3GPP TSG-RAN WG2 #116bis-e R2-220xxxx

eMeeting, 17th – 25th January, 2022

Agenda Item: 8.0.3

Source: MediaTek Inc.

**Title: Report of [AT116bis-e][018][NR17] Gaps Coordination (Mediatek)**

Document for: Discussion and decision

# 1 Introduction

This is report for the following AT116bis-e mail discussion.

* [AT116bis-e][018][NR17] Gaps Coordination (Mediatek)

Scope: List the relevant gap features and potential opportunities regarding commonality, parts that need coordination (e.g. common capability/overall limitation). Collect comments, e.g. on feasibility, ambition levels, what to decide now, what to postpone etc. Consider proposals from tdocs submitted to 8.0.3.

Intended outcome: Report, ambition level up to rapporteur.

Deadline: For On-Line CB W2

Deadline – Friday Week1 UTC 2300

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
| Company | Name | Email Address |
| MediaTek (Rapp) | Felix Tsai | chun-fan.tsai@mediatek.com |
| vivo | Xiaodong Yang | Yangxiaodong5g@vivo.com |
| OPPO | Jiangsheng Fan | fanjiangsheng@oppo.com |
| Huawei, HiSilicon | Lili Zheng | zhenglili4@huawei.com |
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# 3 Discussion

## 3.1 List the relevant gap features

We starting from collecting company view on which features should be discussed in this gap coordination sections. The following is listed of gap related features (modified from [2]).

**Feature 0** – Legacy measurement gap

* There are **26** measurement gap patterns defined in the specification
  + Each pattern is identified by an offset value, a measurement gap length (MGL), and a measurement gap repetition period (MGRP)
  + Some gap patterns are mandatory to be supported
  + Gap pattern 24 and 25 is used for positioning measurement only
* Two type of measurement gap is introduced.
  + (Mandatory) **per UE gap**, where the gap apply to all serving cells
  + (Optional) **per FR gap**, where one FR1 gap and one FR2 gap could be configured. FR1 gap apply to FR1 serving cells and FR2 gap apply to FR2 serving cell
* Measurement Gap is configured only by RRC and is always activated once configured
* For UE supports per FR gap, at most one FR1 gap and one FR2 gap could be configured. Otherwise, at most one per UE gap could be configured.

**Feature 1** – Pre-Configured gap

* Pre-configured gap is a measurement gap that does not always activated once configured.
* Pre-configured gap status (activated or not) is determined by which BWP is activated and other pre-defined rules specified in RAN4 SPEC.
* Pre-configured gap is configured by RRC.
* MAC CE control of activation and deactivation of pre-configured gap is **NOT** support.

**Feature 2** – Concurrent Gap

* Concurrent gaps are multiple measurement gaps, and each gap pattern could be associated with one or multiple frequency layers.
* No new gap pattern is introduced for concurrent gap, the existing R15/R16 gap pattern could be configured for the concurrent gaps.
  + Note that NTN is discussing to have more than one measurement gap, which seems to be covered by this work.

**Feature 3** – Network control small gap (NCSG)

* NCSG is a kind of measurement gap but causes small interruption to the serving cell(s) (i.e. interruption only at start and end of the MGL, not whole MGL).
* R15 gap pattern is reused (Positioning gap pattern is NOT applicable)
* The UE has to report whether it support NCSG per target band per BC

**Feature 4** – ePOS gap (Pre-configured MG for PRS)

* R1 intend to have *multiple* pre-configured measurement gaps (MG) for PRS measurement. RRC to provide the pre-configuration.
* **UL** MAC CE is used to request activate/deactivate of pre-configured PRS MG.
* **DL** MAC CE is used to activate/deactivate a pre-configured PRS MG.
* It seems that same R15/R16 measurement gap pattern will be reused
* Assuming only one activated at a given time

**Feature 5** – NTN Gap

* The agreement is unclear at this moment
* Similar to concurrent gaps but two gaps could be used for same measured frequency
* How many numbers of gap could be configured is not clear.

**Feature 6** – MUSIM gap

* MUSIM gap is the gap the UE will switch to do task from another SIM. The UE does not send or receive data from serving cell(s) of current SIM. (Similar to per-UE measurement gap)
* At most 3 MUSIM gaps (one aperiodic, two periodic) are supported
* R15/R16 gap pattern could be reused, and some additional pattern may be added for MUSIM
* The UE should request gap configuration (using assistance information) to the network
* RAN2 will **not** create MAC CE activation of gaps in MUSIM, but if the common gap discussion allows this anyway, RAN2 will not prevent that, either

**Feature 7** – UL FR2 gap

* UL FR2 gap is similar to FR2 gap but it is used for self-calibration (not measurement). DL data reception is still possible within this gap.
* New gap pattern will be defined for UL FR2 gap pattern. Similar parameters as in measurement gap (i.e., offset, length, period) will be introduced.
* Activate/deactivate FR2 UL gap by RRC (no agreement in RAN2 for MAC CE control for now)

And the following table provide a quick summary on the gap related features

**Table 1 – List the relevant gap feature**

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| --- | --- | --- | --- | --- |
| **Index** | **Gap Feature** | **Purpose** | **Activation/**  **Deactivation** | **Note** |
| 0 | Legacy gap | Measurement | By RRC | Periodic gap  Per UE or Per FR  Max 1 FR1 gap + 1 FR2 gap could be configured |
| 1 | Pre-Configured gap | Measurement | By RRC  and RAN4 Rules |  |
| 2 | Concurrent gap | Measurement | By RRC | FFS Max 2 FR1 gap + 2 FR2 gap could be configured |
| 3 | NCSG | Measurement | By RRC |  |
| 4 | ePOS gap | PRS Measurement | FFS MAC CE |  |
| 5 | NTN gap | Measurement | By RRC |  |
| 6 | MUSIM gap | MUSIM | By RRC | Only per UE gap  Max 2 periodical and 1 aperiodic gap |
| 7 | UL FR2 gap | self-calibration for FR2 cells | FFS MAC CE | Only FR2 gap |

First, let check if companies agree that above features should be discussed in gap coordination item and any high-level comment on the listed features. The rapporteur thinks this table includes all the gap features and would like to confirm with other companies.

**Question 1: Companies are invited to provide general comment on the listed features and Table 1 above. Any feature is missing or which feature is not needed to be included? Any high-level clarification on the each of the feature (with the understanding that details to be discussed in specified WI)?**

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| **Company** | **Comments** |
| vivo | For ePoS gap, RAN1 has agree MAC CE activation. Considering that the positioning requirement from UE, it is valid case, So RAN2 can just follow the agreement. FFS from MAC CE can be removed. |
| OPPO | Just correct the typo for MUSIM gap, we’re open to discuss the coordination for all the above gaps. |
| Huawei, HiSilicon | UL FR2 gap bears little relation to other gap features (others are all DL gaps and have different gap patterns with the UL FR2 gap, thus they will have separate configuration), so we think UL FR2 gap should not be discussed here. |
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Summary 1:

## 3.2 How to do gap coordination

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| **Companies** | **Proposals** |
| Ericsson [1] | Proposal 1 Use this AI to showcase the Measurement Gap Enhancements (MGE) WI progress and the solutions being discussed for each objective.  Proposal 2 Use this AI to gather the views from other Rel-17 WIs requiring gap-related improvements as possible input for the design of the MGE WI solutions.  Proposal 3 Use this AI to see to what extent it is possible to **use the MGE WI solutions to address the needs of the other WIs** requiring gap-related improvements. |
| MTK [2] | Proposal 2: RAN2 to work on **individual** RRC CR for the gap enhancement features first. |
| Huawei [4] | Proposal 1: The one thing in common among the WIs is the configuration of multiple gaps (concurrent gaps). Other features (pre-configured gaps, NCSG, gap activation/deactivation via MAC CE) are only valid in one WI, thus will not be discussed in this AI. |
| Apple [7] | Proposal 1: UL gap and MUSIM gap should be discussed **separately** from the other three gap features (NCSG, pre-MG, concurrent gap). |

On how to coordinate between different R17 gap features, some company suggest to start with individual RRC CR first and can discuss later on how to merge. Some company thinks MGE WI solutions may be able to address the gap features from other WI.

**Question 2: Companies are invited to comment on how to coordinate the gap relevant features.**

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| **Company** | **Comments** |
| vivo | We can discuss how RRC configuration is harmonized for all gap types in 8.0.3 section, i.e., which IE is enhanced and what is IE structure in R17 for all gaps.  We do not combine one topic to another topic. |
| OPPO | We believe the intention for gap coordination is trying to make the ASN.1 design simple, but this work should be carefully organised, not all type of gaps should be coordinated, for instance, MUSIM gap and UL FR2 gap are used for other purpose other than measurements, trying to combine the ASN .1 design with other type of gaps will even make the ASN.1 complex and unreadable, so in our view, the gap coordination can start within MG WI, i.e. the gap coordination for preconfigured gap, concurrent gap and NCSG. As for other type of gaps introduced in R17, individual RRC CR can be the baseline, we can further consider the ASN.1 optimization when we do the merging. |
| Huawei, HiSilicon | As we indicated in our paper, the one thing in common among the WIs is the configuration of multiple gaps (concurrent gaps). Other features (pre-configured gaps, NCSG, gap activation/deactivation via MAC CE) are only valid in one WI.  Therefore, we can try to see how the concurrent gap feature can incorporate gap features from other WIs. |
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Summary 2:

## 3.3 Commonality of gap features

In this section, we discuss the commonality of different gap features.

### 3.3.1 ePOS gap

The following are the proposals related to ePOS gap.

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| **Companies** | **Proposals** |
| Ericsson [1] | Proposal 3 Use this AI to see to what extent it is possible to use the MGE WI solutions to address the needs of the other WIs requiring gap-related improvements. For example:  a) could MUSIM or NTN gaps could be considered within Rel-17’s MGE concurrent gaps?  b) could **pre-configured positioning-specific gaps be covered by Rel-17’s MGE pre-configured gaps**? |
| MTK [2] | Proposal 1: Specify that pre-configured **PRS MG for positioning is not configured together with enhanced gap operation from MG enh. W**I (i.e. pre-configured MG, concurrent gap, or NCSG). |
| Intel [3] | Proposal 3: RAN2 to discuss the two options to move forward for ePOS and MGE measurement gap work:  - Option 1: **Decouple ePOS with MGE for pre-configured gap and concurrent gap**  - Option 2: **Reuse the same concurrent gap structure to support ePOS pre-configured gap**  Proposal 4: RAN2 to discuss NTN measurement gap in NTN WI. |

Several comments mentioned that ePOS gap may be considered as pre-configured gap or concurrent gap. Some company suggest that they should be decoupled or they should not be configured together. Rapporteur understands that ePOS gap is not discussed in RAN2 yet but maybe we can discuss based on RAN1 input.

**Question 3: Do companies think ePOS gap could be consider as pre-configured gap or concurrent gap or both ? Any view on simultaneous enabling the ePOS gap and other MGE features?**

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| **Company** | **Comments** |
| Vivo | No, we do not combine one topic to another topic  From our understanding, only two issues can be discussed in 8.0.3 section. 1) common RRC singling design for harmonize the ASN.1 and 2) simultaneous gaps configuration issue for all gap types. |
| OPPO | As mentioned in Q2, the gap coordination can start within MG WI, an individual RRC CR for ePOS gap is more desirable at this stage. |
| Huawei, HiSilicon | We think the pre-configured MG discussed in Positioning WI has the different meaning with the pre-configured MG discussed in MG enhancement.  However, the concurrent gap has already taken PRS into account. In our understanding, the positioning gap can be considered as one of the concurrent gap. |
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Summary 3:

### 3.3.2 MUSIM gap

The following are the proposals related to MUSIM gap.

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| **Companies** | **Proposals** |
| Ericsson [1] | Proposal 3 Use this AI to see to what extent it is possible to use the MGE WI solutions to address the needs of the other WIs requiring gap-related improvements. For example:  a) could **MUSIM** or NTN gaps could be considered within Rel-17’s **MGE concurrent gaps**?  b) could pre-configured positioning-specific gaps be covered by Rel-17’s MGE pre-configured gaps? |
| Intel [3] | Proposal 1: For MUSIM, **aperiodic gap can be operated independently from MG WI**  Proposal 2: For MUSIM, **periodic gap can be incorporated with concurrent gap framework** (re-use the same configuration, activation and pattern) and can be discussed in MG WI |

It seems that MUSIM gap could be consider as concurrent gap. Not sure how to deal with the aperiodic gap. Anyway, Rapporteur would like check company’s understanding on this aspect.

**Question 4: Do companies think MUSIM gap could be consider as concurrent gap? Any view on how to handle the aperiodic MUSIM gap?**

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| **Company** | **Comments** |
| vivo | No, we do not combine one topic to another topic  From our understanding, only two issues can be discussed in 8.0.3 section. 1) common RRC singling design for harmonize the ASN.1 and 2) simultaneous gaps configuration issue for all gap types. |
| OPPO | No, as mentioned in Q2, the gap coordination can start within MG WI, an individual RRC CR for MUSIM gap is more desirable at this stage. Trying to combine the MUSIM gap ASN .1 design with other type of gaps will even make the ASN.1 complex and unreadable. Especially considering the aperiodic MUSIM gap is hard to do the coordination with other type of periodic gaps. |
| Huawei, HiSilicon | Yes for periodic gaps in MUSIM, no for aperiodic MUSIM gap. Aperiodic gap can be discussed in MUSIM WI. |
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Summary 4:

### 3.3.3 NTN gap

The following are the proposals related to NTN gap.

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| **Companies** | **Proposals** |
| Ericsson [1] | Proposal 3 Use this AI to see to what extent it is possible to use the MGE WI solutions to address the needs of the other WIs requiring gap-related improvements. For example:  a) could MUSIM or **NTN gaps** could be considered within Rel-17’s **MGE concurrent gaps**?  b) could pre-configured positioning-specific gaps be covered by Rel-17’s MGE pre-configured gaps? |
| Intel [3] | Proposal 4: RAN2 to discuss NTN measurement gap in NTN WI. |
| Nokia [6] | Proposal 4: Model **NTN gaps as concurrent gaps**. |

It seems that NTN gap could be consider as concurrent gap. However, we may have to wait for more agreement from NTN section.

**Question 5: Do companies agree that NTN gap could be consider as concurrent gap?**

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| **Company** | **Agreed or not** | **Comments** |
| vivo | no | No, we do not combine one topic to another topic  From our understanding, only two issues can be discussed in 8.0.3 section. 1) common RRC singling design for harmonize the ASN.1 and 2) simultaneous gaps configuration issue for all gap types. |
| OPPO | Maybe | As mentioned in Q2, the gap coordination can start within MG WI, an individual RRC CR for NTN gap is more desirable at this stage. Maybe considering the coordination when we clearly know how NTN gap looks like. |
| Huawei, HiSilicon | No | First, there haven’t been enough agreements on NTN gaps yet.  Besides, in our understanding, the multiple NTN gaps can share one gap configuration by adding a list of gap offsets (modelled as single gap instead of concurrent gaps) since they could differ only in offsets. |
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Summary 5:

## 3.4 Maximum number of parallel gaps

There are some proposals to clarify the maximum number of parallel gaps.

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| **Companies** | **Proposals** |
| Ericsson [1] | Proposal 4 Use this activity as a means of clarifying the **maximum number of parallel (independent) gap patterns that need to be supported by the specifications**, considering all Rel-17 WIs. |
| Huawei [4] | Proposal 4: Total number of multiple gaps configured to the UE (regardless of the features enabled or the purpose of gaps) shall not exceed **the limitation set in the MG enhancement WI for concurrent MGs**. |
| Vivo [5] | Proposal4：Send **LS to RAN4** to ask whether all kinds of gap can be configured together for the UE and how to handle the gap collision if different gaps are configured together and there are overlap between them. |
| Nokia [6] | Proposal 1: RAN2 to clarify whether UE capable of concurrent measurement gaps covers any case where measurement gaps can be used concurrently (i.e. NTN, MUSIM, UL gaps). |
| Apple [7] | Proposal 2: RAN2 aims for no impact to legacy measurement gap before RAN4 concludes on simultaneous configuration on legacy measurement gap and new gaps.  Proposal 5: RAN2 should **ask RAN4** the maximum number of gaps or maximum percentage of gap duration can be configured simultaneously to UE. |

Some companies think that we should ask RAN4 and some company suggest to use the limitation of concurrent gap from MGE WI. Rapporteur thinks it may be premature to decide an exact number at this moment but anyway let’s collect companies views first.

**Question 6: Companies are invited to comment the maximum number of parallel gaps could be configured/activated (considering all R17 new gaps and legacy gap). Do you agree to ask RAN4?**

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| **Company** | **Comments** |
| vivo | We should give the initialized discussed about this question in 8.0.3 section and Send LS to ask RAN4 for the whole picture. |
| OPPO | Asking RAN4 is more desirable as RAN2 doesn’t know the co-existence rules among different type of gaps. |
| Huawei, HiSilicon | We think the maximum number shall not exceed the limitation set in the MG enhancement WI for concurrent MGs. No need to ask RAN4 since RAN4 may not be interested in coordinating the multiple features. |
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Summary 6:

## 3.5 MAC CE Control on gap activation

The following are the proposals related to MAC CE control of gap activation/deactivation.

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| **Companies** | **Proposals** |
| MTK [2] | Proposal 3: Do NOT introduce common MAC CE framework to activate/deactivate all (new) gaps. If needed, new MAC CE could be introduced in individual WI and control its own gap(s). |
| Vivo [5] | Proposal2: Whether MAC CE activation/deactivation is used can be discussed by separated WI. |

Currently, MAC CE activation/deactivation is discussed in ePOS gap and FR2 UL gap. It is not so clear whether other features should follow the same conclusion and use the MAC CE control. It seems not so straightforward to enable MAC CE control for other features. Two companies suggest that it should be discussed in related WI and should NOT simply enable MAC CE control for all gap features.

**Question 7: Do companies agree that “Whether MAC CE activation/deactivation is used can be discussed by separated WI”?**

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| **Company** | **Agreed or not** | **Comments** |
| vivo | yes |  |
| OPPO | Agree |  |
| Huawei, HiSilicon | Agree |  |
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Summary 7:

## 3.6 Other details

There are some other proposals that rapporteur think it belongs to ASN.1 code discussion. It is suggested to discuss this later.

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| **Companies** | **Proposals** |
| Huawei [4] | Proposal 2: In Rel-17, the configuration signalling of MG should consider the various combinations of these features (MG enhancement, NTN, Positioning, MUSIM) except for the case of simultaneous enabling of NTN and Positioning.  Proposal 3: Concurrent gaps can be associated to use cases. The use case can be RS type like SSB, CSI-RS, PRS, or RAT type, or specific scenario like MUSIM. |
| Vivo [5] | Proposal1: To discuss whether the common RRC gap configuration can include the following IEs  - Measurement gap ID  - Gap purpose (MUSIM, UL gap) or related RS type or Frequency or BWP/Cell  - Gap parameters  - [length, period, offset, interruption]  - Timing reference |
| Nokia [6] | Proposal 3: Add an additional gap configuration for Rel-17 gaps.  Proposal 5: Model pre-configured gaps as additional configuration within existing GapConfig.  Proposal 6: Create new gap configuration for NCSG.  Proposal 7: Model concurrent gaps using legacy per-UE/per-FR gaps together with an "additional" gap types for each case in the Rel-17 signalling.  Proposal 8: RAN2 to discuss whether the proposed configuration structure in Annex B can be used as baseline for the common configuration development. |

Finally, companies could provide other comments on gap coordination if needed.

**Question 8: Any other comments or suggestions on gap coordination?**

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| **Company** | **Comments** |
| vivo | We should give harmonized ASN.1 for all gap types. |
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Summary 8:

# 4 Conclusions

Base on the discussion in section 2, we propose the following:

**Proposal 1:**

# 5 References

[1] [R2-2201565](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2201565.zip) Gaps coordination Ericsson

[2] [R2-2201238](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2201238.zip) Discussion on gap coordination MediaTek Inc.

[3] [R2-2200221](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2200221.zip) Joint discussion for measurement gaps Intel Corporation

[4] [R2-2200292](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2200292.zip) Discussion on gaps coordination Huawei, HiSilicon

[5] [R2-2200588](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2200588.zip) Discussion on Gap coordination vivo

[6] [R2-2201057](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2201057.zip) Commonalities with measurement gaps in Rel-17 Nokia, Nokia Shanghai Bell

[7] [R2-2201109](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2201_R2_116bis-e/Docs/R2-2201109.zip) Discussion on gap features Apple