**3GPP TSG-RAN WG2 Meeting #116-e R2-211xxxx**

**Electronic Meeting, Nov 1 – 12, 2021**

**Agenda item: 8.22**

**Source: Intel (Rapporteur)**

**Title:** **Pre-Configured MG (Intel)**

**Document for: Discussion**

# Introduction

This is email discussion on pre-configured MG for WI “NR measurement gap enhancements”:

* [AT116-e][040][MGE] Pre-Configured MG (Intel)

Scope: Progress the pre-configured MG objective, Identify agreements, potential agreements, open issues and related LS questions to ask RAN4, can consider partial TP if suitable.

Intended outcome: Report, Draft LS

Deadline: Monday W2

In order for companies to have the same understanding of RAN4 LS, we thought it would be good if we have the same understanding of the terminology used in RAN4 LS:

**Part 1: Understanding of the terminology from RAN4 LS**

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| * RAN4 provided the following information for the preconfigured MG. NW can control activation/deactivation of pre-configured MG   + RRC-based activation/deactivation method is supported.     - Network can indicate active/deactive status per BWP     - Details of signalling are FFS.   + FFS if MAC CE based activation/deactivation method is supported * All existing MG patterns #0~25 in Rel-16 are applicable for the pre-configured MG * The common configuration parameters of pre-configured MG (e.g. MGRP, MGL, etc) are the same as those of Rel-16 legacy MG. The pre-configured MG can be configured in way similar to the configuration of the Rel-16 legacy MGs |

Q1: what is in the pre-configured gap? Our understanding is it may contain one more both of the following:

* A) measurement gap configuration parameters such as MGRP, MGL etc.
* B) MG status (active/de-active) per BWP. MG status is where the network configures if MG should be activated (i.e. the preconfigured MG used for RRM measurement) when the corresponding BWP becomes active BWP. (for some solution only)

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| **Company** | **A or B or both** | **Comment** |
| Huawei, HiSilicon | Both, but | B seems to refer to the RRC-based method. However, RAN4 provides two solutions: rule-based solution and RRC-based. And based on the online discussion, several companies expressed that RRC-based solution is not needed.  [Rapp]: Agree B is not needed for all solution. It is good to have the same understanding of the terminology. May be it helps with discussion to leave the wording as is but further discussion which solution may need to include B.  Therefore, we think B should be reworded to:   * B) MG can be activated/deactivated..   [HW2] In response to the rapporteur’s comment:  Adding “(for some solution only)” still could not answer this question “Q1: what is in the pre-configured gap?” because the rule-based solution is excluded by B.  [Rapp]: Agree with comment. The intention is to have companies same understanding which solution contains A or both. Thanks for clarifying. |
| ZTE | Both, but | Same view as HW. For B, both rule-based and network-controlled solutions mentioned in RAN4 LS, so the wording of B) is not so accurate.  In addition, for network-controlled solution, it is still unclear how can network make the right decision (e.g. gap is not needed in one BWP), if we still rely on e.g. R16 *interFrequencyMeas-NoGap-r16* capability, then RRC signalling becomes redundant, because rule-based solution is sufficient.  [Rapp]: see comment above. |
| Apple | Both | From our understanding, MG status is the main merit of pre-MG. It could be either configured by RRC signaling per BWP, or controlled by a rule defined somewhere in 38.133.  Huawei’s wording looks acceptable. |
| LGE | Both, but | We also think rule-based solution is sufficient, but we should check whether we understand RAN4’s intention correctly. |
| DENSO | Both, but | Similar view as Huawei and ZTE. In addition to the rule-based solution to determine the need of gap (like interFrequencyConfig-NoGap-r16), it is not so clear how the RRC-based activation/deactivation works. If needed, it could be used to set the initial status when the preconfigured MG is configured for the UE, albeit the initial status can also be determined by the rule-based approach... |
| OPPO | a) | A pre-configured function will include one measurement Gap or legacy measurement gap with pre-configured gap indication.  For pre-configured gap configuration,   * Option 1: may include one measurement gap configuration if legacy gap configuration is not used. But RAN2 should specify how to handle legacy measurement gap configuration IE. * Option 2: one pre-configured MG indication in legacy measurement gap configuration.   RAN2 should discuss whether the per BWP gap status is necessary or not. It is fine to only use implicit rules defined in RAN4.  [Rapp]: Can you clarify what is implicit rule defined in RAN4 for BWP gap status? Meaning if this status is signal to the UE or UE determines. |
| MediaTek | Both | For a), we understand that it includes an indication to tell UE that this is pre-configured MG  For b), it is unclear what does “for some solution” means. I believe that intention is trying to say that it is “for RRC-based control solution”.  [Rapp] this question is to exercise to collect companies understanding what is included in the pre-configured gap configuration. (a) is the actual gap configuration and (b) is the BWP gap status. Currently there are 2 solution: (1) RRC based NW controlled and (2) UE autonomous. My understanding is that for solution (2) b is not needed and hence some solution.  Company comments that RRC-based solution is not needed also agree that RRC-based solution is already included in RAN4 LS. We should not revert RAN4 agreement unless there is really critical issue. |
| Vivo | Both | First, we agree with Huawei, network configured MG status is just one approach.  Regarding the update from Rapporteur, we think it is not accuracy enough. In our understanding, MG status, i.e. activated/de-activated is anyway part of pre-MG, but just network configurated approach is “for some solution only”. Thus, we prefer Huawei’s wording.  [Rapp]: Hopefully first step is to get same understanding. How to configure and if combined will be stage 3 details. We are ok with re-wording. RAN4 LS use “active status per BWP” if this is clearer enough for companies. |
| Ericsson | A) and…  (see comment) | For us, a pre-configured MG is a MGP that, unlike legacy MG, upon configuration it could be “OFF”.  Hence, it’s a MGP + a NW config. indication pointing out to the UE whether the gap is a pre-configured one, i.e., that it can be configured but not necessarily setup (depending on “condition/s”).  We believe it’s important to avoid mixing the term “status” (in B)) with the previously mentioned “NW config indication”.  As pointed out by other companies above, RAN2 first needs to discuss whether the “status per BWP” is needed. According to our understanding, there is no need to have it (e.g., we can follow a similar approach as for Rel-16’s “inter-freq no gap measurement”). |
| Nokia | Both, but | For B), we share ZTE’s comment that “for network-controlled solution, it is still unclear how can network make the right decision (e.g. gap is not needed in one BWP)”. We agree that if the RRC-based Pre-MG (de)activation rely on e.g. R16 interFrequencyMeas-NoGap-r16 capability, the RRC-based mechanism seems not necessary.  Instead, to enable the RRC-based mechanism, we think R16 defined *NeedForGap* capability reporting should be extended from per-band/BC to BWP level, thus NW can configure the gap is needed or not for one BWP according to the reported capability. In this way, UE can decide the gap requirement based on not only whether the BWP contains the frequency domain resources of the target SSB, but also the resultant configuration of the serving cell. |
| Samsung | Both, but to confirm with RAN4 | We also think rule-based solution could work at least for Pre-MG based on BWP switch (There is still an FFS in RAN4 LS for other triggers), but needs to confirm with RAN4 as it is not clear why RAN4 agreed that RRC based solution is also needed. |
| Xiaomi | Both | For b), we also think the wording “(for some solution only)” is not clear enough. |
| CATT | Both | Huawei’s wording seems ok. |
| Intel | Both | Our understanding is that (A+B) will be signal for NW-controlled solution and (A only) will be signal for rule-based based solution. |

**Summary Q1:**

Majority of the companies (12/14) understanding pre-configured measurement gap includes both (A) and (B) below except 2 companies:

* A) measurement gap configuration parameters such as MGRP, MGL etc
* B) MG status (active/de-active) per BWP

Two companies don’t think (B) is needed mainly because they don’t think NW-controlled RRC based solution is not needed hence (B) is needed.

In addition, companies seem to use the terminology “rule-based solution” and “network-controlled solution”. Rapporteur thinks that maybe it is good to use these two terminologies to refer to the two type of solution. Proposals will be combined with the next few questions.

RAN4 provided the following information.

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| * NW can control activation/deactivation of pre-configured MG   + RRC-based activation/deactivation method is supported.     - Network can indicate active/deactive status per BWP     - Details of signalling are FFS.   + FFS if MAC CE based activation/deactivation method is supported |

Q2: what is “NW-controlled” activation/deactivation pre-configured gap? It seems like there are different understand of what “NW-controlled” means. We try to summarize different views below:

* Understanding 1) NW pre-configures gap (A+B above), then sends 1 bit signal to enable the feature. Meaning the UE uses legacy gap before network sign to activate the pre-configured gap.
* Understanding 2) NW provides pre-configured gap (A above), then signals to activate/deactivate the pre-configured gap dynamically upon BWP switching. This means if BWP switching requires gap (but not previous enable), NW will need to signal.
* Understanding 3) NW doesn’t pre-configure gap but provides pre-configured gap (A above) via RRC signalling when UE needs gap and release the preconfigured gap configuration upon BWP switching when UE doesn’t need gap. (Note: Rapporteur thinks this is not difference than legacy operation)
* Understanding 4) NW provides pre-configured gap (A +B above), and gap is activated/deactivated upon BWP switching. For each active BWP, whether a gap should be activated or deactivated is based on the configuration of B (original B provided by rapporteur).

