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

eMeeting, 20th – 30th April, 2020

Agenda Item: 6.20.1.1

Source: MediaTek Inc.

**Title: Report of [AT109bis-e][049][TEI16] Need for Gap (Mediatek)**

Document for: Discussion and decision

# 1 Introduction

This is report for the following e-mail discussion.

**[AT109bis-e][049][TEI16] Need for Gap (Mediatek)**

Scope: Treat papers above on Need for Gap. If convergence is difficult, this may be treated on-line. Keep this simple please.

Wanted Outcome: Agreed solution, if possible Agreed-in-principle CRs

Deadline: April 28 0700 UTC

# 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#109e, 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).

[R2-2002308](file:///D%3A/Documents/3GPP/tsg_ran/WG2/RAN2/2002_R2_109e/Docs/R2-2002308.zip) Report of [AT109e][080][TEI16] NeedForGap capability (MTK) MediaTek discussion Rel-16 NR\_newRAT-Core, TEI16

* Noted

Agreements and FFSs [AT109e][080][TEI16]:

* In dynamic need for gap reporting, the network could deconfigure the feature temporarily in order to prevent UE from sending the information. The UE shall report the NeedForGap information if the feature is enabled by the network from disable (i.e. the UE reports the information no matter the capability is changed or not).
* In Rel-16, the reporting of additional NeedForGap information based on the potential band combinations is not supported. The UE reports the NeedForGap information based on resultant configuration (current configured band combination).
* In Rel-16, the reporting of measurement gap requirement information with granularity of frequency range (e.g. FR1 and/or FR2) is not supported.
* It is FFS whether to introduce a target band filter configuration for dynamic need for gap reporting. If agreed, the UE only reports the NeedForGap information for the corresponding target bands provided by the network.
* It is FFS whether to report NeedForGap information for intra-frequency measurement. If agreed, the intra-frequency NeedForGpp information should be reported by separate IE (different from the one for inter-frequency measurement).

This offline discussion continues to discuss the open issues in NeedForGap. The rapporteur would like to suggest companies to keep this feature simple so that we could finalize the design in Rel-16.

## 2.2 Target band filter

The first FFS issue is regarding to whether to have the target band filter controlled by the network.

* It is FFS whether to introduce a target band filter configuration for dynamic need for gap reporting. If agreed, the UE only reports the NeedForGap information for the corresponding target bands provided by the network.

Based on the discussion in last meeting [1], the majorities prefer to have the target band filter control. Some companies also think it is essential function to complete the *NeedForGap* signaling. The papers that submitted in this meeting [2], [3] also suggested to define this target band filter. Thus the rapporteur suggest that the opponent companies could further check whether this is acceptable to them or there are still technique concerns. In addition, it is still unclear that whether we should have this signaling to always present or not. The rapporteur’s understanding is that we should have band filter as mandatory configuration. But it would be good to check with other companies.

**Question 1: Do companies agree to introduce a target band filter for NeedForGap information? If yes, how would you prefer to have this signaling?**

* **Option 0 – Not support target band filter**
* **Option 1 – Mandatory to configure band filter while the function is enabled**
* **Option 2 – Optional to configure band filter while the function is enabled**

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| **Company** | **Prefer** **Option** | **Comments** |
| MediaTek | Option 1 | It makes no sense for the UE to report a NR bands that are not supported by the network. Thus we support to have the band filter.We also think that the simplest way is that NW will always configure the band filter while the dynamic reporting function is enabled. This is similar to the design in normal capability band filter. We assume that the NW should have no problem to configure this. As indicated by some companies, this filter is kind of essential design in NeedForGap signaling, it makes sense that we should configure this always. Otherwise, it would result in the same situation as this filter is not supported.  |
| Huawei | Option 2 | Option 2 is more flexible from network’s viewpoint:If filtering bands are included, UE reports *NeedForGap* capability corresponding to the indicated bands; otherwise UE reports *NeedForGap* capability corresponding to all supported target bands.We think band filter was not proposed at an early stage of this *NeedForGap* discussion, and having it as mandatory feature is too restrictive to the network. |
| Google | Option 2 | Option 2 is more flexible. |
| Qcom | Option-1 | For the ease of implementation and to reduce the size of the message, we prefer the target band filter to always be provided by the network. |
| OPPO | Option 2 | It is more flexible. If the filter band is not provided, the UE will be based on the UE capability and gap purpose to report the NeedForGap indication. |
| Nokia | Option 1 | Agree with MediaTek.We think when the function is enabled, mandatory filter would be more aligned with existing capability request procedures. Network always know only certain bands are deployed and network can just ask for all of those. If companies want to keep more flexibility, we are fine to have a special value in band filter to ask UE report capability corresponding to all supported target bands. |
| ZTE | Option 2 | We are fine to not have target band filter (Option 1), if we introduce this, it should not be a mandatory requirement to network.  |
| Apple | Option 1 | Option 1 is more reliable from UE point of view to mandate NW always configure this when NeedForGap is enabled. |
| CATT | Option 2 | We think Option 2 is more flexible from network’s viewpoint |
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**Summary 1:**

If the target band filter is configured, we also need to confirm what would be the reporting content form the UE. Based the discussion in [1], some companies seem have different understanding on how the UE should report. It would good to clarify that even if the target band filter is configured, the band indicator is still included in NeedForGap information reporting as proposed in [4]. The UE reports the bands that is supported by the UE and enquired by the NW, thus the reporting information may not have the same number of entries as target filter list. (Maybe less if some bands are not supported by the UE). Therefore, to avoid ambiguity, including the band indicator field (*bandNR-r16*) in the reporting information is still needed. With this design, the rapporteur’s understanding is that the UE does NOT have to echo back the applied filter in the reporting information. It would be good to confirm with other companies on this aspect.

NeedForGapsBandlistNR-r16 ::= SEQUENCE (SIZE (1..maxBands)) OF NeedForGapsNR-r16

NeedForGapsNR-r16 ::= SEQUENCE {

 bandNR-r16 FreqBandIndicatorNR

 gapIndication-r16 ENUMERATED {gap, no-gap, spare2, spare1}

}

**Question 2: If the target band filter is configured, do companies agree that the UE still include the band indicator in the NeedForGap reporting information?**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | It is much simpler that the UE just always include the band indicator. With the target band filter, the size is further reduced and there should be no size concern to include the band indicator. To avoid potential ambiguity and more complicate procedure text, we hope that the simple design proposed in [4] is acceptable.  |
| Huawei | Depends on the conclusion of Q1 | If the majority view of Q1 is Option 1, i.e. the band filter is mandatorily provided, then UE does not need to include the band indicator, because both the network and the UE can understand there’s a one-to-one correspondence between the reported *NeedForGap* capabilities and the filtering bands.If the majority view of Q2 is Option 2, it’s preferred that the UE always includes the band indicator, because this consistent behavior makes the spec easier to understand. |
| Google | Yes | It is better to provide band indicator with the NeedForGap so that the NeedForGap reporting information is self-contained information. |
| Qcom | No/Yes | Approach#1* Network knows exactly what was transmitted in the NeedForGapsConfigNR, not sure why UE needs to include redundant/known info in the NeedForGapsInforNR?
* NeedForGapsInfoNR should only include a bit mapping enum (gap/no-gap) for the request target bands
* Hence no need of the “gapIndication-r16”

Approach#2* UE reports in the NeedForGapsInfoNR only the Frequency band indicators where no gap is required
* Target bands requested by network that were not included in the report 🡪 gap is applied by default (as per current behavior)
* Hence no need of the “gapIndication-r16”
 |
| OPPO | Yes/No | Case 1: if the filter band is provided in the prior DL message, it seems one bitmap is enough to indicate NeedForGap for the corresponding band in filter bands.Case 2: during the SCell add/release procedure, the UE may update the NeedForGap indication, and there is no filter band configured. In this case, the band indicator will be necessary. |
| Nokia | Yes | Even band filter is provided in prior DL message, band indicator is also needed in the case the requested bands is not fully supported by UE (i.e. some requested bands in band filter may not be supported by UE).We have the same view with MediaTek that including band indicator is much simpler and it will avoid potential ambiguity. |
| ZTE | Yes | Similar view as MediaTek. We prefer a simple approach.  |
| Apple | Yes | If the conclusion of Q1 is Option 2 (optional to set), it might be much simpler to always let UE indicate the bandNR to make the procedure part easy to capture. |
| CATT | Yes | Agree with MediaTek and ZTE. |
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**Summary 2:**

## 2.3 Intra-Frequency measurement

The next issue is that whether we should support NeedForGap signaling for intra-frequency measurement and how to report this if supported.

* It is FFS whether to report NeedForGap information for intra-frequency measurement. If agreed, the intra-frequency NeedForGpp information should be reported by separate IE (different from the one for inter-frequency measurement).

This part currently marked as FFS in the CR [4].

NeedForGapsInfoNR-r16 ::= SEQUENCE {

 intraFreq-needForGap-r16 ENUMERATED {gap, no-gap}

 interFreq-needForGap-r16 NeedForGapsBandlistNR-r16

}

-- editor Note FFS whether to introduce intraFreq-needForGap

NeedForGapsBandlistNR-r16 ::= SEQUENCE (SIZE (1..maxBands)) OF NeedForGapsNR-r16

NeedForGapsNR-r16 ::= SEQUENCE {

 bandNR-r16 FreqBandIndicatorNR

 gapIndication-r16 ENUMERATED {gap, no-gap, spare2, spare1}

}

The NR intra-frequency may require measurement gap depending on BWP configuration. In R15, whether the measurement gap is required is defined in 38.300 as following:

- For SSB based intra-frequency measurement, a measurement gap configuration is always provided in the following case:

- Other than the initial BWP, if any of the UE configured BWPs do not contain the frequency domain resources of the SSB associated to the initial DL BWP.

Some companies think that UE may be able to perform gapless intra-frequency measurement thus suggest to report *NeedForGap* also for intra-frequency measurement. However, from the discussion in last e-mail discussion [1] and also the proposals in [2] and [3], it seems that companies have different understanding on what does *NeedForGap* information for intra-frequency mean. Assuming that the UE could indicate “no-gap” or “gap” for intra-frequency measurement, what does this imply for intra-frequency measurement?

**Question 3: What is your understanding on NeedForGap information reported for intra-frequency measurement (if agreed)?**

* **Understanding 1 [2]**
	+ **“gap” -- the original rule in 38.300 applies**
	+ **“no-gap” -- it implies that the UE does not need measurement gap to measure the SSB associated to the initial DL BWP for all configured BWPs. FFS it is reported per UE or per serving cell.**
* **Understanding 2 [3]**
	+ **“gap” -- NW side will always configure measurement gap for intra-frequency measurement, no matter that at this moment the SSB is within active BWP or not**
	+ **“no-gap” -- NW side will not configure any gap for its intra-frequency measurement, no matter that at this moment the SSB is within active BWP or not.**
* **Others, please clarify**

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| **Company** | **Comments** |
| MediaTek | Our view (understanding 1) is explained in the discussion paper [2]. While the UE indicates gap is needed for intra-frequency measurement, we think that original rule in 38.300 applies (i.e. UE still could perform gapless intra-frequency while SSB is inside BWP). Otherwise, this implies that the performance is worse than Rel-15. No benefit to have this additional signaling.We would also like to clarify this capability should not be changed due to BWP switching. If the UE reports “no gap”, it should apply to all current configured BWP (for that serving cell or for all serving cell). |
| Huawei | Understanding 1.*NeedForGap* is an optimization in R16, for both inter-frequency and intra-frequency cases.If UE reports “gap is required”, the mechanism should fall back to R15 behavior, that is, the network checks if the SSB is contained in the active BWP. |
| Google | Understanding 1. |
| Qcom | We support Understanding-1 |
| OPPO | Understanding-1 |
| Nokia | Understanding 1.When UE reports “gap”, we think original rule in 38.300 should be inherited in dynamic intra frequency measurement, as it makes no sense to configure measurement gap when UE measure SSB within active BWP considering UE already support this gapless measurement case in Rel-15. |
| ZTE | Understanding-1?For “no gap” bullet, the wording ”for all configured BWPs” is unclear to us, our understanding is:* + **“no-gap” -- it implies that the UE does not need measurement gap to measure the SSB associated to the initial DL BWP ~~for all configured BWPs~~ ,no matter whether the SSB is within active BWP or not. FFS it is reported per UE or per serving cell.**
 |
| Apple | Understanding 1. For intra frequency case, understanding 1 is fine.The problem we tried to discuss in [3] is actually for the same band as serving cell indicated in the target band filter, UE can report whether a gap is needed. Nevertheless, after a second thought, if companies feel the intra band reporting is already supported in current CR draft, we are also fine.  |
| CATT | Understanding-1 |
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**Summary 3:**

With further thinking on what is *NeedForGap* information for intra-frequency measurement, companies are invite to provide their view on whether we should define this signaling or not.

**Question 4: Do companies agree to report of NeedForGap information for intra-frequency measurement?**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | We think that the original rule in 38.300 is enough. The UE only requires gap if current active BWP is not initial BWP and the active BWP does not include the concerned SSB. It is our understanding that in most case the BWP configuration includes the SSB, and thus it is not essential to optimize the case that active BWP does not include SSB. For simplicity, we propose to focus the *NeedForGap* signalling design on inter-frequency measurement in Rel-16.If majorities prefer to have this and provided we could have common understanding form the discussion in Q3, we could consider how to indicate this intra-frequency NeedForGap indicator in simple way. |
| Huawei | Yes | We still hold the opinion that intra-frequency case should not be excluded.In terms of gap requirement, “intra-frequency with SSB outside the active BWP” is quite similar to inter-frequency, and this signaling won’t be more difficult to report than inter-frequency. We could not assume the active BWP always contains the serving cell SSB in all network deployments, so intra-frequency *NeedForGap* indication is useful. |
| Google | Yes | It is better to consider all possbile deployment cases from the beginning so we prefer to support reporting NeedForGap for intra-frequency measurement. |
| Qcom | Yes | If one network is deployed with SSB outside the active BWP is enough to cause complexity in the future to resolve this issue. |
| OPPO | No | It is more complex than inter-frequency case, we can consider this case in next release if necessary.  |
| Nokia | Yes | We agree the intention to indicate *NeedForGap* for intra-frequency measurement, as discussed in last meeting, UE may be able to perform gapless measurement even if SSB is outside current active BWP. |
| ZTE | Yes | We are ok to consider intra-frequency case, but if companies cannot easily reach consensus on the signalling design, we would suggest to postpone it to next release.  |
| Apple | Yes | We agree with Huawei that for intra-frequency case, reporting whether gap is needed for “SSB outside of the active BWP” is beneficial.So a separate indication for intra frequency can cover that part and if UE reports no gap is needed, NW side will always not configure gap for UE. |
| CATT | Yes | We think it’s flexibility to support *NeedForGap* for intra-frequency measurement. |
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**Summary 4:**

As discussed in [2], if agreed to have this intra-Frequency NeedForGap indicator, we should discuss whether to report this per UE, per serving cell or per band.

**Question 5: If agreed to define NeedForGap signaling for intra-frequency measurement, how would you prefer to signal it?**

* **Option 1 – Per UE**
* **Option 2 – Per serving cell**
* **Option 3 – Per supported (and enquired) band**

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| **Company** | **Prefer****Option** | **Comments** |
| MediaTek | Option 1 or 2 | In our paper [2], we proposed to per UE report for simplicity. But we are also fine to report it per serving cell. We don’t think reporting per band is a good idea, it looks quite strange in case of intra-band CA is configured.  |
| Huawei | Option 2 | We have some concern on per-UE indication, because UE *NeedForGap* capability could be affected by factors like carrier bandwidth. Considering that per serving cell indication won’t bring much overhead, Option 2 is a good way to go. |
| Google | Option 2 | The UE NeedForGap capability for a band can be different depending on the UE is in CA or not. Therefore, we prefer option 2. |
| Qcom | Option-2 |  |
| OPPO | Option-2 |  |
| Nokia | Option 2 |  |
| ZTE | Option 2 |  |
| Apple | Option 2 | Per serving cell reporting provides better flexibility. |
| CATT | Option-2 |  |
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**Summary 5:**

## 2.4 Other issues

In [3], it is proposed to confirm that dynamic NeedForGap is only for SSB based measurement. This is also rapporteur’s understanding and thinking that it is already clear in current draft CRs. Actually, the whole NR need for gap information design is for SSB-based measurement only. We are not sure whether gapless CSI-RS measurement is possible and may need RAN4 input on this.

**Question 6: Do companies agree to confirm that the NR NeedForGap information reporting is only for SSB-based measurement in Rel-16?**

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | Yes | Although this should be clear in the proposed CRs, we see no harm to confirm this with an agreement.  |
| Huawei | Yes | For R15, RAN4 hasn’t finished CSI-RS related requirements. RAN4 is currently working on CSI-RS requirements for R16 and hasn’t completed yet, so we prefer to keep this discussion simple and focus on SSB based measurement. |
| Google | Yes |  |
| Qcom | Yes |  |
| OPPO | Yes  |  |
| Nokia | Yes |  |
| ZTE | Yes |  |
| Apple | Yes | It’s good for delegates to follow the progress, though we also agree the CR already indicates it’s for SSB measurement. |
| CATT | Yes  |  |
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In [3], it is proposed to send an LS to RAN4 to inform the agreement made in RAN2 on dynamic NeedForGap and ask if they have any concerns. The rapporteur would like to check first on the intention of sending this LS and what would be the main content in the LS.

**Question 7: Do companies agree to send an LS to RAN4 on NeedForGap signaling design? If yes, what would be the main purpose/content for this LS?**

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| **Company** | **Comments** |
| MediaTek | In general, we are fine to inform RAN4 on the design of NR *NeedForGap* signaling. We think the main purpose is just for information sharing. Although RAN4 could of course raise their concern, we do not think the signaling will surprise RAN4. We understand that RAN4 already think that this capability is useful in Rel-15 but RAN2 does not really have time to conclude how to do it.At this meeting, we also think there is no urgent to trigger the LS. As RAN2 still working on the details and we could inform RAN4 after the signaling design is completed. |
| Huawei | Agree with MediaTek. |
| Google | Agree with MediaTek |
| Qcom | Agree with MediaTek |
| OPPO | Agree with MediaTek |
| Nokia | Agree with MediaTek. |
| ZTE | Agree with MediaTek |
| Apple | As mentioned in our revised paper R2-2003828, there is one on-going R16 topic of inter-frequency measurement without measurement gap in RAN4 under RRM enhancement WI, and it was agreed that the UE can perform inter-frequency SSB based measurements without measurement gaps if the SSB is completely contained in the active BWP of the UE. It is not clear on the relation between dynamic NeedForGap and RAN4 inter-frequency measurement without MG. In addition, we may need to understand on the UE behavior with dynamic NeedForGap, e.g. how to handle scheduling restriction or whether it would shorten the UE measurement period. It would be helpful if RAN2 can check this new feature with RAN4 and then it can avoid potential issues in RAN2 spec in the future.  |
| CATT | Agree with MediaTek |
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As explained in R2-2003828 (revision of [3]), SCS of target band is a decisive factor when UE uses the same RF chain to perform measurement. Else if UE can spare an extra RF chain to perform inter-frequency measurement, SCS of target carrier will not matter that much. Since the RF architecture in UE is invisible to NW side, the only way we can see is to let NW side provide the SCS of target band together with the band number, so that UE can make an accurate decision regarding whether gap is needed for measurement.

Question 8: Do companies think SCS of target band SSB is required for UE to determine whether gap is needed?

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| **Company** | **Comments** |
| Apple | Yes.We think SCS is a decisive factor for UE to make decision. For simplicity, we only explained with RF chain in the paper. However, even with an extra RF which shares the same FFT as serving cell, UE still needs a gap to perform measurement if target SSB uses a different SCS. Note that the RAN4 WI on inter-frequency measurement without gap requires that source and target SSB use the same SCS.To solve the problem, two ways we can see:1. Let NW indicate the SCS of target band SSB to UE in the filter;
2. The “needforgap” indication is made regardless the target SSB SCS, assuming that UE always uses a spare RF chain to perform measurement. In this case, some text might be needed to make it clear that SCS is regardless.

We understand that we are under strict time limitation and companies may not want new thing, but still would like to check whether companies are interested in this. |
| CATT | We think in R15 the definitions of intra-frequency measurement and inter-frequency measurement have already considered the SCS impact. In RAN4, there are still under discussion about whether the gap is needed for different SCS for inter-frequency measurement but in one BWP. Currently there is no conclusion on this issue. Thus we prefer to wait further RAN4 progress. |
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## 2.5 Comment on CRs

For LTE, the NeedForGap CRs (R2-2000718 and R2-2002108) are already in principle in last meeting. We provide a new version in R2-2002781 and R2-2002782. The only update is the chances are based on the new R16 specifications.

For NR, we propose the CRs in R2-2002783, R2-2002784, and R2-2002785. It should be updated based on the outcome of this offline discussion. For 38.331 CR [4], one change compared to the version in previous meeting is that the IE *needForGapsConfigNR* is moved to IE *OtherConfig*. The intention is just to make sure that people understand that this is configuration, not one-shot polling bit.

Companies are invited to provide suggestions except for the issues that are discussed in previous sections.

**Question 9: Any other comments or suggestion on current proposed NeedForGap CRs?**

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| **Company** | **Comments** |
| Apple | As said in the reply to Q7, due to the on-going RAN4 Rel-16 topic where it was agreed that the UE can perform inter-frequency SSB based measurements without measurement gaps if the SSB is completely contained in the active BWP of the UE and if the SSB SCS is the same, the scope of NeedForGap may be adjusted to be differentiated from that particular scenario.We are also fine to leave the change to CR after receiving RAN4 reply LS.In addition, this also relates to the SCS matter mentioned in Q8. The RAN4 topic on inter-frequency measurement is only applicable to the same SCS case, thus a potential change to the CR is to also limit “NeedForGap” to “inter-frequency SSB based measurements regardless the SCS of target SSB”. |
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# 3 Conclusions

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

Potential easy agreement:

Need further discussion:

# 4 References

[1] R2-2002308, “Report of [AT109e][080][TEI16] NeedForGap capability (MTK)”, MediaTek

[2] R2-2002770, “Remaining issue on NR NeedForGap signaling”, MediaTek

[3] R2-2002811, “Discussion on NeedForGap”, Apple

[4] R2-2002784, “Introduction of NeedForGap capability for NR measurement - 38.331”, MediaTek