3GPP TSG-RAN WG2 #121bis R2-2304199

eMeeting, 17th Apr. – 26th Apr 2023

Agenda Item: 7.25.1

Source: MediaTek Inc.

**Title:** **Report of** **[AT121bis-e][023][MGE] Measurements without gap with interruption**

Document for: Discussion and decision

# 1 Introduction

This is report for the following AT121bis-e mail discussion.

* [AT121bis-e][023][MGE] Measurements without gap with interruption (MediaTek)

Scope: Converge on solution. If possible, revise draft CRs to be agreeable. If needed produce a reply LS (intel, Catt).

Intended outcome: Report, endorsed CRs (if possible), approved LS out - if needed

Deadline: EOM (CB online only if needed, otherwise offline only).

Deadline – Tuesday (04/25), 0500 UTC

There may be a need to comeback online, so please provide your initial comment before **Tuesday (04/25), 0500 UTC**. Early feedback is appreciated.

# 2 Contact Points

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

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| MediaTek (Rapp) | Felix Tsai | chun-fan.tsai@mediatek.com |
| Qualcomm Inc | Mouaffac | [mambriss@qti.qualcomm.com](mailto:mambriss@qti.qualcomm.com) |
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# 3 Discussion

## 3.1 Backward Compatibility

The current discussion note is as below:

[R2-2302431](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2302431.zip) LS on measurements without gap (R4-2303306; contact: Intel, CATT) RAN4 LS in Rel-18 NR\_MG\_enh2-Core To:RAN2

Moved from 7.25.3

* Noted

[R2-2303103](file:///D:\Documents\3GPP\tsg_ran\WG2\RAN2\2304_R2_121bis\Docs\R2-2303103.zip) Discussion on NeedForGaps with interruption Huawei, HiSilicon discussion Rel-18 NR\_MG\_enh2-Core

[R2-2302776](file:///D:\Documents\3GPP\tsg_ran\WG2\RAN2\2304_R2_121bis\Docs\R2-2302776.zip) Discussion on RAN4 LS for Rel-18 measurement gaps Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MG\_enh2-Core

DISCUSSION

- MTK think both approaches work (Nokia vs Huawei). Prefers the simpler HW approach but ok in general. HW approach is reflected in the proposed CRs below.

- Nokia think that the issue with legacy is semantical UE indicate gaps when it need interruption.

- MTK and Nokia both think there is a difference of opinion how to interpret the R16 behaviour (and they have different opinions). There is no intention to resolve that part in R2.

- Apple prefer R16 extension, seems to work, but also agrees with Nokias explanation.

- ZTE wonder what is meant by R16 ext, isn’t that the Nokia proposal?

- CATT think we need no update of R16 behaviour ..

- Chair: There seems to be confusion on the detailed level what is proposed.

* Both Noted
* In the current R2 discussion/CRs there is no intention to change legacy definitions or behviour (It is understood that there may be difference of opinions).

RAN2 concluded there is no intention to change legacy behavior (although there may be different view). There should be no further discussion on the meaning of R16 (or R17) fields.

However, during the discussion, some company seems have different understanding on what UE should indicate the Rel-16 fields while the UE reporting new Rel-18 indicator on interruption is needed or not. From rapporteur point of view, it is clear from the LS (see below) that RAN4 are discussing the scenario of “UE report “no-gap” and there is additional capability signaling request to differentiate interruption is needed or not for this scenario.

|  |  |
| --- | --- |
| 1. **NR SSB-based inter-frequency and intra-frequency measurements without gaps**   Firstly, for the case of the NR SSB based inter/intra-frequency measurement without gap when UE report “no-gap” via *NeedForGapsInfoNR (Rel16),* RAN4 has discussed this issue and reached the following agreement:   |  | | --- | | **<Agreement in R4#105>**   * Introduce additional Rel-18 UE signalling to differentiate UE supporting no gap with interruption |   Therefore, RAN4 would like to ask RAN2 to introduce additional Rel-18 UE signalling to enable the UE to indicate to the NW whether interruption is needed for the case of NR SSB based inter/intra-frequency measurement without gap. |

It should be nature to assume the UE also indicating no-gap in Rel-16 NeedForGap signaling while new interruption indicator is reported (as proposed by several companies).

Companies are invited to provide view on this aspect. In particular, do you think there is compatibility issue here.

**Question 1: Do companies agree that UE reporting Rel-18 signaling to indicate “no-gap with interruption” or “no-gap without interruption” should also report “no-gap” in Rel-16 NeedForGap signaling?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agreed or not** | **Comments** |
| MediaTek | Agreed | We understand this is original intention from RAN4.  Legacy gNB who doesn’t understand the Rel-18 fields will just assume measurement gap is NOT needed. It is unclear whether there is interruption, but it doesn’t matter. The situation is the same as handling Rel-16 UE reporting no-gap. Note that there is no R16 RAN4 requirement for Rel-16 NeedForGap feature and that’s why RAN4 is discussing the requirement in this Rel-18 WID.  It is strange for a UE to indicate no gap needed (with interruption) in Rel-18 capability but indicating gap is needed in Rel-16 capability.    If companies have strong concern, we can also consider independent reporting of Rel-18 and Rel-16 capability. |
| Qualcomm Inc | Check comment | In case we agreed on having the Rel-18 extension as part of Rel-16/Rel17, then we need to make sure both reported IEs are consistent. |
|  |  |  |
| CATT | Agree | Considering legacy gNB also needs to know the no-gap information from UE side and only R16 IE could be interpreted, we think this behaviour is right. |
| OPPO | Agree | Share the similar view with Rapporteur. |
| ZTE | Agree | We agree with the proposal, but we think the question is when Rel-18 reporting is not configured, can the UE still report “no gap” in Rel-16 NeedForGap signalling if the UE does not support no gap without interruption?  [Rapp] When Rel-18 reporting is not configured, the UE follows Rel-16 behavior. There is no intention to clarify whether Rel-16 “no-gap” indicator including interruption or not. |
| Huawei, HiSilicon | Agree |  |
| Apple | Agree | We commented online that UE can report “gap” in this case to meet the legacy gNB’s demand. However, after a second thought, we realized that it is a new requirement to Rel-18 UE. In order to do so, Rel-18 UE needs to repot two different indications to Rel-18 gNB (no-gap with interruption in Rel-18 field, and no-gap in Rel-16 field) and Rel-16 gNB (with gap in Rel-16 field). It is not desirable from UE implementation.  Our understanding now is legacy network may have to accommodate the interruption UE may have if UE reports “no-gap” to Rel-16 network. |
| Intel | Agree | We understand this is RAN4 intention to introduce no-gap with/without interruption in Rel18. They will need to be consistent in Rel16 as well. |
| Samsung | Agree |  |
| Xiaomi | Agree |  |
| vivo | Comments | We understanding the reporting should be based on the network enabler, if the network enables R18 capability reporting, the UE can just follow and it also means it is R18 network.  The important part is how to design the enabler from the Network side.  [Rapp] Thanks for the comment. Control Flag is discussed in Q3. |
| LGE | Agree |  |
| Ericsson | Agree |  |
| Nokia, Nokia Shanghai Bell | Depends on signalling | As ZTE indicated, this depends on how the request is done and the chosen signalling option. This seems to be only valid for option 1 and option 3 – if we go with option 2, there is no such issue.  [Rapp] To clarify, this is more related to Option 3 (in Q2). For option 1 and option 2, we can somehow make it independent.  We would remind that the intent is not to change the legacy behaviour. Therefore, we will not accept any proposal that would re-interpret the existing “no-gaps” behaviour as allowing interruptions – that is not what the current RAN4 requirements allow. |

Summary

A clear majority agree that UE reporting Rel-18 signaling to indicate “no-gap with interruption” or “no-gap without interruption” should also report “no-gap” in Rel-16 *NeedForGap* signaling. Some company also mentioned this depends on signaling design (i.e. discussion in Q2 and onwards). Rapporteur thinks probably there is no need to make standalone proposal here. The proposal for Q1 will be combined with other questions.

## 3.2 NR Solution

For NR, according to contribution from companies, there could be several different options to introduce new capability to indicate the interruption is needed or not.

* **Option 1 (new R18 reporting)**: Introduce *NeedForGapsInfoNR-r18*, i.e. {gap, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 2 (new R18 reporting, including NCSG)**: Introduce *NeedForGapNCSG-InfoNR-r18*, i.e. {gap, ncsg, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 3 (extend the R16 reporting)**: Introduce a new *NeedForInterruptionInfoNR-r18* IE to indicate whether interruption is needed when UE reports no-gap in *NeedForGapsInfoNR-r16*.

Sample ASN.1 code for option 1

NeedForGapsInfoNR-r18 ::= SEQUENCE {

intraFreq-needForGap-r18 NeedForGapsIntraFreqList-r18,

interFreq-needForGap-r18 NeedForGapsBandListNR-r18

}

NeedForGapsIntraFreqList-r18 ::= SEQUENCE (SIZE (1.. maxNrofServingCells)) OF NeedForGapsIntraFreq-r18

NeedForGapsBandListNR-r18 ::= SEQUENCE (SIZE (1..maxBands)) OF NeedForGapsNR-r18

NeedForGapsIntraFreq-r18 ::= SEQUENCE {

servCellId-r18 ServCellIndex,

gapIndicationIntra-r18 ENUMERATED {gap, no-gap-with-interruption, no-gap-no-interruption}

}

NeedForGapsNR-r18 ::= SEQUENCE {

bandNR-r18 FreqBandIndicatorNR,

gapIndication-r18 ENUMERATED {gap, no-gap-with-interruption, no-gap-no-interruption}

}

Sample ASN.1 code for option 2

NeedForGapNCSG-InfoNR-r18 ::= SEQUENCE {

intraFreq-needForNCSG-r18 NeedForNCSG-IntraFreqList-r18,

interFreq-needForNCSG-r18 NeedForNCSG-BandListNR-r18

}

NeedForNCSG-IntraFreqList-r18 ::= SEQUENCE (SIZE (1.. maxNrofServingCells)) OF NeedForNCSG-IntraFreq-r18

