3GPP TSG-RAN WG2 Meeting #115-e R2-210xxxx

Electronic, August 16 –August 27, 2021

Agenda Item: 8.10.3.3

Source: CMCC

Title: Report of [AT115-e][112][NTN] SMTC and gaps (CMCC)

Document for: Discussion and Decision

# 1 Introduction

The UE measurement issue caused by propagation delay difference between satellites had been discussed in previous meetings, but there are still some controversial issues left. Hence, this offline discussion aims to address the left issue and reach some agreements for topics in 8.10.3.3 as follows:

* [AT115-e][112][NTN] SMTC and gaps (CMCC)

Final scope: Discuss the proposals in [R2-2108286](file:///C:\Data\3GPP\Extracts\R2-2108286%20Remaining%20Issues%20on%20SMTC%20and%20measurement%20Gap%20configuration%20for%20NTN.docx)

Intended outcome: Summary of the offline discussion with e.g.:

§ List of proposals for agreement (if any)

§ List of proposals for further discussion

Final deadline (for companies' feedback): Thursday 2021-08-26 1000 UTC

Final deadline (for rapporteur's summary in R2-2109135): Thursday 2021-08-26 1500 UTC

Proposals marked "for agreement" in R2-2109135 not challenged Friday 2021-08-27 0300 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

We’d like to organize the offline discussion into two phases as follows:

**Phase1:** Participants are invited to give comments on the questions before the deadline and the deadline for phase1 is Thursday 2021-08-26 1000 UTC. After the deadline of phase1, the rapporteur will give the summary very soon and trigger Phase2 discussion with proposals.

**Phase2:** Companies are encourage to comments on the proposals in the summary before Thursday 2021-08-26 1500 UTC.

**Note1:** All the proposals listed in the summary will be categorized into two types:

**Type1:** proposal for agreement, e.g. reach consensus by the majority.

**Type2:** proposal needs further discussion.

Note2: Proposals marked "for agreement" in R2-2109135 not challenged Friday 2021-08-27 0300 UTC will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).

**Background of the issues**

For NTN scenario, as shown in Fig.1, the situation on propagation delay difference in NTN system is quite different from that in TN system leading to quite large propagation delay difference. Then UE will miss the SSB/CSI-RS measurement window of neighbour satellites in NTN system, which is not expected. Therefore, the measurement configuration containing both SMTC and MG need to consider the propagation delay or propagation delay difference information as mentioned in [1~8].



**Fig.1 Distance difference between two satellites**

# 2 Discussion

In the RAN2 113bis-e meeting, one or more SMTC configuration(s) associated to one frequency can be configured has been agreed. While there is FFS issue that **(a) can the UE be configured with multiple SMTCs per carrier and use them all in parallel?** Considering different propagation delays between different satellites and a given UE, it is necessary to provide SMTC configuration for the UE to adapt to different propagation delays. So, companies are invited to provide preference about that whether to allow the UE be configured with multiple SMTCs per carrier and use them in parallel.

**Question 1: Do companies prefer to allow the UE be configured with multiple SMTCs per carrier and use them in parallel?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Yes |  |
| Lenovo | Yes | The propagation delays to different neighboring cells may be different. |
| Ericsson | yes | Our understanding is that this was agreed |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
| LGE | Yes |  |
| Nokia | Yes | Regarding Ericsson’s comment: it was agreed to have multiple SMTCs configured, but not necessarily to have them all used in parallel. But OK to support it, if the maximum number is reasonable and UE vendors are fine to measure concurrently according to multiple SMTCs. |
| MediaTek | Yes, but | While the UE could be configured with multiple SMTCs per carrier, it does not necessarily mean that all SMTCs would be used in parallel. The network may choose to activate some of the SMTCs for use at a given point in time, based on assistance information from the UE. |
| Intel | Yes |  |
| vivo | Yes |  |
| CATT | Yes |  |
| ITRI | Yes | We agree to allow the UE be configured with multiple SMTCs per carrier, but it is not necessary the UE to use the multiple SMTC in parallel. |
| Xiaomi | Yes |  |

Summary:

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Regarding the specific maximum number of SMTC configuration in one measurement object with the same *ssbFrequency*, and considering the potential requirement for NR positioning, the current 2 SMTC configuration is not enough[1][2][8], however, there may be not so much appropriate neighbor satellites. So we could define the maximum number as 3 or 4.

**Question 2: Do companies would like that the specific maximum number of SMTC configuration in one measurement object with the same *ssbFrequency* can be 3 or 4? Or please provide your preferred maximum number.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Yes |  |
| Lenovo | Yes |  |
| Ericsson | yes |  |
| OPPO | Maximum 4 |  |
| Huawei, HiSilicon | Yes |  |
| LGE | Yes | The more gaps, the more service interruption from serving cells. The measurements should be configured only for essential neighbor cells based on the location of the UE and the neighbor cells. |
| Nokia | Maximum 4 | If companies are really eager to go beyond 2 then 4 is the next reasonable value. |
| MediaTek | Yes |  |
| Intel | Yes |  |
| vivo | Maximum 4 |  |
| CATT | Yes |  |
| ITRI | Yes |  |
| Xiaomi | Yes |  |

Summary:

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For the FFS issue that how the NW knows which SMTC (incl. offsets/periodicity, etc.) is relevant for a particular UE. Generally, the measurement configuration is generated and provided by NW, based on the propagation delay difference between at least one target cell and the serving cell for a given UE. Nevertheless, to address this issue, both the NW-based SMTC/GAP configuration scheme and the UE-based SMTC/GAP selection scheme could be considered.

**Option 1:** **NW-based solution,** i.e. the final SMTC/measurement gap configuration is generated and provided by NW, based on the propagation delay difference between at least one target cell and the serving cell of a given UE.

**Option 2: UE-based solution,** i.e. the NW configures a UE with multiple SMTC/measurement gap configurations corresponding to different propagation delay information, and the UE select an appropriate measurement configuration matching the UE-calculated propagation delay difference. Further, to have a consistent understanding between UE and NW, UE needs explicitly or implicitly report the selected SMTC/measurement gap configuration to the NW

**Question 3: Which option is companies’ preference, option 1, option 2 or both?**

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| --- | --- | --- |
| **Company** | **Option 1, option 2 or both** | **Comment / alternative proposal** |
| CMCC | Both |  |
| Lenovo | Both | Option 1 can be the baseline. For option 2 alignment between UE and NW could be necessary. |
| Ericsson | either | If option 2 the explicit indication helps network to know a configured measurement gap is not needed. However, it may be changing over time and we need to be careful not to introduce too much extra signaling. |
| OPPO | Option 1 | SSBs are transmitted by network and among different cells, they may not be transmitted in a synchronous way. Therefore, for option 2, UE may not be able to accurately determine where and when it can receive SSBs from neighbor cells and if reporting the wrong gap to the NW, it will cause bad interruption and meanwhile measurement cannot be done as wanted.  For option 1, SMTC/gap configuration is always feasible and in the control of NW, with assistance information from UEs, e.g. propagation delay difference between serving/neighbor cells. |
| Huawei, HiSilicon | Both | Same view with Lenovo. |
| LGE | Option 1 only. | If multiple gaps are blindly configured, it will lead to unnecessary service interruption, until the selected gaps are indicated by UE. This will be repeated whenever gaps need to be updated. The option 2 has no benefit, compared to option 1. |
| Nokia | Both, with the preference for Option 2 | Such SMTC reconfiguration will be UE-specific and the number of updates will depend on the UE location relative to the footprint of the corresponding satellite-cells targeted. Thus, the signaling overhead needs to be considered carefully. This is why we think UE-based scheme may actually work better.  The UE is configured with the SMTC and the threshold corresponding to a shift of the measured SSB/SMTC. The UE reports to the NW the shift it has observed (if it is above the threshold) and the NW may reconfigure the UE accordingly. |
| MediaTek | Either | As a starting point, we can assume that the NW controls the entire procedure, as it is best aware of the satellite layout. There could be assistance information from the UE as discussed in Q4 to aid this selection. |
| Intel | Both |  |
| vivo | Opt. 1 | RAN2 has agreed that “*after AS security is established, gNB can obtain a GNSS-based location information from the UE using existing signalling method, i.e., by configuring includeCommonLocationInfo in the corresponding reportConfig*”. The gNB can obtain the propagation delay difference between the target cell and the serving cell of a given UE based on the GNSS-based location information from the UE, so the final SMTC/measurement gap configuration is generated and provided by NW is a simpler solution. |
| CATT | Both | Same view with Lenovo. |
| ITRI | Option 1 | Option 1 could be the baseline. For option 2 there may need additional signaling to align the understanding between UE and the network. |
| Xiaomi | Option 1 only | Agree with OPPO. Based on UE assistance information, NW can always configure suitable SMTC/gap window. So, NW-based solution for SMTC/measurement gap configuration is enough. |

Summary:

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RAN2 had agreed that the multiple SMTC configurations are enabled by introducing different new offsets in addition to the legacy SMTC configuration. FFS how the offsets will be managed/signalled. Hence, for NW-based SMTC/GAP Configuration scheme, the final SMTC/measurement gap configuration is generated and provided by NW, based on the propagation delay difference between at least one target cell and the serving cell of a given UE. And network can derive the propagation delay difference between at least one target cell and the serving cell according to the ephemeris and/or UE reported information like propagation delay or UE location, etc., which is similar to the traditional procedure of UE requesting something from the NW, and the serving cell correspondingly provided proper measurement configuration to the UE taking the UE reported information into account.

Proposal 3: RAN2 can regard NW-based SMTC/GAP configuration scheme as baseline, i.e., the serving cell provided proper measurement configuration to the UE according to the ephemeris and/or UE reported information like UE location or propagation delay etc.

**Question 4: Do you think it is necessary of the UE to report assistant information to the NW (which can be configured by NW or upon NW’s request) to assist NW calculating the offset for SMTC/GAP configurations?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Yes | to assist NW calculating the offset for SMTC/GAP configurations |
| Lenovo | Yes | UE assistance information of the propagation delay difference can help in appropriate measurement gap/window configuration. The assistance information can be the propagation delay difference from the UE to its serving and neighboring cells, or just the propagation delay from the UE to its neighboring cells with TA reported in connected mode. |
| Ericsson | yes | UE’s location is useful and might be needed to be able to configured SMTC properly |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes | The assistance information could be the propagation delay. |
| LGE | Yes, but not always. | We assume basically NW can calculate the offset based on the location of UE and neighbor cells. However, the UE’s location that NW knows may be not up-to-date. In this case, UE would fail to successfully measure the neighbor cell using the configured SMTC/gap. UE should be required to report the assistance information only when the SMTC/gap configured by NW is invalid. |
| Nokia | yes | This is essential for the whole scheme to work. It may be implemented according to what we have described for Q3 and in our R2-2103336. The signaling overhead should be considered, if e.g. what Ericsson proposes (UE location reporting) is pursued. |
| MediaTek | Yes | A coarse location information can be used for this purpose. |
| Intel | Yes |  |
| vivo | Yes | The NW needs assistant information to calculate the offset for SMTC/GAP configurations. |
| CATT | Yes | UE’s location can be used to compensate the offset for SMTC/GAP configurations. |
| ITRI | Yes | We think UE location is useful for configuring UE-specific SMTC /measurement gap. |
| Xiaomi | Yes | Propagation delay difference can be configured as UE assistance information. |

**Question 5: If the answer to question 4 is yes, which information would you prefer, UE location or propagation delay?**

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| --- | --- | --- |
| **Company** | **UE location or propagation delay** | **Comment / alternative proposal** |
| CMCC | No strong position on this |  |
| Lenovo | Propagation delay | Propagation delay difference is the very reason of the issue. The assistance information can be the propagation delay difference from the UE to its serving and neighboring cells, or just the propagation delay from the UE to its neighboring cells with TA reported in connected mode.  More specifically, as information of propagation delay difference between feeder links can be obtained by network implementation, the propagation delay difference or delay included in UE assistance can be associated with the service links.  UE location information is not always available due to privacy risks or UE’s consent. And to calculate the delay difference the location must be accurate enough. The propagation delay difference or delay is of less signaling overhead and can be directly used by network. |
| Ericsson | location | Already been discussed |
| OPPO | Propagation delay difference | Agree with Lenovo that propagation delay difference is the root cause for the issue. Therefore, it is the most straightforward form to be reported by the UE for NW to configure the SMTC and gap.  From UE’s perspective, service link’s propagation delay difference is sufficient, since NW can be aware of the feeder link’s propagation delay difference. |
| Huawei, HiSilicon | Propagation delay | Propagation delay helps to adjust the offset of SMTC configuration. |
| LGE | SFTD | Prefer to reuse SFTD measurements. |
| Nokia | The shift of actually measured SSB versus the configured SMTC | As we have shown in our R2-2103336, the UE may report how much in time the SSB is shifted, compared to what has been configured for SMTC. |
| MediaTek | Location | Coarse location should be enough. |
| Intel | Propagation delay, location, and SFTD |  |
| vivo | UE location | See our views for Q3, since GNSS-based location information reporting is allowed from the previous agreements, we think RAN2 can reuse the agreement to avoid additional discussion.  Furthermore, if the assistance information is the propagation delay difference from the UE to its serving and neighboring cells, UE should first calculate the propagation delay between UE and serving cell and the propagation delays between UE and neighbor cells based on location information and ephemeris information, and then obtain the propagation delay difference from the UE to its serving and neighboring cells. On the contrary, if the assistance information is UE location, it is beneficial to UE since the UE does not need to perform these procedures (but leave it to the NW). |
| CATT | UE location | UE location is been discussed in LCS aspect. |
| ITRI | UE location |  |
| Xiaomi | Propagation delay difference | Agree with Lenovo and OPPO. Propagation delay difference can be used to assist SMTC/Gap configuration directly.  The feeder link propagation delay difference can be acquired by network to assist SMTC/measurement gap configuration. So, UE only need to report the service link propagation delay difference as the assistance information for SMTC/measurement gap configuration. |

If UE-based solution is supported, in order for the UE and the NW to have a consistent understanding, do companies agree to introduce an explicit or implicit indication to the NW to report the selected SMTC/measurement gap configuration, e.g. a configuration index.

**Question 6: Do companies agree that introducing an explicit or implicit indication to the NW to report the selected SMTC/measurement gap configuration by the UE to keep an alignment?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| Lenovo | Yes if supported | Aligned understanding between UE and NW for the measurement gap/window is necessary. |
| Ericsson | positive | We think it is useful but are bit concerned on added signaling |
| OPPO | No | We think NW-based solution is sufficient in Rel-17. |
| Huawei, HiSilicon | Yes | NW-based solution can be taken as a baseline. If UE-based solution is also adopted, then the alignment is needed. |
| LGE |  | We don’t support UE-based solution, but if agreed, the UE and NW should have the same understanding on the selected SMTC/GAP. |
| Nokia | No | The UE should report the time shift/offset it has applied, no need to jump between multiple SMTC configurations, which may anyway not cover the whole range of neighbours (considering UE’s position and satellite movement). |
| MediaTek | Yes, if UE based is supported (Option 2 in Q3) | Required to keep the UE and the network aligned. |
| Intel | Yes |  |
| vivo | Yes, only if UE-based solution is supported | It is necessary for UE and NW to keep aligned with each other. |
| CATT | Yes |  |
| ITRI | Yes | If UE-based solution is supported, we think the alignment between UE and the network is necessary. |
| Xiaomi | No | NW-based solution is sufficient for SMTC/measurement gap configuration. |
|  |  |  |

Summary:

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To help the NW to configure the SMTC/Gaps correctly, UE needs to report some assistance information [4][5][6][8], e.g. propagation delays to different satellites or propagation delay difference information between at least one target cell and the serving cell, etc.. Then, taking into account the larger RTT compared to the terrestrial network, to reduce the reporting overhead, the reporting granularity of the propagation delay could be a specific delay or a step range, for example 10ms or 100ms as a step.

Question 7: Do compaines agree that considering the large RTT delay, the reporting granularity of the propagation delay could be a specific delay or a step range to reduce the reporting overhead?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Agree |  |
| Lenovo | Agree |  |
| ericsson |  | If we go with the option then yes |
| OPPO | Step range can be considered | These details can be further discussed. In general, we think some step range can be considered, like that for timing advance. |
| Huawei, HiSilicon | Agree |  |
| LGE | No | The maximum SMTC duration and MGL is 5ms and 6ms, respectively. If the offset between the SSB burst and the configured measurement window is larger than 5ms, the SSB burst would be entirely invisible from the UE. The unit of the assistance information should be smaller than ms. Though the unit of assistance information is 1ms, 10bits is sufficient to indicate the propagation delay of each neighbor cell. |
| Nokia |  | Yes, the shift we are discussing above could be expressed as the time step. We do not think it is necessary to report the entire value of the propagation delay. |
| MediaTek |  | Prefer coarse location information instead. |
| Intel | FFS | We are open to consider them as a delay or step however it is challenging to agree without having more details on how they are defined. Moreover it is not clear how much range would be required and what would be the signaling overhead impact. |
| vivo | See comments | We think location info is sufficient for the NW to calculate the propagation difference. But if UE calculated propagation difference is finally agreed, perhaps this signaling overhead issue can be left to Stage-3 discussion as a next step. |
| CATT | Agree |  |
| ITRI | Yes | If propagation delay is agreed to be reported from UE, we prefer a step range to reduce the overhead. |
| Xiaomi | FFS | We can discuss this solution after propagation delay report is agreed. This issue and the solution can be a FFS, which can be discussed in next step. |

Summary:

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Regarding another FFS issue, **is there any validity: in time or for certain location only, foreseen in such multiple SMTC configuration**? Definitely, to improve measurement robustness, the validity of the measurement configuration needs to be considered due to the long RTT and the high-speed movement of the satellite[1][7][8]. So, In case of NW-based SMTC/GAP Configuration scheme, a timer or a location threshold with a pre-configured drift rate or a relative value is needed to enable the UE can timely refresh the SMTC or GAP configuration to compensate the delay variation from the satellite’s moving.

**Question 8: Do companies agree that in case of NW-based SMTC/GAP Configuration scheme, a timer or a location threshold with a pre-configured drift rate or a relative value is needed to enable the UE can timely refresh the SMTC or GAP configuration to compensate the delay variation from the satellite’s moving.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Agree |  |
| Lenovo | Agree |  |
| Ericsson | no | How does UE update configuration? Timer sounds complicated. Network can also update the configuration |
| OPPO | See comments | We are not sure about the problem and how the timer/location threshold is supposed to work. In general, we feel that this may depend on how NW configures the UE to report assistance information and based on the reported assistance information configures the appropriate SMTC/gaps. This is very similar to the case of UE’s TA reporting for NW to configure/update the Koffset. We think it can well handled by the NW. |
| Huawei, HiSilicon | Agree |  |
| LGE | No | It seems a signalling optimization. NW can update the measurement windows according to the neighbour cell’s movement. |
| Nokia | Yes | We wonder how can the NW handle the UE-specific SMTC configurations, which will vary depending on time and location, in other way than by associating them with some validity mechanisms (restricting the use to certain time ranges or areas)? |
| MediaTek | Yes | A drift threshold could be introduced to trigger the switch between gap configurations to measure a neighbour satellite. When the neighbour cell delay changes by a certain threshold, the UE can send a report to the network. |
| Intel | Maybe | We are open to consider this proposal but would like to better understand how it would work in relation to the overall mechanism |
| vivo | Agree |  |
| CATT | Agree |  |
| ITRI | No | Network can update the configuration when necessary. |
| Xiaomi | Agree |  |

As some companies mentioned to send LS to RAN4 on the SMTC and GAP configuration in NTN, what’s your view?

**Question 9: Do companies consider that we should send LS to RAN4 on the SMTC and GAP configuration in NTN, e.g. maximum number of SMTC configuration per frequency?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment / alternative proposal** |
| CMCC | Agree |  |
| Lenovo | Agree |  |
| Ericsson | yes | About maximum n of measurement gaps is fine |
| OPPO | Agree | We can send LS to RAN4 if RAN2 decides the maximum SMTC and gap numbers and ask RAN4 to provide feedback. |
| Huawei, HiSilicon | Agree |  |
| LGE | Yes |  |
| Nokia | Yes, if | If we reach sufficient/solid number of agreements this meeting. Otherwise – too early. |
| MediaTek | Agree, when this topic progresses | When we do reach some agreement on SMTC and gap configuration and usage, it would be useful to check with RAN4 for feedback. |
| Intel | Yes |  |
| vivo | Agree |  |
| CATT | Agree |  |
| ITRI | Yes |  |
| Xiaomi | Agree |  |

# **3 Summary**

Summary:

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# **4 Conclusion**

**List of proposals for agreement (if any):**

**List of proposals that require online discussions:**

# 5 References

1. R2-2001627 Impact of CG/SPS with periodicities non dividing HF length Sequans Communications[R2-2107521](file:///C:\\Data\\3GPP\\Extracts\\R2-2107521%20Further%20views%20on%20SMTC%20configurations%20for%20NTN.docx" \o "C:Data3GPPExtractsR2-2107521 Further views on SMTC configurations for NTN.docx) Further views on SMTC configurations for NTN Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_NTN\_solutions-Core [R2-2105000](file:///C:\Data\3GPP\archive\RAN2\RAN2%23114\Tdocs\R2-2105000.zip)
2. [R2-2107566](file:///C:\Data\3GPP\Extracts\R2-2107566%20SMTC%20and%20MG.doc) SMTC and MG enhancements Qualcomm Incorporated discussion Rel-17 NR\_NTN\_solutions-Core [R2-2105434](file:///C:\Data\3GPP\archive\RAN2\RAN2%23114\Tdocs\R2-2105434.zip)
3. [R2-2107878](file:///C:\Data\3GPP\Extracts\R2-2107878%20Measurement%20window%20enhancements%20for%20NTN%20cell.doc) Measurement window enhancements for NTN cell LG Electronics Inc. discussion Rel-17
4. [R2-2107911](file:///C:\Data\3GPP\Extracts\R2-2107911%20UE%20assistance%20for%20measurement%20gap%20and%20SMTC%20configuration%20in%20NTN%20(Revision%20of%20R2-2105819).docx) UE assistance for measurement gap and SMTC configuration in NTN Lenovo, Motorola Mobility discussion Rel-17
5. [R2-2108067](file:///C:\Data\3GPP\Extracts\R2-2108067.docx) SMTC enhancement in NTN Sony discussion Rel-17 NR\_NTN\_solutions-Core
6. [R2-2108198](file:///C:\Data\3GPP\Extracts\R2-2108198%20Remaining%20Issues%20on%20SMTC%20and%20measurement%20Gap%20configuration%20for%20NTN.docx) Discussion on UE feedback based SMTC and GAPS measurement configuration Rakuten Mobile, Inc discussion Rel-17 [R2-2105389](file:///C:\Data\3GPP\archive\RAN2\RAN2%23114\Tdocs\R2-2105389.zip)
7. [R2-2108326](file:///C:\Data\3GPP\Extracts\R2-2108326%20Efficient%20Configuration%20of%20SMTC%20and%20Measurement%20Gaps%20in%20NR-NTN.docx) Efficient Configuration of SMTC and Measurement Gaps in NR-NTN MediaTek Inc.
8. R2-2108286 Remaining Issues on SMTC and measurement Gap configuration for NTN CMCC,Ericsson,ZTE Corporation,Huawei,CATT,Lenovo, Motorola Mobility discussion Rel-17 NR\_NTN\_solutions-Core

# 6 Contact information

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| --- | --- |
| Company | Delegate contact |
| Lenovo | Min Xu (xumin13@lenovo.com) |
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