**3GPP TSG-RAN WG4 Meeting # 98-e R4-210xxxx**

**Electronic Meeting, 25th Jan. – 5th Feb., 2021**

**Agenda item:** 11.8.4

**Source:** Moderator (Fraunhofer HHI)

**Title:** Email discussion summary for [98e][237] NR\_NTN\_solutions\_RRM

**Document for:** Information

# Introduction

This lead summary document captures issues related to NR NTN RRM. It contains a summary of the contributions under section 11.8.4 at TSG-RAN WG4 #98e, together with identified key open issues and recommends topics/questions to be handled via email discussions. The goal of this document is also to provide recommendation on prioritization of discussion and whether any issues should be postponed.

Please also note the draft TSG-RAN WG4 #98e meeting agenda with respect to NTN topic:

* 1. Solutions for NR to support non-terrestrial networks (NTN) [NR\_NTN\_solutions]
		1. General and work plan [NR\_NTN\_solutions-Core]
		2. Use cases, deployment scenarios, and regulatory information [NR\_NTN\_solutions-Core]

\* Include exemplary bands discussion

* + 1. Coexistence aspects [NR\_NTN\_solutions-Core]
			1. Simulation assumptions [NR\_NTN\_solutions-Core]
			2. UE requirements aspects [NR\_NTN\_solutions-Core]
			3. BS requirements aspects [NR\_NTN\_solutions-Core]
		2. RRM core requirements [NR\_NTN\_solutions-Core]
			1. General [NR\_NTN\_solutions-Core]
			2. Timing requirements [NR\_NTN\_solutions-Core]
			3. Measurement requirements [NR\_NTN\_solutions-Core]

According to the RAN4#98-e E-meeting Arrangements and Guidelines, the following schedule has been proposed:

* Stage 1: Moderators kick off email discussion (Monday, Jan. 25th)
* Stage 2: Companies provide comments for the 1st round (Jan. 25th – Wednesday 6 PM UTC, Jan. 27th)
* Stage 3: Moderators summarize the status and possible proposals, recommending what decisions can be made for 1st round. A formal TDoc will be used (Thursday 6 PM UTC, Jan. 28)
* Stage 4: After receiving the summary from moderators, session chair may approve documents, make agreements or assign new CRs, WFs, LSs, etc. (no later than Monday 8am UTC, Feb. 1)
* Stage 5: Companies provide comments for 2nd round.
	+ Draft WF/LS and revised CRs/TPs shall be shared by Wednesday 1am UTC, Feb. 3.
	+ Commenting shall stop by Wednesday 11pm UTC, Feb. 3.
	+ Formal TDocs of WF/LS/CRs/TPs shall be uploaded to the Inbox (except Cat A CRs) by Thursday 1am UTC, Feb. 4.
	+ Draft moderator summary shall be shared by Thursday 9 AM UTC, Feb. 4, but moderators are strongly encouraged to share it earlier if possible and delegates to comment as early as possible.
* Stage 6: Moderators provide 2nd round summary with a formal TDoc by Thursday 6 PM UTC, Feb. 4.
* Stage 7: Session chairs announce close of sessions (no later than 6 PM UTC, Feb. 5). Final decisions will be captured in Chairman meeting report (to be shared after the meeting is closed)

A total of 16 TDocs have been provided for this agenda:

|  |  |  |  |
| --- | --- | --- | --- |
| **TDoc Number** | **Title** | **Source** | **For** |
| [**R4-2100646**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100646.zip) | Discussion on measurement requirements for NTN | LG Electronics UK | Discussion |
| [**R4-2100647**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100647.zip) | Discussion on timing requirements for NTN | LG Electronics UK | Discussion |
| [**R4-2100714**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100714.zip) | Discussion on timing requirements for NTN | Xiaomi | Discussion |
| [**R4-2100715**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100715.zip) | Discussion on measurement requirements for NTN | Xiaomi | Discussion |
| [**R4-2100780**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100780.zip) | Discussion on UE Pre-compensation for UL synchronization for in NTN | MediaTek inc. | Discussion |
| [**R4-2100802**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100802.zip) | Discussion on NTN RRM measurement requirements | CMCC | Discussion |
| [**R4-2100819**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100819.zip) | Discussion on NTN timing requirements | CMCC | Discussion |
| [**R4-2101541**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101541.zip) | Discussion on timing requirements for NR NTN RRM | OPPO | Discussion |
| [**R4-2101712**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101712.zip) | Discussion on NTN measurement | Huawei, HiSilicon | Discussion |
| [**R4-2101864**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101864.zip) | Architecture and reference point | Ericsson | Approval |
| [**R4-2101865**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101865.zip) | RRM Timing requirements | Ericsson | Approval |
| [**R4-2101866**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101866.zip) | RRM Measurement Requirements | Ericsson | Approval |
| [**R4-2101882**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101882.zip) | NTN PVT Accuracy Aspects | THALES | Information |
| [**R4-2102813**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102813.zip) | Discussion on general issues for NTN RRM | Huawei, HiSilicon | Discussion |
| [**R4-2102814**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102814.zip) | Discussion on NTN timing related requirements | Huawei, HiSilicon | Discussion |
| [**R4-2102893**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102893.zip) | Discussion on RRM in NTN Systems | Qualcomm Incorporated | Discussion |

# Topic #1: General RAN4 RRM NTN related aspects

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

General RAN4 RRM NTN related aspects discussions are required to decide on the way forward, and to provide an initial RRM list of parameters to be considered by RAN4 RRM work.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101864 | Ericsson | **Observation 1:** If the reference point is placed at the gNB, then the gNB would experience only nominal, or at least close to nominal UL frequency and nominal UL to DL slot delay to consider. **Observation 2:** If the reference point is placed at the gNB then standardization would be simplified, since this is the existing rel-16 baseline in 3GPP and greatly increase the possibilities to reuse existing gNB RF and BB SW and HW.**Proposal 1:** Sent information LS to RAN1 with RAN4 implications for different reference points. |
| R4-2101865 | Ericsson | **Observation 1:** The delay in the TA control loop corresponds to significant part of CP already at SCS = 15 kHz.**Assumption 1:** The effect of the RTT in the TA control loop is not considered in this contribution since that is a function of the final mechanism chosen in RAN1. However CP will still have to be preserved.**Observation 2:** If gNB is time and synchronization reference then we get a requirement set which is more compatible with existing release-17 baseline.**Proposal 1:** RAN4 to investigate the impact on existing gNB requirements for the cases when satellite and gNB is time and frequency reference. |
| R4-2102813 | Huawei, HiSilicon | **Proposal 1:** RAN4 to clarify the scenarios to be considered for NTN RRM, including but not limited to* Frequency Range
* Support of CA and DC
* Deployment of cells/beams
* Mobility

**Proposal 2:** RAN4 to consider defining the NTN RRM requirements for * Basic mobility procedure (cell reselection and HO)
* RRM measurement (delay and accuracy)
* Serving cell related (RA, timing and RLM)
 |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: Reference point (RP) to be considered for time and frequency synchronization

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Send information LS to RAN1**

* Proposals
	+ Option 1: Send information LS to RAN1 with RAN4 implications for different reference points.
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 1-2: Possibility of using satellite and gNB as time and frequency reference**

* Proposals
	+ Option 1: RAN4 to investigate the impact on existing gNB requirements for the cases when satellite and gNB is time and frequency reference.
	+ Option 2: TBA
* Recommended WF
	+ TBA

### Sub-topic 1-2: NTN Use cases and scenarios

*Open issues and candidate options before e-meeting:*

**Issue 1-3: Scenarios to be considered for NTN RRM**

* Proposals
	+ Option 1: RAN4 to clarify the scenarios to be considered for NTN RRM, including but not limited to
		- Frequency Range
		- Support of CA and DC
		- Deployment of cells/beams
		- Mobility
	+ Option 2: TBA
* Recommended WF
	+ TBA

### Sub-topic 1-3: NTN RRM requirements

*Open issues and candidate options before e-meeting:*

**Issue 1-4: Definition of NTN RRM requirements**

* Proposals
	+ Option 1: RAN4 to consider defining the NTN RRM requirements for
		- Basic mobility procedure (cell reselection and HO)
		- RRM measurement (delay and accuracy)
		- Serving cell related (RA, timing and RLM)
	+ Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 1-1: New options:* Option 2, since there seems to be confusion in RP definition from Option 1.
* RAN1 is currently discussing RP for frequency synchronization and RP for time synchronization. The RP may not be the same.

Sub topic 1-2: New options:* Option 2: RAN4 to investigate the impact on existing gNB requirements for the cases when satellite is frequency reference and gNB is time reference.
* Option 3 (preferred): RAN4 to investigate the impact on existing gNB requirements for the cases when satellite is time reference and gNB is frequency reference.

Sub topic 1-3: New options:* Option 2, as the first 2 items from Option 1 does not seem to be RRM.

Sub topic 1-4:* Option 1, seems fine. Please also see recommended Way Forward for RRM (R4-2017268) from RAN4#97e,

….Others: |
| Qualcomm | **Issue 1-1: Send information LS to RAN1**It is unclear what will be asked in the LS. We can discuss it in the second round if things get clearer.**Issue 1-2: Possibility of using satellite and gNB as time and frequency reference**Can supporting company clarify what is the definition of reference point of timing and frequency? In our understanding, from UE perspective, initial UL timing is determined based on individual timing offset between the UE and the satellite and some common parameters such as N\_TA\_offset and a network configured NTN specific offset. Here N\_TA\_offset is static and the network configured NTN specific offset is semi-static, i.e. it can be reconfigured as needed especially in LEO scenario. For the frequency offset, Doppler shift cased in the feeder link won’t be propagated to the service link.It will be good to clarify the definition and differences between timing and frequency offsets.**Issue 1-3: Scenarios to be considered for NTN RRM**For frequency range, it may have an impact on beam management because it is coupled with other parameters like user terminal type which will have different UE capabilities in terms of beam forming and so on.For CA/DC, we first want to focus on non-CA/DC scenario. If a scenario where one satellite can have multiple feeder links needs to be considered in Rel-17, we can extend single CC to CA and/or DC as needed.**Issue 1-4: Definition of NTN RRM requirements**There will be for sure more requirements to be defined for Rel-17 NTN. A better question is probably “what RRM requirements can be deprioritized”. |
| CMCC | **Issue 1-1: Send information LS to RAN1**RAN4 should wait for RAN1’s agreement.**Issue 1-2: Possibility of using satellite and gNB as time and frequency reference**THALES proposed two specific options, in our views, RAN4 should also investigate the impact on existing gNB requirements for the cases when gNB is time reference and gNB is frequency reference. but the final decision should depend on RAN1’s agreements.**Issue 1-3: Scenarios to be considered for NTN RRM**The last three bullets are under discussing in RAN1/2, we don’t recommend overlapping discussion. RAN4 should focus on the operating bands and frequency range.**Issue 1-4: Definition of NTN RRM requirements**All bullets can be the candidates for discussion. |
| Apple | **Issue 1-3: Scenarios to be considered for NTN RRM**Option 2. FR and CA/DC might be discussed in RF session, deployment of cells/beams might be determined by RAN1, mobility might be determined by RAN2**Issue 1-4: Definition of NTN RRM requirements**Fine with option 1. |
| LGE | **Issue1-1**The issue of reference point is RAN1 work. So RAN4 needs to wait for RAN1 decision.**Issue 1-3**Option 2. We agree that the scenarios in option1 need to be considered. However, the frequency range and the deployment of cells/beams will be discussed other NTN session [310] and [311]. And RAN4 shall focus on single carrier, intra mobility within NTN with higher priority based on RAN1 and RAN2 discussion.**Issue 1-4**RAN4 needs to define NTN RRM requirements as option 1. |
| Ericsson | Sub topic 1-1: Issue 1-1: It will be up to RAN1 to decide reference point, but we prefer option 1, to send LS and give RAN4 input to RAN1 decision. Issue 1-2: It will be up to RAN1 to decide reference point, but we prefer option 1, to send LS and give RAN4 input to RAN1 decision. We prefer to have gNB as time and frequency refence, but RAN4 is contribution driven and impact of existing gNB requirements due to having time and frequency reference at satellite can also be investigated.Sub topic 1-2:Issue 1-3: Option 2: Many scenarios can be considered, but first priority is a basic NTN system with idle and active mode procedures for at least and NTN DL and an NTN UL, with NTN-NTN and NTN-TN mobility for that carrier.Issue 1-4: Refer to response for issue 1-3. |
| Xiaomi | Issue 1-1:It is purely RAN1 issue, RAN4 should wait for RAN1 agreement, and no need to send LS to RAN1.Issue 1-2:It is purely RAN1 issue, RAN4 should wait for RAN1 agreement.Issue 1-3:RAN4 should focus on single CC first, the support of frequency range and CA/DC band combination should be decide in RF session. And the deployment of cells/beams should be determined in RAN1, and mobility scenarios should be decided by RAN2.Issue 1-4:In general, option 1 is fine for us, however, RAN4 may also need to consider the beam related requirements (beam management and beam switching) based on RAN1 agreements on beam management and beam deployment.  |
| OPPO | Issue 1-4: option 1 is fine, not precluding some other requirements from RAN1 on BM. |
| MediaTek | Issue 1-1:We can wait for RAN1’s conclusion. Issue 1-2:No problem to investigate. What would be impact on the requirements, from proponent’s view? Issue 1-3:We can focus on single CC first.* Frequency range and CA/DC band combination need input from RF session.
* And the deployment of cells/beams should be determined in RAN1.

