Proposal # 11**: Per FR NCSG reuses the existing per FR UE capability.   **Measurement applicability:**   * **Proposal # 12**: In the first phase of the WI consider only the scenario in which the UE is configured only with NCSG pattern. * **Proposal # 13**: The UE is not expected to measure 2 inter-frequency/RAT layers in parallel even if UE reports the support of NCSG to both corresponding bands * **Proposal # 14**: NCSG pattern is also supported for FR2 i.e. not NCSG is NOT downpriotized for FR2. * **Proposal # 15**: When NCSG is configured then during the ML the existing scheduling restriction requirements defined in TS 38.133 shall also apply.   **Signaling aspects:**   * **Observation # 2**: NCSG capability signaling should not cause backward compatibility problem for legacy network not comprehending NCSG. * **Observation # 3**: NeefForGap signaling structure is not extensible. * **Proposal # 16**: NeefForGap signaling structure is not reused for NCSG.   **Proposal # 17**: Let RAN2 decide NCSG signaling details and any relation between NCSG and ‘NeedForGap’ based on RAN4 technical input on NCSG pattern design. |

## Open issues summary and Companies views’ collection for 1st round

NCSG of this WI are as follows:

* + *Network Controlled Small Gap (NCSG) specification [RAN4, RAN2]*
    - *RRM requirements for NCSG [RAN4]*
      * *Requirements for Visible Interruption Length (VIL) for different numerologies in FR1 and FR2*
      * *Specification of NCSG patterns, Measurement Length (ML), and Visible Interruption Repetition Period (VIRP)*
      * *Requirements for DL reception and UL transmission during ML, before start VIL and after end VIL*
      * *Measurement requirements with NCSG*
    - *Specification of applicability of NCSG patterns [RAN4]*
    - *Procedures and signaling for NCSG patterns [RAN2]*

### Sub-topic 2-1 Scenarios and use cases

[*Moderator notes: in the last meeting, the usage of NCSG for the interruption reducing was agreed. The other usage of NCSG like the legacy MGs can be FFS.*

* *“****The use cases of NR NCSG can be***
  + *Eliminate/reduce interruption rate and interruption length/duration due to measurements on [deactivated Scell, Scell with dormant BWP or unused RF chain*
  + *FFS on* 
    - *intra-frequency measurements with MG,*
    - *inter-frequency measurements with MG,*
    - *inter-RAT measurements*,

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#### **Issue 2-1-1 NCSG usage for intra/inter-frequency/inter-RAT measurements with MG**

* Option 1 (CATT, Intel): No need define NCSG for the general measurement which can be done with the legacy MGs.
* Option2 (Qualcomm, Huawei, CMCC, Ericsson, ZTE, Nokia, OPPO, MTK): NCSG can be used for intra-frequency measurements with MG, inter-frequency measurements with MG, inter-RAT measurements.
* Option2a (Huawei): Support NCSG for intra-frequency, inter-frequency and/or inter-RAT measurements which do not require MG but NCSG based on UE capability

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2a.  Maybe it is just a wording issue, but technically if e.g. an inter-freq measurement requires MG, then NW should configure MG rather than NCSG. |
| CMCC | Option 2. In our understanding, the benefit to introduce NCSG is to reduce the interruption to the serving carriers when performing the RRM measurement with spare RF chain. It is beneficial to apply NCSG to intra-frequency measurements with MG, inter-frequency measurements with MG and inter-RAT measurements. We do not see the reason to preclude these scenarios. |
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#### **Issue 2-1-2 Other NCSG usages**

* Option 1 (Apple): RAN4 shall study whether and how much we can benefit from using NCSG for measurement on deactivated SCC before concluding the use case
  + .

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We are open to more discussions.  In our understanding, this means when UE is configured with NCSG, then it is not allowed to cause interruption due to measurement on deactivated SCC. |
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### Sub-topic 2-2 NCSG pattern

#### **Issue 2-2-1 General NCSG pattern design principle**

[*Moderator notes: the general NCSG pattern design can be further decoupled to the questions below*.]