NeedForNCSG-BandListNR-r18 ::= SEQUENCE (SIZE (1..maxBands)) OF NeedForNCSG-NR-r18

NeedForNCSG-IntraFreq-r18 ::= SEQUENCE {

servCellId-r18 ServCellIndex,

gapIndicationIntra-r18 ENUMERATED {gap, ncsg, no-gap-with-interruption, no-gap-no-interruption}

}

NeedForNCSG-NR-r18 ::= SEQUENCE {

bandNR-r18 FreqBandIndicatorNR,

gapIndication-r18 ENUMERATED {gap, ncsg, no-gap-with-interruption, no-gap-no-interruption}

}

Sample ASN.1 code for option 3

NeedForInterruptionInfoNR-r18 ::= SEQUENCE {

intraFreq-needForInterruption-r18 SEQUENCE(SIZE (1.. maxNrofServingCells)) OF NeedForInterruptionNR-r18,

interFreq-needForInterruption-r18 SEQUENCE(SIZE (1..maxBands)) OF NeedForInterruptionNR-r18

}

NeedForInterruptionNR-r18 ::= SEQUENCE {

intrIndication-r18 ENUMERATED {no-gap-with-interruption, no-gap-no-interruption} OPTIONAL

}

Note that companies prefer O3 should agree on Q1. Companies prefer O1 or O2 could agree on Q1, which implies additional field description to ensure “consistent” reporting from UE.

**Question 2: Which option do companies prefer to introduce new Rel-18 gap with interruption capability in NR?**

* **Option 1 (new R18 reporting)**: Introduce *NeedForGapsInfoNR-r18*, i.e. {gap, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 2 (new R18 reporting, including NCSG)**: Introduce *NeedForGapNCSG-InfoNR-r18*, i.e. {gap, ncsg, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 3 (extend the R16 reporting)**: Introduce a new *NeedForInterruptionInfoNR-r18* IE to indicate whether interruption is needed when UE reports no-gap in *NeedForGapsInfoNR-r16*.
* **Other** – Please provide in your comments

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| MediaTek | Option 3 | We believe that O3 is more aligned with RAN4 intention. O1/O2 could also work but request more SPEC change. |
| Qualcomm Inc | Option-2 | Reason behind supporting Option-2:   * Option-1 seems incomplete version of option-2 as it does not provide the “NCSG” option. So for sake of completeness option-2 seems more adequate to cover all possible cases. * Option-3 is an extension of Rel.16, so if UE does not support Rel-16 MGE feature, instead it only supports Rel-17 MGE, in this case, this UE won’t be able to support the “no gap with interruption” option, as Rel-17 only has “gap/no-gap-no-ncsg/no-ga-ncsg”. So extending Rel.16, is not enough, we need to extend Rel.17 as well in this case.   [Rapp] For option 3, it is assumed no need to extend Rel-17. See also summary for Q4. |
| CATT | See comments. | The legacy gap indication for NSCG is similar as follows. If we extend it to NSCG, this R18 IE in option2 seems not correct. It should include the case of no gap with no interruption, no gap with interruption, no gap and no NCSG and with interruption, no gap and no NCSG with interruption. Furthermore, if we agree to introduce the interruption case to NSCG, the correct way may be to make the *NeedForGapNCSG-InfoNR-r18 includ* no gap and no NCSG and with intterrupiton, no gap and no NCSG with interruption, at the same time, to extent *NeedForGapsInfoNR-r16* with no gap with no interruption, no gap with interruption as what is done in option 3.  NeedForNCSG-IntraFreq-r17 ::= SEQUENCE {  servCellId-r17 ServCellIndex,  gapIndicationIntra-r17 ENUMERATED {gap, ncsg, nogap-noncsg}  }  Besidse, the UE only reporting R17 IE not R16 IE seems a corner case, as we know, some combination of legacy IE and new IE is applied to indicate a specific case is a common method in RAN2.  [Rapp] If my understanding of CATT’s comment correctly, CATT think O2 is incorrect extension of NCSG. So, CATT should be fine with O1 and O3. |
| OPPO | Option1 or Option 3 | I understand all the solutions will touch the issue how R18 UE capability will survive on top of R16/R17 capability, Op3 is simpler, Op1 is also acceptable, and still don’t understand the strong motivation to involve NCSG. |
| ZTE | Option 3 with modifications | The Rel-17 reporting signalling can also be used to report the need of legacy gap. see below agreement made in RAN2\_118:  “*R2 think R17 UEs not capable of NCSG can use the R17 NeedForNCSG signalling mechanism to report “gap” or “nogap-noncsg”*”.  The network may configure either Rel-16 reporting or Rel-17 reporting, but no matter which one is enabled, the UE should be able to indicate “interruption” information on top of it.  Therefore, for Option 3, we think it is not just extension of Rel-16 signalling, it can also be the extension of Rel-17 reporting, depends on which is configured by the network. More specifically:   1. When network configures Rel-16 NeedForGap reporting and Rel-18 reporting, for UE indicates “nogap” in Rel-16 signalling, the UE can further indicate whether it needs interruption or not via Rel-18 signalling; 2. When network configures Rel-17 NeedForGapNCSG reporting and Rel-18 reporting, for UE indicates “nogap-noncsg” in Rel-17 signalling, the UE can further indicate whether it needs interruption or not via Rel-18 signalling;   [Rapp] This is somehow related to Q4 on whether to extend NCSG. |
| Huawei, HiSilicon | Option 3 | We don’t think “ncsg” should be involved.  The R17 NCSG design is quite complete and there is no ambiguity for that. If the UE reports “nogap-noncsg” in the R17 signalling, it is certain that interruption is not allowed.  The only ambiguity lies in the R16 signalling when UE report “no-gap”, that’s why an extension is needed. |
| Apple | Option 3 is preferred | Option 3 is the cleanest way to go which also reflects RAN4 agreement.  For UE supporting Rel-17 reporting (nogap-noncsg, nogap-ncsg), from our understanding, nogap-noncsg implies no interruption (which should be also aligned with RAN4 understanding). Thus, there seems no need to combine Rel-17 and Rel-18 reporting. |
| Intel | Option 1 | We think option 1 is what RAN4 intended and the simplest implementation |
| Samsung | Option 3 |  |
| Xiaomi | Option 1 or 3 | We think it is not needed to involve NCSG. |
| Vivo | Option 3 | Option3 is simple to design enabler form the network. |
| LGE | Option 3 | Both option 1 and 3 work. If we go with option 3, RAN2 doesn’t need to revisit this issue even though RAN4 concludes the ‘with/without interruption’ needs to be reported when ‘nogap-noncsg’ is reported via R17 signalling. |
| Ericsson | Option 3 (eventually O1) | Both Option 1 and 3 work for us. However, O3 appears to be more in line with RAN4’s LS.   Ultimately, and to avoid ambiguities (as the one we have now) we see a need to clarify in Rel-16/17/18 signalling/spec exactly what each value refers to.   Note that for O3, an extension of Rel-16 field should be named gapIndication-v18x (i.e., to extend the value range). |
| Nokia, Nokia Shanghai Bell | Option 2 | NCSG does not require new interruptions and shall not be changed. RAN4 did not say anything about that. Option 2 is the most straightforward and isolates any signalling tot he Rel-18 branch.  **Option 1:** We don’t understand why this would include “gaps” option – when would that be used? Also, this is now incomplete option so NW would potentially have to ask both Rel-16/17 and Rel-18 signalling – how would those be interpreted together?  **Option 3:** This option can also work as an extension, but then it only relevant if NW asks for the Rel-18 information.  [Rapp] On “NW asks”, it is discussed in Q3. |

Summary

Majority prefers option 3. Most companies are okay with option 1 and 3. Two companies prefer option 2 but some companies comment that they don’t understand why NCSG is involved. One company think the way to extend NCSG in option 2 is incorrect. To avoid complicate discussion on NCSG extension and NCSG is indeed NOT mentioned in RAN4 LS, rapporteur suggests to go with option 3. Combine with the summary in Q1, it seems that we can take P1 in R2-2303103 as WF.

**Proposal 1: Introduce a new UE indication *NeedForInterruptionInfoNR-r18* associated with *NeedForGapsInfoNR-r16* to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports no-gap in *NeedForGapsInfoNR-r16*.**

One company ([R2-2303400](file:///D:\Documents\3GPP\tsg_ran\WG2\RAN2\2304_R2_121bis\Docs\R2-2303400.zip)) suggests to discuss whether to introduce a network configuration to enable Rel-18 interruption reporting.

Rapporteur understands for option 1 or 2, new network configuration to enable Rel-18 interruption reporting is needed while in option 3, it may reuse the existing control flag from Rel-16.

If there is new network configuration to enable the reporting, it seems that we should also have new capability to indicate that whether the UE supports the interruption reporting.

**Question 3: Whether a network configuration (like *NeedForGapsConfigNR-r16*) to enable Rel-18 interruption reporting is needed? Whether a new capability (like *nr-NeedForGap-Reporting-r16*) to indicate UE supporting of Rel-18 interruption reporting is needed?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **New control (O1, O2)** | **New control (O3)** | **Comments** |
| MediaTek | Yes | No strong view | For option 3, it can work with or without controlling flag. If no new controlling flag, it is assumed that the UE always report the interruption information if R16 flag is enabled. The legacy gNB could just ignore the unknown Rel-18 extension. This is even simpler but may be tricky because NW will not understand some field in Reconfiguration Complete or Resume Complete message.  New capability is needed if we have new controlling flag. Otherwise, new capability is not needed. |
| Qualcomm Inc | Yes | Yes for both (configuration and capability) | For O1/O2, it’s very obvious that configuration and capability are needed  For O3:  -new capability is definitely needed for Rel-18 extension  -if UE signalled the support Rel-18 extension, UE still does not know if network do support the Rel-18 extension, hence UE can not just report the Rel-18 extension unless network explicitly requested, to avoid interoperability issue when network is a Rel-18 network. |
| CATT | Yes |  |  |
| OPPO | Yes | Yes |  |
| ZTE | Yes | See comment | For option 3, we think it depends on the question we asked in Q1.  If we want to avoid the impact to legacy network, e.g. “no gap” always means no interruption, the UE should report “gap” when it does not support no gap without interruption.  Then separate configuration is needed, so the UE knows whether it should report “gap” or “no gap” when it can only do no gap with interruption.  However, if no matter interruption is needed or not, the UE can indicate “no gap” to legacy gNB, then it seems separate configuration is not that critical, but it can avoid the UE to report something that cannot be comprehended by the network. |
| Huawei, HiSilicon | Yes | Yes for configuration, no for capability | For Option 3,  We prefer to have a new configuration, because the reported requirement for interruption is per target band and the signalling overhead is wasted if reported to a legacy gNB who cannot understanding the information.  But the configuration for enabling the R18 reporting could be quite simple, e.g. 1-bit flag in RRCReconfiguration and RRCResume.  Without the UE capability, the NW configures this additional flag to all UEs that support the R16 NeedForGap reporting. If the UE does not support the R18 extension, it simply ignores this 1-bit configuration. |
| Apple | Yes | No strong view for configuration | We agree with CATT’s analysis. Our understanding is how UE report “gap” in Rel-16 reporting should be consistent with legacy and Rel-18 gNB(s). If this is the common understanding, both network configuration and change to UE capability would not be very critical.  However, if UE needs to adapt its reporting to legacy and Rel-18 gNB(s), the configuration flag would be required. UE capability would be required as well. |
| Intel | Yes | Yes | In all options, NW controlled is needed either by configuration or new UE cap. |
| Xiaomi | Yes | Yes |  |
| Vivo | Yes | Yes |  |
| LGE | Yes | Yes for configuration |  |
| Ericsson | Yes | Yes, for both | For O3, we think the cleanest approach would be to also have the UE capability. |
| Nokia, Nokia Shanghai Bell | Yes | Yes | We need new control – otherwise legacy network behaviour could be impacted. Let’s take an example where UE supports no gaps with interruption.  1) In legacy network, UE has to indicate “gaps” since no gaps with interruptions is not currently allowed.  2) In network where Rel-18 mechanism is used, UE can report “no gaps with interruption” since network specifically requests such information. |

Summary

For option 3, majority prefers to have network control and UE capability. Few companies think configuration or capability is not needed but there seems no strong objection to have it. As we usually extend a feature with NW control and UE capability, rapporteur suggest to follow legacy rule.

**Proposal 2: Introduce a new network configuration to enable Rel-18 interruption reporting in RRC response message and a new UE capability to indicate the UE supporting of this dynamic reporting.**

Another discussion point is mentioned in [R2-2303294](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303294.zip) on extension the interruption indicator to NCSG (R17 field)

* Proposal 1: There is a need for RAN2 to extend the concept ‘no-gap measurement with interruption’ to NCSG, i.e. UE needs to indicate to NW whether the interruption is needed or not when reporting ‘nogap-noncsg’ via *NeedForGapNCSG-InfoNR-r17*.

**Question 4: Do companies agree to extend the concept ‘****no-gap measurement with interruption’ to NCSG?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agreed or not** | **Comments** |
| MediaTek | Tend to disagree | We think that this is NOT discussed in RAN4 although it makes some sense. |
| Qualcomm Inc | Check comments | As clarified earlier, If we decided to go with the extension approach, it has to be extended for both Rel.16 and Rel.17, as not all UEs will be supporting both MGE releases, some UEs may support one version of the MGE (either Rel.16 or Rel.17) … to avoid this redundancy, we suggested to go with Option-2 above. |
| CATT | See comments | Although this is not mentioned by RAN4, but we think it is reasonable to extend it to NCSG case, at least for the case of nogap-noNCSG. |
| OPPO | Disagree | No RAN4 requirements yet, why to have this extention? |
| ZTE | Yes | See our response to Q2, RAN2 already agreed to support using Rel-17 signalling to request legacy gap requirement. We cannot mandate the network to enable Rel-18 reporting only when Rel-16 reporting is configured.  We understand this was not discussed in RAN4, but similarly, RAN4 may not know Rel-17 signalling can also be applied to non-NCSG UEs.  We suggest to confirm this understanding in RAN2 and inform RAN4. If they found any problem, they can tell us. |
| Huawei, HiSilicon | No | Even though RAN2 agreed to support using R17 signalling to request legacy gap requirement, there is no ambiguity in the R17 signalling. If the UE reports “nogap-noncsg” in the R17 signalling, it is certain that interruption is not allowed.  The motivation to promote allowing R17 signalling to request legacy gap is exactly that R17 signalling has no ambiguity. Otherwise the R16 signalling would suffice.  [ZTE] Based on your comments, if a UE only supports “no gap with interruption”, when the network enables R16 + R18 NeedForGap reporting, the UE can indicate “no gap” in R16 signalling and further indicate “with interruption” in R18 signalling. However, if the network enables R17 NeedForGap reporting, the UE can only indicate “gap” or “ncsg” in R17 signalling (depends on whether it supports ncsg), the UE is not allowed to indicate “nogap-noncsg” to the network.  If this is the case and all companies have the same understandings, then we agree with Ercisson that it should be explicitly captured in spec, i.e. nogap-noncsg always means “no interruption”.  [Rapp] R17 clarification is not in the scope of this email discussion although rapporteur understanding is also that *nogap-noncsg* implies “no interruption”. |
| Apple | No | For NCSG, RAN4 did not think UE needs to report “interruption” or “no interruption” to “nogap-noncsg”. Our view is RAN4 thought “nogap-noncsg” implies “no interruption”. |
| Intel | no | We don’t think it is in scope of RAN4 LS. |
| Samsung | No |  |
| Xiaomi | No |  |
| vivo | No |  |
| LGE | No, | but OK to ask RAN4 about it. |
| Ericsson | No | We see no clear ambiguity with Rel-17 signalling.  However, it still appears beneficial to clarify this understanding further explicitly in the spec (i.e., as commented by Huawei *“If the UE reports “nogap-noncsg” in the R17 signalling, it is certain that interruption is not allowed.”*) |
| Nokia, Nokia Shanghai Bell | No | RAN4 did not ask to do that, so RAN2 shall not do it. |

Summary

A clear majority disagree to extend the concept of no-gap with interruption to NCSG. Some companies think that it is already clear that Rel-17 nogap-noncsg implies no interruption. Most companies prefer not to do this as it is not requested by RAN4.

**Proposal 3: RAN2 understands that no need to extend the concept of “no-gap measurement with interruption” to Rel-17 *NeedForGapNCSG* reporting.**

## 3.3 LTE Solution

On the impact to LTE part, it seems easier. There is no NCSG and it is reported in static way. So, we don’t need to discuss aspect like controlling flag.

Based on the contributions, there are two options to introduce new capability on interruption information for LTE.

* **Option 1 (new R18 reporting)**: Introduce new capability IE to indicate 3 different gap requirement information, i.e. {gap, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 2 (extend the R16 reporting)**: Introduce a new UE indication *interRAT-NeedForInterruptionNR-r18* to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports FALSE (i.e. no gap) in *interRAT-NeedForGapsNR-r16*.

Sample ASN.1 code for option 1

MeasGapInfoNR-r16 ::= SEQUENCE {

interRAT-BandListNR-EN-DC-r16 InterRAT-BandListNR-r16 OPTIONAL,

interRAT-BandListNR-SA-r16 InterRAT-BandListNR-r16 OPTIONAL

}

MeasGapInfoNR-r18 ::= SEQUENCE {

interRAT-BandListNR-EN-DC-r18 InterRAT-BandListNR-r18 OPTIONAL,

interRAT-BandListNR-SA-r18 InterRAT-BandListNR-r18 OPTIONAL

}

InterRAT-BandListNR-r16 ::= SEQUENCE (SIZE (1..maxBandsNR-r15)) OF InterRAT-BandInfoNR-r16

InterRAT-BandListNR-r18 ::= SEQUENCE (SIZE (1..maxBandsNR-r15)) OF InterRAT-BandInfoNR-r18

InterRAT-BandInfo ::= SEQUENCE {

interRAT-NeedForGaps BOOLEAN

}

InterRAT-BandInfoNR-r16 ::= SEQUENCE {

interRAT-NeedForGapsNR-r16 BOOLEAN

}

InterRAT-BandInfoNR-r18 ::= SEQUENCE {

interRAT-NeedForInterruptionNR-r18 ENUMERATED {gap, no-gap-with-interruption, no-gap-no-interruption}

}

Sample ASN.1 code for option 2

MeasGapInfoNR-r16 ::= SEQUENCE {

interRAT-BandListNR-EN-DC-r16 InterRAT-BandListNR-r16 OPTIONAL,

interRAT-BandListNR-SA-r16 InterRAT-BandListNR-r16 OPTIONAL

}

MeasGapInfoNR-v18xy ::= SEQUENCE {

interRAT-BandListNR-EN-DC-v18xy InterRAT-BandListNR-v18xy OPTIONAL,

interRAT-BandListNR-SA-v18xy InterRAT-BandListNR-v18xy OPTIONAL

}

InterRAT-BandListNR-r16 ::= SEQUENCE (SIZE (1..maxBandsNR-r15)) OF InterRAT-BandInfoNR-r16

InterRAT-BandListNR-v18xy ::= SEQUENCE (SIZE (1..maxBandsNR-r15)) OF InterRAT-BandInfoNR-v18xy

InterRAT-BandInfo ::= SEQUENCE {

interRAT-NeedForGaps BOOLEAN

}

InterRAT-BandInfoNR-r16 ::= SEQUENCE {

interRAT-NeedForGapsNR-r16 BOOLEAN

}

InterRAT-BandInfoNR-v18xy ::= SEQUENCE {

interRAT-NeedForInterruptionNR-r18 ENUMERATED {no-gap-with-interruption, no-gap-no-interruption} OPTIONAL

}

**Question 5: Which option do companies prefer to introduce new Rel-18 gap with interruption capability in LTE?**

* **Option 1 (new R18 reporting)**: Introduce new capability IE to indicate 3 different gap requirement information, i.e. {gap, [no-gap-with-interruption], [no-gap-no-Interruption]}.
* **Option 2 (extend the R16 reporting)**: Introduce a new UE indication *interRAT-NeedForInterruptionNR-r18* to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports FALSE (i.e. no gap) in *interRAT-NeedForGapsNR-r16*.

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| MediaTek | Option 2 | In LTE, the difference between two options seems quite small. We would still prefer extending of R16. It seems more logical to extend the capability reporting rather than replace the old one. |
| CATT | See comment | The similar option as in NR is applied. |
| OPPO | Either | See the comments for NR part. |
| ZTE | Option 2 | We’d better align the solutions for LTE and NR.  However, for “interRAT-BandListNR-EN-DC-v18xy” field, as we know, RAN4 haven’t conclude on MR-DC case, so we are not sure whether it is needed. Open to hear other company’s views.  [Rapp] interRAT-BandListNR-EN-DC-v18xy is for NR target bands supported to be configured as EN-DC. It does not imply the measurement in EN-DC. |
| Huawei, HiSilicon | Option 2 | In LTE, the need for gaps is reported as part of UE capability, in a static way. In contrast, NR introduced a dynamic reporting based on NW configuration. Since there is no NW configuration to enable/disable the reporting, in LTE, the UE will always report the need-for-gap capability if it is capable of doing so. Therefore, with Option 1, the R18 UE must always report both R16 signalling (interRAT-NeedForGapsNR-r16) and R18 signalling (gap, no-gap-no-interruption, no-gap-with-interruption) per band if supported. For option 2, the R18 UE shall only report existing R16 signalling (interRAT-NeedForGapsNR-r16) and complementary R18 indication (1 bit-with/without interruption) per band if supported. In other words, Option 2 introduces one additional bit for each band while Option 1 requires the UE to report band information repeatedly.  [Rapp] Actually, we should discuss whether the new field (*interRAT-NeedForInterruptionNR-r18*) is mandatory present or not. If it is optional, there is no difference on the size. |
| Apple | Option 2 |  |
| Intel | Option 2 | In RAN4 LS, "ONLY on top of ‘interRAT-NeedForGapsNR-r16’ capability to support case a-1." |
| Samsung | Option 2 |  |
| Xiaomi | Option 1 or 2 |  |
| vivo | Option 2 |  |
| LGE |  | Prefer to apply the same option for NR and LTE. |
| Ericsson | Option 2 | No need to have the same approach. |
| Nokia, Nokia Shanghai Bell | Option 1 | Same as for NR: We should create new signallling for the new case to avoid any issues with re-interpreting the legacy signalling. |

Summary

A clear majority agree option 2. One company disagree with option 1 and think it re-interpreting the legacy signalling. However, RAN4 LS does indicate this is based on Rel-16 capability as it mentioned “on top of ‘*interRAT-NeedForGapsNR-r16’* capability”. Based on this, rapporteur suggest to go with option 2.

**Proposal 4: For inter-RAT NR measurement in LTE, introduce a new UE indication (e.g. *interRAT-NeedForInterruptionNR-r18*) to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports FALSE (i.e. no gap) in *interRAT-NeedForGapsNR-r16*.**

## 3.4 Reply LS

Finally, there is proposal from [R2-2303071](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303071.zip) to send a Reply LS to RAN4.

* Proposal 5: Send a LS to RAN4 to inform RAN2 decisions.

Rapporteur suggests to discuss whether the LS is needed and what to be included in the LS.

**Question 6: Do companies think Reply LS to RAN4 is needed? If yes, please also briefly indicate the content and action to R4.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| MediaTek | No (for now) | Reply LS not necessary in our view (for now).  RAN4 send some request to RAN2 and we are doing the CR according to the requitement. Unless we want to revert RAN4 agreement or there is some action to RAN4, we don’t see the need to Reply the LS now.  However, depending on the outcome of previous questions, RAN2 may have to inform RAN4 if we have some surprising conclusion. |
| Qualcomm Inc | No | I don’t see the need to do so. |
|  |  |  |
| CATT | See comment | If we agree to extend it to NCSG case, we suggest notice it to RAN4. |
| OPPO | No | No clear motivation. |
| ZTE | See comment | Same view as CATT. |
| Huawei, HiSilicon | No |  |
| Apple | No |  |
| Intel | No |  |
| Samsung | No |  |
| Xiaomi | No |  |
| vivo | No |  |
| LGE | No strong view | But OK to ask RAN4 about it. |
| Ericsson | Not for now | This could come later when making all Rel-16/17/18 codepoints clear. |
| Nokia, Nokia Shanghai Bell | No strong view | Fine to send LS if we have something to tell. |

Summary

No clear consensus to send LS for now. However, it can be re-discussed if company find some issue to check with RAN4 depending on RAN2 progress.

**Proposal 5: No need to send Reply LS for R2-2302431 in this meeting.**

## 3.5 CR

Rapporteur suggests to discuss the CR after above open issue is converged.

No real discussion on CR details. Suggest to postpone.

**Proposal 6: CRs for gap with interruption are postponed.**

# 4 Conclusions(Phase 1)

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

**Proposal 1: Introduce a new UE indication *NeedForInterruptionInfoNR-r18* associated with *NeedForGapsInfoNR-r16* to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports no-gap in *NeedForGapsInfoNR-r16*.**

**Proposal 2: Introduce a new network configuration to enable Rel-18 interruption reporting in RRC response message and a new UE capability to indicate the UE supporting of this dynamic reporting.**

**Proposal 3: RAN2 understands that no need to extend the concept of “no-gap measurement with interruption” to Rel-17 NeedForGapNCSG reporting.**

**Proposal 4: For inter-RAT NR measurement in LTE, introduce a new UE indication (e.g. *interRAT-NeedForInterruptionNR-r18*) to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports FALSE (i.e. no gap) in *interRAT-NeedForGapsNR-r16*.**

**Proposal 5: No need to send Reply LS for R2-2302431 in this meeting.**

**Proposal 6: CRs for gap with interruption are postponed.**

# 5 Conclusions(Phase 2)

After further email discussion in R2 reflector, original proposal is rewording to

**Proposal 1: Introduce UE capability and indication for the Rel-18 case where interruption is needed for NR SSB based measurement without gap. The UE reports Rel-18 indication only if network requests it.**

* **The Rel-18 indication (e.g. *NeedForInterruptionInfoNR*) can be included in in *RRCReconfigurationComplete* and *RRCResumeComplete* message.**
* **The Rel-18 indication is in addition to the legacy *NeedForGaps* information. The UE may report 3 different cases:**
  + **If gap is needed, the UE reports “gap” in Rel-16 field and empty field in corresponding R18 IE.**
  + **If gap is NOT needed and there is no interruption, the UE reports “no-gap” in Rel-16 field and “no-gap-no-interruption” in Rel-18 field**
  + **If gap is NOT needed but there is interruption, the UE reports “no-gap” in Rel-16 field and “no-gap-with-interruption” in Rel-18 field**
* **If the NW does not request Rel-18 *NeedForInterruptionInfoNR*, the UE only reports *NeedForGaps* in the legacy way.**

**Proposal 3: RAN2 understands that no need to extend the concept of “no-gap measurement with interruption” to Rel-17 *NeedForGapNCSG* reporting. RAN2 assumes "nogap-noncsg" in Rel-17 *NeedForGapNCSG* signalling implies "no gap and no interruptions".**

**Proposal 4: For inter-RAT NR measurement in LTE, introduce a new UE indication (e.g. *interRAT-NeedForInterruptionNR-r18*) to indicate whether interruption is needed (no-gap-with-interruption) or not (no-gap-no-interruption) when UE reports FALSE (i.e. no gap) in *interRAT-NeedForGapsNR-r16*.**

**Proposal 5: No need to send Reply LS for R2-2302431 in this meeting.**

**Proposal 6: CRs for gap with interruption are postponed.**

# 6 References

[1] [R2-2302431](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2302431.zip), “LS on measurements without gap (R4-2303306; contact: Intel, CATT)”, RAN4

[2] [R2-2303103](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303103.zip), “Discussion on NeedForGaps with interruption”, Huawei, HiSilicon

[3] [R2-2302776](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2302776.zip), “Discussion on RAN4 LS for Rel-18 measurement gaps”, Nokia, Nokia Shanghai Bell

[4] [R2-2303071](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303071.zip), “Consideration on measurement without gap”, CATT

[5] [R2-2303294](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303294.zip), “Discussion on R18 no gap with interruption”, ZTE

[6] [R2-2303400](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303400.zip), “Discussion on Rel-18 gap enhancement “, Apple

[7] [R2-2303612](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303612.zip), “Introduction of measurements without gap with interruption” , MediaTek, draftCR Rel-18 36.331

[8] [R2-2303613](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303613.zip), “Introduction of measurements without gap with interruption”, MediaTek, draftCR Rel-18 36.306

[9] [R2-2303614](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303614.zip), “Introduction of measurements without gap with interruption” , MediaTek, draftCR Rel-18 38.331

[10] [R2-2303615](file:///D:/Documents/3GPP/tsg_ran/WG2/RAN2/2304_R2_121bis/Docs/R2-2303615.zip), “Introduction of measurements without gap with interruption”, MediaTek, draftCR Rel-18 38.306