Issue 1-4:Option 1 can be considered as the new requirement needs to be revised for NTN UEs. For other requirements, RAN4 can also identify whether the existing RRM requirements can also be also applied to NTN UEs. |
| Huawei | **Issue 1-1: Send information LS to RAN1**RAN4 could wait for RAN1’s agreement, we do not see particular need to send LS.**Issue 1-2: Possibility of using satellite and gNB as time and frequency reference**We are fine with option 1, and there is no need to restrict on which cases to study for now, but companies can bring their analysis based on their preferences.**Issue 1-3: Scenarios to be considered for NTN RRM**Option 1 is our proposal, and we would like to clarify that the intention is NOT to discuss and make decision on these bullets in RRM, but to list the scenarios that may impact development of RRM requirements. From RRM side, we can which requirements can be discussed independently of the scenarios that are to be decided in other session or WG, and which requirements need to be based on other WG conclusions (so we need to wait). We can also discuss if any prioritization can be agreed now, e.g. working on single carrier case first.**Issue 1-4: Definition of NTN RRM requirements**Support option 1, of course, this is a min set and starting point, and more requirements can be discussed later. |
| CATT | **Issue 1-1: Send information LS to RAN1**Unclear about the intention of the LS. **Issue 1-2: Possibility of using satellite and gNB as time and frequency reference**Option 2. It is not possible to use satellite or gNB timing and frequency as the reference.**Issue 1-3: Scenarios to be considered for NTN RRM**Option 2. Prefer to focus on FR1 and single carrier case.**Issue 1-4: Definition of NTN RRM requirements**Option 1 could be considered as the starting point. More considerations are needed. |
| Nokia, Nokia Shanghai Bell | **Issue 1-1:** The proposed LS should be revised to provide specific information on RAN4 understanding of reference point for time and frequency. This is to ensure that RAN1 is aware of the implications of defining the reference point with respect to gNB or satellite. Thus, Option 1 is acceptable.**Issue 1-2:**Option 1 is reasonable because there is an impact of the reference point definition on existing RRM requirements. **Issue 1-3:**Option 2 as there is dependency on the outcome of discussions in other working groups.**Issue 1-4:**RRM requirements are not limited to those in Option 1. |
| Hughes/EchoStar | Issue 1-1:Option1 – and wait for RAN1’s conclusion. Issue 1-3:Option 2Issue 1-4:Option 1 can be considered as the new requirement needs to be revised for NTN UEs.  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 1-1** | *Tentative agreements: There is consensus to wait for RAN1’s decision on the RP. Regarding the LS, it is unclear what will be asked.**Candidate options: Wait for RAN1’s decision on the RP. FFS on the LS, pending further clarification.****Recommendations for 2nd round: Ericsson should clarify what will be asked in the LS.*** |
| **Issue 1-2** | *Tentative agreements: Final decision is up to RAN1, but most companies agree that RAN4 should also investigate the issue.* *Candidate options: RAN4 to investigate the impact on existing gNB requirements for the cases when**- Option A: satellite and gNB is time and frequency reference**- Option B: satellite is frequency and gNB is time reference**- Option C: satellite is time reference and gNB is frequency reference****Recommendations for 2nd round:* *RAN4 should discuss which of the options to investigate, and send a LS to RAN1 with RAN4 input if necessary.*** |
| **Issue 1-3** | *Tentative agreements: Most companies have a strong preference towards Option 2: Keep scenarios to be considered for NTN RRM TBA.**Candidate options:**Recommendations for 2nd round: Wait for RAN1, RAN2 and RAN4-RF to specify scenarios. The focus shall be on FR1 and single CC first.* |
| **Issue 1-4** | *Tentative agreements: All companies agree that Option 1 can be used as a starting point, but other requirements (for example beam related) can and should be added and discussed later.**Candidate options: Option 1: RAN4 to consider defining the NTN RRM requirements for* * *Basic mobility procedure (cell reselection and HO)*
* *RRM measurement (delay and accuracy)*
* *Serving cell related (RA, timing and RLM)*

*Recommendations for 2nd round: Use Option 1 as starting point for NTN RRM requirements, but do not preclude other requirements, such as beam related requirements, in the future.* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM requirements | Fraunhofer |

## Discussion on 2nd round (if applicable)

Moderator suggests to focus discussion on Issues 1-1 and 1-2.

**Issue 1-1**: Send information LS to RAN1 regarding reference point

* Ericsson should clarify what will be asked in the LS.

**Issue 1-2**: Possibility of using satellite and gNB as time and frequency reference

* *Candidate options: RAN4 to investigate the impact on existing gNB requirements for the cases when*
	+ *Option A: satellite and gNB is time and frequency reference*
	+ *Option B: satellite is frequency and gNB is time reference*
	+ *Option C: satellite is time reference and gNB is frequency reference*
* Recommendation: RAN4 should discuss which of the options to investigate, and send a LS to RAN1 with RAN4 input if necessary.

**Outcome of GTW session (01. Feb. 2021):**

• Issue 1-1: Session chair: Defer the LS. Further discuss the impacts of different reference points on RRM requirements and inform RAN1 in case any common observations are identified.

• Issue 1-2: Further investigate the impact of different timing and frequency reference points based on RAN1 design on the RRM requirements. Inform RAN1 if any issues are identified.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Will share our view if there is any new issue from companies based on the agreement made in the GTW session.Further investigate the impact of different timing and frequency reference points based on RAN1 design on the RRM requirements. Inform RAN1 if any issues are identified. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: GNSS requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

The topic should at least cover:

* GNSS used on UE, precision and accuracy requirements
* GNSS used on Satellite, precision and accuracy requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100780 | MediaTek Inc. | **Observation 5:** GNSS accuracy in the device and on-board of satellite are expected to be sufficiently accurate, i.e. ±3 m.**Proposal 3:** No RRM requirement impacted by GNSS accuracy. |
| R4-2102813 | Huawei, HiSilicon | **Proposal 3:** RAN4 to discuss whether GNSS accuracy is taken as * An assumption to define other requirements, or
* An implicit or explicit requirements
 |
| R4-2102814 | Huawei, HiSilicon | **Proposal 2:** RAN4 needs to study the reference GNSS scenario for deriving the UE position error.* Option 1: Considering worst scenario.
* Option 2: Considering a typical scenario, with introducing the GNSS signal parameters for this scenario.
 |
| R4-2100819 | CMCC | **Proposal 5:** Both explicit way and implicit way can be considered to specify the UE GNSS positioning accuracy requirement.**Proposal 6:** Defining the requirements without on-board GNSS as the baseline. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: GNSS usage

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Definition of GNSS requirements**

* Proposals
	+ Option 1: Defining the requirements **without** on-board GNSS as the baseline.
	+ Option 2: Defining the requirements **with** on-board GNSS as the baseline.
* Recommended WF
	+ TBA

### Sub-topic 2-2: GNSS accuracy

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Impact of GNSS accuracy on RRM requirements**

* Proposals
	+ Option 1: RRM requirements are **not** impacted by GNSS accuracy
	+ Option 2: RRM requirements are impacted by GNSS accuracy
* Recommended WF
	+ TBA

**Issue 2-3: GNSS accuracy requirement**

* Proposals
	+ Option 1: GNSS accuracy is taken as an assumption to define other requirements
	+ Option 2: GNSS accuracy is taken as an implicit or explicit requirement
* Recommended WF
	+ TBA

**Issue 2-4: Reference GNSS scenario**

* Proposals
	+ RAN4 needs to study the reference GNSS scenario for deriving the UE position error
		- Option 1: considering worst case scenario
		- Option 2: Considering a typical scenario, with introducing the GNSS signal parameters for this scenario
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 2-1: * Option 2, but this should be clarified that is the assumption for satellite. For UE has already been decided as part of Rel-17.

Sub topic 2-2:* Option 2. Some assumptions on the GNSS requirements accuracy have to be considered.

Sub topic 2-3: * Probably Option 1, but the assumptions have to be realistic.

Sub topic 2-4:* Option 1 seems easier.
* Option 2: how many “typical” scenarios we might need to consider?

….Others: |
| Qualcomm | **Issue 2-1: Definition of GNSS requirements**Option 2. It should apply to HAPS too.**Issue 2-2: Impact of GNSS accuracy on RRM requirements**Needs more investigation. And in our understanding, whether and how much impact is foreseen can be different for different requirements, e.g. L1/L3 measurements, time/frequency pre-compensation accuracies, etc.**Issue 2-3: GNSS accuracy requirement**Option 1. What matters is what level of GNSS accuracy can be assumed in terms of PVT and update frequency. We should also take into account “lossy compression of PVT information” and “level of GNSS integration (e.g. UE may not be able to get real time GNSS information as frequent as required, and there can be a time/clock offset between GNSS receive and NR module)”. Besides, if there can be any nontrivial (residual) time/frequency error propagation in feeder link(s), it should be also taken into consideration.**Issue 2-4: Reference GNSS scenario**Not sure about what are the worst and typical scenarios and in terms of what. |
| CMCC | Sub topic 2-1: Issue 2-1: Definition of GNSS requirementsSince not all of the satellites support on-board GNSS, we support Option1 to take the requirements without on-board GNSS as the baseline.Sub topic 2-2:Issue 2-2: Impact of GNSS accuracy on RRM requirementsWe prefer Option2 that RRM requirements are impacted by GNSS accuracy.Issue 2-3: GNSS accuracy requirementWe think Option2 contains Option1. Each option is OK for us.Issue 2-4: Reference GNSS scenarioIf we consider requirements for A-GNSS in 38.171 as a starting point when defining requirements, we observe that the typical scenario is the worst scenario. The requirements as follows for reference:

| Success rate | 2-D position error | Periodical reporting interval |
| --- | --- | --- |
| 95 % | 100 m | 20 s |

For this issue, we propose to list the typical scenario first. Such as multi-path scenario, moving scenario and so on. |
| Apple | **Issue 2-2: Definition of GNSS requirements**Option 2. Need more check if we have formal conclusion or agreement on how much the GNSS accuracy is (including UE GNSS and on-board GNSS if equipped). **Issue 2-3: Definition of GNSS requirements**Either option is fine as long as GNSS accuracy is taken into account for corresponding RRM requirements.**Issue 2-4: Reference GNSS scenario**Option 1. |
| LGE | Issue 2-2Option 2. GNSS accuracy could impact RRM requirements.Issue 2-3Either option is fine to us. But, we think that explicit requirement for GNSS accuracy is beyond the scope of RAN4Issue 2-4What is the worst and typical scenario for NTN?  |
| Ericsson | Sub topic 2-1: Issue 2-1: Ericsson is fine with the existing frame in WID, i.e. GNSS capable UE (option1), but we are not against option 2. Option 2 is also fine for Ericsson.Issue 2-2: First we need to find out which RRM requirements we need, option 1, then we need to consider ways to fulfill them. This means that at a later stage in requirement development, then GNSS might impact RRM requirements (or the procedures, mechanisms). This is option 2.Issue 2-3: Refer to comment for Issue 2-2.Issue 2-4: Worst case (option 1) has to be considered. We are not against typical cases, to be studied as well. |
| Xiaomi | Issue 2-1:Support option 2Issue 2-2:Option 2, GNSS accuracy may impact RRM requirements, e.g. UE specific TA estimation.Issue 2-3:Either option is fine for us, similar comment as LG, explicit requirement for GNSS accuracy is out of 3GPP scope.Issue 2-4:Firstly, we need identify clearly what is the worst scenario and typical scenario. |
| MediaTek | Issue 2-1:Support option 2. Issue 2-2:Option 1, because the impact will be very limited. But fine to further check. Issue 2-3:Option 1. It could also be an implicit requirement. Issue 2-4:Not sure what is the worst/typical case in this stage. |
| Huawei | Issue 2-1:Suggest FFS, not sure if we should agree to exclude option 1 for now.Issue 2-2:Support option 2. At least GNSS accuracy will impact the UE timing requirements.Issue 2-3:Option 1. Issue 2-4:Either option 1 or option 2 is acceptable. |
| CATT | Sub topic 2-1: Option 2.Issue 2-2:It’s premature to make a decision between option 1 and option 2.Issue 2-3: Option 1.Issue 2-4: It depends on the exact scenarios. Maybe one of them and maybe both. |
| Hughes/EchoStar | **Issue 2-1: Definition of GNSS requirements**Option 2.**Issue 2-2: Impact of GNSS accuracy on RRM requirements**Option 1**Issue 2-3: GNSS accuracy requirement**Option 1**Issue 2-4: Reference GNSS scenario**Either |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 2-1** | *Tentative agreements: Most companies prefer Option 2 (Defining the requirements with on-board GNSS as the baseline). It should be clarified that this assumption is for satellite/HAPS only, as the decision for UE has already been made as part of Rel-17.**Candidate options:**- Option 1: Defining the requirements without on-board GNSS as the baseline.**- Option 2: Defining the requirements with on-board GNSS as the baseline.**Recommendations for 2nd round: Further discussion necessary. Use Option 2 as baseline and discuss how to handle satellites/HAPS without on-board GNSS.* |
| **Issue 2-2** | *Tentative agreements: Most companies prefer Option 2, although there are some concerns.* *Candidate options:**- Option 1: RRM requirements are not impacted by GNSS accuracy**- Option 2: RRM requirements are impacted by GNSS accuracy**Recommendations for 2nd round: Further discuss the options and the foreseeable impact.* |
| **Issue 2-3** | *Tentative agreements: Strong preference towards Option 1, as long as the assumptions are realistic. Explicit requirements are outside the scope of RAN4.**Candidate options:**- Option 1: GNSS accuracy is taken as an assumption to define other requirements**- Option 2: GNSS accuracy is taken as an implicit or explicit requirement**Recommendations for 2nd round: GNSS accuracy is taken as an assumption to define other requirements. Explicit accuracy requirements are outside the scope of RAN4.* |
| **Issue 2-4** | *Tentative agreements: Typical and worst case scenarios have to be defined before a decision can be made.**Candidate options:** *Option 1: considering worst case scenario*
* *Option 2: Considering a typical scenario, with introducing the GNSS signal parameters for this scenario*

*Recommendations for 2nd round: Companies should define typical and worst case scenarios. Not sure if this can be done during RAN4#98-e or at a later meeting.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM requirements | Fraunhofer |

## Discussion on 2nd round (if applicable)

Moderator suggests to focus discussion on Issues 2-1 and 2-2. Issue 2-4 should be postponed until typical and worst case scenarios are defined.

**Issue 2-1**: Definition of GNSS requirements

* Candidate options:
	+ Option 1: Defining the requirements without on-board GNSS as the baseline.
	+ Option 2: Defining the requirements with on-board GNSS as the baseline.
* Proposal: Use Option 2 as baseline and discuss how to handle satellites/HAPS without on-board GNSS.