#### **Issue 2-2-1-1 Which legacy MGs can be reused by NCSG**

*[Moderator notes: The general NCSG design principle:*

* + *Option 1. Define NCSG patterns for All 26 MG patterns in Rel16*
  + *Option 2 Define NCSG patterns for subset of the legacy MG patterns in [TS38.133 v16.5.0]*
  + *FFS on which subset of legacy MG patterns*

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* Option 1. Define NCSG patterns for All 26 MG patterns in Rel16
* Option 2 (Intel, Ericsson, CATT, Apple, Huawei, MTK, CMCC, vivo, ZTE) Define NCSG patterns for subset of the legacy MG patterns in [TS38.133 v16.5.0]
  + Option 2a (Apple, MTK, CMCC, ZTE) pattern #0~#23
  + Option 2b(Intel, Ericsson, CATT, Nokia, OPPO): Select the patterns in which ML= MGL-VIL1-VIL2 is large enough to accommodate possible SMTC window.
  + Option 2c (vivo) The following two rules can be used to define the subset of MGs where NCSG is defined
    - Do not design NCSG for legacy NR measurement gap when the MGL of that legacy measurement gap is less than a particular threshold, for example 4ms for FR1 (3.5ms for FR2)
    - Do not design NCSG for legacy NR measurement gap when the percentage of (VIL1+VIL2)/ML is larger than a particular threshold, for example 2.
    - From UE power consumption point of view, it is suggested that NCSG for legacy NR measurement gap with MGRP = 20ms are not defined.
  + Option 2d(Ericsson) : Define NCSG patterns for synchronous and asynchronous operations corresponding to legacy gap patterns with ID # 0, # 1, #13 and # 14.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We support to exclude legacy MGP #24 and #25.  For other legacy MGPs, further evaluate if NCSG patterns should be defined after RAN4 decides on VIL and ML. |
| CMCC | Option 2a. Gap pattern #24 and #25 are introduced in positioning WI, which is used to enable the longer PRS measurement. The motivation to introduce Gap pattern #24 and #25 seems contradict with the motivation of introducing NCSG. From this point of view, Gap pattern #24 and #25 can be precluded from NCSG. For gap pattern #0~#23, considering that except the mandatory gap patterns, other gap patterns are optionally supported, if we only define NCSG patterns for the selected gap patterns, it is possible that for the supported gap pattern, there is no corresponding NCSG pattern and the benefit of NCSG cannot be experienced. |
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#### **Issue 2-2-2-2 Define the separated NCSG patterns for sync and async scenarios**

* Option 1 (Ericsson, Nokia): Yes
  + Different NCSG patterns for synchronous and asynchronous operations in FR1
  + Same NCSG patterns for synchronous and asynchronous operations in FR2.
* Option 2 (ZTE, OPPO):
  + No need to separate NCSG patterns needed for synchronous and asynchronous operations.
* Option 3 (CMCC): same NCSG patterns for synchronous and asynchronous operations, provided that the NCSG pattern only comprise the RF retuning time and ML. Interruption is not captured in VIL(RRT) and specified separately.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Support option 2 |
| CMCC | This issue is related with whether interruption is captured in VIL or not. If VIL is defined as the equivalent time of the interrupted slots, there are some drawbacks. On one hand, if different NCSG pattern for synchronous and asynchronous operation is adopted, there may be too many NSCG patterns. On the other hand, if same NCSG pattern for synchronous and asynchronous operation is designed, the benefit of introducing NCSG for synchronous scenario will be sacrificed.  Based on above consideration, we propose that interruption is not captured in VIL, VIL is the RF retuning time (RRT). And the interruption is specified separately. In this case, the NCSG pattern only comprise the RRT and ML. And same NCSG patterns can be used for synchronous and asynchronous operations. We propose a new option:  Option 3: same NCSG patterns for synchronous and asynchronous operations, provided that the NCSG pattern only comprise the RRT and ML. Interruption is not captured in VIL and specified separately. |
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#### **Issue 2-2-2-3 Gap pattern index for NCSG**

* Option 1 (MTK):
  + When UE supports NCSG, the supported gap pattern index shall be the same as its reported legacy MG pattern capability.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We cannot agree on option 1 for now, and we suggest to defer the UE capability related discussions to a later stage when the basic mechanism and requirements are clear. |
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#### **Issue 2-2-2 Visible Interruption Length (VIL)**

[*Moderator notes: “VIL” discussed here is the one of parameter which can decide the exact NCSG pattern. We can decouple it from the interruption requirements firstly.*

*And in the last meeting, the following agreements were achieved.*

*“The NCSG gap patterns are defined based on the absolute RF retuning time or not?*

