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

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.8.4.1, 8.8.4.3

**Source:** Moderator (Fraunhofer HHI)

**Title:** Email discussion summary for [98-bis-e][222] NR\_NTN\_solutions\_RRM\_1

**Document for:** Information

# Introduction

This summary document captures issues related to general and measurement-related NR NTN RRM requirements. It contains a summary of the contributions under section 8.8.4.1 and 8.8.4.3 at TSG-RAN WG4 #98-bis-e, 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. Timing-related requirements and TDocs related to the LS reply to R1-2102263 (R4-2104763 in part and R4-2104764) shall be treated in [223] NR\_NTN\_solutions\_RRM\_2.

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

* Stage 1: Moderators kick off email discussion (Monday, Apr. 12)
* Stage 2: Companies provide comments for the 1st round (Apr. 12 – **Wednesday 8am UTC Apr. 14**)
* Stage 3: Moderators summarize the status and possible proposals, recommending what decisions can be made for 1st round. A formal TDoc will be used (**Wednesday 11pm UTC, Apr. 14**)
* 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 Friday 3pm UTC, Apr. 16)
* Stage 5: Companies provide comments for 2nd round starting from **Thursday 8am UTC, Apr. 15**
* Stage 6: Moderators provide 2nd round summary with a formal TDoc by **Tuesday 9am UTC, Apr. 20**
* Stage 7: Session chairs announce close of sessions (no later than **5pm UTC, Apr. 20**). Final decisions will be captured in Chairman meeting report (to be shared after the meeting is closed)

A total of 15 TDocs have been provided for this agenda:

|  |  |  |  |
| --- | --- | --- | --- |
| **Tdoc Number** | **Title** | **Source** | **For** |
| [**R4-2104598**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104598.zip) | NTN RRM measurement requirements | CMCC | Discussion |
| [**R4-2104603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104603.zip) | Discussion on general NTN RRM related issues | CMCC | Discussion |
| [**R4-2104690**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104690.zip) | Discussion on measurement requirements for NR NTN | Xiaomi | Discussion |
| [**R4-2104763**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104763.zip) | Discussion on RRM requirements for NTN | CATT | Discussion |
| [**R4-2104766**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104766.zip) | Discussion on measurement requirements for NTN | CATT | Discussion |
| [**R4-2104816**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104816.zip) | Measurement RRM requirements for NTN | Ericsson | Discussion |
| [**R4-2104834**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104834.zip) | On GNSS measurement for NTN | Apple | Discussion |
| [**R4-2104986**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104986.zip) | Discussion on RRM measurement requirements for NTN | NEC | Approval |
| [**R4-2105142**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105142.zip) | Discussion on NTN GNSS requirement | LGE UK | Discussion |
| [**R4-2105143**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2105143.zip) | Discussion on measurement requirements for NTN | LGE UK | Discussion |
| [**R4-2106939**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106939.zip) | Discussion on measurement in NTN | Huawei, HiSilicon | Discussion |
| [**R4-2107030**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107030.zip) | Discussion on general issues for NTN RRM | Huawei, HiSilicon | Discussion |
| [**R4-2107254**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107254.zip) | NTN - On reference points | Nokia, Nokia Shanghai Bell | Discussion |
| [**R4-2107256**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107256.zip) | NTN - On measurement requirements | Nokia, Nokia Shanghai Bell | Discussion |
| [**R4-2107292**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107292.zip) | Measurement requirements 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** |
| R4-2104603 | CMCC | **Proposal 1:** Do not define the timing RP in RAN4, further study the frequency RP after RAN1’s final decision about frequency pre-compensation scheme. |
| R4-2107030 | Huawei, HiSilicon | **Proposal 1:** RAN4 can consider to send LS to RAN1 regarding the observed implementation impact of the DL-UL delay depending on the RP for time synchronization. |
| R4-2107254 | Nokia, Nokia Shanghai Bell | **Observation 1:** Having the time reference point at the satellite means RAN4 has to define timing requirement for both gNB and UE towards the satellite.  **Observation 2:** Implementation of time reference point at the gNB requires less RAN4 specification work, and is less complex in terms of gNB implementation.  **Proposal 1:** RAN4 to specify at least requirements for the gNB as time reference point. |
| R4-2104986 | NEC | **Proposal 1:** If RAN4 confirms the IDC interference aspect of GNSS and L-band issue, RAN4 to look at performance degradation using simulation framework. Based on the performance degradation observed in simulation framework, RAN4 to study the solution for handling IDC interference aspect of GNSS and L-band. |
| R4-2104834 | Apple | **Proposal:** RRM room would determine whether interruptions or measurement gaps is expected for GNSS measurements during NTN operation after the IDC interference from L-band NTN to GNSS is evaluated/confirmed in RF session. |
| R4-2105143 | LGE | **Proposal 1.** L-band in-device coexistence problem can be handled in the RF session since it is caused by out-of-band RF leakage issues such as IDC harmonic/emission interference. Discussion about MG for GNSS measurement can be triggered in RRM session once the potential issue for in-device coexistence is verified in the RF session. |

## 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

In the WF R4-2103680 developed during RAN4#98-e it was concluded to

* Defer sending an LS to RAN1. Further discuss the impacts of different reference points on RRM requirements and inform RAN1 in case any common observations are identified.
* 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.

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

**Issue 1-1: Definition of reference point**

* Proposals
  + Option 1: Do not define timing RP in RAN4, further study frequency RP after RAN1’s final decision about frequency pre-compensation scheme.
  + Option 2: RAN4 to specify at least requirements for the gNB as time reference point.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 1-2: LS to RAN1 regarding observed implementation impact of DL-UL delay**

* Proposals
  + Option 1: RAN4 can consider sending an LS to RAN1 regarding the observed implementation impact of the DL-UL delay depending on the RP for time synchronization.
  + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 1-2: In device coexistence (IDC) issue of GNSS and L-band

L-band UL is very close to GNSS which may be a potential IDC issue.

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

**Issue 1-3: Confirmation of IDC issue**

* Proposals
  + Option 1: If RAN4 confirms the IDC interference aspect of GNSS and L-band issue, RAN4 to look at performance degradation using simulation framework. Based on the performance degradation observed in simulation framework, RAN4 to study the solution for handling IDC interference aspect of GNSS and L-band.
  + Option 2: TBA
* Recommended WF
  + If Option 1 is agreeable, RAN4 RF should confirm the IDC interference aspects. Based on the outcome of the RF considerations, RAN4 RRM can study solutions for handling IDC interference aspects of GNSS and L-band. Defer discussion of Issue #6-14 until then.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 1-1: Option 1. RAN4 could wait for RAN1’s agreement.  Issue 1-2: Option 2. RAN4 could wait for RAN1’s agreement, we do not see particular need to send LS.  Issue 1-3: Agree with Option 1 and the Recommended WF. |
| Ericsson | Sub topic 1-1:  Issue 1-1: Agree with Recommended WF.  Issue 1-2: Agree with Recommended WF.  Sub topic 1-2:  Issue 1-3: Agree with Recommended WF. It should be discussed in RF session. |
| Apple | Issue 1-1: Option 1.  Issue 1-2: Option 2.  Issue 1-3: fine with recommended WF. RRM room could determine whether interruptions or measurement gaps is expected for GNSS measurements during NTN operation after the IDC interference from L-band NTN to GNSS is evaluated/confirmed in RF session |
| CMCC | **Issue 1-1:** We support Option1. For timing RP, it can be any point within feeder link from RAN1’s perspective. We propose not to define explicit RP in RAN4.  However, we can specify the RAN4 requirements with some RP assumptions. We prefer the gNB as time reference point and the satellite as frequency RP.  **Issue 1-2:** Option 2. We don’t see any issues which are needed to inform RAN1, we can wait for RAN1’s conclusion.  **Issue 1-3:** We are OK to first discuss and confirm the IDC interference in RF session, and we believe IDC mechanism specified in RAN2 can cover any in-device interference. So, there is no need to spend time in RAN4 to discuss the interruptions or measurement gaps for GNSS measurements during NTN operation. |
| Qualcomm | Issue 1-1: Option 1.  Issue 1-2: Option 2.  Issue 1-3: Fine with recommended WF. Both in-device and inter-device coexistence/interference between NR transceiver and UE GNSS receiver need to be investigated and confirmed in RF session. After that, RAN4 can discuss the detailed solutions. Depending on the impact, if identified, RAN2 may also have to be involved. |
| ZTE | Issue 1-1: Agree with Recommended WF. The definition of RP is up to RAN1, however, RP at gNB could be a start point for RAN4 requirement discussion. Option 2 is acceptable for us.  Issue 1-2: Option 1.It will be helpful for RAN1 to get observations from RAN4’s view.  Issue 1-3: Agree with recommended WF. The issue should be identified by RF session firstly. |
| Xiaomi | Sub topic 1-1:  Issue 1-1: Support option 1, RAN4 should wait for RAN1’s agreement on the RP.  Issue 1-2: Option 2, agree with CMCC, do not see the necessity to send LS to RAN1.  Sub topic 1-2:  Issue 1-3: Agree with Recommended WF. Wait for the conclusion in RF session. |
| Samsung | Issue 1-3: Agree with the recommended WF. Conclusion from RF session is needed. |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# 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

Based on the outcome of RAN4#98-e captured in the WF R4-2103680 the requirements shall be defined with on-board GNSS as the baseline and FFS on how to handle satellites/HAPS without on-board GNSS capabilities. RRM requirements can be assumed to be impacted by GNSS accuracy, although the degree of impact and specific RRM requirements that are impacted are FFS. Furthermore it was concluded that companies should define typical and worst-case scenarios.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104603 | CMCC | **Proposal 2:** PVT accuracy requirements should consider the on-board GNSS requirements.  **Proposal 3:** Define two sets of PVT accuracy requirements with and without on-board GNSS respectively. Prioritize the study of requirements with on-board GNSS requirements.  **Proposal 4:**   * The worst-case scenario should be considered with first priority; the corresponding minimum requirements are as below:  | **System** | **Success rate** | **2-D position error** | **Max response time** | | --- | --- | --- | --- | | All | 95 % | 100 m | 20 s |  * The typical-case scenario can be studied as well, the corresponding minimum requirements are as below:  | **System** | **Success rate** | **2-D position error** | **Max response time** | | --- | --- | --- | --- | | All | 95 % | 50 m | 2 s | |
| R4-2107030 | Huawei, HiSilicon | **Proposal 2:** RAN4 assumes that ephemeris of the satellite/HAPS is made available to UE in defining the RRM requirements. No further discussion on whether the satellite or HAPS has on-board GNSS.  **Proposal 3:** RAN4 not to identify the list of RRM requirements impacted by GNSS accuracy, but the impact of GNSS accuracy should be considered when defining each requirement.  **Proposal 4:** Take the worst case from 38.171 as the assumption of GNSS accuracy for defining RRM requirements. |
| R4-2105142 | LGE | **Proposal 1:** GNSS accuracy has no impact for RRM requirement/performance at least in FR1.  **Proposal 2:** RAN4 further studies position accuracy of without on-board GNSS satellite to verify the degree of impact for its requirement. |
| R4-2104816 | Ericsson | **Observation 1:** Requirement of UE specific TA isn’t defined specifically now. it implies no clear evaluation criteria of GNSS accuracy for impact Timing Advance. We assume total Timing Advance achieved is based on GNSS accuracy.  **Observation 2:** Before time(r) and location based CHO are fixed in RAN2, it is difficult to discuss ‘time(r)’ and ‘location’ impact to RRM.  **Proposal 1:** Criteria of GNSS accuracy must be more stringent than current TA accuracy requirement anyhow. Further evaluation of GNSS needs calculation with available satellite speed and elevation/azimuth angle and UE position in cell and needs to take error introduced between satellite and gateway into account.  **Proposal 2:** GNSS accuracy for location-based CHO need to be checked after location-based CHO is clear in RAN2.  **Proposal 3:** It is recommended to separate time to first fix (TTFF) and time to subsequent fix (TTSF) of GNSS signal impact to RRM requirements. 20s in TTFF is only defined as addition for initialization/ramp up.  **Proposal 4:** Measurement period needs to further study with assumption securing Timing Advance in proper scope: 1: Te ; 2: Timing Advance adjustment accuracy. Further evaluation of GNSS needs calculation with available satellite speed and elevation/azimuth angle and UE position in cell and needs to take error introduced between satellite and gateway into account. |
| R4-2104763 | CATT | **Observation 1:** The ephemeris can be used for satellites and achieved from satellite system such as measured by earth station.  **Observation 2:** The gNB can handle the HAPS without on-board GNSS with time and frequency pre-compensation and uplink transmit timing control signal NTA. UE pre-compensation should not be expected.  **Observation 4:** The requirements of UE transmit timing can be defined based on UE capability of GNSS accuracy. |

## 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

This sub-topic discusses if on-board GNSS capabilities are assumed or not.

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

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

* Proposals
  + Option 1: RAN4 assumes that ephemeris of the satellite/HAPS is made available to UE in defining the RRM requirements. No further discussion on whether the satellite or HAPS has on-board GNSS.
  + Option 2: The ephemeris can be used for satellites and achieved from satellite system such as measured by earth station. The gNB can handle the HAPS without on-board GNSS with time and frequency pre-compensation and uplink transmit timing control signal NTA. UE pre-compensation should not be expected.
  + Option 3: RAN4 further studies position accuracy of without on-board GNSS satellite to verify the degree of impact for its requirement.
  + Option 4: TBA
* Recommended WF
  + TBA

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

This sub-topic discusses the impact of GNSS accuracy on various RRM requirements.

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

**Issue 2-2: Consideration of on-board GNSS equipment**

* Proposals
  + Option 1: PVT accuracy requirements should consider the on-board GNSS requirements.
  + Option 2: Define two sets of PVT accuracy requirements with and without on-board GNSS respectively. Prioritize the study of requirements with on-board GNSS requirements.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 2-3: GNSS accuracy impact on RRM requirements**

* Proposals
  + Option 1: GNSS accuracy has no impact for RRM requirement/performance at least in FR1.
  + Option 2: RAN4 not to identify the list of RRM requirements impacted by GNSS accuracy, but the impact of GNSS accuracy should be considered when defining each requirement.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 2-4: Criteria of GNSS accuracy**

* Proposals
  + Option 1: Criteria of GNSS accuracy must be more stringent than current TA accuracy requirement anyhow. Further evaluation of GNSS needs calculation with available satellite speed and elevation/azimuth angle and UE position in cell and needs to take error introduced between satellite and gateway into account.
  + Option 2: The requirements of UE transmit timing can be defined based on UE capability of GNSS accuracy.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 2-5: GNSS accuracy for location-based CHO**

* Proposals
  + Option 1: GNSS accuracy for location-based CHO need to be checked after location-based CHO is clear in RAN2.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-6: Impact of time to first fix/time to subsequent fix on RRM requirements**

* Proposals
  + Option 1: It is recommended to separate time to first fix (TTFF) and time to subsequent fix (TTSF) of GNSS signal impact to RRM requirements. 20s in TTFF is only defined as addition for initialization/ramp up.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-7: Measurement period**

* Proposals
  + Option 1: Measurement period needs to further study with assumption securing Timing Advance in proper scope: 1: Te ; 2: Timing Advance adjustment accuracy. Further evaluation of GNSS needs calculation with available satellite speed and elevation/azimuth angle and UE position in cell and needs to take error introduced between satellite and gateway into account.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-8: Reference GNSS scenario**

* Proposals
  + Option 1:   
    The worst-case scenario should be considered with first priority; the corresponding minimum requirements are as below:

| **System** | **Success rate** | **2-D position error** | **Max response time** |
| --- | --- | --- | --- |
| All | 95 % | 100 m | 20 s |

The typical-case scenario can be studied as well, the corresponding minimum requirements are as below:

| **System** | **Success rate** | **2-D position error** | **Max response time** |
| --- | --- | --- | --- |
| All | 95 % | 50 m | 2 s |

* + Option 2: Take the worst case from 38.171 as the assumption of GNSS accuracy for defining RRM requirements.
  + Option 3: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 2-1: Option 1.  Issue 2-2: Option 1.  Issue 2-3: Option 1. Based on the simulation result, the impact because of UE timing compensation error is marginal. (0.012 = 3% error budget of Te of 0.39 us in FR1.)  Issue 2-4: More discussion would be needed. Option 1 seems reasonable in general, A bit unclear how these criteria would impact on the UE requirement.  Issue 2-5: Option 1. RAN4 could wait for RAN2’s agreement.  Issue 2-6: Option 1.  Issue 2-8: Disagree on defining based on the worst case (option 1 and option 2), which would be un-realistic for NTN system.  To ensure that the relevant system needs (e.g. PRACH timing), the nominal value of 15m / 30 m would be assumed and also including the prediction error in Gateway. |
| Erisson | Sub topic 2-1:  Issue 2-1: Support option 1.  Sub topic 2-2:  Issue 2-2: Support option 1.  Issue 2-3: Agree with Recommended WF  Issue 2-4: Support option 1.  Issue 2-5: Support option 1.  Issue 2-6: Support option 1.  Issue 2-7: Agree with Recommended WF. We encourage the discussion.  Issue 2-8: Agree with Recommended WF. |
| Apple | Issue 2-1: option 1  Issue 2-2: option 1  Issue 2-3: agree with option 2. The impacts could be studied during the requirement design.  Issue 2-4: option 3. GNSS accuracy shall be based on the legacy GNSS capability since we did not have such GNSS enhancement in this NTN WI.  Issue 2-5: option 1.  Issue 2-6: Option 2. Need more discussion in RAN4 to figure out the accuracy or response time difference between TTFF and TTSF before this conclusion.  Issue 2-7: fine with recommended WF.  Issue 2-8: Option 2, and also fine with the recommended WF. |
| CMCC | Issue 2-1: We partially agree with Option1 that RAN4 assumes that ephemeris of the satellite/HAPS is made available to UE in defining the RRM requirements. However, whether the ephemeris is precise or has some error should be further studied.  Issue 2-2: We prefer Option2. We are also Ok with Option1 if the satellites with on-board GNSS is the typical scenario.  Issue 2-3: We support Option2 which provides a general guidance for the specification of all RRM requirements.  Issue 2-4: Basically, we agree with Option1 and Option2, we think they are not conflict Options.  For Option1, we agree that GNSS accuracy must be more stringent than current TA accuracy requirement, and further evaluation is needed. We also observed that the current GNSS accuracy in TS 38.171 is only applied for RRC-CONNECTED UE and the response time is TTFF which may not meet the GNSS application scenarios in NTN.  Issue 2-5: We support Option1.  Issue 2-6: We support Option1. We agree with Apple that the difference between TTFF and TTSF should be studied.  Issue 2-7: Option2. Further investigate after final decision about where to capture UE specific TA estimation error.  Issue 2-8: We support Option1. We propose Option1 in our contribution, and we would like to add some clarification here. We think that we can consider the worst-case scenario with first priority and study the typical-case scenario as well. We are also open to further investigate the value of position error and response time in the Table above. |
| Qualcomm | Issue 2-1: Option 1  Issue 2-2: Option 1. For the detailed formats of satellite’s ephemeris are supposed to be discussed and determined by other working groups.  Issue 2-3: Option 2  Issue 2-4: The discussion needs to be based on more specific RRM measurement requirements.  Issue 2-5: Option 1  Issue 2-6: The discussion needs to be based on more specific RRM requirements and respective scenarios.  Issue 2-7: Is the measurement period for GNSS signal reception? It is a bit unclear what the issue is for and what the context of the proposals is.  Issue 2-8: The worst set of performances from 38.171 doesn’t necessarily have to be considered for defining RRM requirements. However, a reference set of GNSS accuracy and response time can differ by target requirements and scenarios, e.g. RRC state, DRX configuration, UE mobility, UE type such as handheld vs. VSAT, UE position relative to beam footprint, satellite type, etc. |
| ZTE | Issue 2-1: Agree with recommended WF.  Issue 2-2: Option 1.  Issue 2-3: Agree with recommended WF. Further study is needed to identify GNSS accuracy impact on RRM requirements.  Issue 2-4: Agree with recommended WF.  Issue 2-5: Option 1.  Issue 2-6: Option 2.  Issue 2-7: Agree with recommended WF.  Issue 2-8: Fine with recommended WF. |
| Xiaomi | Issue 2-1: Support option 1.  Issue 2-2: Support option 1  Issue 2-3: Prefer option 2  Issue 2-4: the criteria of GNSS accuracy should be considered when defining the corresponding RRM requirements.  Issue 2-5: Support option 1;  Issue 2-6: More discussion is needed.  Issue 2-7: Need more discussion, need to clarify the motivation of this proposal.  Issue 2-8: Prefer option 1, and we also think the further discussion on the typical position error assumed in NTN scenario is needed. |
| Samsung | Issue 2-1  Support Option 1. Suggest to prioritize the scenario that on-board GNSS is supported.  Issue 2-4  More discussion is needed. It’s still unclear whether such criteria would have impact on UE requirements.  Issue 2-7  Fine with the recommended WF. More discussion is needed. |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

1. Topic #3: PVT Satellite precision

During RAN4#98-e, it was concluded to postpone the discussion until RAN1 has reached a decision. While the discussion is still not concluded, some agreements were made in RAN1.

* 1. Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104603 | CMCC | **Proposal 5**: PVT accuracy requirements should be first studied based on the ephemeris format which includes the satellite position and velocity state vectors. |

* 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 3-1: Requirements for PVT computation and distribution

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

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

* Proposals
  + Option 1: PVT accuracy requirements should be first studied based on the ephemeris format which includes the satellite position and velocity state vectors.
  + Option 2: TBA
* Recommended WF
  + TBA
  1. Companies views’ collection for 1st round
     1. Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 3-1: To clarify, would this accuracy be the side condition for defining the UE requirement, instead of a UE requirement? |
| Ericsson | Sub topic 3-1:  Issue 3-1: Support recommended WF. Ephemeris is one of factors impacting PVT accuracy measured, should RRM check PVT accuracy or should take PVT accuracy as input? |
| Apple | Issue 3-1: agree with recommended WF. Is this PVT accuracy given by RAN1 or assumed by RAN4? |
| CMCC | Issue 3-1: For the question raised by MTK and Ericsson, we would like to reply that the accuracy should be the side condition for defining the RRM requirement.  In RAN1, there are two options of ephemeris format below:  Option 1: Ephemeris format based on satellite position and velocity state vectors;  Option 2: Ephemeris format based on orbital elements  We think we can start the PVT accuracy requirements study based on Option1 as the baseline in RAN4. |
| Qualcomm | Issue 3-1: For the detailed formats of satellite’s ephemeris are currently being discussed and will be determined by other working groups. A similar question as MTK and Ericsson. |
| Xiaomi | Issue 3-1: similar question as Apple, the PVT accuracy is discussed in RAN1 or RAN4? |
| Samsung | Issue 3-1: Not clear whether such PVT accuracy should be defined by RAN1 or RAN 4. |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

* + 1. CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

* + 1. CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

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

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

1. Topic #4: NTN UL Time synchronization requirements

The issues for this topic are treated in [223] NR\_NTN\_solutions\_RRM\_2.

1. Topic #5: NTN UL Frequency synchronization requirements

During RAN4#98-e, it was tentatively agreed for RAN4 to investigate factors that can affect time and frequency pre-compensation accuracy requirements. Specific requirements are FFS.

* 1. Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104603 | CMCC | **Proposal 6**: At least the following factors will affect time/frequency pre-compensation accuracy requirements: • The accuracy of GNSS • PVT information accuracy • The frequency of reading GNSS information • The frequency of acquiring PVT information |
| R4-2107030 | Huawei, HiSilicon | **Proposal 5:** RAN4 not to further discuss time/frequency pre-compensation accuracy requirements as a general issue. |
| R4-2104763 | CATT | **Observation 5:** The legacy requirement for UE transmit frequency error can be reused for NTN UE.  **Observation 6:** Relaxed Te will be defined including time pre-compensation accuracy based on UE capability of GNSS accuracy. |

* 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 5-1: Frequency accuracy requirements

*Sub-topic description:*

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

**Issue 5-1: Time/Frequency pre-compensation accuracy requirements**

* Proposals
  + Option 1: RAN4 not to further discuss time/frequency pre-compensation accuracy requirements as a general issue.
  + Option 2: At least the following factors will affect time/frequency pre-compensation accuracy requirements:  
    • The accuracy of GNSS  
    • PVT information accuracy  
    • The frequency of reading GNSS information  
    • The frequency of acquiring PVT information
  + Option 3: The legacy requirement for UE transmit frequency error can be reused for NTN UE. Relaxed Te will be defined including time pre-compensation accuracy based on UE capability of GNSS accuracy.
  + Option 4: TBA
* Recommended WF
  + TBA
  1. Companies views’ collection for 1st round
     1. Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 5-1: Option 1, it can be discussed in the corresponding timing/frequency requirement threads. |
| Ericsson | Sub topic 5-1:  Issue 5-1: (2021-04-13): Option1. |
| Apple | Issue 5-1: option 1 from RRM perspective. |
| CMCC | Issue 5-1: Option 1. |
| Qualcomm | Issue 5-1: Frequency accuracy requirement is supposed to be discussed in RF session as per the agreement made in the previous RAN4 meeting. Timing accuracy requirement is in our understanding supposed to be discussed in the email thread#223 as per the email discussion guideline. |
| Xiaomi | Issue 5-1: Support option 1, this issue should be discussed in email thread#223. |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

* + 1. CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

* + 1. CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

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

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

1. Topic #6: NTN Measurements

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

* 1. Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2106939 | Huawei, HiSilicon | **Proposal 1:** Legacy CHO delay requirements can be used as a baseline to define NTN specific CHO delay requirements.  **Proposal 2:** NTN specific location based measurement can consider requirements for A-GNSS in 38.171 as a starting point.  **Proposal 3:** The existing accuracy of RRM measurement quantity in current spec can be reused for NTN RRM measurement as a starting point.  **Proposal 4:** No interruption needs to be specified for GNSS and L-band.  **Proposal 5:** Regarding SMTC and MG in NTN, RAN4 wait for the progress in RAN2. |
| R4-2107292 | Qualcomm | Network Topologies  **Observation 1**: In NTN with frequency reuse factor larger than 1, inter-cell mobility under the same satellite can be seen as BWP switching based L1 mobility.  **Proposal 1**: To facilitate technical discussion about mobility/measurement development, RAN4 to discuss the following aspects and define reference scenarios:   * Frequency reuse factor, e.g. 3 or 7 * Mapping between frequency resource of beam footprint and Cell-ID/ SSB-ID/ BWP-ID, e.g. frequency resource in a cell group for frequency-reuse under a satellite   + cells share a common Cell-ID and use different BWP-IDs with different SSB-IDs   + cells have different Cell-IDs   L1/L3 Measurements  **Proposal 2**: RAN4 to further discuss the following aspects:   * Whether to define same or different measurement accuracy and/or latency requirements for intra-satellite cell mobility and inter-satellite cell mobility * Whether to define same of different requirements in terms of the number of measurement cells for intra-satellite and inter-satellite, e.g. 7 cells for intra-satellite and 3 cells for inter-satellite, etc. * Location and/or timer based measurement relaxation, e.g. measurement interval can be relaxed when UE is close to the centre of beam footprint for GEO and/or non-GEO with at least earth-fixed cell   **Proposal 3**: RAN4 to investigate L1/L3 measurement requirements for GEO and non-GEO separately.   * Whether or not the requirements can be defined in the same manner for GEO and non-GEO will be determined after the investigation * Whether legacy RLF and BFD requirements are relevant for NTN UEs, e.g. legacy BLER value of a hypothetical PDCCH transmission and/or PDCCH format for out-of-sync and BFD can be reused   Interruption/Measurement Gaps for GNSS Measurements  **Proposal 4**: If a coexistence issue in terms of interruption to GNSS receiver from NTN uplink signals/channels (in-device and/or inter-devices, i.e. inter-UEs’ uplinks) is identified for certain frequencies/bands, RAN4 to consider the following approaches:   * If interruption to GNSS receiver from intra-UE and/or inter-UE NTN uplink is identified,   + consider introducing a UE specific uplink gap and/or a common uplink gap for GNSS measurement for multiple inter-UEs, or   + consider defining uplink interruption requirements in terms of, e.g. interruption ratio every [X]ms |
| R4-2104598 | CMCC | **Proposal 1**: RAN4 to discuss measurement and mobility for the following scenarios with high priority. • Intra-NTN for both RRC Connected and Idle/Inactive modes with higher priority  • 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 • between NTN and TN for RRC Inactive/Idle modes  (note) not all possible mix of scenarios may be available  **Proposal 2**: Since IDC mechanism will be specified in Rel-17 RAN2 TEI, there is no need for RAN4 to discuss interruptions or measurement gaps for GNSS measurements during NTN operation.  **Proposal 3**: RAN4 to study the following aspects for further discussion of (new) SMTC and Measurement Gap based requirements 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 • 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 • No new measurement gap pattern is needed according to RAN2 latest email discussion • FFS: whether/how to split detailed work between Rel-17 work items, NTN and MG enhancement • The multiple measurement gaps of NTN should be based on the outcome of MG enhancement WI, and further enhancement in NTN WI may be considered for NTN scenario if needed. |
| R4-2104690 | Xiaomi | **Observation 1**: 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 1**: it is not necessary to introduce new SMTC window or new measurement gap in NTN.  **Proposal 2**: The starting point of measurement gap can be determined by the following aspects:  1. Gap offset 2. Measurement gap timing advance (mgta) 3. Propagation delay difference between serving cell and neighbour cell  **Proposal 3**: The existing cell reselection delay requirement based on the existing S criteria can be reused for cell reselection in NTN scenarios.  **Proposal 4**: RAN4 need to define the reasonable cell reselection margin for cell reselection in NTN scenarios.  **Proposal 5**: 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 6**：The timeline for NTN CHO should be defined the time between the end of the last TTI containing the RRC command and the end of the reception of the new PRACH.  **Proposal 7**: The existing conditional handover delay requirement defined in Rel-16 can be reused as baseline for NR NTN CHO, the additional propagation delay should be considered in NTN CHO delay requirement.  **Proposal 8**: RAN4 is to define the RRM requirements for time/timer and location based CHO triggering event. |
| R4-2104816 | Ericsson | **Proposal 5:** It is feasible to receive GNSS positioning signals without any measurement gap or interruption in 3GPP radio reception or transmission.  **Observation 2**: Before time(r) and location based CHO are fixed in RAN2, it is difficult to discuss ‘time(r)’ and ‘location’ impact to RRM.  **Proposal 6**: Current Cell (re)selection and CHO based on RSRP/RSRQ should still be a fundamental requirement in NTN. Current idle/active mobility requirements should be start point without change. |
| R4-2105143 | LGE | **Proposal 2**. RAN4 should study the RAN4 impact of multiple configuration and multiple (or one) offsets for SMTC/MG.  **Proposal 3**. To prevent the performance degradation, RAN4 needs to study conditions that new or enhanced SMTC/MG is required.  **Proposal 4**. RAN4 should consider UE behavior for misaligned between measurement resources and SMTC/MG window due to inaccurate information such as propagation delay or location.  **Proposal 5**. Existing requirements for conditional HO in NR could be reused for intra/inter-NTN handover with service link switching.  **Proposal 6**. RAN4 needs to determine whether feeder link switching based handover for one NTN satellite would be handled in Rel-17. |
| R4-2104986 | NEC | **Proposal 2:** RAN4 to at least prioritize the measurement requirements for earth moving cells.  **Proposal 3:** RAN4 to discuss multiple and concurrent MG based solution for NTN in MG enhancements WI. |
| R4-2104766 | CATT | **Observation 1:** The DRX should not be longer than 320ms for NTN system.  **Observation 2:** The side condition for RRM measurement requirements may be defined at Es/Iot ≥ -3 dB.  **Observation 3:** NTN FR2 UE should not need receiving beam sweep, or reduced beam sweeping, e.g. 2 times.  **Observation 4:** It may be appropriate that the update rate of ephemeris parameters is 1 time per second.  **Observation 5:** How to do the pre-compensation of feeder link should be decided by RAN1 and its error may be negligible compare with pre-compensation of service link done by UE.  **Observation 6:** The priority for GEO, LEO, and HAPS may not be defined their priority ahead and can be set measurement frequency priority by network as TN NR system.  **Observation 7:** HAPS can be measured as very large cell.  **Observation 8:** The existing mobility methodologies can be reused for NTN scenarios with limitation of DRX cycle and the number of measurement samples.  **Observation 9:** The GNSS receiving should not be interrupted, and interrupting data communication can be allowed.  **Observation 10:** The propagation delay difference can’t impact SMTC configuration and measurement not using GAP. Using longer measurement GAP and supporting multiple GAP patterns may solve this issue for measurement using GAP. How to deal with these issues should be decided by RAN1/RAN2. |
| R4-2107526 | Nokia, Nokia Shanghai Bell | **Observation 1:** A static SMTC window duration may be unable to handle serving and neighbour cell propagation delay variations.  **Observation 2:** The transparent satellite amplification type impacts UE and network interpretation of measurements. |
| R4-2104834 | Apple | **Proposal:** RRM room would determine whether interruptions or measurement gaps is expected for GNSS measurements during NTN operation after the IDC interference from L-band NTN to GNSS is evaluated/confirmed in RF session. |

* 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 6-1: General RRM NTN measurement requirements

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

**Issue 6-1: DRX cycle**

* Proposals
  + Option 1: The DRX should not be longer than 320ms for NTN system.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-2: Side condition for RRM measurement requirements**

* Proposals
  + Option 1: The side condition for RRM measurement requirements may be defined at Es/Iot ≥ -3 dB.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-3: Beam sweeping**

* Proposals
  + Option 1: NTN FR2 UE should not need receiving beam sweep, or reduced beam sweeping, e.g. 2 times.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-4: RRM procedures based on UE position**

* Proposals
  + Option 1: For NTN-specific location based measurements, consider the requirements for A-GNSS in 38.171 as a starting point.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-5: Update rate of ephemeris**

* Proposals
  + Option 1: It may be appropriate that the update rate of ephemeris parameters is 1 time per second.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-6: Feeder link pre-compensation**

* Proposals
  + Option 1: How to do the pre-compensation of feeder link should be decided by RAN1 and its error may be negligible compare with pre-compensation of service link done by UE.
  + Option 2: TBA
* Recommended WF
  + TBA
    1. Sub-topic 6-2: Mobility

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

**Issue 6-7: Definition of mobility/measurement aspects**

* Proposals
  + Option 1: To facilitate technical discussion about mobility/measurement development, RAN4 to discuss the following aspects and define reference scenarios:
    - Frequency reuse factor, e.g. 3 or 7
    - Mapping between frequency resource of beam footprint and Cell-ID/ SSB-ID/ BWP-ID, e.g. frequency resource in a cell group for frequency-reuse under a satellite  
      ─ cells share a common Cell-ID and use different BWP-IDs with different SSB-IDs  
      ─ cells have different Cell-IDs
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-8: Intra-satellite/Inter-satellite cell mobility**

* Proposals
  + Option 1: RAN4 to further discuss the following aspects:
    - Whether to define same or different measurement accuracy and/or latency requirements for Intra-satellite cell mobility and inter-satellite cell mobility
    - Whether to define same of different requirements in terms of the number of measurement cells for intra-satellite and inter-satellite, e.g. 7 cells for intra-satellite and 3 cells for inter-satellite, etc.
    - Location and/or timer based measurement relaxation, e.g. measurement interval can be relaxed when UE is close to the centre of beam footprint for GEO and/or non-GEO with at least earth-fixed cell
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-9: L1/L3 measurement requirements**

* Proposals
  + Option 1: RAN4 to investigate L1/L3 measurement requirements for GEO and non-GEO separately.
    - Whether or not the requirements can be defined in the same manner for GEO and non-GEO will be determined after the investigation
    - Whether legacy RLF and BFD requirements are relevant for NTN UEs, e.g. legacy BLER value of a hypothetical PDCCH transmission and/or PDCCH format for out-of-sync and BFD can be reused
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-10: Scenarios for measurement and mobility**

* Proposals
  + Option 1: RAN4 to discuss measurement and mobility for the following scenarios with high priority.
    - Intra-NTN for both RRC Connected and Idle/Inactive modes with higher priority
    - 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
    - between NTN and TN for RRC Inactive/Idle modes
    - (note) not all possible mix of scenarios may be available
  + Option 2: The priority for GEO, LEO, and HAPS may not be defined their priority ahead and can be set measurement frequency priority by network as TN NR system. HAPS can be measured as very large cell.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 6-11: Cell selection and re-selection**

* Proposals
  + Option 1: The existing cell reselection delay requirement based on the existing S criteria can be reused for cell reselection in NTN scenarios.
  + Option 1a: The existing mobility methodologies can be reused for NTN scenarios with limitation of DRX cycle and the number of measurement samples.
  + Option 2: RAN4 need to define the reasonable cell reselection margin for cell reselection in NTN scenarios.
  + Option 3: 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 6-12: Conditional hand over requirements**

* Proposals
  + Option 1: Use existing cell (re)-selection and conditional handover (CHO) delay requirements as baseline. Additional propagation delays should be considered.
  + Option 2: The timeline for NTN CHO should be defined the time between the end of the last TTI containing the RRC command and the end of the reception of the new PRACH.
  + Option 3: RAN4 is to define the RRM requirements for time/timer and location based CHO triggering event.
  + Option 4: TBA
* Recommended WF
  + TBA

**Issue 6-13: Feeder link switching based handover**

* Proposals
  + Option 1: RAN4 needs to determine whether feeder link switching based handover for one NTN satellite would be handled in Rel-17.
  + Option 2: TBA
* Recommended WF
  + TBA
    1. Sub-topic 6-3: Measurement gap and SMTC

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

**Issue 6-14: Interruptions or measurement gaps for GNSS measurements**

* Proposals
  + Option 1: Since IDC mechanism will be specified in Rel-17 RAN2 TEI, there is no need for RAN4 to discuss interruptions or measurement gaps for GNSS measurements during NTN operation.
  + Option 2: It is feasible to receive GNSS positioning signals without any measurement gap or interruption in 3GPP radio reception or transmission. No interruption needs to be specified for GNSS and L-band.
  + Option 3: If a coexistence issue in terms of interruption to GNSS receiver from NTN uplink signals/channels (in-device and/or inter-devices, i.e. inter-UEs’ uplinks) is identified for certain frequencies/bands, RAN4 to consider the following approaches:
    - If interruption to GNSS receiver from intra-UE and/or inter-UE NTN uplink is identified,

─ consider introducing a UE specific uplink gap and/or a common uplink gap for GNSS measurement for multiple inter-UEs, or

─ consider defining uplink interruption requirements in terms of, e.g. interruption ratio every [X]ms

* + Option 4: The GNSS receiving should not be interrupted, and interrupting data communication can be allowed.
  + Option 5: RRM room would determine whether interruptions or measurement gaps is expected for GNSS measurements during NTN operation after the IDC interference from L-band NTN to GNSS is evaluated/confirmed in RF session
* Recommended WF
  + Defer discussion about this issue #1-3 is cleared. The issue has to be looked at by the RF session, and only if issues are identified there, the discussion can continue in RRM.

**Issue 6-15: Discussion of SMTC and MG**

* Proposals
  + Option 1: Regarding SMTC and MG in NTN, RAN4 wait for the progress in RAN2.
  + Option 1a: The propagation delay difference can’t impact SMTC configuration and measurement not using GAP. Using longer measurement GAP and supporting multiple GAP patterns may solve this issue for measurement using GAP. How to deal with these issues should be decided by RAN1/RAN2.
  + Option 2: It is not necessary to introduce new SMTC window or new measurement gap in NTN.
  + Option 3: RAN4 to discuss multiple and concurrent MG based solution for NTN in MG enhancements WI.
  + Option 4: To prevent the performance degradation, RAN4 needs to study conditions that new or enhanced SMTC/MG is required.
  + Option 5: TBA
* Recommended WF
  + TBA

**Issue 6-16: SMTC and MG based requirements**

* Proposals
  + Option 1: RAN4 to study the following aspects for further discussion of (new) SMTC and Measurement Gap based requirements 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
    - 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
    - No new measurement gap pattern is needed according to RAN2 latest email discussion
    - FFS: whether/how to split detailed work between Rel-17 work items, NTN and MG enhancement
    - The multiple measurement gaps of NTN should be based on the outcome of MG enhancement WI, and further enhancement in NTN WI may be considered for NTN scenario if needed.
  + Option 2: RAN4 to at least prioritize the measurement requirements for earth moving cells.
  + Option 3: TBA
* Recommended WF
  + TBA

**Issue 6-17: Measurement gap starting point**

* Proposals
  + Option 1: The starting point of measurement gap can be determined by the following aspects:

1. Gap offset  
2. Measurement gap timing advance (mgta)   
3. Propagation delay difference between serving cell and neighbour cell

* + Option 2: TBA
* Recommended WF
  + TBA

**Issue 6-18: SMTC and gap window misalignment**

* Proposals
  + Option 1: RAN4 should consider UE behavior for misaligned between measurement resources and SMTC/MG window due to inaccurate information such as propagation delay or location.
  + Option 2: RAN4 should study the RAN4 impact of multiple configuration and multiple (or one) offsets for SMTC/MG.
  + Option 3: TBA
* Recommended WF
  + TBA
  1. Companies views’ collection for 1st round
     1. Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Issue 6-1: More discussion would be needed. Is option 1 only for LEO or also apply for GEO?  Issue 6-3: It would be too eerily to decide on the FR2 beam sweeping.  Issue 6-4: It should be a case-by-case discussion. It may need to firstly identify which requirement would be impacted by the GNSS accuracy.  Issue 6-5: Fine with Option 1.  Issue 6-6: It should be decided by RAN1.  Issue 6-7: The mapping should be RAN1/RAN2 discussion.  Issue 6-13: Fine with Option 1.  Issue 6-15: Option 1.  Issue 6-17: Bullet 3 under option 1 is ongoing discussion in RAN2.  Issue 6-18: Option 2 is ongoing discussion in RAN2.  One comment on Option 1, UE should not be required to measure the SSB not in the SMTC for L3, when the SSB and SMTC are misaligned. |
| ERICSSON | Sub topic 6-1:  Issue 6-1: (2021-04-13): It should be RAN2 scope, we suggest no discussion here before RAN2’s outcome.  Issue 6-2: Agree with Recommended WF.  (2021-04-13): It should be RAN1 scope, we suggest no discussion here before RAN1’s outcome.  Issue 6-3: (2021-04-13): FR2 isn’t in current scope.  Issue 6-4: Support option 1.  Issue 6-5: Agree with Recommended WF.  Issue 6-6: Support option 1. It’s not about RRM.  Sub topic 6-2:  Issue 6-7: Agree with Recommended WF.  (2021-04-13):  Issue 6-8: Agree with Recommended WF.  Issue 6-9: (2021-04-13): It should be studied after RAN2 fixes mobility and BM.  Issue 6-10: (2021-04-13): Support option 1.  Issue 6-11: (2021-04-13): Options are not contradictory.  Issue 6-12: Agree with Recommended WF.  Issue 6-13: (2021-04-13): Essentially, it’s just handover based on RAN2’s outcome.  Issue 6-14: Agree with Recommended WF. The issue must be looked at by the RF session .  Issue 6-15: (2021-04-13): Support option 1.  Issue 6-16: (2021-04-13): Support option 1.  Issue 6-17: (2021-04-13): RAN2 needs fix SMTC issue firstly.  Issue 6-18: (2021-04-13): RAN2 needs fix SMTC issue firstly. |
| Apple: | Sub topic 6-1:  Issue 6-1: Option 2.  Issue 6-2: Option 2; need to discuss case by case in requirement design, e.g., HO may have different SNR condition from neighbor cell measurement.  Issue 6-3: Option 2. Need more conclusions from RAN1.  Issue 6-4: Option 1.  Issue 6-5: Option 2.  Issue 6-6: Option 1  Sub topic 6-2:  Issue 6-7 ~ issue 6-13: agree with the recommended WF and more RAN1/RAN2 inputs are needed  Sub topic 6-3:  Issue 6-14: Option 5 and agree with recommended WF.  Issue 6-15: Option 1. |
| CMCC | **Issue 6-1: DRX cycle**  RAN4 should wait for RAN2 decision on applicable DRX cycle for NTN system  **Issue 6-2: Side condition for RRM measurement requirements**  More analysis on the side condition for NTN scenario is needed.  **Issue 6-3: Beam sweeping**  RAN4 should wait for RAN1 decision on the beam sweepting  **Issue 6-4: RRM procedures based on UE position**  OK with option 1 as a starting point. But whether the worst case or typical case of GNSS requirements should be used still need further discussion.  **Issue 6-5: Update rate of ephemeris**  Need further discussion.  **Issue 6-6: Feeder link pre-compensation**  OK with option 1  **Issue 6-7: Definition of mobility/measurement aspects**  More RAN1/RAN2 input are needed  **Issue 6-8: Intra-satellite/Inter-satellite cell mobility**  More RAN1/RAN2 input are needed  **Issue 6-9: L1/L3 measurement requirements**  Option 1 can be used as the guidance for further discussion. But still more RAN1/RAN2 input are needed  **Issue 6-10: Scenarios for measurement and mobility**  For option 1, we prefer to prioritize earth moving cells. Since in our view, from RRM perspective, earth fixed scenario is a subset of earth moving scenario.  And we also prefer to remove HAPs from the priority list and work on the common part between HAPs and NTN first.  **Issue 6-11: Cell selection and re-selection**  There is no dependency between the options. More RAN1/RAN2 input are needed  **Issue 6-12: Conditional hand over requirements**  More RAN1/RAN2 input are needed  **Issue 6-13: Feeder link switching based handover**  From RRM HO requirements perspective, there is no special for the case of feeder link switching. This can be handled in Rel-17 following RAN2 agreements.  **Issue 6-15: Discussion of SMTC and MG**  Option1, option2, option3.  **Issue 6-16: SMTC and MG based requirements**  This issue overlaps with issue 6-10 and 6-15  **Issue 6-17: Measurement gap starting point**  Option1 can be considered as starting point. But RAN2 is discussing this, prefer to avoid conflict discussion.  **Issue 6-18: SMTC and gap window misalignment**  More RAN1/RAN2 input are needed |
| Qualcomm | Issue 6-1: Option 1 is unclear whether it is only for non-GEO and whether it should be applicable to all types of non-GEO irrespective of altitude. And even for GEO, it is also unclear whether UE speed matters or not. Note that aircraft scenario is also included in use case in our understanding. Does Option 1 propose to limit DRX configuration or consider requirement applicability rules and/or limitations in RAN4 RRM spec?  Issue 6-2: For Option 1, premature to discuss and we want to see more supporting arguments and contexts.  Issue 6-3: For Option 1, we can see the motivation. However, we can’t see where the number 2 comes from. And this is also typically dependent on PC.  Issue 6-4: What does the “starting point” exactly mean? We don’t want to repeatedly discuss the same topic at almost the same level of detail and make almost the same agreement. In the previous RAN4#98e meeting, “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.” was agreed.  Issue 6-5: We understand the context of Option 1. However, the way it is written in the list of proposals is incomplete that we can’t see the implication for further RAN4 discussion. For example, it is unclear whether it is for network broadcasting periodicity requirement, UE SIB reading frequency, all types of satellites, etc.  Issue 6-6: We don’t even know whether there was any agreement about feeder link pre-compensation in any working group and if there is any plan to make a decision in RAN1.  Issue 6-7: Okay with leaving it to RAN2.  Issue 6-8: Seems RAN4 is not ready for the relevant discussion on the first two bullets of Option 1. For the third bullet of Option 1, we believe RAN4 can start a discussion about measurement relaxation in terms of, e.g. measurement interval, even without RAN2 input.  Issue 6-9: For the second bullet of Option 2, we believe the group can start a discussion even without RAN2 input. For non-GEO, UE may have to predict radio link issue because service link quality can change much faster than GEO due to, e.g. pathloss change. In GEO, due to a large round trip delay, UE may also have to predict radio ink issue in a similar manner as non-GEO to avoid radio link re-establish procedure.  Issue 6-11: We can further discuss all Options.  Issue 6-12-13: Wait for RAN2 progress.  Issue 6-14: Agree with recommended WF  Issue 6-15: Option 1  Issue 6-16: Do not see the significance of the discussion for now.  Issue 6-17: Wait for RAN2 progress.  Issue 6-18: Option 2 is ongoing discussion in RAN2. |
| Xiaomi | Issue 6-1: Need more discussion on DRX cycle, it is too early to make any conclusion on DRX cycle. And the conclusion from RAN2 is also needed,  Issue 6-2: Need more discussion.  Issue 6-3: RAN4 need more conclusion from RAN1 on the beam sweeping before discussing this issue.  Issue 6-4: Option 1 can be used as the starting point.  Issue 6-5: need more discussion.  Issue 6-6: The pre-compensation of feeder link should be decided by RAN1. Whether its error can be negligible is FFS  **Mobility**  Issue 6-7: The frequency reuse factor and beam mapping should be discussed in RAN1.  Issue 6-8: it is too early to discuss these aspects and more RAN1/2 conclusions are needed.  Issue 6-9: Need more discussion and more RAN1/2 conclusions are needed.  Issue 6-10: Option 1 is fine.  Issue 6-11/12: these are our proposals, which are some general thinking on cell reselection requirement and HO requirement for NTN scenarios. They can be as the starting point to have some analysis and more RAN1/2 conclusion is needed.  Issue 6-13: To clarify, do we need to specify the requirements for NTN satellite in RRM session?  Issue 6-14: Fine option 1 and option 5, it is not urgent to conclude this issue in RRM session.  Issue 6-15: Fine with option 1 and option 2. For option 3, we prefer to use Rel-15/16 MG design as baseline.  Issue 6-17: This is our proposal which can resolve the timing misalignment between MG and SMTC of neighbour cell.  Issue 6-18: Need more conclusions from RAN2. |
| Samsung | Issue 6-6: Fine with Option 1  Issue 6-14: Fine with the WF  Issue 6-15: Option 1  Issue 6-17: Fine Option 1. It looks reasonable to have such starting point. But we need to avoid conflict discussion with that in RAN2. |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

* + 1. CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

* + 1. CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

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

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

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** |
| R4-2104603 | CMCC | *Agreement in RAN4#98-e meeting:*   * *RAN4 is to study the RRM requirements for beam switching once RAN1 has determined the final PCI mapping mechanism for NTN scenario.* * *Further clarification and input from RAN1 and RAN2 is necessary, especially on beam/BWP/PCI mapping mechanisms and details.*   According to the current PCI mapping progress in RAN1, both Option a and Option b in Figure 1 is supported. In Option a and FRF>1 case, beam switching may result in a BWP switching, and a re-synchronization may be needed. The specific mechanisms of BWP/beam switching have not been completed yet in RAN1, RAN4 should wait for the conclusion of BWP/beam switching scheme.    **Figure 1: 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. Companies views’ collection for 1st round
     1. Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

* + 1. CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 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** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

* + 1. CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

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

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents