3GPP TSG-RAN WG2 Meeting #109e R2-200xxxx

eMeeting, 24th February - 06th March 2020

Agenda Item: 6.20.1.1

Source: MediaTek Inc.

**Title: Report of [AT109e][080][TEI16] NeedForGap capability (MTK)**

Document for: Discussion and decision

# 1 Introduction

This is report for the following e-mail discussion.

* [AT109e][080][TEI16] NeedForGap capability (MTK)

 Scope: Progress this based on agreements and papers above

 Intended outcome: issues resolution, solution agreements, work on CRs (for next meeting)

 Deadline: Mar 4

# 2 Discussion

## 2.1 Background

In RAN2#108, RAN2 discussed how to define the NeedForGap capability signaling in REL-16 and has the following agreement.

[R2-1914580](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CRAN2%5CDocs%5CR2-1914580.zip) Measurement gap capability information for Rel-16 UE Intel Corporation discussion Rel-16 TEI16

* For Release-16, if both the network and UE support such capability reporting, the measurement gap requirement information for NR target is reported back by the UE in the UE response to a NW configuration RRC message where this is reported based on the resultant configuration.
* Assumption: UE report *NeedForGap* capability for supported NR bands

Then in RAN2#109, the following agreement is made

[R2-2000716](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_109_e%5CDocs%5CR2-2000716.zip) Report of [108#58][TEI16] NeedForGap Signaling (MTK) MediaTek Inc. discussion

* The use of dynamic Need for gaps is configured by RRC.
* The UE includes the *NeedForGap* signalling In RRC Resume Complete, The UE always includes it.
* The UE includes the *NeedForGap* signalling In RRC Reconfiguration Complete, The UE includes the signalling if NeedForGap is changed.
* FFS if there are additional conditions (e.g. additional network control) and/or additional trigger (network request).

This offline discussion continues to discuss the open issues in NeedForGap.

## 2.2 Additional NW control on NeedForGap reporting

During the online discussion, some companies mentioned that it is desired for the NW to disable the NeedForGap reporting in RRC Reconfiguration Complete. The main reason is to avoid large RRC message size at cell edge. However, the rapporteur understand the current agreement already allow NW to do this. The dynamic reporting function is controlled by RRC, thus the NW could turn off the feature completely if it does not want UE to report it.

**Question 1: Do companies agree that the NW could deconfigure the “dynamic needForGap reporting” temporarily in order to prevent UE from sending the information?**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | Yes | Legacy networks will not be able to utilize the information from any new *NeedForGap* signalling but will suffer from the increased UL message size, and it is well-known from LTE that some network nodes may not be updated frequently and roaming causes UEs supporting different features to connect to both updated and non-updated networks. For this reason, RAN2 has always tried to ensure networks can control what UE reports. Therefore, we think NW must be able to control the message size, i.e. whether UE is allowed to include the *NeedForGap* reporting in the RRC response message. Since handovers may occur in extreme RF conditions scenarios (e.g. RACH in cell edge with bad RF conditions or during HO), allowing UEs to increase the message size when network is not expecting that may lead to failures in the UE RRC response message (e.g. *RRCReconfiguration* *complete*), which can reduce the overall system performance.However, we think the NW may deconfigure the “dynamic *needForGap* reporting” temporarily with below two options:**Option1:** add a high-level control flag *nr-needForGapsReportConfig* control field in *RRC Reconfiguration* message so that network could enable or disable the reporting of NR measurement gap information.**Option2:** If proposal for Question3 is agreed, NW may send empty list of requested band filter in *RRC Reconfiguration* message so that network could disable the reporting of NR measurement gap information.We are open to adapt Option1 or Option2. |
| OPPO | Yes  | The current agreements already support this requirement.  |
| Huawei | Yes | We also think it is already agreed according to the minutes:* The use of dynamic Need for gaps is configured by RRC.
 |
| MediaTek | Yes |  |
| Apple | Yes | The draft CR captures that in RRCReconfiguration message, nr-needForGapsReportConfig could be either disabled or enabled. We think this field is sufficient. |
| CATT | Yes | Agree with OPPO and Huawei. It is already supported based on the current agreements. Maybe we don’t need agree anything for this Q1, just based on current agreement. |
| QCOM | Yes | This behaviour is already supported. Network can enable/disable the dynamic NeedForGap as needed. |
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**Summary:** TBD

**Proposal X:**

Based on current agreement, in RRC Reconfiguration Complete, the UE only reports the NeedForGap information if it is changed. During the online discussion, some companies also pointed out that the NW may want to request the capability no matter it is changed or not. Therefore, we would like to check with companies’ view on this. Whether a new indicator is needed to force the UE to report the NeedForGap information.

**Question 2: Do companies agree to introduce an additional “NeedForGap Request” flag in RRC Reconfiguration to force the UE to report the NeedForGap information in the corresponding Reconfiguration Complete message (No matter the capability is changed or not)?**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | Maybe | If NW has prior *NeedForGap* capability and the capability is not changed from UE’s perspective, we don’t see a clear use case to force UE to report the capabilities again in normal scenarios. However, we acknowledge this could be an additional option for network but at least this should not be the default behaviour. We are open to follow majority view here. |
| OPPO | No | If the network allows the UE to report the NeedForGap information, it is up to UE decision to report or not. we do not think the network force the UE to do it. |
| Huawei | No | We think the switch on/off control in Question 1 is enough. There is no need for the UE to repeat the capability signalling if it is not changed. |
| MediaTek | Yes, but no strong view | We are OK to support the “force response” function if necessary. |
| Apple | No | We would like to understand first if NW side has retrieved NeedforGap related capability, what is the targeting case to force UE to report again with the same UE capability? |
| CATT | No with comments | We think the UE doesn’t need to report the NeedForGap information if the capability is not changed. However, we need to clarify when the UE reports the first NeedForCap information. For example, if dynamic Need for gaps is enabled by RRC and the UE never report any NeedForCap information to this gNB/cell, the UE needs to report the NeedForCap information as the first NeedForCap information regardless the NeedForGap information is changed or not. |
| QCOM | MAY BE | We don’t see a use case for this scenario other than providing a more flexible approach. If Q2 is combined with Q3, will make more sense, i.e. if network modified the target band filter, expected behaviour could be either of these two:1- UE provides the NeedForGap info in the complete message2- **or** it could beleft to the network to explicitly request the UE to provide the NeedForGap InfoNo strong opinion, we will go with the majority. |
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**Summary:** TBD

**Proposal X:**

In [2], it is proposed to have a target band filter for the NeedForGap information. To reduce message size, the UE only reports the NeedForGap information for the target bands that is configured by the NW. As it is not discussed in original e-mail discussion, it would be good to collect other companies’ view on this.

**Question 3: Do companies agree to introduce a target band filter for NeedForGap information? If the target band filter is configured, the UE only reports the NeedForGap information for the corresponding bands.**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | Yes | In current solution, *NeedForGap* indicators are included into RRC Response message, the signalling overhead is not negligible (e.g. 12 bits/per band \* N of UE supported bands).The message size grown in *RRCReconfigurationComplete* may bring coverage issue even adding high level control as proposed in Question1 (e.g. *nr-needForGapsReportConfig*). For example, in the case UE is in cell edge, it may have no opportunity to report *NeedForGap* to save the size of *RRCReconfigurationComplete* as always because of bad RF conditions (with *nr-needForGapsReportConfig=false*). Additionally, if network only supports limited bands (e.g. hardware restriction in NW), it makes no sense to ask UE to report the gap indictors for each supported target band (with big message size) which will not be used or potentially be used by network.We think it is essential to introduce the target band filter (similar as legacy LTE and NR band filter) on top of current solution to make it more future proofing (with more bands to be supported by UE), especially in NR we have up to 1024 entries for bands while only very limited bands supported by NW. |
| OPPO | No | We agreed to use the dynamic reporting for the NeedForGap information reporting. It is already reduced the singling overhead compared the semi-static reporting.We can see the necessary to reduce the signalling overhead further based on dynamic reporting mechanism (……reported based on the resultant configuration). |
| Huawei | Yes | It helps to reduce some signalling overhead. |
| MediaTek | Yes | We also think it is reasonable to have target band filter. It could reduce the signalling overhead. |
| Apple | Yes | If NW has no deployment on certain NR bands, there is no point for UE to report the NeedForGap capability on thosed bands. We think this could reduce the signaling overhead. |
| CATT |  | No strong view as the dynamic reporting has already reduced the signalling overhead. |
| QCOM | Yes | We agree with Nokia’s comment. |
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**Summary:** TBD

**Proposal X:**

In [2], it is proposed to have a potential band combination filter in the dynamic need for gap configuration. The UE reports the NeedForGap information not only for current band combination, but also for the “potential” band combination provided in the list. The motivation is to allow NW to know the gap capability before inter-band handover or adding a new SCell.

**Question 4: Do companies agree to introduce a “potential band combination list” in the dynamic NeedForGap configuration? The UE reports the NeedForGap information not only for current band combination but also for the “potential” band combination provided in the list.**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | Yes | In legacy LTE NeedForGap design, it is feasible for NW to know the gap capability for potential band combination list before inter-band handover or adding a new SCell, while current NR solution disable this possibility, which will bring measurement configuration restrictions or ambiguity in NW.Two scenarios need to be considered if NW has no measurement gap information for the “target” resultant configuration:**1. For Handover**Target node cannot configure proper inter-freq measurements in handover command until UE report the cap capability to target cell after handover completed.**2. For Scell Addition** NW cannot properly handle existing inter-freq measurements in *RRCReconfiguration* message (i.e. to add the Scells) until UE report the cap capability to NW after Scell addition completed. During Scell addition, NW has to blindly configure gap for existing inter-freq measurements as NW has no measurement gap information for the resultant configuration after Scell addition. (e.g. When UE is configured with 1 carrier with inter-freq measurements and NW don't know the gap capability of 2 carriers, NW has to blindly keep or modify measurement gaps for existing measurements when adding Scell).The ambiguity handling of measurement gap in Scell addition will cause UE either cannot measure the inter-freq object or add unnecessary extra gap.  |
| OPPO | No  | We should avoid making this too complex. |
| Huawei | No | It adds complexity to the configuration and reporting procedure. |
| MediaTek | No | The mechanism is too complicate and somehow violate the principle of dynamic reporting. The UE reports the gap capability based not only on the current band combination but also other L1 parameters. The new added “potential” BC has only partial information of “potential” new resultant configuration. We don’t think this a good approach in dynamic reporting.For the concerns raised by Nokia, we think the NW will anyway get latest information after handover or SCell addition. There is only short period that UE “cannot measurement” or “there is unnecessary gap”, We do not consider that as essential issue and prefer to keep thing simple in R16. If necessary, we could discuss this enhancement in R17. |
| Apple | No | First, we think this is a quite complicated optimization which should not be considered at this stage. Second, for handover case, can’t we use the common procedure to let UE report the NeedForGap in RRCreconfigurationcomplete to target gNB? This is the same as normal RRCreconfiguration proceudre and we don’t see why further optimization is required in this scenario. |
| CATT | No | It will introduce additional signalling overhead and complexity. |
| QCOM |  | No strong view. |
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**Summary:** TBD

**Proposal X:**

## 2.3 Need for gap reporting content

The following is the proposed ASN.1 define for NR need for gap reporting content in the draft CR.

NeedForGapsInfoNR ::= SEQUENCE {

 intraFreq-needForGap ENUMERATED {gap, no-gap}

 interFreq-needForGapsFR CHOICE {

 needForGapsFR ENUMERATED {all, FR1-band, FR2-band, none},

 needForGapsBandlistNR NeedForGapsBandlistNR

 }

}

There are 2 aspects that are fully discussed and it would be better to get more companies’ comment on this.

The first one related to measurement gap requirement information on intra-frequency measurement. Unlike LTE, the NR intra-frequency may require measurement gap depending on BWP configuration. During the discussion, it is pointed out that some UE may be able to perform gapless measurement even if SSB is outside current active BWP. There is however no consensus on whether intra-frequency and inter-frequency measurement on the same band will have the same needForGap capability. So, it is proposed to have a separate capability bit for NR intra-frequency measurement.

**Question 5: Do companies agree to introduce a separate capability bit for NR intra-frequency measurement (e.g. intraFreq-needForGap)?**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | No | We agree the intention to indicate *NeedForGap* for intra-frequency measurement, while we are wondering why introduce a separate capability bit for intra-frequency.In proposed CR, as the UE will report the band indicator related to each NeedForGap together with at least “current” serving cell’s resultant configuration, we think it can indicate *NeedForGap* for either inter-frequency or intra-frequency measurement.NeedForGapsNR ::= SEQUENCE { bandNR FreqBandIndicatorNR, gapIndication ENUMERATED {gap, no-gap, spare2, spare1}} |
| OPPO | No  | Agree with Nokia. |
| Huawei | Intra-frequency capability should be included. Slightly prefer one indication for both intra and inter-frequency. | In LTE, the *NeedForGap* indication is per-band. Intra-freq is not involved in *NeedForGap* because intra-freq measurements can always be performed without gaps in LTE. The reason why intra-freq measurements in NR sometimes need gaps is that SSB can be outside of the active BWP. Therefore, we should not exclude the intra-frequency cases.As for the signaling design, we agree with Nokia that the indication could be per-band. |
| MediaTek | Yes | We think that gap is used mainly for inter-frequency case and only limited case of intra-frequency measurement requires gap, so we should not focus the discussion for intra-frequency. For the same target band, whether the intra-frequency and inter-frequency could reuse the same capability is highly depends on UE implementation. If we want to consider intra-frequency measurement too, we think a separate capability bit is needed. |
| Apple | No | As explained by rapporteur, the intra-frequency measurement may need gap or not depending on BWP configuration, we think if BWP switching is taken into account for NeedForGap determination, it might get too dynamic.To our understanding, if some BWP configuration requires gap for intra-frequency meas and some does not, UE should better indicate “gap” to accommodate the worst case. |
| CATT | No | Agree with Nokia. |
| QCOM | No strong view |  |
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**Summary:** TBD

**Proposal X:**

The second one related to grouping of the target bands based on FR1 and FR2. To save the message size, it is proposed that the UE could report single measurement gap requirement information for all FR1 bands or all FR2 bands (if it requests gap for all bands in FR2). Please note that this may be related the mechanism in Question 3 (target band filter). It may need further clarification if both proposals are agreed.

**Question 6: Do companies agree that the UE could report measurement gap requirement information for FR1 bands and/or FR2 bands (i.e. with granularity of frequency range instead of per band)?**

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| **Company** | **Yes/No** | **Comments** |
| Nokia | No | We prefer proposal in Question3(target band filter) to control the message size as legacy LTE/NR by using band filter in capability enquiry. With granularity of frequency range (FR1/FR2) instead of per band, UE doesn’t have the flexibility to inform network about this capability with a higher granularity, for example, if UE want to specify FR-1 needs gap, but some of the FR1-bands can be gapless. However, on top of target band filter, we are open to support it if majorities want to have this high-level flag. |
| OPPO | Yes  | It can reduce the signalling overhead. |
| Huawei | Yes | Same view with OPPO. |
| MediaTek | No | With the proposal in Q3, we think that this FR1/FR2 group does not help much to reduce the signalling overhead. Combine the 2 proposals may require some further clarification. For example, if UE does not request gap for all the requested target FR1 bands but it may need gap for some other bands, could the UE report gapless measurement for FR1 bands?We thus prefer a NW configured target band filter instead of UE grouping based on FR1/FR2 if possible. |
| Apple | Yes | This design could reduce signaling overhead. |
| CATT | Yes | The signalling can be further reduced. |
| QCOM | No strong view |  |
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**Summary:** TBD

**Proposal X:**

## 2.4 Other comments

We have uploaded a draft 38.331 CR based on current agreement. The only changed is remove the condition to report NeedForGap in handover case. Except for the above open issues (Q1 to Q6), companies are invited to provide any other comment or suggestion on the 38.331 CR.

**Question 7: Any other comments or suggestion on current 38.331 CR?**

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| **Company** | **Comments** |
| Nokia | No.  |
| Huawei | There’s an FFS in the minutes:* The use of dynamic Need for gaps is configured by RRC.
* The UE includes the *NeedForGap* signalling In RRC Resume Complete, The UE always includes it.
* The UE includes the *NeedForGap* signalling In RRC Reconfiguration Complete, The UE includes the signalling if NeedForGap is changed.
* FFS if there are additional conditions (e.g. additional network control) and/or additional trigger (network request).

We prefer to clearly list the scenarios that could lead to *NeedForGap* capability change, e.g.:**The UE includes the *NeedForGap* signalling in RRC Reconfiguration Complete when the capability is changed, due to e.g. the function is enabled for the first time, handover, SCell addition/release, change of L1 parameters.**It could be in the chairman notes, not necessarily in the 38.331 CR. The intention is to provide clear guidance to the UE, to make sure the network and UE are on the same page regarding when to expect the signalling. We are open on this. If most companies think it is common understanding and no need to capture, it’s ok for us. |
| Apple | In RRCReconfiguration message, in the field description for *nr-needForGapsReportConfig****,*** “and *RRCResumeComplete*” could be removed.Similarly, in RRCResume message, in the field description for *nr-needForGapsReportConfig****,*** “*RRCReconfigurationComplete and*” could be removed. |
| QCOM | For the FFS item, we support Huawei proposal, as we should allow UE to report any change to the network, e.g. due to L1 change or HO trigger or SCell addition/release.  |
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**Summary:** TBD

**Proposal X:**

# 3 Conclusions

Base on the discussion in section 2, we have the following proposals:

# 4 References

[1] R2-2000716, “Report of [108#58][TEI16] NeedForGap Signaling (MTK)”, MediaTek

[2] R2-2001445, “Discussion on FFS issue in NR SA NeedForGap Signalling”, Nokia