* + *Option 1: NO, based on a generic interrupted duration [FFS]* 
    - *Option1-1: ML=MGL-VIL1-VIL2*
    - *Option1-2: ML=legacy MG window length*
  + *Option 2: Yes, based on the RF retuning time (RRT). ML=MGL-RRT1-RRT2*
    - *FFS on the length of RRT”*

]

* Option 1a (Qualcomm, Intel, Ericsson, vivo): VIL should be explicitly defined base on the number of interrupted durations in absolute time
  + - e.g. VIL1 and VIL2 for FR1 and FR2 are defined as follows:

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| --- | --- | --- | --- | --- |
| **FR** | **VIL1** | | **VIL2** | |
| **Sync** | **Async** | **Sync** | **Async** |
| **FR1** | 1 ms | 2 ms | 1 ms | 2 ms |
| **FR2** | 0.75 ms | | 0.75 ms | |

* Option 1b (Apple, CATT): VIL should be explicitly defined based on the number of interrupted duration in slot
* Option 2( MTK, Huawei, CMCC, Nokia): based on absolute RF retuning time (tentatively denoted as “RRT:).

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2.  On the exact value for RTT, we suggest 1ms for FR1 NCSG and 0.75ms for FR2 NCSG. |
| CMCC | Option 2. it is proposed to define VIL and interruption separately, and the VIL is the RF retuning time (RRT), which is 0.5ms for FR1 and 0.25ms for FR2. Interruption is specified separately or independently from VIL(RRT). |
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#### **Issue 2-2-3 Measurement Length (ML)**

[*Moderator notes: beside the design principle of VIL in 2-2-2, how to design ML shall be decided. In the last meeting, there are two options below for ML:*

* + - *Option1-1: ML=MGL-VIL1-VIL2*
    - *Option1-2: ML=legacy MG window length*

]

* Option 1(Apple, CATT, vivo): ML=MGL-VIL1-VIL2
* Option 2(Huawei, Qualcomm): ML=legacy MG window length

[*Moderator notes: please the proponents clarify whether the legacy MG window length here is MGL*.]

[In our understanding, the legacy MG window length is equal to legacy MGL-2\*(RF retuning time). For 6ms MGL, the MG window length is 5ms for FR1.]

* Option 3(Ericsson, MTK):
  + - * ML = Legacy MGL – 2\*RRT
      * Where: RRT = 0.5 ms for FR1 and 0.25 ms for FR2

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2.  On legacy MG window length, we understand it is the effective measurement time in legacy MGPs. We agree with the example from QC, that with MGP #0, the legacy MG window length is 5ms. |
| CMCC | Option 3 |
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### Sub-topic 2-3 Configuration of NCSG

#### **Issue 2-3-1 How can NCSG be configured explicitly**

[*Moderator notes: in the last meeting, the NCSG explicit configuration was agreed. But how this explicated configuration can be shall be FFS.* ]

* Option 1 (OPPO) NCSG configuration shall be based on legacy MG configuration
* Option 1a (MTK) : Introduce a single bit for existing MeasGapConfig to transform the legacy gap into NCSG (detail to be left to RAN2).

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Support option 1a. |
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### Sub-topic 2-4 Measurement requirements impacts

#### **Issue 2-4-1 Interruption requirements**

*[Moderator notes: There are multiple kinds of interruption requirements in current 38.133 and 36.133 because of the different reasons (e.g. Scell activation, DRX transition, measurement on SCC, ...). The proposals on this issue from the different companies may be targeted to the different scenarios of interruption requirements. Please companies also clarify the exact interruption requirements*

*]*

* Option 1 (Intel): The interruption requirements in TS38.133 and TS36.133 shall be revisited
* Option 2(Ericsson): Existing interruption requirements for SCell activation/deactivation can serve as starting point for the study of VIL requirements
* Option 3(CMCC): the interruption is proposed as following:

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| --- | --- | --- | --- | --- |
| ***SCS*** | ***Synchronous*** | | ***Asynchronous*** | |
|  | ***interruption length before measurement*** | ***interruption length after measurement*** | ***interruption length before measurement*** | ***interruption length after measurement*** |
| ***15KHz SCS*** | ***1 slot*** | ***1 slot*** | ***2 slots*** | ***2 slots*** |
| ***30KHz SCS*** | ***2 slots*** | ***2 slots*** | ***3 slots*** | ***3 slots*** |
| ***60KHz SCS*** | ***3 slots*** | ***3 slots*** | ***4 slots*** | ***4 slots*** |
| ***120KHz SCS*** | ***6 slots*** | ***6 slots*** | ***7 slots*** | ***7 slots*** |

* Option 3a (Qualcomm) Translate 1ms(FR1) and 0.75ms(FR2) into the number of interrupted slots for defining the interruption requirements for the synchronous case and one more slot is added for asychrnous case.
* Option 4(MTK)
  + VIL on active victim serving cells is the number of interrupted slots calculated based on
    - Aggressor reference cell RRT,
    - Victim cell SCS, and
    - Sync or async. operation
  + E.g.
  + Total number of interrupted slots on all serving cells for synchronous operation with per-UE measurement gap or per-FR measurement gap

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| SCS  (kHz) | VIL (slot) | |
| MGTA = 0ms, RRT=0.5ms | MGTA = 0.5ms, RRT=0.5ms |
| 15 | 1 | 1 |
| 30 | 1 | 1 |
| 60 | 2 | 2 |
| 120 | 4 | 4 |
| NOTE 1: NR SCS of 120 kHz is only applicable to the case with per-UE measurement gap.  NOTE 2: Non-overlapped half-slots occur before and after the VIL. Whether a Rel-17 UE can receive and/or transmit in those half-slots is up to UE implementation. | | |

* Option 5(Huawei): RAN4 to further discuss the condition, capability and impacts to measurement requirements for UE to use NCSG to control interruptions due to measurement on deactivated SCC or Scell in dormancy

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 5 is our proposal, and it is related to using NCSG for measurement on deactivated SCC, i.e. issue 2-1-2.  For interruption requirements due to VIL, we support option 3a, and besides the sync/async, other consideration factors include victim cell SCS, with/without MGTA, RTD between serving cells and DL/DL. |
| CMCC | The key point is that not to capture interruption in VIL, the VIL (RRT) and interruption are specified separately. And different interruption requirements are specified for sync and async scenario. The detailed value in option 3 is based on the existing interruption requirements for SCell activation/deactivation. |
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#### **Issue 2-4-2 Measurement mode**

* Option 1 (MTK, Huawei): The existing measurement mode requirements (effective MGRP, data scheduling depends on gap configuration) can be the baseline.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 1. |
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#### **Issue 2-4-3 CCSF**

* Option 1 ( Huawei): NCSG is considered as MG for defining measurement requirements.
* Option 1a (Qualcomm, Ericsson, CATT): Support only one layer can be measured for each NCSG occasion, which is the assumption for deriving CSSF.
* Option 2(MTK): Introduce a new CSSF dedicated for NCSG

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 1  We can also support option 1a because if NCSG is considered MG, then only one layer can be measured in each NCSG occasion.  On option 2, we understand it is same as option 1 when concurrent MG is not considered. |
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### Sub-topic 2-5 Capability support

#### **Issue 2-5-1 Per-UE or Per-FR capability support**

[*Moderator notes: in the last meeting, the following agreements were achived.*

* *FFS on Per-UE or Per-FR capability support* 
  + *Option 1:per UE and per FR NCSG for RRM measurement needs the specific UE capability.*
  + *Option 2: No additional NCSG capability for per-UE and per-FR differentiation is needed*
  + *Others*

]

* Option 1 (Apple, MTK, Ericsson, CATT, OPPO): No additional NCSG capability for per-UE and per-FR differentiation is needed.
* Option 1 (Nokia):
  + if UE supports NCSG, it is mandated to support actual mandatory MG patterns from per-UE gap patterns #0, #1, #4-9 for NCSG usage.
  + In case UE supports NCSG and per-FR gap patterns, it is mandated to support also actual mandatory MG patterns gap #12-19 in FR2 for NCSG usage.
* Option 3 (Huawei): **related UE capability can be FFS**

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We cannot agree on option 1 or option 2 for now, and we suggest to defer the UE capability related discussions to a later stage when the basic mechanism and requirements are clear. |
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### Sub-topic 2-6 Measurement Applicability

#### **Issue 2-6-1 whether NCSG can be configured simultaneously with legacy gap pattern**

* Option 1a (Qualcomm, Nokia). Yes. NCSG can be configured concurrently with legacy MG in the context of multiple concurrent and independent gaps.
* Option 1b(Huawei, Ericsson). In the first phase of the WI , No
  + FFS on how to apply the measurement requirements (e.g. CSSF) under this assumption

Recommend WF: Could we agree the following proposal:

**“***Discuss simultaneous configuration of NCSG and legacy MG based on concurrent MG framework in a later phase.* **“**

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| **Company** | **Comments** |
| Huawei | Option 1b. |
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#### **Issue 2-6-2 RF combination limitation**

* Option 1a. (MTK): UE is only required to measure one frequency layer in each NCSG occasion..
* Option 1b. (Ericsson): UE is note expected to measure 2 inter-frequency/RAT layers in parallel even if UE reports the support of NCSG to both corresponding bands

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We understand this issue is already covered by issue 2-4-3. |
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#### **Issue 2-6-3 Rx beam limitation**

* Option 1. (MTK, Ericsson): NCSG pattern is also supported for FR2
* Option 1a. (MTK)NW needs to be informed that the inter-frequency measurements with NCSG is CBM or IBM with serving cells in FR2.
* Option 2(CATT) NCSG in FR2 should be deprioritized in current stage.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We can support option 1.  On option 1a, we think the issue is valid, but RAN4 may need to check with RAN2 on the feasibility of informing NW the CBM or IBM between inter-frequency measurements and serving cells in FR2. |
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#### **Issue 2-6-4 Scheduling and measurement restriction**

* Option 1 (Ericsson, CATT): When NCSG is configured then during the ML the existing scheduling restriction requirements defined in TS 38.133 shall also apply,
* Option 1a(Qualcomm): RAN4 to discuss if existing scheduling restrictions of 9.2.5.3.3 for measurement on FR2 intra-frequency cell shall be extended for the use case of measurement on intra- or inter-frequency cell via NCSG instead of legacy MG.
* Option 2(Huawei): Scheduling restriction for NCSG is FFS, and check with RAN2 on the feasibility of informing NW the CBM or IBM between inter-frequency measurements and serving cells in FR2.

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | Option 2.  The issue is related to issue 2-6-3, and if enhance the scheduling restriction for FR2, it means current scheduling restriction requirements do not apply. |
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### Sub-topic 2-7 Signaling

#### **Issue 2-7-1 Necessary signaling for NCSG?**

* Option 1 (Huawei): Signalling supports for NCSG include at least
* NCSG configuration
* UE capability related to NCSG patterns and per-UE/per-FR NCSG
* UE capability related to need for NCSG for a target carrier
* Option 2 (Nokia): Defer these discussions after NCSG pattern design as well as NCSG applicability and UE capability support are finalized

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | We can support option 1, and we suggest to defer the UE capability related discussions to a later stage when the basic mechanism and requirements are clear. |

#### **Issue 2-7-1 How to consider the relation between NCSG and ‘NeedForGap’?**

* Option 1 (Intel, Apple): The “NeefForGap” signaling structure can be reused for NR NCSG as a start point
* Option 1a (MTK, ZTE): Rel-17 NCSG capability is reported on top of existing RAN2 ‘NeedForGap’ ignaling structure with a new component ‘NCSG’.
* Option 2 (Ericsson, CMCC, OPPO): Don’t reuse Rel-16 ‘NeedForGap’ ignaling for NCSG
* Option 3(Ericsson, CATT)
  + Let RAN2 decide NCSG signaling details and any relation between NCSG and ‘NeedForGap’ based on RAN4 technical input on NCSG pattern design

Recommended WF: Further discussion needed. Collect companies’ views.

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| **Company** | **Comments** |
| Huawei | There is a discussion for Rel-16 on the requirements for “NeedForGap”. We suggest to defer discussion on this issue after we have conclusion for Rel-16 “NeedForGap”. |
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### CRs/TPs

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

### Open issues

## Discussion on 2nd round

Please only comment on topics that are selected for discussion in 2nd round.

*[Moderator notes: all 2nd round discussions are moved to a dedicated Email thread for WF on the Email reflector.*

]

#### **Issue 2-1-1: NCSG Scenarios**

Recommended WF:

## Summary on 2nd round

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc status update recommendation** |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on R17 NR MG enhancements – Pre-configured MG | Intel |  |
| WF on R17 NR MG enhancements – NCSG | Intel |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
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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** |
|  | WF on R17 NR MG enhancements – Pre-configured MG |  |  |  |
|  | WF on R17 NR MG enhancements – NCSG |  |  |  |
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Notes:

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