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| **Company** | **Which understanding (1/2/3)** | **Comment** |
| Huawei, HiSilicon | None of them | Our understanding of this “NW-controlled” is as follows:  Understanding 4) NW provides pre-configured gap (A above) and provides the activation/deactivation information per BWP.  However, as we commented in Q1, we don’t think this RRC-based solution is necessary.  [Rapp]: please clarify if “the activation/deactivation information per BWP” is sent to the UE in the same message as (A) or a separate message dynamically.  [HW2] It could be the same message or a separate message (but not so dynamically because as per RAN4 LS, “cannot be changed after BWP switching”).  The NW can choose to configure MG parameters such as MGRP, MGL etc (A), and configure the 1-bit indication (indicating it is a pre-configured MG) in the same or separate message. In the same message means the NW configures a pre-MG directly, in a separate message means the NW turns a legacy MG into a pre-MG.  The NW also configures the activation/deactivation information per BWP, either in the same message (which configures the MG parameters), or in a different message. In both cases, the NW will not update the activation/deactivation information, unless there’s change in the gap configuration or there’s BWP addition/removal. BWP switching will not cause the NW to reconfigure this activation/deactivation information.  The new Understanding 4) is aligned with our understanding of the “NW-controlled” in RAN4 LS (even though we don’t like the RRC-based method)  [Rapp]: Thank you for the clarification. This question is to understand RAN4 LS so all companies are in the same page. We understand different companies have different preference towards solution which can be discussed later. |
| ZTE | None | Our understanding of ”NW-controlled” is:  Understanding 4) NW provides pre-configured gap (A +B above), and gap is activated/deactivated upon BWP switching. For each active BWP, whether a gap should be activated or deactivated is based on the configuration of B (original B provided by rapporteur).  [Rapp]: added understanding 4 above |
| Apple | Understanding 4 |  |
| LGE | Understanding 4 | We have the same understanding as HW and ZTE. |
| DENSO | Understanding 4) |  |
| OPPO | None | Our understanding is:  If use implicit rule, the network configured pre-configured measurement gap configuration or pre-configured measurement gap indication, it means the pre-configured measurement gap maybe activated. Other legacy behaviour is followed.  If per BWP status is used, it is understanding 4 (but not preferred).  [Rapp]: this question is to understand RAN4 LS. Preference of solution can be discussed later. If I understand correctly, the implicit rule can be classified as UE autonomous solution. |
| MediaTek | Understanding 4 |  |
| vivo | None | I am a little confuse on whether companies have different “understanding” on the LS. BUT actually is seems that companies have different “preference”.  It is not a good idea to mis-interpret RAN4 LS. I assume it is very clear in the LS what this “NW-control” means (copy the wording from RAN4 LS):   1. NW provides pre-configure MG 2. “Network can indicate active/deactive status per BWP” details of signalling are FFS.   Our understanding on the FFS part is per-BWP indication, e.g. 1bit.  Regarding “gap is activated/deactivated upon BWP switching”, it falls into “*Additional explicit rules for pre-configured MG autonomous activation/deactivation*”  [Rapp]: as I mentioned this question is to understand RAN4 LS and not indicate preference (we will do that in the last question). Here is the exact copy and paste from RAN4 LS:   * The pre-configured MG activation/deactivation is triggered by the DCI/Timer based BWP switch   FFS if additional conditions for pre-configured MG activation/deactivation shall be considered   * NW can control activation/deactivation of pre-configured MG   + RRC-based activation/deactivation method is supported.     - Network can indicate active/deactive status per BWP     - Details of signalling are FFS.   Rapp understanding is that the “active/deactive status per BWP” is not part of the FFS. Please clarify if company has different understanding. |
| Ericsson | None | Our understanding of RAN4’s LS point by point is the following:  *“NW can control activation/deactivation of pre-configured MG”* From a RAN2 point of view, one shouldn’t confuse the “activation/deactivation” here, with the “active/deactive status per BWP” below.   For us, what is meant here is simply that the NW indicates (or not) that it’s configuring the UE with a pre-configured MG, e.g., by means of a flag/indication.   *“RRC-based activation/deactivation method is supported”* The flag/indication mentioned above is RRC-based, e.g., as done for Rel-16’s “inter-freq no gap meas” in MeasConfig.  *“Network can indicate active/deactive status per BWP”* The NW *“can”* indicate a “per BWP” status. To achieve this, in addition to the previously mentioned flag, each BWP would need another indication allowing the UE to know whether to *setup* (*“activate”)* the (pre)configured MG when switching to this BWP.  However, we don’t see this as a requirement imposed by RAN4, nor that this is needed. |
| Nokia | Understanding 4 |  |
| Samsung | Understanding 4 |  |
| Xiaomi | Understanding 4 |  |
| CATT | Understanding 4 |  |
| Intel | Understanding 4 | We are ok with understanding 4 wording |

**Summary Q2:**

Majority (11/14) of the companies agree “NW-controlled” activation/deactivation pre-configured gap has the following understanding:

* A) measurement gap configuration parameters such as MGRP, MGL etc
* B) MG status (active/de-active) per BWP
* Understanding 4) NW provides pre-configured gap (A +B above), and gap is activated/deactivated upon BWP switching. For each active BWP, whether a gap should be activated or deactivated is based on the configuration of B

One company discuss solution based on UE autonomous activation/deactivation which is not rapporteur intended for this question. 2 companies think that RAN4 LS intended the part where NW can indicate “per BWP” is FFS and RRC based solution is not needed. But rapporteur thinks that RAN4 LS is cleared that NW-controlled solution includes “Network can indicate active/deactive status per BWP” refer to (B). Therefore, rapporteur proposal the following proposal for understanding of RAN4 LS. Note that this doesn’t mean RAN2 needs to adopted NW-controlled based solution.

