3GPP TSG RAN WG2 Meeting #113bis-e R2-17xxxxx

**Electronic meeting, 12th-20th April 2021**

**Agenda item:** 8.12.3.1

**Source:** Intel Corporation

**Title:** Summary of offline 106 - [NTN] SMTC and gaps - first round

**Document for:**  Discussion and decision

# Introduction

The intention is to continue the email discussion [post113-e][108][1] as part of the offline Summary of offline 106 - [NTN] SMTC and gaps with the following scope.

* Initial scope: Continue the discussion on p3.1, p7 and p12 and p13 from [R2-2102866](file:///C%3A%5CData%5C3GPP%5CExtracts%5CR2-2102866_post113-e_108_NTN_SMTC_MeasGap.docx) [1].
* Initial intended outcome: Summary of the offline discussion with e.g.:
	+ List of proposals for agreement (if any)
	+ List of proposals that require online discussions
	+ List of proposals that should not be pursued (if any)
* Initial deadline (for companies' feedback): **Wednesday 2021-04-14 22:00 UTC**
* Initial deadline (for rapporteur's summary in R2-2104365): **Thursday 2021-04-15 02:00 UTC**
	+ Proposals marked "for agreement" in R2-2104365 not challenged until Thursday 2021-04-15 14:00 UTC will be declared as agreed via email by the session chair.
	+ For the rest the discussion will continue in a second round of the offline discussion until Monday 2021-04-19. Further details on the scope/intended outcome/exact deadlines to be announced by the session chair after Thursday 2021-04-15 14:00 UTC.

This discussion also considers the agreements taken in this RAN2#113bis-e meeting (copied here below) and the inputs provided by companies in the related email discussion #108 [1] (report summary for the selected proposals is included in Annex for quicker reference) as well as in the related TDocs [2]-[9].

*1. For Rel-17 NTN, Rel-17 NR operation is enhanced (e.g. the SMTC configuration and UE measurement gap configuration) aiming to address the issues associated with the different/larger propagation delays, and the satellites (considering e.g. their deployment, mobility, height, minimum elevation and prioritizing typical NTN scenarios).*

*2. Rel-17 NTN will not rely only on network implementation to address the issue explained in agreement 1.*

*3. Enhancements of the SMTC configuration is supported for Rel-17 NTN.*

*4. Optional new UE assistance is defined in Rel-17 NTN for network to properly (re)configure the SMTC and/or measurement gap.*

# Discussion

## SMTC configuration

RAN2 agreed to enhance the SMTC configuration for Rel-17 NTN. This section aims to discuss key questions raised and further clarify on the proposed solution aiming to find a common agreeable solution.

Some companies raised the concern that the support of multiple SMTC configurations with multiple measurement objects is already possible from legacy signaling. Moreover, it was also clarified that if several neighbour cells with same SSB frequency belong to different satellites, multiple SMTCs have to be provided in order to detect SSB from different satellites. On other hand, legacy operation only allows up to 2 SMTC configurations.

1. For Rel-17 NTN, do you agree to enable the usage of one or more SMTC configuration(s) e.g. with one or more offset(s) or SMTC periodicity/duration associated to each SMTC configuration? If not, please explain your concern or aspect to further clarify.

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| **Company’s name** | **Yes/No** | **Company’s comments (if any)** |
| Samsung | Yes/No | The offset concept can potentially be used with enhanced version of legacy signaling |
| MediaTek | Yes (Different Satellite) | Each SMTC window can be configured for each neighbor satellite after compensating for propagation delay difference. |
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1. If yes for Discussion point 1), do you agree that SMTC configuration can be associated with one or more cells (satellites), i.e. legacy signaling approach is maintained? If not, please explain your concern and/or preference.

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| **Company’s name** | **Yes/No** | **Company’s comments (if any)** |
| Samsung | Yes | We have two types of neighbors of the current serving cell for quasi-Earth-fixed beams: current physical neighbors of the serving cell for existing beams and upcoming/future neighbors for future beams that would cover the same geographic area. Furthermore, one SMTC configuration can be used to detect one set of cells and another SMTC configuration can be used to detect another set of cells. Finally, since propagation delays would be different for different sets of neighbor cells, including the timings for the validity of the SMT configuration would be quite important. For example, the UE can use one SMTC configuration to detect neighbor cells between t1 and t2 and another SMTC configuration to detect neighbor cells between t2 and t3. |
| MediaTek | Yes | Legacy signaling approach can be maintained to associate different SMTCs with different satellites. |
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1. If yes for Discussion point 1), do you have any preference on how to define the multiple SMTC configurations considering e.g.
2. Offset(s)
3. SMTC periodicity/duration
4. Others

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| **Company’s name** | **Option(s)** | **Company’s views** |
| Samsung | c [can be used with a and b] | One SMTC configuration can be used to detect one set of cells and another SMTC configuration can be used to detect another set of cells. Include the timings for the validity of the SMT configuration so that the UE can use one SMTC configuration to detect neighbor cells between t1 and t2 and another SMTC configuration to detect neighbor cells between t2 and t3. |
| MediaTek | a) | Using an offset is necessary to match different RTTs experienced by different satellites.  |
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1. For option (a) of Discussion point 3), do you have any preference on how to define the offset(s) e.g. in relation to the propagation delay of the serving cell (satellite) and neighbor cells (satellite(s)) and multiple SMTC configurations? Note: this discussion point aims to clarify the solution details although the question might be more related to stage-3 discussion.

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| **Company’s name** | **Company’s views** |
| Samsung | We suggest the use of the serving cell as the timing reference and make use of propagation delay differences between (i) UE-serving cell delay and (ii) UE-a set of neighbor cells with similar distances. We should have different sets of neighbor cells based on propagation delay differences. |
| MediaTek | The offset is calculated by the network using differences in RTT between serving and neighbor satellites at cell edge. This is then used to appropriately configure SMTC on the serving cell using serving cell timings. |
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1. For option (b) of Discussion point 3), do you have any preference on how to define the different/additional SMTC periodicity/duration? Note: this discussion point aims to clarify the solution details although the question might be more related to stage-3 discussion.

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| **Company’s name** | **Company’s views** |
| Samsung | No specific preference as long as we have (i) time validity of SMTC configurations for different sets of neighbor cells and (ii) multiple cells of a given set sharing the same SMTC for search for signaling efficiency and effective neighbor search. |
| MediaTek | We do not see a reason why the SMTC periodicity or duration would change for different satellites in the same network. |
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1. Do you agree that SMTC configuration is adjusted to accommodate the multiple/different propagation delays explicitly? If yes, should the adjustment be performed by the UE and/or by the network?

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| **Company’s name** | **Yes / No**  | **UE/NW (if yes)** | **Company’s comments (if any)** |
| Samsung | No |  | As long as the network configures SMTC configurations valid for certain time periods, the UE can effectively search for neighbors and reliably detect suitable neighbors. |
| MediaTek | Unclear | NW | Unclear what “explicit” means here. We assume the network adjusts the SMTC configurations taking into account propagation delays of serving and neighbor cells. |
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1. Is there other topics to discuss as part of the SMTC configuration enhancements?

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| **Company’s name** | **Company’s views** |
| Samsung | Discuss the usability of (i) sharing a given SMTC configuration per set of neighbor cells and (ii) specifying time validity of SMTC configurations to avoid frequent SIB changes and frequent UE processing. |
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## Measurement gap configuration

1. Do you agree that network should be able to configure multiple measurement gap patterns to a given UE for Rel-17 NTN scenarios?

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| **Company’s name** | **Yes/No** | **Company’s comments (if any)** |
| Samsung |  | We should try to minimize measurement gaps. Let’s discuss this further. |
| MediaTek |  | Ideally the number of measurement gaps should be minimized. However, if multiple neighbor satellites exist, it will be difficult to avoid this scenario, unless SSBs are transmitted every 5ms. We need to discuss if we need to optimize for such scenarios. |
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1. If yes for Discussion point 8), do you have any preference on how to handle RAN2 work considering related RAN4 ongoing work on this same topic?
2. RAN2 waits for RAN4 progress aiming to re-use the same framework of the solution
3. RAN2 informs RAN4 on the assumption that RAN4’s solution can also apply to Rel-17 NTN scenario
4. RAN2-centric solution is considered to enable multiple measurement gap patterns for NTN.
5. Others approach.

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| **Company’s name** | **Option(s)** | **Company’s views** |
| Samsung | d | Let’s seek company responses and identify main proposals for further discussion. RAN2 can drive the effort without waiting for RAN4. |
| MediaTek |  | We need to first discuss if we optimize measurement gaps to support multiple neighbor satellites. |
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## UE assistance

1. Do you support to define UE’s location related information as part of the new UE assistance? If yes, do you have any preference on how UE’s location is known by UE considering, e.g.:
	1. Based on GNSS.
	2. Based on RTT measurement.
	3. Based on coarse location information represented by the TAC/TAI mapped from the geographical area.
	4. Other means.

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| **Company’s name** | **Yes/ No** | **Option(s)** | **Company’s comments (if any)** |
| Samsung | Yes | a and d | The UE position can be used by SMTC and several other operations (e.g., Timing Advance, Scheduling, TA/Paging Management, country-borders for 5GC selection). Some UE vendors have concerns about the UE consuming significant processing power for determining the UE position by continuously or frequently observing GNSS. Hence, RAN2 can invest some time to discuss (i) how frequently idle/inactive/connected UEs need to observe the GNSS to determine the UE position (e.g., less frequently for idle/connected state and more frequently for connected state), (ii) position report signaling (RRC, MAC CE), and (iii) report format (e.g., absolute or relative), and (iv) need for “transformed” position coordinates instead of actual coordinates when the security has not been activated. The network and the UE know the confidential reference point coordinates.Example Solutions.1. Use of a new MAC CE and/or new compact “UE Position” IE in existing RRC signaling messages.2. Rule-based update from the UE (e.g. “distance between the last reported position and current position exceeds a threshold,” periodic UE position reporting). 3. Incremental or relative UE position to reduce signaling overhead. X’=X - Xref, Y’=Y - Yref, and Z’=Z – Zref, where X, Y, and Z are absolute position coordinates and Xref, Yref, and Zref are absolute reference position coordinates (to be broadcast by the gNB).4. Transformed UE position when security has not yet been activated. X’’=X - Xsec, Y’’=Y - Ysec, and Z’’=Z – Zsec, where X, Y, and Z are absolute position coordinates and Xsec, Ysec, and Zsec are absolute reference position coordinates of a security reference point (known to HSS and UE; intra-network signaling for AMF to learn about this reference point). |
| MediaTek | No |  | UE location information is unnecessary. If propagation delay at cell edge is compensated, all UEs at cell edge will have correct measurement timing. Only UEs at cell edge need to perform handover and require accurate measurement timing. |
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1. Do you support to define UE’s propagation delay related information as part of the new UE assistance? If yes, do you have any preference on how it is defined considering, e.g.:
	1. An absolute value based on propagation delay from neighboring cells.
	2. A relative value based on the SFTD.
	3. Other means.

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| **Company’s name** | **Yes/ No** | **Option(s)** | **Company’s comments (if any)** |
| Samsung | No | TA Reporting | No need if we already have suitable TA reporting |
| MediaTek | No |  |  |
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# Report: summary and proposals

Section to be updated by rapporteur

1. xxx
2. xxxx.

# Conclusion

The observations captured are the following:

**Observation 1.** xxxx.

The proposals captured are the following:

**Proposal 1.** xxx

# Annex: companies’ point of contact

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| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Intel Corporation | Marta Martinez Tarradell | marta.m.tarradell@intel.com |
| MediaTek Inc. | Abhishek Roy | Abhishek.Roy@mediatek.com |
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# Reference

1. R2-2102866, Report of [post113-e][108][NTN] SMTC and measurement gap, Intel Corporation.
2. R2-2103057, Multiple SMTC configurations, Qualcomm Incorporated.
3. R2-2103182, Discussion on measurement in NTN, Xiaomi Communications.
4. R2-2103336, Post-[108][NTN] views on SMTC and measurement gaps, Nokia, Nokia Shanghai Bell.
5. R2-2103356, Discussion on updating the timing for SMTC and measurement gap configuration, ITRI.
6. R2-2103362, Measurement window enhancements for NTN cell, LG Electronics Inc.
7. R2-2103700, Discussion on SMTC/Gap enhancements for NTN, CMCC.
8. R2-2104145, SMTC and MG configuration for NTN, Convida Wireless.
9. R2-2104200, Measurement enhancement for NTN, ETRI.

# Annex

The summary report of [post113-e][108] [1] related to the proposals 3.1, 7, 12, and 13 is copied below for reference.

## SMTC configuration

### Option 2) “enhancements of SMTC configuration”

19 companies support this option 2) “enhancements of SMTC configuration” (APT, Nokia, OPPO, LGE, MediaTek, Qualcomm, Ericsson, Sony, Lenovo, Xiaomi, CMCC, Rakuten, Thales, Samsung, CATT, Intel, Magister, ITRI, ZTE), and 2 companies do not support this option (Huawei, HiSilicon).

* Qualcomm, Huawei, and HiSilicon explain that multiple SMTC configurations with multiple measurement objects (as per this option) is already possible from legacy signaling. Huawei and HiSilicon also clarify that if several neighbour cells with same SSB frequency belong to different satellites, multiple SMTCs have to be provided in order to detect SSB from different satellites. ZTE clarifies that options 2.a) and 2.b) aim to provide more than one SMTC configurations per measurement object (i.e. per frequency). **Rapporteur**: adds that legacy operation only allows up to 2 SMTC configurations, and suggests that option 2.a) is re-phrased in proposal below to capture explicitly this proposed new operation.

**Option 2.a)** **Multiple SMTC configurations with multiple offsets**

13 companies preferred option 2.a) Multiple SMTC configurations with multiple offsets (APT, OPPO, MediaTek, Sony, Lenovo, CMCC, Rakuten, Thales, Samsung, Intel, Magister, ITRI, ZTE)

* MediaTek explains that it support this option a) for different satellites, i.e. each SMTC window can be configured for each neighbour satellite after compensating for propagation delay difference.
* Ericsson explains that the adjust of SMTC should be done in a deterministic way e.g. UE is configured with few possible adjustment options and UE then indicates which one it uses.
* Sony explains that either multiple SMTC configurations per neighbour satellite or a list of cells needing offsets. This should be enabled configuring the cells with an offset value.
* Lenovo explains that the offset should at least refer to the propagation delay difference between serving satellite and neighbor satellite(s).

The following argument was explained by not supporting company for option 2.a):

* Sony explains that multiple SMTC configurations may not be suitable from resource utilisation point of view.

**Option 2.b) Single SMTC configuration per group cell**

7 companies prefered option 2.b) Single SMTC configuration per group cell (APT, OPPO, Ericsson, Sony, Samsung, ITRI, ZTE).

* APT clarifies their support for multiple SMTC windows either per cell or per satellite.
* Samsung clarifies that a set of neighbor cells may correspond to a set of cells of one satellite, or a set of cells of multiple satellites with similar propagation delay differences. Different sets of neighbor cells will have different SMTC configurations which would reduce signaling. In addition, timestamp information could be included as to indicate the validity of the configuration provided to UE.
* ITRI supports network controlled SMTC configuration with enhanced SMTC to support cell specific or frequency specific time drifting of SMTC window (to bear up the propagation delay change according to satellite moving).
* ZTE points that should understand the typical scenarios and the expected propagation delay differences before discussing whether the configurations should be group per satellite, per cell or per a list of cells.

The following arguments were explained by not supporting companies for option 2.b):

* APT and CMCC explain that a single SMTC window may not cover the propagation delay difference between serving satellite and neighbor satellite.
* Nokia explains that individual SMTC configuration per cell (i.e. not per frequency) is not a feasible approach, as the same cell would still be measured with different propagation delay by different UEs.
* Rakuten explains that this increasing the SMTC window size (without understanding of required extension) will result in resource PRB wastage.

The following companies consider options 2.a) and 2.b) as the same kind of enhancement (OPPO, Ericsson, Samsung).

**Option 2.c) Other approaches**

* Nokia, Xiaomi and CATT explain that UE should be allowed to shift its observed window by a configurable offset and notify the network about the shift, to ensure synchronization. **Rapporteur**: this solution is discussed as part of section 2.4.3 “UE updates SMTC window based on relative movement of neighbor cell’s SSB” (with its report summary in section 2.6.4.3) and the corresponding UE assistance in section 2.4.2 (with its report summary in section 2.6.4.2).
* Qualcomm supports the enhancement of single SMTC configuration with multiple offsets. **Rapporteur**: as explained above the description of option 2.a) is re-phrased in proposal below to capture explicitly this operation.
* Ericsson, Huawei, HiSilicon and ZTE suggest extending the lengths of the SMTC window.
* Ericsson proposes that UE informs to the network if certain PCI(s), of the ones configured in the *measConfig*, cannot be detected at all. This assistance information would be helpful for the network to provide an updated SMTC/gap config to measure the missing PCI(s). **Rapporteur**: the solution is discussed in section 2.4.2 as part of the corresponding UE assistance (with its report summary in section 2.6.4.2).
* Xiaomi supports having an SMTC configuration per UE and per NTN cell/group cell. **Rapporteur**: as explained above the description of option 2.a) is re-phrased in proposal below to capture this operation as part of FFS.

**Rapporteur:** The following proposals are suggested taken into consideration companies’ views provided. Note that the description of options 2.a) and 2.b) are merged and re-phrased in proposal below aiming to include all the related comments provided.

**Proposal 3.** [To agree] [19/21] Enhancements of the SMTC configuration is supported for Rel-17 NTN.

**Proposal 3.1.** [To agree] [13/21] To enable the usage one or more SMTC configuration(s) with one or more offset(s) associated to each SMTC configuration in order to account for the different propagation delays. FFS if SMTC configuration can be associated with one or more cells and/or with one or more satellites. FFS how to define the offset in relation to the propagation delay of the serving satellite and neighbor satellite(s). FFS the details on how multiple SMTC configurations work in relation to the new offsets (e.g. whether one or more offset(s) associated to each SMTC configuration).

**Proposal 4.** [FFS] [4] FFS whether to slightly extend the lengths allowed for the SMTC window.

## Measurement gap configuration

### Solution 3) Multiple measurement gap patterns (discussion point 8))

13 companies support to enable solution 3) multiple measurement gaps (APT, Nokia, OPPO, LGE, MediaTek, Qualcomm, Xiaomi, CMCC, Rakuten, Thales, Samsung, Intel, Magister), and 8 companies support not to enable solution 3) (Ericsson, Sony, Lenovo, CATT, Huawei, HiSilicon, ITRI, ZTE).

* Nokia indicates that it should be defined associated rules when each configuration is applied.
* MediaTek points that solution 3) mainly address scenarios with different satellites.

The following arguments were explained by supporting companies for solution 3):

* It could lead to less interruption in UL/DL transmissions.
* It allows efficiently handle the measurement of different satellites with proper configuration.
* RAN2 should consider related work ongoing in RAN4 to enable multiple measurement gaps in Rel-17 NR.

The following arguments were explained by not supporting companies for solution 3):

* Ericsson indicates that having different gap patterns per satellite may result in a flexible varying pattern when looking at the union of gaps pattern which may be preferable for network scheduling.
* Sony clarifies that specification may need to describe how to choose the specific pattern.
* Lenovo points that multiple measurement gaps limit the resource a UE can use for data tx/rx.
* CATT explains that the propagation delay cannot be assumed static due to the movement of the satellites.

**Rapporteur:** The following proposal is suggested taken into consideration companies’ views provided:

**Proposal 7.** [To agree] [13/21] Multiple measurement gap patterns are supported for Rel-17 NTN.

## How network configures SMTC and measurement gap configuration

### Option b) UE assistance for network to properly (re)configure the SMTC and/or measurement gap (discussion point 13))

19 companies support option b) “UE assistance for network to properly (re)configure the SMTC and/or measurement gap” (APT, OPPO, LGE, Qualcomm, Ericsson, Sony, Lenovo, Xiaomi, CMCC, Rakuten, Thales, Samsung, CATT, Intel, Huawei, HiSilicon, Magister, ITRI, ZTE) and 2 companies do not support option b) (Nokia, MediaTek).

**Option b.1) UE reports location information**

9 companies support option b.1) (APT, Qualcomm, Ericsson, Thales, Samsung, CATT, Intel, Magister, ZTE).

* APT explains that NW can obtained rough UE location can be obtained via multiple RTT measurements if there are UE privacy concerns.
* ZTE explains that UE’s location might be known/defined e.g. based RTT or coarse location info represented by the TAC/TAI mapped from the geographical area UE).

The following arguments were explained by not supporting companies:

* MediaTek indicates that this information is unnecessary.
* Xiaomi, CMCC and Rakuten have concerns due to the UE privacy risk.

**Option b.2) UE reports propagation delay from neighboring cells**

8 companies support option b.2) (APT, OPPO, Lenovo, Xiaomi, CMCC, CATT, Intel, ITRI).

* APT clarifies that feeder link delay will be provided by NW.
* OPPO explains that this option can address the concern about UE privacy.
* Lenovo clarifies that UE reports its calculation for delay difference (or the propagation delay to neighbour)
* CATT points that frequent reporting may be needed due to the change of the propagation delay with the movement of the satellite.

**Option b.3) Other UE assistance information.**

* Nokia suggest that UE can report the adjustments on the observed window as UE has applied based on its UE own measurements of the propagation shift. **Rapporteur**: this enhancement is also supported by Xiaomi and CATT in section 2.2.2 (as explained in its report summary provided in section 2.6.2.2), and by ZTE in section 2.4.3 “UE updates SMTC window based on relative movement of neighbor cell’s SSB”. The related proposal below addresses the UE assistance and leaves the discussion on whether UE can do the change on its own to section 2.4.3 “UE updates SMTC window based on relative movement of neighbor cell’s SSB” (with its report summary in section 2.6.4.3).
* Sony, Xiaomi and Intel suggest that UE reports measurement gap changes might be helpful based on its calculations.
* Ericsson, Xiaomi, Rakuten and Intel propose that UE informs to the network if certain PCI(s), of the ones configured in the *measConfig*, cannot be detected at all. This assistance information would be helpful for the network to provide an updated SMTC/gap config to measure the missing PCI(s). **Rapporteur**: similar enhancement is also supported by LGE in section 2.2.2 (as explained in its report summary provided in section 2.6.2.4).
* Qualcomm and Samsung indicate that it would be useful if UE can report its TA (e.g. in Msg5).
* Rakuten explains how UE could update SMTC autonomously (considering neighbour cells ephemeris and UE’s location). Rakuten also explains how UE calculates the propagation delays to obtain the desirable change . **Rapporteur:** the solution is discussed as part of section 2.2.4 (with its report summary in section 2.6.2.4).
* Samsung suggests to report neighbor cell measurements.
* Huawei, HiSilicon, Qualcomm suggest that UE report SFTD periodically. **Rapporteur:** propagation delay reporting and SFTD aims to address the same kind of information (where propagation delay is absolute value and SFTD is relative value). Updated related proposal below to include this.

**Rapporteur:** The following proposal is suggested taken into consideration companies’ views provided:

**Proposal 11.** [To agree] [19/21] New UE assistance is defined in Rel-17 NTN for network to properly (re)configure the SMTC and/or measurement gap.

**Proposal 12.** [To discuss] [9/21] To discuss if a UE can report location information. If this reporting is agreed, FFS how UE’s location is known by UE (e.g. based on GNSS and/or RTT measurement and/or coarse location info represented by the TAC/TAI mapped from the geographical area UE); and, FFS how frequent this information is exchanged (e.g. periodically vs upon request).

**Proposal 13.** [To discuss] [11/21] To discuss if a UE can report propagation delay related information. If this reporting is agreed, FFS whether this information is defined as an absolute value based on propagation delay from neighboring cells or relative value based on the SFTD; and, FFS how frequent this information is exchanged (e.g. periodically vs upon request).

**Proposal 14.** [FFS] FFS if the following new UE reporting is defined:

**Proposal 14.1.** [FFS] [7] To allow a UE to report desirable adjustments on its measurement gap window based on UE’s own measurements of the propagation delay shift.

**Proposal 14.2.** [FFS] [5] To allow a UE to inform the network if certain PCI(s), of the ones configured in the measConfig, cannot be detected at all. This assistance information would be helpful for the network to provide an updated SMTC/gap configuration to measure the missing PCI(s).

**Proposal 14.3.** [FFS] [2] To allow a UE to report TA (e.g. in Msg.5).

**Proposal 14.4.** [FFS] [1] To allow a UE to report neighbor cell measurements.