**3GPP TSG-RAN WG2 #129** ***draft***

Athens, Greece, 17 – 21 February 2025

**Agenda item: 7.2**

**Source: MediaTek Inc. (Rapporteur)**

**Title: Discussion on the feature set granularity in pdcch-RACH-AffectedBandsList-r18**

**Document for: Discussion and decision**

# 1 Introduction

This email discussion is to try to reach conclusion on the following email discussion.

* [POST129][034][LTM] LS to RAN4(Mediatek)

 Intended outcome: Agree to LS for RAN4 identifying RAN2 interpretation options and asking RAN4 for feedback

 Deadline: March 4th

In RAN2 #129 meeting, RAN2 discussed the ambiguity of UE capability *pdcch-RACH-AffectedBandsList-r18* and agree to clarify that for the bands which UE does not support PDCCH ordered RACH for LTM, the corresponding element is meaningless, regardless of whether the UE reports *noInterruption* or *interruption* for that element.

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| * For those bands indicated in appliedFreqBandListFilter where the UE does not support PDCCH-ordered RACH towards target bands for LTM (which can be further indicated by rach-EarlyTA-Measurement-r18), it is up to UE implementation to select noInterruption or interruption for that element of pdcch-RACH-AffectedBandsList-r18, and such indication does not represent anything.
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A CR (R2-2501558) was prepared to clarify this in TS 38.306. However, during an unofficial offline discussion, companies raised separate concerns about the definition of feature set granularity. Different understandings may impact the wording of the CR. Therefore, the CR is postponed and RAN2 would further discuss the definition and see whether to send an LS to RAN4 for clarification.

# 2 Contact points

*Participants in the email discussion are requested to complete the following table.*

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Ericsson | Antonino Orsino | antonino.orsino@ericsson.com |
| Huawei, HiSilicon | David Lecompte | david.lecompte@huawei.com |
| Xiaomi | Yujian Zhang | zhangyujian@xiaomi.com |
| CATT | Rui Zhou | zhourui@catt.cn |
| MediaTek | Xiaonan Zhang | xiaonan.zhang@mediatek.com |
| ZTE | Liujing | liu.jing30@zte.com.cn |
| LG Electronics (LGE) | Siyoung Choi | see0.choi@lge.com |
| Nokia | Jedrzej | jedrzej.stanczak@nokia.com |
| vivo | Chenli | Chenli5g@vivo.com |

# 3 Discussion

## 3.1 Background

The UE capability *pdcch-RACH-AffectedBandsList-r18* has feature set granularity with a list of bands:

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| ***pdcch-RACH-AffectedBandsList-r18***Indicates whether UE may cause interruption on DL slot(s) on serving cells due to PDCCH-ordered RACH transmission towards target bands.Each "source-target" pair indicates the band pair between the target band for RACH transmission and band under UE's current band combination.The target bands only consist of the bands indicated in *appliedFreqBandListFilter*. They are listed in the same order as in *appliedFreqBandListFilter* and the first entry correspond to the first entry on *appliedFreqBandListFilter* and so on. |

For each reported capability of *pdcch-RACH-AffectedBandsList-r18* (per FS), there is a band list with the equal length of *appliedFreqBandListFilter*, which is mirrored from the *FreqBandList* indicated by the network. According to TS38.331, for each component of the list, there is an ENUMERATED with two values {*noInterruption*, *interruption*}.

FeatureSetDownlink-v1830 ::= SEQUENCE {

 -- R4 39-4: Interruption on DL slot(s) due to PDCCH- ordered RACH transmission

 pdcch-RACH-AffectedBandsList-r18 SEQUENCE (SIZE (1..maxBandsMRDC)) OF ENUMERATED {noInterruption, interruption} OPTIONAL,

 Irrelevant IE has been omitted

}

The feature set granularity is defined as “per band per band combination” in TS 38.306. It means one specific band among the indicated band combination. In the following examples, Rapporteur would like to use “[A,**B**,C]” **(use bold to mark B)** to represent the FS of band B in band combination [A,B,C] for simplicity. As the indicated band list of this capability, Rapporteur would like to use list (A,B,C,D,E,F,G) to represent *noInterruption to band B and E*, while *interruption* to other bands A,C,D,F,G for simplicity.

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| For example, for [A,**B**,C]=> (A,B,C,D,E,F,G), it represent in the feature set of “band B in band combination [A,B,C]”, the reported list includes 7 bands as components. For the second (B) and fifth (E) components, UE indicated *noInterruption*, for the rest of the components, UE indicated *interruption.*  |

## 3.2 Different options of understanding

Since the unofficial offline started very late in Friday morning and not all companies joined the discussion. Rapporteur would like to first explain the different understandings for the feature set structure in this capability among companies:

**Understanding 1:** **Band list is for target bands.** **Per band of BC is the source band to perform RACH. The interruption is for all bands in the current band combination.**

For example: For UE report [A,**B**,C]=> (A,B,C,D,E,F,G)

It indicates in band combination [A,B,C], if source band B perform early RACH to band B or E, there is no interruption. If source band B perform early RACH to band A,C,D,F,G, there is interruption. **The interruption is for all bands in the current band combination (All serving bands will be interrupted)**.