**Proposal 1: “NW-controlled” activation/deactivation pre-configured gap has the following understanding:**

* **A) measurement gap configuration parameters such as MGRP, MGL etc**
* **B) MG status (active/de-active) per BWP**
* **NW provides pre-configured gap (A +B above), and gap is activated/deactivated upon BWP switching. For each active BWP, whether a gap should be activated or deactivated is based on the configuration of B**

Q3: what is “RRC-based activation/deactivation”? Our understanding is that NW-controlled activation/deactivation (in Q2) using RRC message. Do you share the same understanding?

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| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes |  |
| Apple | Yes |  |
| LGE | Yes |  |
| DENSO | Yes |  |
| OPPO | Yes |  |
| MediaTek |  | I don’t quite understand the question. The RRC-based solution is understanding 4 above, where the configuration B is **RRC** configuration.  [Rapp]: this question simply ask if company agrees on RAN4 LS where the activation/deactivation part is RRC configured in the RRC based solution. From your comment, it looks like you agree configuration B is RRC configured. |
| vivo | Yes |  |
| Ericsson | See comment | We believe that from a RAN2 point of view, it is better not to confuse (or even mix) the terms: status, activation/deactivation, or NW indication.  Please see our answer to Q2. |
| Nokia | Yes |  |
| Samsung | Yes |  |
| Xiaomi | Yes |  |
| CATT | Yes |  |
| Intel | Yes |  |

**Summary Q3:**

All companies except one (12/14) agree RRC-based activation/deactivation is using RRC message. One company express confusion on the question but from comment, rapporteur thinks the understanding seems to align. This question is for understanding so rapporteur doesn’t think any proposal needs to be made.

Q4: what is “MAC-CE based activation/deactivation”? Our understanding is that NW-controlled activation/deactivation (in Q2) using MAC-CE message. Do you share the same understanding?

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| **Company** | **Yes/No** | **Comment** |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes | But we don’t think MAC-CE based solution is needed.  [Rapp]: for understanding only 😊 |
| Apple | Yes | MAC CE based activation/deactivation is still FFS in RAN4. We think it should be put on hold until RAN4 determines to go with it. |
| LGE | Yes, | but it is not needed. |
| DENSO | Yes | Same understanding as Apple that it is FFS in RAN4. |
| OPPO | Yes | No need to discuss MAC CE based method and it is open in RAN4. |
| MediaTek |  | MAC CE solution is still FFS and we don’t need to discuss this now.  I don’t know how to use MAC CE in understanding 4. |
| vivo | Yes | This part is FFS in RAN4. We should wait for RAN4 progress. |
| Ericsson | Yes | We agree with others, better to wait for further RAN4 input. |
| Nokia | Yes | It’s up to RAN4 to decide MAC-CE based activation/deactivation. |
| Samsung | Yes | Agree with others. It is FFS in RAN4. |
| Xiaomi | Yes | Agree with vivo. We can wait for RAN4 progress. |
| CATT |  | MAC CE based activation/deactivation is still FFS in RAN4. Wait for RAN4’s further conclusion. |
| Intel | Yes | Also agree to wait for RAN4 progress. We in fact don’t think it is needed. |

**Summary Q4:**

12/14 companies agree MAC-CE based activation/deactivation is using MAC-CE message. But most companies either expressed MAC-CE based is not needed or should be FFS wait for RAN4 progress.

**Proposal 2: MAC-CE based activation/deactivation is FFS until RAN4 further input.**

Q5: what is “UE autonomous pre-configured MG activation/deactivation”? It seems like there are different understandings on this, we try to summarize different understanding below:

* Understanding 1) NW provides pre-configures gap (A+B above), UE activates the pre-configure gap based on BWP status (B).
* Understanding 2) NW provides pre-configures gap (A only), UE and network determines whether the pre-configured gap should be activated or not (not based on pre-defined rules). For example, if the active BWP is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.