**Issue 2-2**: Impact of GNSS accuracy on RRM requirements

* Candidate options:
	+ Option 1: RRM requirements are not impacted by GNSS accuracy
	+ Option 2: RRM requirements are impacted by GNSS accuracy
* Proposal: FFS

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 2-1**: Definition of GNSS requirementsSupport Option 2. In our understanding, whether or not it is on-board GNSS is not immediately related to UE requirement development. What matters is whether UE is provided with GNSS information, e.g. PVT, of satellite(s) by any means. And our understanding is the information will be broadcasted by the serving cell(s).**Issue 2-2**: Impact of GNSS accuracy on RRM requirementsIn general Option 2. More importantly, whether and how much impact is foreseen can be different for different requirements, e.g. L1/L3 measurements, time/frequency pre-compensation accuracies, etc. |
| Xiaomi | **Issue 2-1**: Definition of GNSS requirementsSupport option 2, RAN1 is agreed to introduce UE specific TA estimation based on UE’s GNSS-required position and the serving satellite ephemeris information or PVT information which will be broadcast by the serving cell. **Issue 2-2**: Impact of GNSS accuracy on RRM requirementsSupport option 2, GNSS accuracy could have some impact on RRM requirements, e.g. UE specific TA estimation. |
| CMCC | **Issue 2-1**: Definition of GNSS requirementsWe prefer Option1 before because we concern the on-board GNSS deployment, **but if the satellites or HAPS equipped with the on-board GNSS is the typical case, we are also fine with Option2**.**Issue 2-2**: Impact of GNSS accuracy on RRM requirementsWe support Option2. At least, timing accuracy and frequency pre-compensation accuracies will be impacted by GNSS accuracy. But the degree of impact needs further study. For example, whether the influence is negligible.  |
| Ericsson | **Issue 2-1**: Definition of GNSS requirementsWe are fne with Proposal: Use Option 2 as baseline and discuss how to handle satellites/HAPS without on-board GNSS.**Issue 2-2**: Impact of GNSS accuracy on RRM requirementsSamme comment as 1st round: First we need to find out which RRM requirements we need, option 1, then we need to consider ways to fulfill them. This means that at a later stage in requirement development, then GNSS might impact RRM requirements (or the procedures, mechanisms). This is option 2. |
| Nokia, Nokia Shanghai Bell | **Issue 2-2**: Impact of GNSS accuracy on RRM requirementsFurther discusisons seem necessary as it is anticipated not all RRM requirements are impacted GNSS accuracy. The requirements need to be considered on a case-by-case basis. |
| THALES | **Issue 2-1**: Definition of GNSS requirementsIt can be Option 2 for both satellite and HAPS.The precision with which the system knows the trajectory of the satelites is not depending only on the on-board GNSS precision/performance, but also on the solutions of orbit determination available in the satellite control center. At the end, the determination of the orbit plays a more important role in the final performance with respect to GNSS performance itself. **Issue 2-2**: Impact of GNSS accuracy on RRM requirementsOption 2 is ok. However, it is important to know that the precision of on-board GNSS (on satellite) will depend on the satellite orbit, so RAN4 will have to consider some sub-cases.Moreover, as a function of the type of the deployed system and its parameters (service link frequency for example), RAN4 should probably define different requirements for the precision of the trajectory of the satellites (or perhaps the precision of system knowledge of the satellite trajectory). |
| LGE | **Issue 2-1**: Definition of GNSS requirementsWe don’t have strong view. Both options are fine to us.**Issue 2-2**: Impact of GNSS accuracy on RRM requirementsSupport option 2. GNSS accuracy could impact delay compensation mechanism discussed in RAN1. It implies that RRM requirement might be affected by GNSS accuracy and hence more investigation is needed. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: PVT Satellite precision

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2101882 | Thales | **Proposal 1:** It is assumed that the NTN infrastructure (NTN control function) can provide updates of the actual Ephemeris at the necessary frequency to prevent excessive ageing that would prevent successful uplink synchronisation. |
| R4-2102814 | Huawei, HiSilicon | **Observation 1:** RAN1’s decision on the format of the satellite ephemeris parameters are needed to deriving the UE position error. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1: Requirements for PVT computation and distribution

**Issue 3-1: NTN PVT Accuracy Aspects**

* Proposals
	+ Option 1: It can be assumed that the NTN infrastructure (NTN control function) can provide updates of the actual Ephemeris at the necessary frequency to prevent excessive ageing that would prevent successful uplink synchronisation.
	+ Option 2: RAN1’s decision on the format of the satellite ephemeris parameters are needed to deriving the UE position error.
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 3-1: Both Option 1 and Option 2 may be possible.….Others: It has to be decided if the satellite is assisted by the NTN infrastructure (satellite can provide PVT information, while the NTN control function may provide ephemeris information).  |
| Qualcomm | **Issue 3-1: NTN PVT Accuracy Aspects**This doesn’t seem a discussion topic for RAN4 to make any conclusion. |
| CMCC | Sub topic 3-1: Issue 3-1: NTN PVT Accuracy AspectsWe observed that Option1 and Option2 are not conflicting options. This issue can be discussed after RAN1’s decision. |
| Apple | **Issue 3-1: NTN PVT Accuracy Aspects**Option 2. |
| LGE | Issue 3-1PVT accuracy can impact timing or measurement behavior. Even if it can be assumed that NTN infrastructure can provide updates of PVT information, it should guarantee valid PVT information with timer, so NTN UE shall not use obsolete PVT information for timing or measurement. |
| Ericsson | Sub topic 3-1: Issue 3-1: We are not aware of any agreement on NTN control function updates characteristics. This makes it hard to decide on option 1 now. RAN1 decision on format for PVT might impact derivation of UE position error. |
| Xiaomi | Issue 3-1:Similar view as QC, it is not a RAN4 topic, and it depends on RAN1’s decision. |
| MediaTek | Issue 3-1: Fine with Option 2.  |
| Huawei | Issue 3-1:Both PVT-based ephemeris format and orbit element-based ephemeris format are discussed in RAN1. RAN1’s inputs are needed. RAN4 shall focus the impacts of satellite ephemeris format on RRM requirements. |
| CATT | Issue 3-1:It is RAN1 discussion. |
| Nokia, Nokia Shanghai Bell | Issue 3-1:The same observation as CMCC, i.e., Options 1 and 2 deal with different issues. For Option 1, is the NTN control function defined in 3GPP? |
| Hughes/EchoStar | Issue 3-1: Option 2. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 3-1** | *Tentative agreements: No clear consensus can be seen yet. Many companies see this as a RAN1 topic.**Candidate options:** *Delay further discussion until RAN1 has reached a decision*

*Recommendations for 2nd round: Discuss delaying further discussion until RAN1 has reached a decision* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM requirements | Fraunhofer |

## Discussion on 2nd round (if applicable)

Moderator suggests delaying further discussion until RAN1 has reached a decision.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Unless a specific work is requested by other working group(s), we do not clearly understand what RAN4 should discuss. |
| Xiaomi | Fine with moderator’s suggestion. |
| THALES | We are fine with the suggestion from the moderator and with further discussing updates of ephemeris and necessary frequency to prevent excessive ageing. However, the satellite ephemeris parameters are not directly related to UE position error, so maybe Option 2 has to be formulated, e.g. “format of the satellite ephemeris parameters need further discussion”. |
| LGE | Support moderator’s suggestion. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: NTN UL Time synchronization requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100647 | LG Electronics | **Proposal 1**: Wait for RAN1 decision since UL synchronization requirement highly depends on RAN1 progress. |
| R4-2100714 | Xiaomi | **Observation 1:** The accuracy of UE specific TA estimation may depend on the accuracy of GNSS positioning and the accuracy of ephemeris information calculation.**Proposal 1:** RAN4 is to introduce the accuracy requirement for the UE specific TA estimation for an NTN UE in RRC\_idle and RRC\_inactive mode.**Observation 2:** The TA adjustment accuracy requirement depends on whether the common TA mechanism is introduced or not, which is being discussed in RAN1.**Proposal 2:** the TA adjustment accuracy can be defined as the same ratio of the TA adjustment step size (±1/4 of TA adjustment step) specified for legacy NR. |
| R4-2100780 | MediaTek Inc. | **Observation 1:** By using propagation method based on gravity with SIB periodicity of 10s:* The timing error is 0.003 us, which is only about 0.01\*Te in SCS of 15kHz, as specified in TS 38.133.

**Observation 2:** By using propagation method based on linear extrapolation with SIB periodicity of 2s:* The timing error is 0.04 us, which is around 0.12\*Te in SCS of 15kHz
* Te is the initial transmission timing error requirement as specified in Table 7.1.2-1, TS38.133.

**Observation 3:** UL timing error contributed by UE pre-compensate satellite Delay can be ranged from 0.01\*Te ~ 0.12\*Te.**Proposal 1:** No need to relax Te specified in in Table 7.1.2-1 for NTN UEs. |
| R4-2100819 | CMCC | **Proposal 1**: For initial transmission timing, the existing *Te* requirements defined in Table 7.1.2-1 can be a baseline for R17 NTN network.**Proposal 2**: For LEO NTN network gradual timing adjustment, the maximum amount of the magnitude of the timing change in one adjustment and the maximum aggregate adjustment rate should be studied, such as Tq’ per X ms.* evaluate the value X based on service demand and UE capability
* calculate Tq’, i.e., Tq’≥(79Tc+Tq/200)×X.

**Proposal 3:** The R16 gradual timing adjustment requirements can be a baseline for GEO NTN network.**Proposal 4:** UE timer accuracy can be kept as that in R16 specification.**Observation 1:** The UE evaluated TA error mainly consists of inaccuracies of UE position and satellite position.**Observation 2:** How to capture the TA update requirements in connected mode should be based on RAN1 agreements. |
| R4-2101541 | OPPO | **Proposal 1:** RAN4 should wait for RAN1’s agreement before concluding on TA adjustment accuracy.**Proposal 2:** NTN delay compensation has impact on TA error.**Proposal 3:** RAN4 further investigate Te based on current NR TN requirements.**Proposal 4:** The Gradual timing adjustment rules have to be modified for NTN, including the parameter Tq (Maximum Autonomous Time Adjustment Step) and Tp (Minimum Aggregate Adjustment rate).**Proposal 5:** Reuse the requirements of NTA\_offset，and UE timer accuracy as in current TS 38.133 specification. |
| R4-2101865 | Ericsson | **Observation 3:** It is important to control the size of Te. The reason for this is that we have to preserve CP.**Proposal 2:** Keep existing Te requirements as defined in TS 38.133, Table 7.1.2-1: Te Timing Error Limit**Observation 4:** In order to preserve CP we get that ΔUE-pos + ΔSat-pos + ΔUE\_timing\_estimate < Te**Observation 5:** A worst case maximum delay variation will trigger a gradual timing adjustment every 10 to 6 ms for FR1 and every 3 to 2.5 ms for FR2 given existing gradual timing adjustment requirements.**Observation 6:** The parameter Tq will have to be modified. For a period of 200 ms we could have a worst case delay variation of 246 \* 64 Tc.**Proposal 3:** The parameter Tq and the maximum aggregate adjustment rate will have to be investigated.**Proposal 4:** Keep  as in existing TS 38.133 specification [3].**Proposal 5:** Keep UE timer accuracy as in existing TS 38.133 specification [3].**Observation 7:** final analysis of Timing Advance adjustment accuracy has to consider the total error budget for regulating TA during a call: ΔUE-pos, ΔSat-pos, Timing Advance adjustment accuracy and TA command resolution error.**Proposal 6:** Final Timing Advance adjustment accuracy depends on the mechanism chosen in RAN1 specification and the final total uncertainty budget. However, Timing Advance adjustment accuracy should scale inversely proportional to SCS (and in current specification it is ±1/4 TA-step (at SCS = 15 kHz)). |
|  |  |  |
| R4-2102814 | Huawei, HiSilicon | **Proposal 1:** For NTN networks, RAN4 needs to study how to define UE transmit timing requirements in RRC idle/inactive mode.* Option 1: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
	+ UE self-estimating error of NTA is counted into the UE transmit timing error.
	+ Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
* Option 2: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
	+ UE self-estimating error of NTA will be counted into the timing advance adjustment error.
	+ UE transmit timing error is derived from the UE capability of estimating downlink timing
* Option 3: Define the requirements on UE transmit timing error limit, UE self-estimating accuracy of NTA and timing advance adjustment accuracy, provided that:
	+ UE transmit timing error is derived from the UE capability of estimating downlink timing
	+ Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.

**Proposal 3:** For NTN networks, RAN4 needs to define UE transmit timing requirements in RRC connected mode, with using the same methodology in RRC idle/inactive mode.**Proposal 4:** For NTN networks, RAN4 need to study the UE autonomous timing adjustment requirements in RRC connected mode, which can be derived from the downlink timing drift and UE self-estimation TA variation. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1: Timing adjustment

*Open issues and candidate options before e-meeting:*

**Issue 4-1: TA adjustment accuracy**

* Proposals
	+ Option 1: RAN4 should wait for an agreement in RAN1 before concluding on TA adjustment accuracy.
	+ Option 2: Final Timing Advance adjustment accuracy depends on the mechanism chosen in RAN1 specification and the final total uncertainty budget. However, Timing Advance adjustment accuracy should scale inversely proportional to SCS (and in current specification it is ±1/4 TA-step (at SCS = 15 kHz)).
	+ Option 3: The TA adjustment accuracy can be defined as the same ratio of the TA adjustment step size (±1/4 of TA adjustment step) specified for legacy NR.
* Recommended WF
	+ TBA

**Issue 4-2: Gradual timing adjustment**

* Proposals
	+ Option 1: The Gradual timing adjustment rules have to be studied and modified for NTN by RAN4, including the parameter Tq (Maximum Autonomous Time Adjustment Step) and Tp (Minimum Aggregate Adjustment rate).
	+ Option 1a: For LEO NTN network gradual timing adjustment, the maximum amount of the magnitude of the timing change in one adjustment and the maximum aggregate adjustment rate should be studied, such as Tq’ per X ms.
		- evaluate the value X based on service demand and UE capability
		- calculate Tq’, i.e., Tq’≥(79Tc+Tq/200)×X
	+ Option 1b: For NTN networks, RAN4 need to study the UE autonomous timing adjustment requirements in RRC connected mode, which can be derived from the downlink timing drift and UE self-estimation TA variation.
	+ Option 2: The R16 gradual timing adjustment requirements can be a baseline for GEO NTN network.
* Recommended WF
	+ TBA

**Issue 4-3: Impact of delay compensation on TA error**

* Proposals
	+ Option 1: NTN delay compensation has impact on TA error.
	+ Option 2: TBA
* Recommended WF
	+ TBA

### Sub-topic 4-2: Timing Error requirements and Timer accuracy

*Open issues and candidate options before e-meeting:*

**Issue 4-4: Te Timing Error Limit**

* Proposals
	+ Option 1: Use existing Te requirements defined in TS 38.133, Table 7.1.2-1, as baseline for R17 NTN networks
	+ Option 2: RAN4 should further investigate Te based on current NR TN requirements
* Recommended WF
	+ TBA

**Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**

* Proposals
	+ Option 1: Reuse the requirements for $N\_{TA}$ Offset and UE time accuracy as defined in the current TS 38.133 specification
	+ Option 2: TBA
* Recommended WF
	+ Reuse the requirements for $N\_{TA}$ Offset and UE time accuracy as defined in the current TS 38.133 specification
		1. Sub-topic 4-3: UE transmit timing requirements

*Open issues and candidate options before e-meeting:*

**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**

* Proposal: For NTN networks, RAN4 needs to study how to define UE transmit timing requirements in RRC idle/inactive mode.
	+ Option 1: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
		- UE self-estimating error of NTA is counted into the UE transmit timing error.
		- Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
	+ Option 2: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
		- UE self-estimating error of NTA will be counted into the timing advance adjustment error.
		- UE transmit timing error is derived from the UE capability of estimating downlink timing
	+ Option 3: Define the requirements on UE transmit timing error limit, UE self-estimating accuracy of NTA and timing advance adjustment accuracy, provided that:
		- UE transmit timing error is derived from the UE capability of estimating downlink timing
		- Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
	+ Option 4: RAN4 is to introduce the accuracy requirement for the UE specific TA estimation for an NTN UE in RRC\_idle and RRC\_inactive mode.
* Recommended WF
	+ TBA