The same rule applies to other FSs (e.g., [**A**,B,C] and [A,B,**C**]).

**Understanding 2:** **Band list represent which source band within the current BC does not have interruption.** **Per band of the BC is the source band to perform RACH to any target band (no differences to those target band).**

For example: For UE report [A,**B**,C]=> (A,B,C)

It indicates in band combination [A,B,C], if source band B perform early RACH to any target band, then source band A and source band B have no interruption, while source band C has interruption.

The same rule applies to other FSs (e.g., [**A**,B,C] and [A,B,**C**]).

**Understanding 3: Band list is for target bands. Per band of the BC is the source band which have interruption or not. Different FSs of the same BC need to be considered together. There is no information of which source band UE perform RACH.**

For example: For UE report

[**A**,B,C]=> (A,B,C,D,E,F,G)

[A,**B**,C]=> (A,B,C,D,E,F,G)

[A,B,**C**]=> (A,B,C,D,E,F,G)

(Looking into the **first column** of the band lists) It indicates in band combination [A,B,C], if UE perform early RACH to target band **A** (the same band), then source band A has no interruption, while source band B and C has interruption.

(Looking into the **second column** of the band lists) It indicates in band combination [A,B,C], if UE perform early RACH to target band **B** (the same band), then source band B and band C has no interruption, while source band A has interruption.

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(Looking into the **fourth column** of the band lists) It indicates in band combination [A,B,C], if UE perform early RACH to target band **D**, then source band A, B, C has interruptioln.

(Looking into the **fifth column** of the band lists) It indicates in band combination [A,B,C], if UE perform early RACH to target band **E**, then source band A, B, C has no interruption.

…

## 3.3 Analysis and discussion

Rapporteur’s understanding is:

1. Understanding 1 follows the legacy method for UE to indicate FS capability. **The interruption applies to the total band combination of the UE's current BC.** Rapporteur think it follows a similar rule as the legacy measurement capabilities, where the UE may experience interruptions to all source cells/bands when performing measurements on the target. Therefore, this may not be an issue.
2. In Understanding 2, the band list represents the source band with or without interruption, and the band of the BC represents the source band to perform early RACH. This capability does not provide information about the target band and it is a great waste to use the length of the whole *appliedFreqBandListFilter* (maximum 1024 bands) to indicates only current band combination. I.e., In the band list, only for the elements inside the current BC is useful, while the elements for all other bands are meaningless.

Moreover, In the RAN4 Feature list, this capability granularity is defined as “Per band pair per band combination (between the target band for RACH transmission and band under UE’s current band combo)”. **Indicating only source band information may not align with RAN4's understanding, which seems incorrect from the rapporteur point of view.**

1. Understanding 3 is not the regular method to indicate FS capability, and the network needs to **consider all FS groups for one BC to understand UE capability**. **It provides additional information on which source band has interruptions or not, but it does not provide information on which source band the UE performs early RACH.** This is the trade off between understanding 1 and 3.
	1. If choosing understanding 1, it means UE has interruption (or not) on all source band when performing early RACH to one target band. Correspondingly, UE can indicate the information of which band to perform early RACH to the target.
	2. If choosing understanding 3, it means UE can report which source band in the current BC has interruption (or not) when performing early RACH to one target band. Correspondingly, UE cannot indicate which source band that performs early RACH to the target.

Since not all companies join the unofficial offline discussion, companies are invited to show/double check their understanding and see how/whether to form a LS. Let's see if we can exclude some interpretations to avoid making the LS overly complex.

* Option 1: Check with RAN4 for all understanding 1, 2, 3.
* Option 2: Confirm that the indicated band list for each FS is for target bands, and only check with RAN4 for understanding 1 and 3.
* Option 3: Confirm the legacy way of FS report (understanding 1), and no need to send LS to RAN4. Revisit the CR R2-2501558 for the ambiguity issue in the next RAN2 meeting.

Companies are also welcomed to provide any other options or comment, including pros and cons analysis for the three understandings.

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| Company | Options | Comments. |
| Ericsson | Option 3 | Our view is that understanding 1 is the correct interpretation of the capability and we would be also okay to not send any LS. |
| Huawei | Option 2 | This UE capability is coming from RAN4 so RAN4 should have the final decision. |
| Xiaomi | Option 3 | Our view is that understanding 1 is correct. Understanding 2 is not aligned with the description of the feature: “The target bands only consist of the bands indicated in *appliedFreqBandListFilter*” since only band in current band combination is indicated as target band in understanding 2.Understanding 3 is not the usual way of signalling the capability. If RAN4 intended to do so, they should have already indicated it clearly in the feature list.With above analysis, we don’t think sending LS to RAN4 is needed. But we’re OK to follow majority view. |
| CATT |  | In general understanding 1 is correct. but I am confused with the sentences highlighted below, **Understanding 1: Band list is for target bands. Per band of BC is the source band to perform RACH. The interruption is for all bands in the current band combination.**For example: For UE report [A,**B**,C]=> (A,B,C,D,E,F,G)It indicates in band combination [A,B,C], if source band B perform early RACH to band B or E, there is no interruption. If source band B perform early RACH to band A,C,D,F,G, there is interruption. **The interruption is for all bands in the current band combination (All serving bands will be interrupted)**.It reads like: If source band B perform early RACH to band A,C,D,F,G, there is interruption to source band B, A,and C.?But my understanding is there is interruption to source band B. otherwise there will be conflicts between source bands if for each source band(A,B,C) UE report different values for a certain target band.[Rapp]: In understanding 1, the indicated source band only indicates the source band/cell that perform RACH to the target. So if [**A**,B,C] and [A,B,**C**] report different value than [A,**B**,C], it only mean using different source cell to perform RACH have different outcomes.Please check if understanding 3 is more in line with you. |
| MediaTek | Slightly prefer Option 2 | Although regular FS report way is understanding1, this feature may be a little bit special as it is defined as “per band pair (1 source +1 target) per BC” in RAN4, not regular “per band per BC”. As Huawei mentioned, RAN4 have the final decision on this and we may need to ask them between understanding 1 and 3.Once this is clear, it is also beneficial to update the wording of spec for clarity. |
| ZTE | Ok with Option 2Not ok with Option 3 | As we know, RAN4 haven’t considered CA/DC case when discussing this feature. Among the different understandings, we are ok to drop Understanding 2 since it cannot reflect the “target band”. In addition, for option 1, the other interpretation could be “only PCell band” is interrupted, which is more aligned with RAN4’s “band pair” concept. So, if only option 1 and option 3 are kept, we prefer to reword them as below: (Note that understanding 1.1 is added to indicate the interruption on source band only, we are open whether to include this one)**Understanding 1: The band list represents the target bands. Per band of BC is the source band (or PCell) on which PDCCH order is sent to trigger RACH. The value “interruption” means that interruption is needed for All serving bands of the current band combination.****Understanding 1.1: The band list represents the target bands. Per band of BC is the source band (or PCell) on which PDCCH order is sent to trigger RACH. The value “interruption” means that interruption is needed for the source band (i.e. PCell and SCell of the same band), there is no interruption for other SCells.****Understanding 3: The band list represents the target bands. Per band of the BC is the source band which have interruption or not. Different FSs of the same BC need to be considered together. This does not differentiate which source band (or PCell) that triggers PDCCH order-based RACH.**Alternatively, considering RAN4 people may not be familiar with RAN2 signalling structure. Instead of listing the understandings, we can just ask some general questions about the capability requirement, and RAN2 can work on the signalling after receiving their feedback. For example, we can ask:**Question 1: For FG39-4 (*pdcch-RACH-AffectedBandsList-r18*), in case the UE is configured with CA/DC band combination, for a given target cell/band that UE transmits RACH preamble to, whether the interruption (or no interruption) requirements on different serving cells/bands can be different (e.g. some serving bands need interruption, some don’t)? And whether the interruption only happens on PCell’s band?****Question 2: On top of question 1, for a given target cell/band, whether the interruption requirement on serving cells/bands changes when the PCell’s band which sends PDCCH order changes?**(If answers “No” to first part of Q1, it means understanding 1 or 1.1 can be adopted. If answers “Yes” to first part of Q1 and “No” to Q2, it means understanding 3 should be adopted. If answers “Yes” to first part of Q1 and “No” to Q2, it means both understanding 1 and 3 are not enough, additional capability signalling will be needed.)  |
| LGE | Option 2 | It seems Understanding 1 is correct. But, in the example of Understanding 1, early RACH to band B may interrupt on a serving band other than the source band (e.g., A or C). We wonder if it is problematic. Hence, it would be good to consult with RAN4 on this issue for clarification. |
| Nokia | Option 3 | We agree that Understanding 1 should apply here (also fine with ZTE’s clarification denoted as Understanding 1.1). We would be fine not to send the LS, but instead rework the CR. |
| vivo | Prefer Option 2,Option 3 is also fine, but some questions still need to check with RAN4 | Agree with the above that understanding 1 is correct for the FS capability. However, in our view, is seems a little strange that the all source bands in the BC has the same interruption operation for this UE capability. For example, [A,**B**,C]=> (A,B,C,D,E,F,G), we think band A and B, C may not have the same RF requirement, thus whether there is interruption when UE performs early RACH on A to target band E may be different from the case when UE performs early RACH on B to target band E. Besides, we want to clarify whether the below interpretation for the understanding 1 is correct: if UE’s PCell is in source band A or B or C, there is no interruption when UE performs early RACH on band A or B or C to band B or E, and there is interruption when UE performs early RACH to band A,C,D,F,G. Furthermore, as ZTE proposed, whether the interruption is only in PCell band or all serving bands in the same CG or all serving bands should be clarified. |

The LS will be provided few days later based on the outcome of the email discussion.

# 4 Conclusion