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| **Company** | **Which understanding (1 or 2)** | **Comment** |
| Huawei, HiSilicon | Understanding 2 | Similar to the R16 inter-frequency no gap feature. The difference is that the R16 inter-f no gap only results in measuring inside of gap or outside of gap, whereas in this R17 feature the configured gap can be deactivated.  [HW2] The revised Understanding 2 is clearer.  [Rapp] thanks |
| ZTE | Understanding 2 | Maybe it is more precise to say:   * Understanding 2) NW provides pre-configures gap (A only), UE and network determines whether the pre-configured gap should be activated or not based on pre-defined rules. For example, if the active BWP is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated. * [Rapp]: clarification agree. Updated above. |
| Apple | Understanding 2 | We would like to point out that "UE autonomous pre-configured MG activation/deactivation” shall only apply when NW doesn’t provide the flag indicating ON/OFF, as agreed in RAN4 (copied below).  [Rapp]: agree and there is only for understanding RAN4 LS.  *o   Additional explicit rules for pre-configured MG autonomous activation/deactivation shall be defined for the case when signalling is not provided* |
| LGE | Understanding 2 |  |
| DENSO | Understanding 2 | We’re also aware of the RAN4 agreement highlighted by Apple. It is better to build common understanding what “signalling” means in this context. Perhaps, it is “RRC-based activation/deactivation”. If so, the necessity of the RRC-based activation/deactivation has to be clarified.  [HW2] That’s also our understanding. The “signalling” refers to RRC-based activation/deactivation information.  [Rapp]: For this question 5, we focus on UE autonomous. For RRC based activation/deactivation, this looks like it refers to NW controlled in question 4. |
| OPPO | Understanding 2 | It is not clear what are the rules. |
| MediaTek | Understanding 2 | Agree with ZTE. |
| vivo | Understanding 2 with comment | Understanding 2) NW provides pre-configured measurement gap, UE and network determines whether the pre-configured gap should be activated or not (based on pre-defined rules). For example, autonomously triggered by existing BWP switching,.  [Rapp]: thanks for the clarification. Rewording is accepted. Clarifying “pre-defined rules” refers to rules that doesn’t signal to UE. |
| Ericsson | Understanding 2, but see comment “bubble” above |  |
| Nokia | Understanding 2 |  |
| Samsung | Understanding 2 |  |
| Xiaomi | Understanding 2 | We are fine with Ericsson’s wording. |
| CATT | Understanding 2 |  |
| Intel | Understanding 2 |  |

**Summary Q5:**

All companies agree “UE autonomous” pre-configured MG activation/deactivation has the following understanding:

* A) measurement gap configuration parameters such as MGRP, MGL etc
* Understanding 2) NW provides pre-configures gap (A only), UE and network determines whether the pre-configured gap should be activated or not (based on pre-defined rules). For example, if the active BWP is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.

**Proposal 3: “UE autonomous” pre-configured gap has the following understanding:**

* **A) measurement gap configuration parameters such as MGRP, MGL etc**
* **Understanding 2) NW provides pre-configures gap (A only), UE and network determines whether the pre-configured gap should be activated or not, based on pre-defined rules. For example, if the active BWP is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.**

**Part 2: pre-configured gap operation**

In this section, we would like to follow RAN4 LS to get the same understanding RAN4 intends. RAN4 LS will be in the box for discussion and reference:

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| * Pre-configured MG(s) are configured per UE or per FR and cannot be changed after BWP switching |

Q6: RAN4 indicates pre-configured gaps are configured per UE or per FR. Do companies agree to introduce the support of per UE or per FR pre-configured gap?

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| **Company** | **Agree/Disagree** | **Comment if disagree** |
| Huawei, HiSilicon | Postpone | We think the UE capabilities will be discussed in RAN4 and included in the feature list as this is a RAN4-centric WI. |
| ZTE | Agree | We think pre-configure gap still have gap type (i.e. per-UE, FR1 gap or FR2 gap). And for per-FR gap, network is allowed to configure pre-configured gap for FR1 and legacy gap for FR2; or vice versa.  For UE capability, whether UE can support pre-configured gap for per-UE gap, but does not support pre-configured gap for per-FR gap, this can be up to RAN4. |
| Apple | Generally Agree and see comment | We think for UE, the support of pre-configured gap remains the same as existing measurement gap.  For the Pre-MG configuration, we believe one pre-configured gap only comprises one gap configuration from perUE, FR1 gap and FR2 gap. That is to say, it should not comprise both FR1 gap and FR2 gap together as the existing measurement gap.  [Rapp]: this is Rapp understanding as well. We can ask RAN4 for clarification if needed. |
| LGE | Agree | But we need to ask RAN4 whether FR1gap and FR2gap can be simultaneously configured as pre-configured gap. |
| DENSO | Agree | Agree with ZTE that mixed configuration with the legacy gap, in case of per-FR is to be decided by RAN4. |
| OPPO | Agree |  |
| MediaTek | Should clarify with R4 | Our understanding is that pre-configured MG could be per-UE gap or per-FR gap (i.e. pre-configured FR1 gap and/or pre-configured FR2 gap).  But whether pre-configured gap could be configured together with legacy gap is unclear. If yes, whether the mixing configuration like pre-configured FR1 gap + legacy FR2 gap is supported should also be clarified by RAN4.  [Rapp] We can check with RAN4 if legacy gap can be configured together with pre-configured gap. In addition, some companies suggest to clarify if FR1 can be configured along with FR2.  Capability part could be discussed later but what kind of operation is allowed should be clarified.  [Rapp]: agree |
| Vivo | Agree in principle | Based on the current information from RAN4, per-UE per-FR per-configured MG should be supported by UE.  Regarding the UE capability discussion, it could be decided after we complete the functional part. |
| Ericsson | Agree | A pre-configured MG should reuse the *MeasGapConfig* field. Hence, support per UE and FR. |
| Nokia | Agree | We understand per-configured MG can be per-UE or per-FR.  The Pre-MG discussed in RAN4 so far has been assumed to be assigned as single MG, and the use of Pre-MG in the context of concurrent MG operation (e.g. co-exist with legacy MG or non-pre-configured concurrent MG for a MO) is another question which need RAN4 clarification. |
| Samsung | Agree | Agree with other companies that we need some clarifications from RAN4. Whether FR1 and FR2 gap can be configured together, can pre-MG be configured with legacy gaps? We also need to know the joint considerations with multiple gaps- i.e. Can preconfigured gaps configured with multiple legacy gaps and can there be multiple pre-MG ? |
| Xiaomi | Agree | Pre-configured MG(s) can reuse the existing measurement gap configuration. Whether per-UE and per-FR pre-configured MG(s) can be configured simultaneously can be decided by RAN4. |
| CATT | Agree | But we need to ask RAN4 whether FR1 gap and FR2 gap can be configured as pre-configured gap simultaneously, and whether pre-configured FR1 (or FR2) gap and legacy FR2 (or FR1) gap can be configured simultaneously. |
| Intel | Agree |  |

**Summary Q6:**

Most companies (12/14) agree to introduce the support of per UE or per FR pre-configured gap. Further questions during the discussion are:

* a) Can FR1 gap and FR2 gap be configured simultaneously for pre-configured gap?
* b) Can legacy gap and pre-configured gap be configured simultaneously?

Rapporteur thinks that it can be further discussed within RAN2 or send LS to RAN4 for clarification.

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| * All existing MG patterns #0~25 in Rel-16 are applicable for the pre-configured MG * The common configuration parameters of pre-configured MG (e.g. MGRP, MGL, etc) are the same as those of Rel-16 legacy MG. The pre-configured MG can be configured in way similar to the configuration of the Rel-16 legacy MGs * The RRC parameter(s) used to differentiate pre-configured MG with the legacy MG are needed when pre-configured MG is being configured   + The exact signalling can be designed by RAN2 |

Q7: RAN4 indicates the pre-configured gap parameters are the same as Rel-16 legacy MG, there are different way to configure the pre-configured gap:

* Option 1) reuse legacy MG and use 1 bit to differentiate pre-configured MG
* Option 2) reuse legacy MG and use BWP status (B above in Q1) to differentiate pre-configured MG
* Option 3) not reuse legacy MG

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| **Company** | **Option** | **Comment** |
| Huawei, HiSilicon | Option 1 |  |
| ZTE | Option 1 |  |
| Apple | See comment | To our understanding, RAN4 LS only says the configuration parameters for pre-MG are the same as those of legacy MG. But it does not mention if Pre-MG reuses the legacy MG without need of introducing new gaps.We do not have strong views whether the Pre-MG reuses the legacy MG. But this kind of discussion should not happen in RAN2 thus we suggest to ask RAN4 on this matter.  [Rapp]: RAN4 left signalling part up to RAN2. Therefore Rapp think this may be stage 3 discussion but should be discuss in RAN2  In addition, if using legacy MG, as commented online, we think the 1 bit for differentiating Pre-MG should not be added inside MeasGapConfig as MeaGapConfig can comprise both FR1 and FR2 gap. Instead, the 1 bit for differentiating pre-MG should be added inside GapConfig. This can be further discussed during ASN.1 signaling design. |
| LGE | Option 1 |  |
| DENSO | Option 1 | Although it is a bit early to plunge into the ASN.1 details, we incline to Apple’s view that the one bit indication should be introduced within the GapConfig. |
| OPPO | Option 1 | Tend to agree option 1. It is not clear the relationship between pre-configured MG and legacy MG. |
| MediaTek | See comment | See our comment in Q6 and based on Apple’s reply above, we have to clarify what kind of operations are intended to be supported. To list different use cases below (not sure if it is full list…..).  Case 1: One legacy per-UE gap + One pre-configured per-UE gap  Case 2: One legacy per-UE gap + pre-configured FR1 gap and/or pre-configured FR2 gap  Case 3: legacy FR1 gap + pre-configured FR2 gap  Case 4: legacy FR2 gap + pre-configured FR1 gap  [Rapp]: This use cases will need to first clarify from RAN4 if legacy gap can be configured along with pre-configured gap. The intention of the question is to get input from companies initial preference of how pre-configured gap should be differentiated from legacy gap. |
| vivo | Option 1 | It is obvious from RAN4 LS:  “The RRC parameter(s) used to differentiate pre-configured MG with the legacy MG are needed when pre-configured MG is being configured” |
| Ericsson | Option 1 |  |
| Nokia | Postpone | We share the view from MediaTek.  If either the Pre-MG can co-exist with legacy MG or Pre-MG can be configured as one of the concurrent MGs to UE, it would be flexible to introduce a new RRC IE for pre-configured MG type. Otherwise, the legacy *MeasGapConfig* IE can be reused.  We think RAN2 should make decision based on the RAN4 conclusion on the co-existence between Pre-MG, legacy MG and concurrent MGs. We have no strong view on the options but think RAN2 should clarify co-existence cases with RAN4 first. |
| Samsung |  | Agree with Nokia that it is better to take the decision after joint consideration with other measurement gap enhancements. If there is no joint consideration, option 1 may be preferable. But better to decide after it is clear. |
| Xiaomi | Option 1. | Where the 1 bit indication should be introduced in can be discussed. |
| CATT | Option 1 |  |
| Intel | Option 1 |  |

**Summary Q7:**

Majority companies (10/14) prefer option 1 where reuse legacy MG and use 1 bit to differentiate pre-configured MG. Other companies either wants to get input from RAN4 or postpone discussion until stage 3. Rapporteur thinks that RAN4 LS indicates signalling is up to RAN2 so no need to send LS. However, we can postpone this discussion in stage 3.

**Proposal 4: Pre-configured gap configuration will reuse legacy MG and use 1 bit to differentiate from legacy gap. (can postpone discussion in stage 3)**

**Part 3: Potential solutions**

There are two main parts of pre-configured gap: (1) configuration of the pre-configured gap and (2) activation and deactivation. We try to map the case below to the LS above in highlighted yellow per our understanding. We would like to get companies view if they think RAN4 intend to support the following cases:

* Case 1: NW signals the pre-configured gap (A+B in Q1) via RRC, then using RRC to enable the feature
* Case 2: NW signals the pre-configured gap (A in Q1) via RRC, then activates/deactivates gap using RRC
* Case 3: NW signals the pre-configured gap (A in Q1) via RRC, then activates/deactivates gap using MAC CE
* Case 4: NW signals the pre-configured gap (A+B in Q1) via RRC, then UE follows BWP status (B) to activates/deactivates gap upon BWP switching
* Case 5: NW signals the pre-configured gap (A in Q1) via RRC, then UE determines whether the pre-configured gap should be activated or not upon BWP switching. For example, if it is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.

Q8: Which case(s) above do companies think are RAN4 intend to support and RAN2 should support:

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Support case(s) (RAN4 intend)** | **Support case(s) (RAN 2)** | **Comment** |
| Huawei, HiSilicon | Case 4 and 5 | Case 5 | The UE is able to determine whether the gap is needed or not as long as the rules are specified, therefore no need to extra RRC signalling to activate/deactivate.  The RRC based method is even more complicated in CA scenarios. |
| ZTE | Case 4 and 5 | Case 5 |  |
| Apple | Case 4 and 5 | Case 4 and 5 | Our understanding is for RAN2 work, Case 4 covers Case 5. And RAN2 would need to support Case 4 as requested by RAN4.  With regards to the argument to mandate the rule based Pre-MG activation/deactivation and not support the RRC signalling to activate/deactivate, it should happen in RAN4 but not in RAN2. |
| LGE | Case 4 and 5 | Case 5 | - Case 4: NW-controlled activation/deactivation.  - Case 5: rule-based activation/deactivation.  As I mentioned earlier, the rule-based solution seems sufficient.  [Rapp]: Just to make sure we have the same understanding. Here rule-based seem like referring to UE autonomous solution where no active/deactive status per BWP is sent to UE. |
| DENSO | Case 4 and 5 | At least Caser 5 | Case 4 could be supported once the scenario becomes clear. |
| OPPO | Case 4 and 5 | Case 5 | See comments in Q1. |
| MediaTek | Case 4 and 5 | Case 4 and 5 | I don’t understand why RAN4 and RAN2 will support different use cases for same feature. Companies should provide technical reason that why the RAN4 defined use cases could not be supported in RAN2. |
| vivo | Case X: NW signals the pre-configured gap (A in Q1) via RRC, then using RRC to activate/ deactivate pre-configured gap.  And Case 5 | Case X and Case 5 | I assume we should follow RAN4 decision. Otherwise, we need send LS to RAN4 for confirmation.  [Rapp]: if I understand correctly for case X from VIVO proposed TP is as follow:  [[  isPreConfiguredMG-r17 ENUMERATED {true} OPTIONAL -- Need S  activatedPreMG-r17 SEQUENCE (SIZE (1.. maxNrofBWPs)) OF ActivatedPreMGPerBWP-r17 OPTIONAL -- Need S  ]]  activatedPreMG-r17 is also signal to the UE. In this case, this can be considered (B) where activation/deactivation information is sent to the UE via RRC. This seems to be case 4. Let me know if something in case 4 that is not matching the case X you describe.  [Rapp]: I think the TP matches case 4. May be there will be different preference in stage 3 detail but in general, per BWP status (activation/deactivation) is sent to the UE. |
| Ericsson | Case 4 and 5 | Case 5 | Case 5: NW signals the pre-configured gap (A in Q1) via RRC, then UE determines whether the pre-configured gap should be setup according to pre-defined rules (e.g., when the reference signal is completely contained within the active BWP). The same rule-based principle applies when the active BWP is switched. |
| Nokia | Case 4 and 5 | Case4 and 5 | We think RAN2 should follow RAN4 LS. |
| Samsung | Case 4 and 5 | Case 5 and .. | Case 4 may be supported after clarification of Q1. |
| Xiaomi | Case 4 and 5 | Case4 and 5 | Follow RAN4’s cases. |
| CATT | Case 4 and 5 | Case 4 and 5 | We need to follow RAN4 request. |
| Intel | Case 4 and 5 | Case 4 and 5 |  |

**Summary Q8:**

All companies (13/14) except one agree RAN4 intends to support case 4 and 5 below:

* Case 4: NW signals the pre-configured gap (A+B in Q1) via RRC, then UE follows BWP status (B) to activates/deactivates gap upon BWP switching
* Case 5: NW signals the pre-configured gap (A in Q1) via RRC, then UE determines whether the pre-configured gap should be activated or not upon BWP switching. For example, if it is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.

As for companies’ preference, it is quite diverse: all 14 companies support case 5 with 7 companies support both case 4 and case 5. One company support case 4 if Q1 is clarified. Rapporteur thinks that the conclusion can be RAN2 at least will support case 5. Since all of the companies agree RAN4 intends to support case 4, and there are some support (50%), RAN2 can further discussion if case 4 is supported or to ask LS to RAN4.

**Proposal 5: At least case 5 is supported for pre-configured gap. FFS for case 4.**

* **Case 4: NW signals the pre-configured gap (A+B in Q1) via RRC, then UE follows BWP status (B) to activates/deactivates gap upon BWP switching**
* **Case 5: NW signals the pre-configured gap (A in Q1) via RRC, then UE determines whether the pre-configured gap should be activated or not upon BWP switching. For example, if it is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.**

During the email discussion, there are some suggestions to send LS to RNA4 to clarify the following:

* Can FR1 gap and FR2 gap be configured simultaneously for pre-configured gap?
* Can legacy gap and pre-configured gap be configured simultaneously?

**Proposal 6: Send LS to RAN4 to clarify:**

* **Can FR1 gap and FR2 gap be configured simultaneously for pre-configured gap?**
* **Can legacy gap and pre-configured gap be configured simultaneously?**

# Conclusion

**Proposal 1: “NW-controlled” activation/deactivation pre-configured gap has the following understanding: (doesn’t mean we need to introduce it in RAN2)**

* **A) measurement gap configuration parameters such as MGRP, MGL etc**
* **B) MG status (active/de-active) per BWP**
* **NW provides pre-configured gap (A +B above), and gap is activated/deactivated upon BWP switching. For each active BWP, whether a gap should be activated or deactivated is based on the configuration of B**

**Proposal 2: MAC-CE based activation/deactivation is FFS until RAN4 further input.**

**Proposal 3: “UE autonomous” pre-configured gap has the following understanding:**

* **A) measurement gap configuration parameters such as MGRP, MGL etc**
* **Understanding 2) NW provides pre-configures gap (A only), UE and network determines whether the pre-configured gap should be activated or not, based on pre-defined rules. For example, if the active BWP is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.**

**Proposal 4: Pre-configured gap configuration will reuse legacy MG and use 1 bit to differentiate from legacy gap. (can postpone discussion in stage 3)**

**Proposal 5: At least case 5 is supported for pre-configured gap. FFS for case 4.**

* **Case 4: NW signals the pre-configured gap (A+B in Q1) via RRC, then UE follows BWP status (B) to activates/deactivates gap upon BWP switching**
* **Case 5: NW signals the pre-configured gap (A in Q1) via RRC, then UE determines whether the pre-configured gap should be activated or not upon BWP switching. For example, if it is overlapped with SSB, then pre-configured gap is deactivated, otherwise it is activated.**

**Proposal 6: Send LS to RAN4 to clarify:**

* **Can FR1 gap and FR2 gap be configured simultaneously for pre-configured gap?**
* **Can legacy gap and pre-configured gap be configured simultaneously?**