**Issue 4-7: UE transmit timing requirements in RRC connected mode**

* Proposals
	+ Option 1: For NTN networks, RAN4 needs to define UE transmit timing requirements in RRC connected mode, with using the same methodology in RRC idle/inactive mode
	+ Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 4-1: Option 1, but it should be further clarified which agreement.Sub topic 4-2: To be further discussed.Sub topic 4-3: Option 1Sub topic 4-4: Option 1Sub topic 4-5: Option 1Sub topic 4-6: Option 1Sub topic 4-7: Option 1….Others: |
| Qualcomm | **Issue 4-1: TA adjustment accuracy**Option 1 and Option 2 in principle.**Issue 4-2: Gradual timing adjustment**In principle, Option 1 and Option 1a.**Issue 4-3: Impact of delay compensation on TA error**Cannot fully understand what Option 1 means. Can a proponent of Option 1 elaborate on it? Is this from UE, satellite, or gNB perspective? NTN delay compensation is about UE autonomous UL pre-compensation? Is it in the context of NGSO where UE may have to predict the target satellite position?**Issue 4-4: Te Timing Error Limit**Option 2. There can be other impairment factors that can add up in satellite and/or gateway.**Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**Is this NTA offset in Table 7.1.2-2? To better understand the issue, can a proponent of Option 1 elaborate on how this is typically defined, what are criteria for the specific values, and why we have non-zero value for FDD?**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**In principle, close to Option 1. Is the minimum UL bandwidth the bandwidth of the configured initial UL BWP?**Issue 4-7: UE transmit timing requirements in RRC connected mode**A bit unclear about what “the same methodology in RRC idle/inactive mode” refers to.  |
| CMCC | Sub topic 4-1: Issue 4-1: TA adjustment accuracyFor this issue, we observe that Option1 is contained by Option2. We support Option2.Issue 4-2: Gradual timing adjustmentOption1 and Option1a is not mutually exclusive. We propose Option1a and Option2 in our contribution. From our point of view, LEO NTN network gradual timing adjustment requirements should be discussed separately with GEO NTN network gradual timing adjustment requirements.We support Option1, Option1a and Option2.Issue 4-3: Impact of delay compensation on TA errorWe support Option1 that UE delay compensation has an impact to TA error. Specifically, the UE delay compensation has an impact to UE estimate TA error. The UE delay compensation accuracy is based on the accuracy of UE GNSS and PVT information. How to capture the inaccuracies should be further discussed. Sub topic 4-2: Issue 4-4: Te Timing Error LimitSince CP length of NTN network is equal to that of TN network, we support Option1 that take existing Te requirements as the baseline. We are also open to Option2 to further investigate.Issue 4-5: $N\_{TA}$ Offset and UE timer accuracySupport recommended WF.Sub-topic 4-3:Issue 4-6: UE transmit timing requirements in RRC idle/active modeWe support Option4, while as we mentioned above, the accuracy of the UE specific TA estimation is based on the accuracy of UE GNSS and PVT information. How to capture the inaccuracies should be further discussed. |
| Apple | **Issue 4-1: TA adjustment accuracy**Option1**Issue 4-2: Gradual timing adjustment**Option 1b**Issue 4-3: Impact of delay compensation on TA error**Need a little clarification on option 1, i.e., NTN delay compensation error has impact on UE autonomous timing adjustment performance.**Issue 4-4: Te Timing Error Limit**Option 1 and option 2 has similar meaning, anyway, we need to use existing Te as a starting point to further investigate the NTN Te requirement.**Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**Option 2. Need to conclude the CA deployment first. If there is no TDD+FDD CA in NTN, then the Nta offset table may need some revision for NTN, since purely FDD may not need TA offset.**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**For NT UE we don’t have such UE Tx timing requirement in IDLE and inactive time(but TA offset can still be indicated from network(SIB1) to UE for RACH). Need more discussion on whether it’s needed for NTN. |
| LGE | Issue 4-1Option 1. Final TA adjustment accuracy highly depends on RAN1 decision. |
| Ericsson | Sub topic 4-1:Issue 4-1: Option 2. Issue 4-2: Option 1.Issue 4-3: Option1. The delay compensation has impact on TA error. We prefer a total budget approach. How big can de TA error be? Which components contribute to TA error and how. The delay compensation is one of these terms. Sub topic 4-2:Issue 4-4: Option 1.Issue 4-5: Option 1.Issue 4-6: We need to study UE tx timing based on total budget. It does not matter so much how we group the terms or what we start from. If one term in total budget is (or is decided) to be small, then another term can be larger etc.Issue 4-7: RAN4 needs to define UE transmit timing requirements in RRC connected mode. We do not limit to particular methodology. |
| Xiaomi | Issue 4-1:Support option 1 at current stage. And we are fine with option 2 and option 3 in principle.Issue 4-2:Option 1Issue 4-4:Both option 1 and option 2 is OK Issue 4-5:Need for further discussion, if the Rx-Tx transition time for NTN UE is revisit, then N\_TA\_offset may be update accordinglyIssue 4-6:Support option 4. Similar view as CMCC, inaccuracy of UE specific TA estimation is due to the inaccuracy of PVT or satellite ephemeris. How to capture this accuracy requirement is FFS. |
| OPPO | **Issue 4-1: TA adjustment accuracy**Option1**Issue 4-2: Gradual timing adjustment**Option 1**Issue 4-3: Impact of delay compensation on TA error**Option 1. TA error may be impacted by UE delay pre-compensation error.**Issue 4-4: Te Timing Error Limit**Option 1 and option 2 are fine.**Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**Option 1 as baseline. FFS the impact of Rx-Tx transition time for NTN.**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**FFS |
| MediaTek | **Issue 4-1: TA adjustment accuracy**Option 1. ongoing discussion in RAN1.**Issue 4-2: Gradual timing adjustment**Option 1.**Issue 4-3: Impact of delay compensation on TA error**The UE timing pre-compensation error can be captured in Te, as specified in clause 7.1.2, and it can be considered as independent to TA error.**Issue 4-4: Te Timing Error Limit**Option 1. Companies can further identify the other impairment factors.**Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**Need for further discussion, related discussion is ongoing in RAN1 for the TA offset.**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**We cannot agree on Option 2 and Option 3 regarding the UE capability of estimating downlink timing. Purely DL timing estimation error is not testable. **Issue 4-7: UE transmit timing requirements in RRC connected mode**Unclear about what is the methodology in RRC idle/inactive mode. Does it refer to any requirement in IDLE mode? |
| Huawei | **Issue 4-1:**RAN4 should study the aspects that will affect the TA adjustment accuracy.For legacy NR network, the TA adjustment accuracy is determined by uplink sampling granularity and defined as +/-0.5\*sampling interval with minimum BW. At least the sampling granularity need to be considered for TA adjustment accuracy requirements.**Issue 4-2:**Generally we agree with option 1. The gradual timing adjustment requirements need to be defined for RRC connected mode. For NTN network, UE self-estimated TA is introduced. The definition of maximum autonomous time adjustment step Tq can be derived from the downlink timing drift and UE self-estimation TA variation.**Issue 4-3:**RAN4 shall study whether UE self-estimated TA (i.e. NTN delay compensation) error is counted into TA adjustment error or UE transmission timing error.**Issue 4-4:**For legacy NR network, the existing UE initial transmission timing error limit value Te depends on the capability of UE downlink timing estimation.**Issue 4-5:** Agree with the recommended WF “Reuse the requirements for $N\_{TA}$ Offset and UE timer accuracy as defined in the current TS 38.133 specification”.**Issue 4-6/4-7:** For legacy NR network, UE transmit timing requirements for RRC connected mode include following aspects:* + UE initial transmission timing error limit value Te
	+ The value of NTA-offset
	+ gradual timing adjustment requirements

Since the TA value is indicated by network, there is no TA uncertainty related requirements.For NTN network, the total TA include two parts: UE specific TA which is estimated by the UE, and common TA which is indicated by the network. So, there exists TA uncertainty due to UE self-estimated TA. If the TA uncertainty is not counted into TA adjustment error, then the TA uncertainty need to be defined within UE transmit timing requirements. In RRC idle/inactive mode, the calculated TA is only applied for initial access. So, there is no need to define gradual timing adjustment requirements for RRC idle/inactive mode.In NTN network, UE transmit timing requirements for RRC idle/inactive mode shall include following aspects:* + UE initial transmission timing error limit value Te
	+ UE self-estimated TA error limit value
	+ Whether to be counted into Te ?
	+ The value of NTA-offset

In NTN network, UE transmit timing requirements for RRC connected mode shall include following aspects:* + UE initial transmission timing error limit value Te
	+ UE self-estimated TA error limit value
	+ Whether to be counted into Te ? (conclusion same as in idle/inactive mode)
	+ The value of NTA-offset
	+ gradual timing adjustment requirements
 |
| CATT | Issue 4-1: Option 2. Issue 4-2: Option 1.Issue 4-3: Option 2Issue 4-4: Option 2.Issue 4-5: Support the recommended WF. “time accuracy” should be “timer accuracy”Issue 4-6: Prefer option 4.Issue 4-7: Option 1. |
| Nokia, Nokia Shanghai Bell | Issue 4-1:Option 3 can be used as a baseline. Thus, Options 1 and 2 are also OK. Issue 4-2:Further discussion is required. Issue 4-4:Option 1.Issue 4-5:Option 1 is Ok.Issue 4-6:Further discussion is necessary. Issue 4-7:Option 1 Ok as a starting point.  |
| Hughes/EchoStar | **Issue 4-1: TA adjustment accuracy**Option 1. ongoing discussion in RAN1.**Issue 4-4: Te Timing Error Limit**Option 1. Companies can further identify the other impairment factors. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 4-1** | *Tentative agreements: Most companies support Option 1, although further clarification to which agreement is necessary. Furthermore, some companies prefers that RAN4 conducts its own study while waiting for RAN1’s decision.**Candidate options:**o Option 1: RAN4 should wait for an agreement in RAN1 before concluding on TA adjustment accuracy.**o Option 2: Final Timing Advance adjustment accuracy depends on the mechanism chosen in RAN1 specification and the final total uncertainty budget. However, Timing Advance adjustment accuracy should scale inversely proportional to SCS (and in current specification it is ±1/4 TA-step (at SCS = 15 kHz)).**o Option 3: The TA adjustment accuracy can be defined as the same ratio of the TA adjustment step size (±1/4 of TA adjustment step) specified for legacy NR.**Recommendations for 2nd round: Specify which RAN1 agreements to wait for and further discuss if RAN4 shall do its own study.* |
| **Issue 4-2** | *Tentative agreements: Most companies support Option 1.**Candidate options:**- Option 1: The Gradual timing adjustment rules have to be studied and modified for NTN by RAN4, including the parameter Tq (Maximum Autonomous Time Adjustment Step) and Tp (Minimum Aggregate Adjustment rate).**Recommendations for 2nd round: Further discussion of the specifics necessary.* |
| **Issue 4-3** | *Tentative agreements: Although four companies support Option 1, others request FFS.**Candidate options:**- Option 1: NTN delay compensation has impact on TA error.**- Option 2: TBA**Recommendations for 2nd round: Supporting companies for Option 1 should elaborate further.* |
| **Issue 4-4** | *Tentative agreements: While Option 1 has the most consensus, most companies are also open to further investigating impairment factors.* *Candidate options:- Option 1: Use existing Te requirements defined in TS 38.133, Table 7.1.2-1, as baseline for R17 NTN networks**- Option 2: RAN4 should further investigate Te based on current NR TN requirements**Recommendations for 2nd round: Use existing Te requirements defined in TS 38.133, Table 7.1.2-1, as baseline for R17 NTN networks while further investigating Te requirements.* |
| **Issue 4-5** | *Tentative agreements: While most companies support Option 1, others ask for further clarification.**Candidate options:* *Option 1: Reuse the requirements for N\_TA Offset and UE time accuracy as defined in the current TS 38.133 specification**Option 2 (new option – Apple): Reuse the requirements for UE timer accuracy as defined in the current TS 38.133 specification, and FFS on N\_TA offset**Recommendations for 2nd round: Proponents of Option 1 should clarify before a decision can be made.* |
| **Issue 4-6** | *Tentative agreements: No consensus could be reached. Further study and discussion is necessary.**Candidate options:**Recommendations for 2nd round: Down-select from the available options, further discussion necessary.* |
| **Issue 4-7** | *Tentative agreements: Although 3 companies support Option 1, at least as a starting point, further discussion is necessary.**Candidate options:**Recommendations for 2nd round: Proponents of Option 1 should clarify.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM timing related requirements | Xiaomi |

## Discussion on 2nd round (if applicable)

Moderator suggests that for issues 4-3, 4-5 and 4-7, proponents of the controversial options should elaborate further. Specifics and down-selections for issues 4-1, 4-2 and 4-6 should be discussed.

**Issue 4-1**: TA adjustment accuracy

Candidate options:

* **Option 1: RAN4 should wait for an agreement in RAN1 before concluding on TA adjustment accuracy.**
* Option 2: Final Timing Advance adjustment accuracy depends on the mechanism chosen in RAN1 specification and the final total uncertainty budget. However, Timing Advance adjustment accuracy should scale inversely proportional to SCS (and in current specification it is ±1/4 TA-step (at SCS = 15 kHz)).
* Option 3: The TA adjustment accuracy can be defined as the same ratio of the TA adjustment step size (±1/4 of TA adjustment step) specified for legacy NR.
* Recommendations for 2nd round: Specify which RAN1 agreements to wait for and further discuss if RAN4 shall do its own study.
* Suggested way forward:
	+ Timing Advance adjustment accuracy requirement depends on the mechanism of TA adjustment step size determined by RAN1 and the total uncertainty budget.
	+ FFS: Timing Advance adjustment accuracy scales inversely proportional to SCS (±1/4 TA-step defined in TS38.133)

**Issue 4-2**: Gradual timing adjustment

* Proposal: The Gradual timing adjustment rules have to be studied and modified for NTN by RAN4, including the parameter Tq (Maximum Autonomous Time Adjustment Step) and Tp (Minimum Aggregate Adjustment rate).
* Recommendation: Further discuss the specifics.
* Suggested way forward:
	+ RAN4 is to study the gradual timing adjustment rules for NR NTN including:
		- Tq (Maximum Autonomous Time Adjustment Step)
		- Tp (Minimum Aggregate Adjustment rate)

**Issue 4-3**: Impact of delay compensation on TA error

* Proposal: NTN delay compensation has impact on TA error.
* Recommendation: Supporting companies should relaborate further.

**Issue 4-4:** Te: Timing Error Limit

* Suggested way forward:
	+ Use existing Te requirements defined in TS 38.133, Table 7.1.2-1, as baseline for R17 NR NTN
	+ RAN4 is to further investigate Te based on existing Te requirements defined in TS 38.133

**Issue 4-5**: N\_TA Offset and UE timer accuracy

Candidate options:

* Option 1: Reuse the requirements for N\_TA Offset and UE time accuracy as defined in the current TS 38.133 specification
* Option 2 (new option – Apple): Reuse the requirements for UE timer accuracy as defined in the current TS 38.133 specification, and FFS on N\_TA offset
* Recommendation: Proponents of Option 1 should elaborate further.
* Suggested way forward:
	+ Reuse the UE timer accuracy requirements as defined in section 7.2 in TS 38.133 for Rel-17 NR NTN
	+ FFS on whether the existing $N\_{TA offset}$value defined in Table 7.1.2-2 in TS38.133 can be reused or not

**Issue 4-6**: UE transmit timing requirements in RRC idle/active mode

* Proposal: For NTN networks, RAN4 needs to study how to define UE transmit timing requirements in RRC idle/inactive mode.
	+ Option 1: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
		- UE self-estimating error of NTA is counted into the UE transmit timing error.
		- Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
	+ Option 2: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
		- UE self-estimating error of NTA will be counted into the timing advance adjustment error.
		- UE transmit timing error is derived from the UE capability of estimating downlink timing
	+ Option 3: Define the requirements on UE transmit timing error limit, UE self-estimating accuracy of NTA and timing advance adjustment accuracy, provided that:
		- UE transmit timing error is derived from the UE capability of estimating downlink timing
		- Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
	+ Option 4: RAN4 is to introduce the accuracy requirement for the UE specific TA estimation for an NTN UE in RRC\_idle and RRC\_inactive mode.
* Recommendation: Down-selection of the available options
* Suggested way forward:
	+ For NTN networks, RAN4 is to study how to define the timing requirements:
		- Option 1: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
			* UE self-estimating error of NTA is counted into the UE transmit timing error.
			* Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
		- Option 2: Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy, provided that:
			* UE self-estimating error of NTA will be counted into the timing advance adjustment accuracy.
			* UE transmit timing error is derived from the UE capability of estimating downlink timing
		- Option 3: Define the requirements on UE transmit timing error limit, UE self-estimating accuracy of NTA and timing advance adjustment accuracy, provided that:
			* UE transmit timing error is derived from the UE capability of estimating downlink timing
			* Timing advance adjustment accuracy is derived from the sampling interval with minimum UL bandwidth.
			* UE self-estimating accuracy is derived from the accuracy of UE GNSS-acquired position and the serving satellite position
		- Other options are not precluded

**Issue 4-7**: UE transmit timing requirements in RRC connected mode

* Option 1: For NTN networks, RAN4 needs to define UE transmit timing requirements in RRC connected mode, with using the same methodology in RRC idle/inactive mode
* Recommendation: Proponents should further elaborate.

**Outcome of GTW session (01. Feb. 2021):**

• Issue 4-3: Tentative agreements: NTN timing compensation accuracy has impact on Te timing error requirements for CONNECTED mode. FFS for IDLE mode.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 4-1**: TA adjustment accuracyOption 1.**Issue 4-2**: Gradual timing adjustmentAgree to the suggested way forward.**Issue 4-3**: Impact of delay compensation on TA errorIn a broad sense, the tentative agreement made in the GTW session is okay with us. And RAN4 should study ”what specific requirements are impacted and how much” and discuss ”whether/how to reflect them in the requirement spec”.NTN timing compensation accuracy has impact on Te timing error requirements for CONNECTED mode. FFS for IDLE mode.For the details about ”timing compenstation” discussed in the GTW session, there seem to be two apsects what companies may want to clarify.1. What is the definition of timing compensation:

RAN1 made the following agreement in RAN#104-e meeting last week.For TA update in RRC\_CONNECTED state, combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops shall be supported for NTN.FFS: Details of the combination of open and closed loop TA control1. Whether/How to take into account serving cell DL timing drift from UE perspective:

As the actuall UL transmission timing is determined based on the TA described above with respect to UE serving cell DL timing, there can be a question about whether/how UE DL timing eventually affects timing compenstatoin accurary error especially when there is large Doppler shift in service link.We think this is kind of a valid point to have a further look especially in NGSO systems.**Issue 4-4:** Te: Timing Error LimitAgree to the suggested way forward. Depending on RAN1/2 design, there can be additional limit to achievable Te requirements.**Issue 4-5**: N\_TA Offset and UE timer accuracyAgree to the suggested way forward.**Issue 4-6**: UE transmit timing requirements in RRC idle/active modeRAN4 can further discuss the issue based on Suggested way forward since it has an open-ended option in it.**Issue 4-7**: UE transmit timing requirements in RRC connected modeUnclear about ” the same methodology in RRC idle/inactive mode”. |
| Apple  | **Issue 4-5:** $N\_{TA}$ **Offset and UE timer accuracy**Agree with the suggested way forward.**Issue 4-6: UE transmit timing requirements in RRC idle/active mode**We still prefer to keep the original option 4 on the table. We are not convinced why need this a dedicated timing requirement in IDLE/inactive mode for NTN but we do not have such requirement for legacy NR. Our understand is the Te requiremet can cover this IDLE mode transmission case as well (RACH timing is already included in Te requirement), as we duplicated below.

|  |
| --- |
| 7.1.2 RequirementsThe UE initial transmission timing error shall be less than or equal to Te where the timing error limit value Te is specified in Table 7.1.2-1. This requirement applies:- when it is the first transmission in a DRX cycle for PUCCH, PUSCH and SRS, or **it is the PRACH transmission**, or it is the msgA transmission.. |

 |
| Xiaomi | **Issue 4-1**: TA adjustment accuracyOption 2.**Issue 4-2**: Gradual timing adjustmentAgree to the suggested way forward.**Issue 4-3**: Impact of delay compensation on TA errorIn general, the tentative agreement made in the GTW session is fine to us. NTN timing compensation accuracy has impact on Te timing error requirements for CONNECTED mode. FFS for IDLE mode.As commented during GTW session, we would like to clarify the following two aspects:1. The NTN timing conpensation accuracy: it is derived from the larger Doppler shift between serving satellite and UE, which may have impact on Te. However, RAN1 is discussing to address this issue. RAN4 can have some analysis on this and need further check with RAN1.
2. UE specific TA estimation: it is derived from the UE’s GNSS position error and serving satellite positioning error.

**Issue 4-4:** Te: Timing Error LimitAgree with the suggested way-forward.**Issue 4-5**: N\_TA Offset and UE timer accuracyAgree with the suggested way-forward.**Issue 4-6**: UE transmit timing requirements in RRC idle/active modeAgree with the suggested way-forward. However, for the titile of issue 4-6, we think it should be generic for both ilde mode and connected. RAN4 need further investigate whether there is necessity to distinguish the UE transmit timing requirement for idle mode and connected mode. If it is necessary, we can define the corresponding requirements in idle mode.**Issue 4-7**: UE transmit timing requirements in RRC connected modeCan be merged with issue 4-6. |
| CMCC | **Issue 4-1**: TA adjustment accuracyWe support the recommended WF.**Issue 4-2**: Gradual timing adjustmentThe recommended WF is OK for us. **Issue 4-3**: Impact of delay compensation on TA errorThe agreements in GTW session can be a baseline for further study.**Issue 4-4:** Te: Timing Error LimitSupport the recommended WF.**Issue 4-5**: N\_TA Offset and UE timer accuracySupport the recommended WF.  |
| Ericsson | **Issue 4-1**: TA adjustment accuracyFinal Timing Advance adjustment accuracy depends on the mechanism chosen in RAN1 specification and the final total uncertainty budget. However, Timing Advance adjustment accuracy should scale inversely proportional to SCS (and in current specification it is ±1/4 TA-step (at SCS = 15 kHz)). But we are fine with the recommendation. We wre impaced by RAN1 mechanism decisions.**Issue 4-2**: Gradual timing adjustmentSupport the recommended WF.**Issue 4-3**: Impact of delay compensation on TA errorPrefer to work on total budget rather than picking a particilar term and make strongstatements and descisions about that.**Issue 4-4:** Te: Timing Error LimitSupport suggested way forward**Issue 4-5**: N\_TA Offset and UE timer accuracySupport suggested way forward**Issue 4-6**: UE transmit timing requirements in RRC idle/active modeWe prefer to work from a total budget. This budget can have many terms. They can bedsitributed as terms in many different ways. It is hard to make a strong statement already now. We agree with Apple’s comment ”. We are not convinced why need this a dedicated timing requirement in IDLE/inactive mode for NTN but we do not have such requirement for legacy NR. Our understand is the Te requiremet can cover this IDLE mode transmission case as well (RACH timing is already included in Te requirement), ”**Issue 4-7**: UE transmit timing requirements in RRC connected modePlease refer to issue 4-6 for comments. |
| Nokia, Nokia Shanghai Bell | **Issue 4-1**: TA adjustment accuracyOption 1 is preferred as there is a dependency on RAN1 decisions.**Issue 4-2**: Gradual timing adjustmentThe suggested way forward is OK.**Issue 4-4:** Te: Timing Error LimitThe suggested way forward is OK.**Issue 4-5**: N\_TA Offset and UE timer accuracyThe suggested way forward is OK. |
| THALES | Issue 4-1: Option 1, but it should be further clarified which agreement.Issue 4-2: Agree with suggested Way Forward.Issue 4-3: Agree with suggested Way Forward.Delay compensation may depend on many parameters: orbit, frequency, compensation method. All these parameters may have an impact on TA error and acceptable TA error. These aspects have to be probably further discussed.Issue 4-4: Agree with suggested Way Forward.Issue 4-5: Agree with suggested Way Forward.Issue 4-6: Agree with suggested Way Forward.However, what is the most important between all previous options is « Define the requirements on UE transmit timing error limit and timing advance adjustment accuracy”Issue 4-7: Agree with suggested Way Forward. |
| LGE | **Issue 4-1**: TA adjustment accuracySupport option1. Final TA adjustment accuracy highly depends on RAN1 decision.Issue 4-2: Gradual timing adjustmentSupport Recommendation and WF from moderator. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #5: NTN UL frequency synchronization requirement

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100780 | MediaTek Inc. | **Observation 1:** By using propagation method based on gravity with SIB periodicity of 10s:* The frequency error is 1.23Hz, which is less than 0.001 ppm at fc = 2GHz.

**Observation 2:** By using propagation method based on linear extrapolation with SIB periodicity of 2s:* The frequency error is 0.42Hz, which is around 0.0002 ppm at fc = 2GHz.

**Observation 4:** UL frequency error contributed by UE pre-compensate satellite Doppler is small and can meet the maximum UL frequency error of ± 0.1ppm for UL transmission.**Proposal 2:** Keep the legacy UL frequency error requirement of ± 0.1ppm for NTN Ues. |
| R4-2102893 | Qualcomm Inc. | **Proposal 1:** RAN4 to investigate factors that can affect time/frequency pre-compensation accuracy requirements, e.g.* Residual time/frequency error at UE side due to mobility and inaccurate position information, e.g. GNSS accuracy and frequency of reading GNSS information
* Residual time/frequency error in LEO due to a fast movement of LEO and an inaccurate PVT information in terms of precision and/or update frequency (subject to higher layer design)
* Residual time/frequency error in GEO if there is a non-negligible local position change
* FFS on whether and what effects should be considered for feeder link
* FFS on pre-compensation for HAPs and HIBS
* FFS on whether and how to consider location-based UL transmission power autonomous adjustment
 |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 5-1: Frequency accuracy requirements

*Open issues and candidate options before e-meeting:*

**Issue 5-1: UL frequency error requirement**

* Proposals
	+ Option 1: Keep the legacy UL frequency error requirement of ± 0.1ppm for NTN Ues.
	+ Option 2: TBA
* Recommended WF
	+ TBA

**Issue 5-2: Time/Frequency pre-compensation accuracy requirements**

* Proposals
	+ Option 1: RAN4 to investigate factors that can affect time/frequency pre-compensation accuracy requirements, e.g.
		- Residual time/frequency error at UE side due to mobility and inaccurate position information, e.g. GNSS accuracy and frequency of reading GNSS information
		- Residual time/frequency error in LEO due to a fast movement of LEO and an inaccurate PVT information in terms of precision and/or update frequency (subject to higher layer design)
		- Residual time/frequency error in GEO if there is a non-negligible local position change
		- FFS on whether and what effects should be considered for feeder link
		- FFS on pre-compensation for HAPs and HIBS
		- FFS on whether and how to consider location-based UL transmission power autonomous adjustment
	+ Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 5-1: It has been already decided that this should be part of RF requirements. Please note RAN4#97e (R4-2017350): “It is agreed to have UL pre-compensation method based on GNSS. The final UE UL frequency accuracy requirement is defined in RAN4 UE RF session.”The value is fine, but is up to RAN4 (RF) to decide. Moreover, this can be defined at both UE & probably BS/satellite level (or **as seen by gNB, and not by UE**).In R4-2017302 it has been proposed:1. **UE shall be able to compensate the frequency offset** due to the satellite mobility when generating its UL carrier frequency.
2. The UE modulated carrier frequency shall be accurate to within ±0.1 ppm **as observed over a period of 1 ms by the gNB.**
3. The UE residual frequency error shall be sufficiently low such that it can be considered included **in the tolerated frequency error of ±0.1 ppm already captured in the specification.**

Sub topic 5-2: Option 1 seems ok, please also see issue 3-1.….Others: |
| Qualcomm | **Issue 5-1: UL frequency error requirement**There can be other frequency error sources in the system, e.g. frequency error at the satellite and gateway, etc. And the errors can add up. Maybe it’s okay for 2GHz frequencies. But it can be problematic for higher frequencies.**Issue 5-2: Time/Frequency pre-compensation accuracy requirements**Option 1. Besides, we would like to add some more aspects based on our comment in Issue 2-3:* PVT information update frequency
* lossy compression of PVT information
* level of GNSS integration (e.g. UE may not be able to get real time GNSS information as frequent as required, and there can be a time/clock offset between GNSS receive and NR module)
* (residual) time/frequency error propagation in feeder link(s) if any
 |
| Apple | **Issue 5-1: UL frequency error requirement**Shall discuss in RF session |
| Ericsson | Sub topic 5-1: Issue 5.1: Option 1. This should be decided by the RF group. Issue 5.2: RAN4 to investigate factors that can affect time/frequency pre-compensation accuracy requirements. This is option 1, in general but we do not agree to specify exact sub bullets already now.  |
| Xiaomi | **Issue 5-1:****It shall be discussed in RF session.** |
| OPPO | **Issue 5-1:**Up to the conclusion of RF session. |
| MediaTek | **Issue 5-1: UL frequency error requirement**Option 1 from our view. To be decided by the RF group.**Issue 5-2: Time/Frequency pre-compensation accuracy requirements**Fine to further investigate.  |
| Huawei | **Issue 5-1: UL frequency error requirement**This should be discussed in RF.**Issue 5-2: Time/Frequency pre-compensation accuracy requirements**Option 1 is fine, and we understand the list is not limiting (other factors can be discussed also) |
| CATT | **Issue 5-1:**It should be discussed later in RF session.**Issue 5-2:**Option 1 could be used as starting point. |
| Nokia, Nokia Shanghai Bell | **Issue 5-1:**This issue should be discussed in the RF session. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 5-1** | *This issue will be handled in the RF session* |
| **Issue 5-2** | *Tentative agreements: Most companies agree that Option 1 can be used as starting point.**Candidate options:**o Option 1: RAN4 to investigate factors that can affect time/frequency pre-compensation accuracy requirements, e.g.**- Residual time/frequency error at UE side due to mobility and inaccurate position information, e.g. GNSS accuracy and frequency of reading GNSS information**- Residual time/frequency error in LEO due to a fast movement of LEO and an inaccurate PVT information in terms of precision and/or update frequency (subject to higher layer design)**- Residual time/frequency error in GEO if there is a non-negligible local position change**- FFS on whether and what effects should be considered for feeder link**- FFS on pre-compensation for HAPs and HIBS**- FFS on whether and how to consider location-based UL transmission power autonomous adjustment**- PVT information update frequency**- lossy compression of PVT information**- level of GNSS integration**- (residual) time/frequency error propagation in feeder link(s)**Recommendations for 2nd round: Further discuss if specific requirements should be listed or not. If yes, (down)select the appropriate requirements.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM requirements | Fraunhofer |

## Discussion on 2nd round (if applicable)

As issue 5-1 will be handled in the RF session, only issue 5-2 is open for discussion.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 5-2: Time/Frequency pre-compensation accuracy requirements**We can see only one option under this this in the moderator’s first round summary. The option 1 is okay with us. |
| Xiaomi | **Issue 5-2: Time/Frequency pre-compensation accuracy requirements**Time pre-compensation accuracy has been discussed in Topic#4. And the frequency pre-compensation accuracy should be discussed in RF session. |
| Ericsson | Issue 5-1 We support: This issue will be handled in the RF sessionIssue 5.2: RAN4 to investigate factors that can affect time/frequency pre-compensation accuracy requirements. This is option 1, in general but we do not agree to specify exact sub bullets already now.  |
| Nokia, Nokia Shanghai Bell | **Issue 5-2: Time/Frequency pre-compensation accuracy requirements**As the list of factors in Option 1 is non-exhaustive, it is preferred to leave it out for clarity.  |
| THALES | **Issue 5-2: Time/Frequency pre-compensation accuracy requirements**Agree with option 1. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #6: NTN Measurements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100646 | LG Electronics | **Proposal 1**: Measurement for intra NTN mobility should be discussed with priority in RAN4.**Proposal 2**: Define the RRM requirement for ephemeris and UE location assisted NTN mobility.**Observation 1:** Using SMTC or MG without propagation delay information from satellite, NTN system performance could be dreaded. **Proposal 3:** Consider propagation delay information from satellite/HAPS to configure SMTC or MG, and FFS for detail procedure.**Observation** : RRM measurement performance could be affected by update period and accuracy of satellite/HAPS PVT and UE location information**Proposal 4:** RAN4 needs to consider the update period and accuracy of satellite/HAPS PVT and UE location information when defining the NTN RRM measurement requirement. |
| R4-2100715 | Xiaomi | **Observation 1:** The existing cell reselection mechanism defined for TN system is not suitable for NTN system due to the unobvious near-far effect for RSRP/RSRQ measurement.**Proposal 1:** RAN4 is to identify whether the existing cell reselection delay requirement based on the existing S criteria can be reused or not for NTN scenarios.**Proposal 2:** RAN4 is to define the RRM requirements for satellite/HAPS ephemeris based cell selection and reselection once RAN2 completes the cell reselection procedure for NTN.**Proposal 3:** Both intra-NTN cell reselection and inter NTN-TN cell resection should be supported.**Proposal 4:** RAN4 is to study whether the existing conditional handover delay requirement based on the CHO procedure and execution condition defined in Rel-16 can be reused or not for NR NTN scenarios.**Proposal 5:** RAN4 is to define the RRM requirements for time/timer and location based CHO triggering event.**Observation 2:** The propagation time difference between serving cell and target neighbour cell will cause the reference signal window of target neighbour cell is not within the measurement gap window configured by the serving cell.**Proposal 6:** RAN4 is to study the enhancement on measurement gap configuration for NR NTN system. |
| R4-2101712 | Huawei, HiSilicon | **Observation 1:** The existing accuracy of measurement quantity in current spec can be reused for NTN scenario.**Observation 2:** CHO handover requirements can be discussed in RAN4 in NTN. If RAN2 introduces new handover conditions, RAN4 needs to evaluate the related accuracy.**Observation 3:** The issue of SMTC and gap window is suggested to be considered in RAN4. |
| R4-2101866 | Ericsson | **Observation 1:** It is practically feasible to receive GNSS positioning signals without any measurement gap or interruption in 3GPP radio reception or transmission.**Proposal 1:** No interruptions or measurement gaps are allowed for GNSS measurements during NTN operation.**Proposal 2:** RAN4 shall consider requirements for A-GNSS in 38.171 as a starting point when defining requirements for further RRM procedures based on UE position. RAN4 needs to verify if existing A-GNSS requirements are sufficient, considering the impact that positioning will have on the further RRM requirements which assume knowledge of UE position**Proposal 3:** RAN4 further discusses measurements in NTN operation for both idle and connected mode once further progress is made in RAN1 and RAN2.**Proposal 4:** RAN4 to discuss about measurements supporting TN / NTN mobility, once the Intra NTN mobility has sufficiently progressed. Intra NTN mobility refers to idle and connected mode mobility between NTN cells (e.g. intra or inter satellite). |
| R4-2102893 | Qualcomm Inc. | **Proposal 2:** RAN4 discussion for mobility and measurement requirements should be limited to the following scenarios until RAN4 receives specific inputs from RAN1/2:* from NTN to NTN for RRC Connected mode
* between NTN and TN for only RRC Inactive/Idle modes
* between GEO type satellites
* between LEO type satellites at the same altitude
	+ Do not consider a scenario where UE monitors both earth fixed and earth moving cells
* between HAPs (FFS on HIBSs)

**Proposal 3:** RAN4 to discuss and define a set of reference models including satellite types and corresponding attributes in the table below. |
| R4-2100802 | CMCC | **Table on NTN RRM measurement requirements** |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 6-1: General RRM NTN measurement requirements

*During RAN4#97-e, an initial discussion on NTN related parameters was started. Possible parameters to be treated with priority were identified. In the Way Forward (R4-2017268), the following NTN measurement related were listed:*

Table 1: NTN Parameters related to Measurement Procedures - Possible parameters to be treated with Priority

|  |  |
| --- | --- |
| Parameter Name | Specific parameter requirement |
| General measurement requirement | Measurement gap |
| UE Measurement capability |
| NR intra-frequency measurements | Requirements applicability |
| NR inter-frequency measurements | Requirements applicability |

Table 2: NTN Parameters related to Measurement Performance Requirements (NR Measurements only) - Possible parameters to be treated with Priority

|  |
| --- |
| Parameter Name/Accuracy Requirement |
| Intra-frequency RSRP accuracy requirements for FR1: * Specific-NTN Absolute SS-RSRP Accuracy
* Specific-NTN Relative SS-RSRP Accuracy
 |
| Inter-frequency RSRP accuracy requirements for FR1* Specific-NTN Absolute SS-RSRP Accuracy

Specific-NTN Relative SS-RSRP Accuracy |
| RSRP Measurement Report Mapping |

*Open issues and candidate options before e-meeting:*

**Issue 6-1: General RRM requirements**

* Proposals
	+ Option 1: RAN4 further discusses measurements in NTN operation for both idle and connected mode once further progress is made in RAN1 and RAN2.
	+ Option 2: The following RRM requirements are the candidates to be discussed for NTN RRM measurement. More items may be added pending on the progress in other WGs.

|  |  |  |
| --- | --- | --- |
| Mobility States | Parameter | Parameter Name |
| RRC\_IDLE /INACTIVE state  | Cell Re-selection | UE measurement capability |
| Measurement and evaluation of serving cell |
| Measurements of intra-frequency NR cells |
| Measurements of inter-frequency NR cells |
| RRC\_CONNECTED state  | Handover Parameters - NR Handover | NR Handover |
| RRC Connection Mobility Control | RRC Re-establishment |
| Random access |
| RRC Connection Release with Redirection |
| General measurement requirement | Measurement gap |
| UE Measurement capability |
| NR intra-frequency measurements | Requirements applicability |
| NR inter-frequency measurements | Requirements applicability |
| NR measurement accuracy requirements | Intra-frequency SS-RSRP/RSRQ/SINR accuracy, including absolute and relative accuracy |
| Inter-frequency SS-RSRP/RSRQ/SINR accuracy, including absolute and relative accuracy |
| SS-RSRP/RSRQ/SINR Measurement report mapping |

* + Option 3: TBA
* Recommended WF
	+ TBA

**Issue 6-2: RRM procedures based on UE position**

* Proposals
	+ Option 1: RAN4 shall consider requirements for A-GNSS in 38.171 as a starting point when defining requirements for further RRM procedures based on UE position. RAN4 needs to verify if existing A-GNSS requirements are sufficient, considering the impact that positioning will have on the further RRM requirements which assume knowledge of UE position
	+ Option 2: RAN4 needs to consider the update period and accuracy of satellite/HAPS PVT and UE location information when defining the NTN RRM measurement requirement.
* Recommended WF
	+ TBA

**Issue 6-3: Use of propagation delay information**

* Proposals
	+ Option 1: Consider propagation delay information from satellite/HAPS to configure SMTC or MG, and FFS for detail procedure.
	+ Option 2: TBA
* Recommended WF
	+ TBA

### Sub-topic 6-2: Mobility

*Open issues and candidate options before e-meeting:*

**Issue 6-4: Measurements for intra- / inter-cell mobility**

* Proposals
	+ Option 1: Measurement for intra NTN mobility should be discussed with priority in RAN4.
	+ Option 2: RAN4 to discuss about measurements supporting TN / NTN mobility, once the Intra NTN mobility has sufficiently progressed. Intra NTN mobility refers to idle and connected mode mobility between NTN cells (e.g. intra or inter satellite).
	+ Option 3: RAN4 discussion for mobility and measurement requirements should be limited to the following scenarios until RAN4 receives specific inputs from RAN1/2
		- from NTN to NTN for RRC Connected mode
		- between NTN and TN for only RRC Inactive/Idle modes
		- between GEO type satellites
		- between LEO type satellites at the same altitude
			* Do not consider a scenario where UE monitors both earth fixed and earth moving cells
		- between HAPs (FFS on HIBSs)
	+ Option 4: Both intra-NTN cell reselection and inter NTN-TN cell resection should be supported.
* Recommended WF
	+ TBA

**Issue 6-5: Cell selection and reselection**

* Proposals
	+ Option 1:
		- RAN4 is to study/identify whether the existing cell reselection and conditional handover delay requirement based on the existing S criteria can be reused or not for NTN scenarios.
		- RAN4 is to define the RRM requirements for satellite/HAPS ephemeris based cell selection and reselection once RAN2 completes the cell reselection procedure for NTN.
* Recommended WF
	+ TBA

**Issue 6-6: Location assisted mobility**

* Proposals
	+ Option 1: Define the RRM requirement for ephemeris and UE location assisted NTN mobility
	+ Option 2: RAN4 is to define the RRM requirements for time/timer and location based CHO triggering event.
* Recommended WF
	+ TBA
		1. Sub-topic 6-3: Measurement gap

*Open issues and candidate options before e-meeting:*

**Issue 6-7: Interruption or measurement gaps for GNSS measurements**

* Proposals
	+ Option 1: No interruptions or measurement gaps are allowed for GNSS measurements during NTN operation.
* Recommended WF
	+ TBA

**Issue 6-8: Measurement gaps for mobility measurements**

* Proposals
	+ Option 1: RAN4 is to study the enhancement on measurement gap configuration for NR NTN system.
* Recommended WF
	+ TBA

**Issue 6-9:** **SMTC and gap window misalignment**

* Proposals
	+ Option 1: The issue of SMTC and gap window is suggested to be considered
* Recommended WF
	+ TBA
		1. Sub-topic 6-4: Reference models

*Open issues and candidate options before e-meeting:*

**Issue 6-10: Reference models**

**Note: Simulation assumptions are also discussed in [98e][311] NTN\_Solutions\_Part2 -> simulation assumptions and bands are discussed in [98e][310] NTN\_Solutions\_Part1 -> bands, architecture and RF. We should align model selection with [98e][311] and bands with [98e][310].**

* Proposals
	+ Option 1: RAN4 to discuss and define a set of reference models including satellite types and corresponding attributes in the table below

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Attributes** | **GEO-S** | **GEO-Ka** | **LEO-S-f** | **LEO-Ka-f** | **LEO-S-m** | **LEO-Ka-m** | **HAPS-S-f** |
| **Satellite altitude** | 35786km | 35786km | 600km [and X>600km] | 600km [and X>600km] | 600km [and X>600km] | 600km [and X>600km] | [50]km |
| **Carrier frequency of serving link** | S band | Ka band | S band | Ka band | S band | Ka band | S band |
| **Beam on earh** | Earth fixed beams | Earth fixed beams | Earth fixed beams | Earth fixed beams | Earth moving beams | Earth moving beams | Earth fixed beams [and/or Earth moving] |
| **Relative speed of satellite/UAS with respect to earth** | Negligible | Negligible | 7.56km/s for 600km[and Ykm/s for Xkm] | 7.56km/s for 600km[and Ykm/s for Xkm] | 7.56km/s for 600km[and Ykm/s for Xkm] | 7.56km/s for 600km[and Ykm/s for Xkm] | [Z]km/s |
| **Typical Min/Max NTN beam foot print diameter** | [100]km/[3500]km (may need to be redefined for the S band) | [100]km/[3500]km (may need to be redefined for the Ka band) | [50]km/[1000]km (may need to be redefined for the S band) | [50]km/[1000]km (may need to be redefined for the Ka band) | [50]km/[1000]km (may need to be redefined for the S band) | [50]km/[1000]km (may need to be redefined for the Ka band) | need to be defined considering the altitude and the band |
| **Min/Max propagation delay contribution to the round trip delay on the radio interface between the gNB and the UE** | 477.48ms/541.46ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter) | 477.48ms/541.46ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter) | 8ms/25.77ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 8ms/25.77ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 8ms/25.77ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 8ms/25.77ms (for the Maximum value, may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | need to be calculated based on the Max HAPS beam foot print diameter and the HAPS’s altitude and reletive movement |
| **Max delay variation as seen by the UE** | Negligible | Negligible | Up to +/-40us/sec (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | Up to +/-40us/sec (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | Up to +/-40us/sec (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | Up to +/-40us/sec (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | need to be calculated based on the Max HAPS beam foot print diameter and the HAPS’s altitude and reletive movement |
| **Channel bandwidth** | 20MHz for each DL and UL | 800MHz for each DL and UL | 20MHz for each DL and UL | 800MHz for each DL and UL | 20MHz for each DL and UL | 800MHz for each DL and UL | [20]MHz for each DL and UL |
| **Terminal type** | Handheld device, PC[3] | VSAT | Handheld device, PC[3] | VSAT | Handheld device, PC[3] | VSAT | Handheld device, PC[3] |
| **Terminal speed** | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined |
| **Max differential delay (b/w edge of satellite coverage and Nadir)****Table 5.3.5-1 of TR38.811/ Table 4.2-2 of TR38.821** | 16ms/10.3 (may need to be recalculated based on the beam foot print diameter) | 16ms/10.3 (may need to be recalculated based on the beam foot print diameter) | 4.4ms/3.12ms(for 600km and 3.18ms for 1200km) (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 4.4ms/3.12ms(for 600km and 3.18ms for 1200km) (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 4.4ms/3.12ms(for 600km and 3.18ms for 1200km) (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 4.4ms/3.12ms(for 600km and 3.18ms for 1200km) (may need to be recalculated based on the Max NTN beam foot print diameter and the satellite’s altitude and reletive movement) | 0.697ms (may need to be recalculated based on the Max HAPS beam foot print diameter and the HAPS’s altitude and reletive movement) |
| **Max Doppler shift** | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined |
| **Max Doppler variation [Hz/sec]** | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined | need to be defined |
| **UE antenna pattern and polarization** | Quasi Isotropic linear polarization [and Co-phased array dual linear polarization] | Circular polarization and Co-phased array dual linear polarization | Quasi Isotropic linear polarization [and Co-phased array dual linear polarization] | Circular polarization and Co-phased array dual linear polarization | Quasi Isotropic linear polarization [and Co-phased array dual linear polarization] | Circular polarization and Co-phased array dual linear polarization | Quasi Isotropic linear polarization [and Co-phased array dual linear polarization] |

* + Option 2: TBA
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 6-1: * Option 2

Sub topic 6-2: * Option 1 & Option 2 are both possible

Sub topic 6-3: * Option 1

Sub topic 6-4:* Option 3, Option 4, potentially also Option 1. Intra-NTN can be prioritized.

Sub topic 6-5: * Ok for 1st part of Option 1

Sub topic 6-6:* Option 1 and Option 2 are both possible.

Sub topic 6-7: * Option 1

Sub topic 6-8:* Option 1

Sub topic 6-9: * Option 1

Sub topic 6-10:* Option 1 has to be down-scoped with conclusions from [98e][310] and [98e][311]

….Others: |
| Qualcomm | **Issue 6-1: General RRM requirements**Technically we do not see a difference between the two options because Option 2 also says “to be discussed” not “to be defined”. As a baseline for the further discussion, okay with Option 2.**Issue 6-2: RRM procedures based on UE position**Both Option 1 and Option 2. Just to better understand the implication of Option 1: Isn’t this only for UE A-GNSS based positioning? Or can/should this be extended to a satellite positioning including HAPS?**Issue 6-3: Use of propagation delay information**There seems to have an overlap study area with Rel-17 measurement gap enhance item specifically “Multiple concurrent and independent MG patterns”. For NTN specific aspect, we can discuss under this Rel-17 NTN RRM item. However, we first need an input from RAN2 if there is any need to update spec and UE measurement behaviour.**Issue 6-4: Measurements for intra- / inter-cell mobility**Option 1, 3, and 4.**Issue 6-5: Cell selection and reselection**Okay with Option 1**Issue 6-6: Location assisted mobility**For location based mobility, we need to wait for RAN2 progress.**Issue 6-7: Interruption or measurement gaps for GNSS measurements**Seems okay with Option 1.**Issue 6-8: Measurement gaps for mobility measurements**Most likely Option 1 will be the case. However, as mentioned in Issue 6-3, there can be some overlap with Rel-17 measurement gap enhancement item, and we first need an input from RAN2 to see if there can be NTN specific issues or it can be covered by general Rel-17 measurement gap enhancement item as one of use cases.**Issue 6-9: SMTC and gap window misalignment**Almost the same comment as above. For SMTC, if it is concerned, probably it is likely a bit outside of Rel-17 measurement gap enhancement work scope.**Issue 6-10: Reference models**We suggest the group define a more concise and comprehensive set of reference table for the further RAN4 work. And okay with the comment from THALES “Option 1 has to be down-scoped with conclusions from [98e][310] and [98e][311]” |
| CMCC | **Issue 6-1: General RRM requirements**We are fine with both Option1 and Option2.**Issue 6-2: RRM procedures based on UE position**Requirements for A-GNSS in 38.171 can be used as a starting point to study the RRM requirements for NTN. The factors in both option1 and option 2 can be considered for the study of NTN RRM requirements. Whether these factors will impact the requirements need further study.**Issue 6-3: Use of propagation delay information**This issue should be discussed in RAN2.**Issue 6-4: Measurements for intra- / inter-cell mobility**Inputs from RAN1/2 are needed for the mobility scenarios. Meanwhile, we prefer RAN4 also consider the priorities when defining RRM requirements. Intra NTN mobility should have high priority among all the scenarios. At this stage, we slightly prefer option1.**Issue 6-5: Cell selection and reselection**Option 1 is OK. Input from RAN2 on the cell reselection procedure is necessary for RAN4 to start the RRM related discussion.**Issue 6-6: Location assisted mobility**Both option1 and option 2 need more input from RAN2. Wait until RAN2 completes the related discussion.**Issue 6-7: Interruption or measurement gaps for GNSS measurements**We support Option1.**Issue 6-8: Measurement gaps for mobility measurements**RAN2 is discussing the measurement gap related enhancement now. Better to avoid overlapping discussion among WGs.**Issue 6-9: SMTC and gap window misalignment**RAN2 is discussing the SMTC and gap related enhancement now. Better to avoid overlapping discussion among WGs. |
| Apple | **Issue 6-1: General RRM requirements**Option 1.**Issue 6-4: Measurements for intra- / inter-cell mobility**Option 1.**Issue 6-7: Interruption or measurement gaps for GNSS measurements**Cannot agree on option 1 at this stage. Needs to see more progress on this topic before have such conclusion. e.g., it’s unclear when UE will perform GNSS measurement or whether on every possible GNSS measurement occasion we would forbid any UE behaviour that cause interruption?**Issue 6-8: Measurement gaps for mobility measurements**More discussion is needed.**Issue 6-9: SMTC and gap window misalignment**More discussion is needed. |
| LGE | Issue 6-1Option 1 and option 2 can be considered, but RAN2 does not consider INACTIVE state for NTN.Issue 6-2RAN1 and RAN2 consider satellite PVT and knowledge of UE position information, so update period of satellite PVT information and UE position information should be considered to define RRM requirements.Issue 6-3In order not to miss the measurement RS within SMTC or MG due to large propagation delay, the propagation delay information obtained by PVT and UE position information can be considered as option 1. Issue 6-4Based on RAN2 discussion, intra NTN mobility has higher priority. So option 1 and option 2 can be considered in RAN4 work. Issue 6-6Option 1Issue 6-7Option 1Issue 6-8Option 1. Due to large propagation delay, current MG configuration could be limited for NTN operation, so RAN4 needs to study impact of current MG configuration for NTN operation.Issue 6-9Support option 1. The misalignment of SMTC and MG window should be resolved. |
| Ericsson | Sub topic 6-1: Issue 6-1: Option 1.Issue 6-2: Both option 1 and option 2 should be considered for RRM procedures based on UE position.Issue 6-3: option 2.Sub topic 6-2:Issue 6-4: Option 2.Issue 6-5: Option 1.Issue 6-6: Why do a hard select between option 1 and option 2 here? Option 1: Define the RRM requirement for ephemeris and UE location assisted NTN mobility. Option 2: RAN4 is to define the RRM requirements for time/timer and location based CHO triggering event. UE is assumed to have GNSS capability and Ephemeris data to support is not ruled out. If CHO is helpful for NTN we should make use of it. However, RAN4 should wait for RAN2 agreements on NTN mobility before starting to define any RRM requirements related to option 1 or option 2.Issue 6-7: Option 1, no interruptions.Issue 6-8: Measurement gaps configuration for NTN should be considered (option 1) but after RAN2 agreements on NTN mobility. RAN4 cannot start discussion on gaps without knowing NTN mobility scenarios and use cases which are discussed in RAN2.Issue 6-9: The issue of SMTC and gap window should be considered (option 1) but after RAN2 agreements on NTN mobility.Issue 6-10: Simulation assumptions are also discussed in [98e][311] NTN\_Solutions\_Part2 -> simulation assumptions and bands are discussed in [98e][310] NTN\_Solutions\_Part1 -> bands, architecture and RF. We should align model selection with [98e][311] and bands with [98e][310]. It is not appropriate to select bands here. We therefore support option 2.  |
| Xiaomi | Issue 6-1:Both option 1 and option 2 is fine, we can use the table in option 2 as a starting point.Issue 6-2:Option 1Issue 6-3:Support option1, RAN4 may start to have some analysis on the impact of propagation delay for SMTC and MG configuration.Issue 6-4:Option 4, as RAN2 agreed that intra-NTN mobility is prioritized, so we are fine with option 1.Issue 6-5:Support option 1.Issue 6-6:Both option 1 and option 2 is fine, but more input from RAN2 is needed before we discuss the related RRM requirements for option 1 and option 2.Issue 6-7:OK with option 1Issue 6-8:Support option 1, RAN4 can start to have some analysis on the impact of propagation delay for SMTC/MG configurationIssue 6-9:Support option 1, RAN4 can start to have some analysis on the impact of propagation delay for SMTC/MG configuration |
| OPPO | Issue 6-3: Support option1.Issue 6-7: Need more discussionIssue 6-8: Support option 1Issue 6-9: This issue is valid, and needs to be considered in both RAN4 and RAN2. |
| MediaTek | **Issue 6-1: General RRM requirements**Fine with Option 2 as the starting point.**Issue 6-2: RRM procedures based on UE position**Fine with Option 2. Option 1 can be a starting point, but it does not mean the requirements should be subject to Option 1. **Issue 6-3: Use of propagation delay information**Fine with Option 1. Need RAN2 input for the detail procedure. **Issue 6-4: Measurements for intra- / inter-cell mobility**Option 1 that intra-NTN can be prioritized. Also fine with Option 2, which is aligned with Option 1. **Issue 6-5: Cell selection and reselection**Fine with Option 1. **Issue 6-6: Location assisted mobility**Fine with Option 1. Option 2 needs more RAN2 input but it should not be precluded.**Issue 6-7: Interruption or measurement gaps for GNSS measurements**Seems okay with Option 1. At least MG is not needed.**Issue 6-8: Measurement gaps for mobility measurements**Wait for RAN2’s conclusion. **Issue 6-9: SMTC and gap window misalignment**Wait for RAN2’s conclusion.  |
| Huawei | Issue 6-1: General RRM requirementsOption 1.Issue 6-2: RRM procedures based on UE positionThe wording “RRM requirements” is not clear. What aspects the RRM requirements based on UE position include.Issue 6-3: Use of propagation delay informationOption 1.Issue 6-4: Measurements for intra- / inter-cell mobilityOption 3. These scenarios are in the WI scope. In addition, we prefer a uniform LEO type satellites, i.e.,do not consider a scenario where UE monitors both earth fixed and earth moving cellsIssue 6-5: Cell selection and reselectionOption 1. Because of the extraordinary high altitude of satellite, the RTD between UE and gNB always has a larger value than that of terrestrial network. Then it will take longer times to report the measurement report and receive handover command. This may result in late handover. In addition, also due to the near-far effect in NTN, the measurement quality has no outstanding difference between cell edge and cell center, so it is hard for network to judge the exact point to send handover command.To deal with the above potential handover issue, CHO can be a candidate solution in NTN. We can further discuss it.Issue 6-6: Location assisted mobilityFirst RAN4 shall figure out the detailed and concrete scheme of location assisted mobility.Issue 6-7: Interruption or measurement gaps for GNSS measurementsOption 1Issue 6-8: Measurement gaps for mobility measurementsThis issue has certain relationship with R17 measurement gap enhancement discussion. Issue 6-9: SMTC and gap window misalignmentOption 1. For UE, SSB transmitted to UE shall experience the feeder link and the service link. When UE is in the overlapping area between two satellites, the experienced propagation path through two transparent satellite can be very various. Then the SMTC window for measurement and the configured gap window may not be aligned. |
| CATT | Issue 6-1: Option 1 or option 2 as a starting point.Issue 6-2: Both option 1 and option 2 Issue 6-3: Seems beyond the scope of RAN4 discussion at current stage.Issue 6-4: Option 4. Further input from RAN1/2 is needed.Issue 6-5: Option 1. Further input from RAN1/2 is needed.Issue 6-6: Pending RAN2 decision.Issue 6-7: Option 1.Issue 6-8: Pending RAN2 conclusion.Issue 6-9: fine with option 1 but pending RAN2 conclusion. |
| Nokia, Nokia Shanghai Bell | Issue 6-1:Options 1 and 2 are OK.Issue 6-2:Options 1 and 2.Issue 6-3:Option 2.Issue 6-4:Options 1 and 2.Issue 6-5:Option 1 is Ok.Issue 6-6:Preferred to wait for RAN2 decisions.Issue 6-7:Option 1 is Ok.Issue 6-8:Preferred to wait for RAN2 decisions.Issue 6-9: Preferred to wait for RAN2 decisions.Issue 6-10:Further discussions are needed on the set of reference models. Hence, Option 2. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 6-1** | *Tentative agreements: No consensus yet. 3 companies support Option 1, 3 companies support Option 2 and 5 companies are open to both Options.**Candidate options:**Recommendations for 2nd round: Further discuss what to use as baseline for further discussion. What would need to be changed in the table to make it agreeable?*  |
| **Issue 6-2** | *Tentative agreements: 6 companies support both options.* *Candidate options:**o Option 1: RAN4 shall consider requirements for A-GNSS in 38.171 as a starting point when defining requirements for further RRM procedures based on UE position. RAN4 needs to verify if existing A-GNSS requirements are sufficient, considering the impact that positioning will have on the further RRM requirements which assume knowledge of UE position**o Option 2: RAN4 needs to consider the update period and accuracy of satellite/HAPS PVT and UE location information when defining the NTN RRM measurement requirement.**Recommendations for 2nd round: Some open questions in the discussion were not answered yet. For the way forward, RAN4 should merge both options as most companies support both.* |
| **Issue 6-3** | *Tentative agreements: While several companies support Option 1, no clear consensus was found yet. Several companies suggest that this issue should be discussed in RAN2.**Candidate options:**o Option 1: Consider propagation delay information from satellite/HAPS to configure SMTC or MG, and FFS for detail procedure.**o Option 2: TBA**Recommendations for 2nd round: Further discuss if this is relevant to RAN4 and/or if a LS to RAN2 is necessary.* |
| **Issue 6-4** | *Tentative agreements: No consensus with a slight preference for Option 1.**Candidate options:**Recommendations for 2nd round: Further discussion necessary.* |
| **Issue 6-5** | *Tentative agreements: Option 1 is agreeable. Further input from RAN1/2 might be necessary.**Candidate options:**Option 1: RAN4 is to study/identify whether the existing cell reselection and conditional handover delay requirement based on the existing S criteria can be reused or not for NTN scenarios.**Recommendations for 2nd round:* |
| **Issue 6-6** | *Tentative agreements: All companies agree that RAN4 needs more input from RAN2.**Candidate options:**Recommendations for 2nd round: Postpone until decision from RAN2 is available.* |
| **Issue 6-7** | *Tentative agreements: All but two companies agree with Option 1.**Candidate options:** *Option 1: No interruptions or measurement gaps are allowed for GNSS measurements during NTN operation.*

*Recommendations for 2nd round: What has to be changed to make this agreeable for everyone?* |
| **Issue 6-8** | *Tentative agreements: Although some companies support Option 1, the consensus seems to be to wait for RAN2 conclusion.**Candidate options:** *Option 1: RAN4 is to study the enhancement on measurement gap configuration for NR NTN system.*

*Recommendations for 2nd round: Postpone discussion until RAN2 has decided.* |
| **Issue 6-9** | *Tentative agreements: Most companies are open to discussion but prefer to wait for RAN2’s input before a firm decision.**Candidate options:* * *Option 1: The issue of SMTC and gap window is suggested to be considered*

*Recommendations for 2nd round: Keep issue FFS while waiting for RAN2 decision.* |
| **Issue 6-10** | *Tentative agreements: Postpone discussion and take into account the conclusions from [98e][310] and [98e][311]**Candidate options:**Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM measurement requirements | Qualcomm |

## Discussion on 2nd round (if applicable)

Based on the draft WF provided by Qualcomm, the issues have been merged for the 2nd round discussion as follows:

**Issue 6-1: General RRM requirements**

* **Proposal:** The following RRM requirements are the candidates to be discussed for NTN RRM measurement. More items may be added pending on the progress in other WGs.

|  |  |  |
| --- | --- | --- |
| Mobility States | Parameter | Parameter Name |
| RRC\_IDLE /INACTIVE state  | Cell Re-selection | UE measurement capability |
| Measurement and evaluation of serving cell |
| Measurements of intra-frequency NR cells |
| Measurements of inter-frequency NR cells |
| RRC\_CONNECTED state  | Handover Parameters - NR Handover | NR Handover |
| RRC Connection Mobility Control | RRC Re-establishment |
| Random access |
| RRC Connection Release with Redirection |
| General measurement requirement | Measurement gap |
| UE Measurement capability |
| NR intra-frequency measurements | Requirements applicability |
| NR inter-frequency measurements | Requirements applicability |
| NR measurement accuracy requirements | Intra-frequency SS-RSRP/RSRQ/SINR accuracy, including absolute and relative accuracy |
| Inter-frequency SS-RSRP/RSRQ/SINR accuracy, including absolute and relative accuracy |
| SS-RSRP/RSRQ/SINR Measurement report mapping |

**Issue 6-2: RRM procedures based on UE position**

* **Proposal:** RAN4 shall consider requirements for A-GNSS in 38.171 as a starting point when defining requirements for further RRM procedures based on UE position. RAN4 needs to verify if existing A-GNSS requirements are sufficient, considering the impact that positioning will have on the further RRM requirements which assume knowledge of UE position. FFS on whether/how to consider following aspects:
	+ Update period and accuracy of satellite/HAPS PVT
	+ Lossy compression of PVT information
	+ Time/frequency error propagation from feeder link(s)

**Issue 6-3: Use of propagation delay information**

* **Recommendations for 2nd round: Further discuss if this is relevant to RAN4 and/or if a LS to RAN2 is necessary.**
* **Suggested Conclusion:** How to configure CSMT and/or MG considering propagation delay information from satellite/HAPS is not in the scope of RAN4 unless requested otherwise by other working group(s), e.g. RAN2

**Issue 6-4/5/6:** Measurement and Mobility

* **Proposal**: RAN4 to discuss measurement and mobility for the following scenarios
	+ Intra-NTN for both RRC Connected and Idle/Inactive modes
		- Between GEO type satellites
		- Between LEO type satellites at the same altitude
			* Between earth fixed cells or between earth moving cells
			* FFS: whether/which to prioritize
		- Depending on satellite/cell deployment topologies consider both scenarios where cells are within a satellite and belong to different satellites
			* FFS: between HAPS
			* FFS: additional scenarios, e.g. between GEO and LEO
		- Between NTN and TN for RRC Inactive/Idle modes
* **Proposal**: For the existing mobility methodologies, RAN4 to study whether the existing requirements can be reused for NTN scenarios, e.g.
	+ S-criteria based cell (re)selection
	+ Time- or timer-based CHO
* **Proposal**: For location-based mobility methodologies, RAN4 to discuss the following when relevant detailed procedures are provided by RAN2
	+ Cell (re)selection
	+ CHO

**Issue 6-7**: Interruption/Measurement Gaps for GNSS Measurements

* **Observation**: No interruptions or measurement gaps are expected for GNSS measurements during NTN operation
	+ Companies are encouraged to investigate further and provide input if any technical issues are found. If any, RAN4 to discuss whether/how to define interruption and/or measurement gap for GNSS measurement in detail.

**Issue 6-8/9**: New SMTC and Measurement Gaps

* **Proposal**: RAN4 to study the following aspects for further discussion of SMTC and Measurement Gap issues in NTN
	+ Propagation delay and/or reception power differences between cells
		- between GEO type satellites
		- between LEO type satellites at the same altitude
			* between earth fixed cells or between earth moving cells
			* FFS: whether/which to prioritize
		- depending on satellite/cell deployment topologies consider both scenarios where cells are within a satellite and belong to different satellites
		- FFS: between HAPs
		- FFS: additional scenarios, e.g. between GEO and LEO
		- whether/how to account for delay propagation from feeder link is up to RAN1/RAN2 assumption/design
	+ Detailed requirements will be discussed when RAN2 solutions, if any, are provided
	+ FFS: whether/how to split detailed work between Rel-17 work items, NTN and MG enhancement

**Issue 6-10 of reference models is excluded since it is captured in RF session topics.**

**Outcome of GTW session (01. Feb. 2021):**

* **Issue 6-3:** Session chair: recommend to wait for RAN2 conclusions.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 6-1: General RRM requirements**Okay with the proposal, but our understanding of the proposal is that it is just a set of candidates for RAN4 discussion, hence, not necessarily all corresponding requirements to be defined.**Issue 6-2: RRM procedures based on UE position**Okay with the proposal with the following update:… RAN4 needs to verify if existing A-GNSS requirements are sufficient for position/location based new procedures introduced by other working groups, if any~~, considering the impact that positioning will have on the further RRM requirements which assume knowledge of UE position~~. …**Issue 6-3: Use of propagation delay information**Support the suggested conclusion with the typo correction “CSMT => SMTC”**Issue 6-4/5/6:** Measurement and MobilityFor the first proposal: Support, but do not want to consider “additional scenarios, e.g. between GEO and LEO” on FFS.For the second proposal: Support.For the third proposal: Support.**Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsAgree to the observation. And a relevant conclusion made in RAN1#104-e last week is copied below:Conclusion:It is up to RAN4 to decide whether interruptions or measurement gaps are required for GNSS measurements during NTN operation**Issue 6-8/9**: New SMTC and Measurement GapsSupport the proposal, but do not want to consider “additional scenarios, e.g. between GEO and LEO” on FFS. Based on analysis results, if any, RAN4 also needs to discuss which to prioritize. |
| Apple | **Issue 6-1: General RRM requirements**We think more conclusion from RAN1/2 is needed before we can define the requirement in the table, but we are generally fine to have it for information.**Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsWe disagree with the observation and would like to keep it open. The reasons are:Firstly, in RF discussion, the NTN GTW session agreed today to work on both S- and L-band for the WI. We did not see big issue in terms of interference between GNSS and S-band, but L-band UL is very close to GNSS. So, we are not sure if there is a potential issue for that combination from IDC harmonic/emission interference perspective. If the IDC harmonic/emission interference exists and is not negligible, we may consider to protect GNSS measurement from aggressor NTN transmission. Secondly, this case is different from legacy NR, because NTN capable UE is mandatory to support GNSS measurement and also GNSS measurement is essential for NTN connection. We think all these IDC interference aspects have to be checked by RAN4 RF session, and we are also checking with our RF experts. At this moment we propose to keep this topic open, i.e.,FFS: whether interruptions or measurement gaps is expected for GNSS measurements during NTN operation. |
| Xiaomi | **Issue 6-1: General RRM requirements**We are fine with the proposed table as a starting point. If NTN specific requirement identified, we can have further discussion.**Issue 6-3: Use of propagation delay information**Fine with the suggested way-forward.**Issue 6-4/5/6:** Measurement and MobilityFine with the proposals**Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsOk with the observation in general, in our understanding, the discussion on GNSS related measurement is out of 3GPP scope.**Issue 6-8/9**: New SMTC and Measurement GapsFine with the proposals |
| CMCC | **Issue 6-1: General RRM requirements**We support the recommended WF.**Issue 6-2: RRM procedures based on UE position**Basically Ok with the proposal, but we think the following bullets are related to satellites/HAPS position and other aspects.**Issue 6-3: Use of propagation delay information**Support the suggested conclusion.**Issue 6-4/5/6: Measurement and Mobility**Support the proposals.**Issue 6-7: Interruption/Measurement Gaps for GNSS Measurements**Support the observation.**Issue 6-8/9**: New SMTC and Measurement GapsRAN2 is discussing the SMTC and measurement gap related enhancement now. Better to avoid overlapping discussion among WGs. |
| Ericsson | **Issue 6-1: General RRM requirements**We support the proposal.**Issue 6-2: RRM procedures based on UE position**We support the proposal.**Issue 6-3: Use of propagation delay information**We agree with Suggested Conclusion**Issue 6-4/5/6:** Measurement and MobilityWe support the proposal**Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsWe agree with stated observation: Observation: No interruptions or measurement gaps are expected for GNSS measurements during NTN operation**Issue 6-8/9**: New SMTC and Measurement GapsWe support the proposal |
| Nokia, Nokia Shanghai Bell | **Issue 6-1: General RRM requirements**The proposal is OK.**Issue 6-2: RRM procedures based on UE position**The proposal is OK.**Issue 6-3: Use of propagation delay information**The suggested conclusion is OK.**Issue 6-4/5/6:** Measurement and MobilityThe proposals are OK.**Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsThe observation is OK.**Issue 6-8/9**: New SMTC and Measurement GapsThe proposals are OK. |
| THALES | **Issue 6-1: General RRM requirements**Agree with the proposal and with the candidate parameters from the proposal.**Issue 6-2: RRM procedures based on UE position**Agree with proposal.**Issue 6-3: Use of propagation delay information**Agree with the proposal if “CSMT” is “SMTC”**Issue 6-4/5/6:** Measurement and MobilityAgree with 3 of the proposals.For the proposal 1, is fine to consider “intra-NTN” with priority. However, it is important to mention that not all possible mix of scenarios may be available, as it depends also on the exemplary frequency bands for example and respective deployments. **Issue 6-7**: Interruption/Measurement Gaps for GNSS MeasurementsWe disagree with the proposal. For exemplary L-band (see the GTW agreement from [98e][310]), NTN UE in-device coexistence study with GNSS may be required for this band.Moreover, for the time being it is not clear the impact of interruption/measurement gaps on the UE capability to synchronize. It also depends on the type of constellation, the width and the type of cell (e.g. if Earth fixed cell or Earth moving cell).**Issue 6-8/9:** New SMTC and Measurement GapsAgree with the proposal to study new SMTC and measurement gaps, but some discussions are still required. It also has to be considered case by case if enhancements are needed / required. RAN4 may also need to consider different behaviour with respect to exemplary bands, and the new parameterisation may also have impact on NTN cell throughput/NTN cell capacity. It also seems that the configuration has to take into account NTN scheduling delays. |
| LGE | **Issue 6-1: General RRM requirements**Support proposal. The RRM requirements in proposal need to be discussed in RAN4.**Issue 6-2: RRM procedures based on UE position**Okay with proposal.**Issue 6-3: Use of propagation delay information** Okay to follow the conclusion in GTW session. **Issue 6-4/5/6:** Measurement and MobilityOkay with proposal.**Issue 6-8/9**: New SMTC and Measurement GapsWe support proposal. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

1. Topic #7: RRM requirements for beam switching

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

* 1. Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100715 | Xiaomi | **Proposal 7:** RAN4 is to study the RRM requirements for beam switching once RAN1 has determined the final PCI mapping mechanism for NTN scenario. |

* 1. Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

* + 1. Sub-topic 7-1: Beam switching

**Issue 7-1: RRM requirements for beam switching**

* Proposals
	+ Option 1: RAN4 is to study the RRM requirements for beam switching once RAN1 has determined the final PCI mapping mechanism for NTN scenario.
	+ Option 2: TBA
* Recommended WF
	+ TBA
	1. Companies views’ collection for 1st round
		1. Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| THALES | Sub topic 7-1: Option 1 seems to be reasonable. Please also note that in RAN4#97e it has been claimed “NTN beam switching is not yet defined. There is no such thing as TN beam switching in legacy NR”.….Others: |
| Qualcomm | **Issue 3-1: RRM requirements for beam switching**Do not see an issue with Option 1. To be clear, there can be two aspects about beam switching. One from UE beam switching and the other from gNB beam switching. For the second one, even though physical beams are formed by a satellite, beam switching is managed by gNB, in our understanding. And there can be differences between earth-fixed and earth-moving based LEO cells. |
| Apple | **Issue 3-1: RRM requirements for beam switching**More RAN1 conclusions on BM is needed before making any conclusion. |
| LG | Sub topic 7-1:It is not clear about the beam switching In our understanding, a satellite can use multi spot beams and each spot beam has its own service coverage. In other words, coverage of satellite is divided into multiple coverage area by multi spot beams. So, UE changes serving beam from satellite when satellite or UE moves. Does the beam switching means that UE changes spot beam from satellite? Does beam switching means cell re-selection if each beam has different PCI? |
| Ericsson | Sub topic 7-1: Issue 7-1 (Issue 7-1: RRM requirements for beam switching): Support option 2. It is better to wait until RAN2 has developed the concept. The feature mentioned in option 1 is unclear so at this stage we cannot assume that RAN4 requirements are needed. |
| Xiaomi | Issue 7-1:Support option 1. Whether this requirement is needed or not depends on RAN1 agreement on the PCI mapping scheme, for option a as shown in the following figure, if multiple spot beam have the same PCI, when one spot beam is leaving and new spot beam is coming with the same PCI, the UE is required to adjust its centre frequency to connect the new spot beam if the frequency factor is larger than 1. |
| OPPO | Option 1 is fine. Need clear clarification of beam management for NTN from RAN1. |
| MediaTek | Fine with Option 1 to study. But the conclusion will need more RAN1/RAN2 conclusions. |
| Huawei | Sub topic 7-1: Option 1 is fine. |
| Nokia, Nokia Shanghai Bell | Issue 7-1:Option 2 as further discussion is required. |

* 1. Summary for 1st round
		1. Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 7-1** | *Tentative agreements: While some companies support Option 1, further input from RAN1 and RAN2 is necessary.**Candidate options:** *Option 1: RAN4 is to study the RRM requirements for beam switching once RAN1 has determined the final PCI mapping mechanism for NTN scenario.*

*Recommendations for 2nd round: Proponents of Option 1 should further clarify the option. Input from RAN1 and RAN2 is necessary before making a firm decision.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | WF on NTN RRM requirements | Fraunhofer |

* 1. Discussion on 2nd round (if applicable)

Moderator suggests that proponents of Option 1 should further clarify the option.

**Companies views’ collection for 2nd round:**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | RAN1 design of beam management and network beam/BWP/PCI mapping details needs to be first provided. |
| Xiaomi | We support option 1, but more input on PCI/BWP/beam mapping mechanism are needed from RAN1. |
| Nokia, Nokia Shanghai Bell | Further discussions are necessary to understand beam switching in general, while waiting for RAN1 output. |
| THALES | Agree with Option 1, and also that beam/BWP/PCI mapping mechanisms/details are required. |
| LGE | We support option 1. |

* 1. Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |