**3GPP TSG-RAN WG4 Meeting # 102-e R4-22XXXXX**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 10.13.5.1, 10.13.5.3, 10.13.5.5

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary: [102-e][220] NR\_NTN\_solutions\_RRM\_1

**Document for:** Information

# Introduction

*The summary covers the contributions submitted under the following Ais*

* *10.13.5.1 - General*
* *10.13.5.3 - Mobility requirements*
* *10.13.5.5 - Measurement procedure requirements*

**GTW session (February 21, 2022)**

Session Chair’s note

Key open issues

* + Topic #1: General
    - Issue 1-4: DRX Cycle => resolved
    - Issue 1-5: Cell Service Time
    - Issue 1-6: Neighbour/Target Cell/Satellite Information Acquisition
    - Issue 1-7: RRM Spec Documentation
    - Issue 1-8: Signalling characteristics
  + Topic #2: Mobility requirements
    - Issue 2-1: Cell selection and reselection
    - Issue 2-2 HO and CHO
  + Topic #3: Measurement procedure requirements
    - Issue 3-1: Multiple SMTCs and Measurement Gap
    - Issue 3-2: Measurement relaxation
    - Issue 3-3: Other aspects for Measurement procedure requirement
  + Topic #4: UE Capability
  + Topic #5: draft CRs

# Topic #1: General

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

## Open issues summary and Companies views’ collection for 1st round

### Issue 1-4: DRX Cycle

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| R4-2204295 | OPPO | **Issue 1-4-2: Applicability of Legacy DRX Cycles for Earth-moving Cell**  **Proposal 1: For earth-moving deployment, UE doesn’t need to fulfil the RRM requirements of 2.56s DRX cycle.** |
| R4-2204520 | LG Electronics UK | **Proposal 2*.*** All Rel-16 DRX cycle lengths should be applicable. Whether and what DRX cycle length to configure is up to NW implementation. |

**Issue 1-4-2: Applicability of Legacy DRX Cycles for Earth-moving Cell**

Agreements (from RAN4#101-b)

* Define RRM requirements for all legacy DRX cycles
  + FFS on applicability of 2.56s DRX cycle for earth-moving LEO deployment

Agreements (from RAN4#101-b)

* Regarding whether 2.56s DRX cycle is applicable for earth-moving LEO deployment.
  + Whether and what DRX cycle length to configure is up to NW, but UE is not required to fulfil the requirements for 2.56s DRX cycle length for earth-moving LEO deployment.

**Moderator’s suggestion**

* Proposals are not different from the above agreements made in the last meeting. No discussion is needed.

### Issue 1-5: Cell Service Time

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| R4-2203928 | CATT | **Issue 1-5-1:** Measurement based on Cell Service Time  **Proposal 1: Before the moment to start detection, measurement and evaluation** **for serving cell stop, UE should start the detection, measurement and evaluation on neighbour cells if the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold for getting better network serving.** |
| R4-2204295 | OPPO | **Issue 1-5-1: Measurement based on Cell Service Time**  **Proposal 2: For neighbouring cells with higher priority, the requirements does not apply when Te-Ts < Tdetect,NR, where**   * **Ts is the time to start detection, measurement and evaluation, which is up to UE implementation** * **Te is the first slot when the cell is scheduled to stop serving the area according to the broadcasted information**   **Proposal 3: For neighbouring cells with equal or lower priority, the requirements does not apply when Te- min(Tsi, Ts-criteria) < Tdetect,NR, where**   * **Tsi is the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’** * **Ts-criteria is the slot when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ is satisfied** * **Te is the first slot when the cell is scheduled to stop serving the area according to the broadcasted information** |
| R4-2204722 | Ericsson | **Issue 1-5-1: Measurement based on Cell Service Time**  ***Proposal 1: UE shall start the detection, measurement and evaluation on neighbour cells prior to S/R criteria evaluation. We don’t see any strong reason to ‘UE shall start the detection, measurement and evaluation on neighbour cells at the time when the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold.’*** |
| R4-2205374 | Huawei, HiSilicon | **Issue 1-5-1: Measurement based on Cell Service Time**  **Proposal 1: UE shall perform neighbour cell measurement when serving cell RSRP is below threshold, which is same as TN requirements.**  **Proposal 2: Requirements for time triggered measurement do not apply if the time span between SIB broadcasting cell stop time and the cell stop time is less than Ttrigger, where Ttrigger is**   * **max(Tdetect,NR\_Intra, Kcarrier\*max(Tdetect,NR\_Inter,i)), when serving cell is above the search threshold** * **max(Tdetect,NR\_Intra, Nlayer\*[60s]), when serving cell is below the search threshold**   **Proposal 3: Capture the location based condition in the applicability condition for the measurement requirements.** |
| R4-2203795 | Apple | **Issue 1-5-1: Measurement based on Cell Service Time**  ***Proposal 1: For NTN, before the stop-time based measurements are triggered, UE shall still start the detection, measurement and evaluation on neighbour cells at the time when the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold.***  ***Proposal 2: The NTN cell reselection requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’ is started to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Tdetect,NR\_Intra and K\*Tdetect,NR\_Inter.***   * ***Tdetect,NR\_Intra is the NTN intra-frequency cell detection delay in IDLE/Inactive mode***   + ***could use HST intra-frequency cell detection delay in IDLE/Inactive mode as baseline.*** * ***Tdetect,NR\_Inter is the NTN inter-frequency cell detection delay in IDLE/Inactive mode.***   + ***could use HST intra-frequency cell detection delay in IDLE/Inactive mode as baseline.*** * ***K is one of the following options:***   + ***Option1: K is the inter-frequency carrier number based on NTN UE measurement capability in IDLE/Inactive mode***   + ***Option 2: K is the higher priority inter-frequency carrier number*** |
| R4-2204240 | Xiaomi | **Issue 1-5-1: Measurement based on Cell Service Time**  **Proposal 1: In NTN idle/inactive mode, if the serving cell service time is broadcasted and applicable, the UE shall start the detection, measurement and evaluation on neighbour cells at the time when the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold.** |
| R4-2204522 | LG Electronics UK | **Measurement in Idle/inactive mode**  ***Proposal 4***: Following condition for intra-frequency measurement should be captured in RRM specification.  - Measurement of intra-frequency NTN cell   * + - When cell stop time is only broadcasted       * UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if Srxlev and Squal condition are met.     - When serving cell reference location is only broadcasted       * UE shall start intra-frequency measurement if the distance between UE and serving cell reference location is longer than a threshold. (The threshold is one of the location-related parameters broadcasted by network)       * UE may choose not to perform intra-frequency measurement if the distance between UE and serving cell reference location is shorter than a threshold and Srxlev/Squal condition is met.     - When both cell stop time and serving cell reference location are broadcasted       * UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if the distance between UE and serving cell reference location or Srxlev and Squal condition are met.   ***Proposal 5***: Following condition for inter-frequency / inter-RAT frequency measurement should be captured in RRM specification.  - Measurement of inter-frequency / inter-RAT frequency NTN cell   * + - When cell stop time is only broadcasted       * If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority and UE shall be able to detect, measure, and evaluate equal or lower priority inter-frequency / inter-RAT frequency layer before the serving cell stops covering the current area.       * If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.     - When serving cell reference location is only broadcasted       * If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ and the distance between UE and serving cell reference location is shorter than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority.       * If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ or the distance between UE and serving cell reference location is longer than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.     - When both cell stop time and serving cell reference location are broadcasted       * FFS (need to wait RAN2 conclusion) |

**Issue 1-5-1-A: Measurement based on Cell Service Time (When to start the detection, measurement and evaluation on neighbour cells)**

Agreements (from RAN4#101-b)

* UE in RRC Idle/Inactive mode shall be able to detect, measure, and evaluate neighbour cells before a serving cell stops serving the area, if Serving cell service time information is broadcasted and applicable, regardless of whether the distance condition based on serving cell reference location or the legacy Srxlev/Squal condition are met. When to start detection, measurement, and evaluation is up to UE implementation.
  + FFS whether UE shall start the detection, measurement and evaluation on neighbour cells at the time when the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold.
* The above does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’ is started to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Tdetect,NR\_Intra and K\*Tdetect,NR\_Inter. Tdetect,NR\_Intra, K, and Tdetect,NR\_Inter are FFS.

**Proposals for RAN4#102**

* In NTN idle/inactive mode, if the serving cell service time is broadcasted and applicable,
  + Option 1-A: CATT, Xiaomi, Apple, Huawei
    - the UE shall start the detection, measurement and evaluation on neighbour cells at the time when the legacy S/R criteria are met, e.g. serving cell RSRP is worse than threshold.
  + Option 1-B: Ericsson
    - UE shall start the detection, measurement and evaluation on neighbour cells prior to S/R criteria evaluation.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Support option 1-A, since the legacy cell selection/reselection in NR is the baseline in NTN, and RAN2 was agreed the UE follow legacy behavior, i.e. based on Srxlev/Squal before the stop-time based measurement are triggered in RAN2#116bis-e meeting. |
| Ericsson | In essence, we understand that it is UE’s implementation that start detection, measurement before or upon meeting S/R criteria. Option 1-A is also acceptable to us. Anyhow, it doesn’t impact existing texts in spec: ‘If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection.’ |
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**Issue 1-5-1-B: Measurement based on Cell Service Time (Requirement applicability)**

**Proposals for RAN4#102**

* Proposal 1:
  + The NTN cell reselection requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’ is started to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger. Ttrigger is
    - Option 2-A: Huawei
      * max(Tdetect,NR\_Intra, Kcarrier\*max(Tdetect,NR\_Inter,i)), when serving cell is above the search threshold
      * max(Tdetect,NR\_Intra, Nlayer\*[60s]), when serving cell is below the search threshold
    - Option 2-B: Apple
      * max(Tdetect,NR\_Intra, K\*Tdetect,NR\_Inter)
      * Tdetect,NR\_Intra is the NTN intra-frequency cell detection delay in IDLE/Inactive mode
        + FFS: use HST intra-frequency cell detection delay in IDLE/Inactive mode as baseline.
      * Tdetect,NR\_Inter is the NTN inter-frequency cell detection delay in IDLE/Inactive mode.
        + FFS: use HST intra-frequency cell detection delay in IDLE/Inactive mode as baseline.
      * K is one of the following options:
        + Option1: the inter-frequency carrier number based on NTN UE measurement capability in IDLE/Inactive mode
        + Option 2: the higher priority inter-frequency carrier number
* Proposal 2: OPPO
  + For neighbouring cells with higher priority, the requirements does not apply when Te-Ts < Tdetect,NR, where
    - Ts is the time to start detection, measurement and evaluation, which is up to UE implementation
    - Te is the first slot when the cell is scheduled to stop serving the area according to the broadcasted information
  + For neighbouring cells with equal or lower priority, the requirements does not apply when Te- min(Tsi, Ts-criteria) < Tdetect,NR, where
    - Tsi is the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’
    - Ts-criteria is the slot when Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ is satisfied
    - Te is the first slot when the cell is scheduled to stop serving the area according to the broadcasted information
* Proposal 3: Huawei
  + Capture the location based condition in the applicability condition for the measurement requirements.
* Proposal 4: LGE
  + Following condition for intra-frequency measurement should be captured in RRM specification.
    - Measurement of intra-frequency NTN cell
      * When cell stop time is only broadcasted
        + UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if Srxlev and Squal condition are met.
      * When serving cell reference location is only broadcasted
        + UE shall start intra-frequency measurement if the distance between UE and serving cell reference location is longer than a threshold. (The threshold is one of the location-related parameters broadcasted by network)
        + UE may choose not to perform intra-frequency measurement if the distance between UE and serving cell reference location is shorter than a threshold and Srxlev/Squal condition is met.
      * When both cell stop time and serving cell reference location are broadcasted
        + UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if the distance between UE and serving cell reference location or Srxlev and Squal condition are met.
  + Following condition for inter-frequency / inter-RAT frequency measurement should be captured in RRM specification.
    - Measurement of inter-frequency / inter-RAT frequency NTN cell
      * When cell stop time is only broadcasted
        + If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority and UE shall be able to detect, measure, and evaluate equal or lower priority inter-frequency / inter-RAT frequency layer before the serving cell stops covering the current area.
        + If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.
      * When serving cell reference location is only broadcasted
        + If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ and the distance between UE and serving cell reference location is shorter than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority.
        + If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ or the distance between UE and serving cell reference location is longer than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.
      * When both cell stop time and serving cell reference location are broadcasted
        + FFS (need to wait RAN2 conclusion)

**Moderator’s suggestion**

* Share your views on each proposal.

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| **Company** | **Comments** |
| Xiaomi | For cell reselection requirement applicability, option 2-A is fine for us.  Proposal 3 is fine  Proposal 4, for the conditions for intra-frequency measurement, the legacy S/R criteria for intra-frequency should be considered, e.g. Srxlev> SIntraSearchP and Squal > SIntraSearchQ. |
| Ericsson | Time-based conditions:  Tdetect,NR\_Intra is for re-selection to newly detectable cell. Before SI ‘serving cell stop time’ is received by UE, the UE may start detection if reselection criteria are fulfilled, or have detected the neighbour cell. **Proposal 1** requests that Ttrigger shall be larger than Tdetect,NR\_Intra. However, if UE starts measurements on neighbor cells before SI receiving, reselection still works without Ttrigger.  We can just update reselection requirements to:  ‘The UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 [1] within Tdetect,NR\_Intra when that Treselection= 0 before serving cell is going to stop serving the area, if applicable’. It is similar to **Proposal 2** and **Proposal4** but doesn’t need too many texts.  But we can consider Proposal 1 in test relevant requirement to ensure UE’s performance, if it’s the purpose of moderator to add ‘requirement applicability’ in title.   * If detectable intra-frequency cell is not detected before last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’ is started:   + The NTN cell reselection requirement does not apply when the time span from the last slot of SI transmission within SI modification period where the broadcasting of ‘serving cell stop time’ is started to the first slot when the cell is scheduled to stop serving the area according to the broadcasted information is less than Ttrigger.   location-based conditions:  The tricky aspect about location-based conditions is figuring out how to specify them.  Proposal 3 may require additional clarity.  Proposal 4‘UE shall start intra-frequency measurement if the distance between UE and serving cell reference location is longer than a threshold’ doesn’t limit the valid and necessary time.  We suggest ‘Once [distance between UE and serving cell reference location is longer than a threshold], the UE shall be able to evaluate whether a newly detectable intra-frequency cell meets the reselection criteria defined in TS38.304 [1] within Tdetect,NR\_Intra when that Treselection= 0 .’ |
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### Issue 1-6: Neighbour/Target Cell/Satellite Information Acquisition

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| R4-2203853 | Qualcomm Incorporated | **Issue 1-6-1: If valid neighbour/target cell’s timing information in terms of validity or accuracy is not provided to UE,**  **Proposal 1**: Depending on whether and what neighbor cell and target cell information is made available to UE, UE requirements are defined as below:   * For mobility requirements, an additional latency for necessary information reading, e.g. NTN specific system information from a target cell, is explicitly added if part of necessary information is either not available or invalid during cell (re)selection and (conditional) handover. * For measurement requirements, at least when configured multiple SMTCs on the same frequency are not mutually exclusive in the time domain, the requirements are applicable only when UE is provided with information of the target measurement cells that have the colliding SMTCs. |
| R4-2203928 | CATT | **Issue 1-6-1:** If valid neighbour/target cell’s timing information in terms of validity or accuracy is not provided to UE,  **Proposal 2: The discussion for valid neighbour/target cell’s timing information should be postponed until RAN2 have decision.** |
| R4-2204520 | LG Electronics UK | **Proposal 1.** UE stops RRM measurement and reporting before acquiring the updated ephemeris information after validity timer is expired. |
| R4-2204722 | Ericsson | **Issue 1-6-1: If valid neighbour/target cell’s timing information in terms of validity or accuracy is not provided to UE,**  ***Proposal 2: RAN4 shall evaluate the extra measurement time in case of no valid necessary information from the serving cell, If the time is long enough to impact mobility, the extra measurement time shall be specified.***  ***Proposal 3: Measurement configurations: SMTCs or MGs shall be limited when no valid necessary information from the serving cell. e.g. duration of SMTC and MGL shall be set longer than a threshold [3], [4]ms.*** |
| R4-2205374 | Huawei, HiSilicon | **Proposal 4: Define “availability of valid target satellite information as side condition”.**   * **The side condition applies to both measurement and mobility** * **This side condition applies to all RRC states**   **Proposal 5: Measurement or mobility requirements do not apply if valid target satellite information is not made available to the UE.** |

**Issue 1-6-1: If valid neighbour/target cell’s timing information in terms of validity or accuracy is not provided to UE,**

Agreements (from RAN4#101-b)

* RAN4 to discuss whether and how to define “availability of valid target satellite information as side condition” in RAN4#102 e-meeting if RAN2 reply LS is received.
* It is recommended companies provide details on the following aspects as well:
  + How to use the availability information, if defined, e.g. for differentiating requirements depending on the availability or for defining requirement applicability rule
  + Whether the above is only for measurement or both measurement and mobility
  + Whether the above is only for RRC Connected mode or irrespective of RRC state

Conclusion (from RAN4#101-b)

* The following can be discussed based on contributions in RAN4 #102 e-meeitng.
  + Whether specify UE behavior whether the UE stops RRM measurements and reporting once the validity timer is expired (i.e., new or additional ephemeris information is not available within the associated validity duration).

**Proposals for RAN4#102**

* Proposal 1: Qualcomm
  + Depending on whether and what neighbor cell and target cell information is made available to UE, UE requirements are defined as below:
    - For mobility requirements, an additional latency for necessary information reading, e.g. NTN specific system information from a target cell, is explicitly added if part of necessary information is either not available or invalid during cell (re)selection and (conditional) handover.
    - For measurement requirements, at least when configured multiple SMTCs on the same frequency are not mutually exclusive in the time domain, the requirements are applicable only when UE is provided with information of the target measurement cells that have the colliding SMTCs.
* Proposal 2: CATT
  + The discussion for valid neighbour/target cell’s timing information should be postponed until RAN2 have decision.
* Proposal 3: Ericsson
  + RAN4 shall evaluate the extra measurement time in case of no valid necessary information from the serving cell, If the time is long enough to impact mobility, the extra measurement time shall be specified.
  + SMTCs or MGs shall be limited when no valid necessary information from the serving cell. e.g. duration of SMTC and MGL shall be set longer than a threshold [3], [4]ms.
* Proposal 4: Huawei
  + Define “availability of valid target satellite information as side condition”.
    - The side condition applies to both measurement and mobility
    - This side condition applies to all RRC states
  + Measurement or mobility requirements do not apply if valid target satellite information is not made available to the UE.
* Proposal 5: LGE
  + UE stops RRM measurement and reporting before acquiring the updated ephemeris information after validity timer is expired.
* Proposal 6: Apple
  + RAN4 to assume that the information needed for measurement and handover would be provided to the UE by the network, otherwise no requirement would be applied.

**Moderator’s suggestion**

* **Discuss what exact information should be included in the side condition:**
  + Define “availability of valid target satellite information as side condition”
    - The side condition should be separately defined for mobility and measurement
    - The side condition should be separately defined for RRM Idle/Inactive and Connected
    - The above doesn’t necessarily mean the conditions shall be different
* **Share your views on the following options in detail:**
  + If the side condition is not met,
    - Option 1: Requirements are not applied, i.e. extra delay won’t be explicitly defined
    - Option 2: Requirements are applied with an explicit extra delay
      * Option 2a: Different requirements are applied.
    - Note: The extra delay can be the amount of time “for UE to acquire the required information” or “for blind/exhaustive search, measurement, etc”

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| **Company** | **Comments** |
| Xiaomi | We think the side condition should be considered for all the RRM requirements which require the valid target satellite information. And if the side condition is not met, the requirement are not applied, follow the similar way in NR. |
| Ericsson | We support Option 2 and Option2a.  Even extra delay won’t be explicitly defined or will be defined, Option 2a still is considerable from measurement configuration perspective. UE needs long SMTC window, e.g. duration of SMTC and MGL shall be set longer than a threshold [3], [4]ms, to against unknown timing of neighbor cell if serving cell doesn’t offer information of neighbor cells. |
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### Issue 1-7: RRM Spec Documentation

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| R4-2204520 | LG Electronics UK | **Proposal 3*.*** The suffix ‘C’ could be used for NTN RRM specification since suffix ‘A’ and ‘B’ are used other sub-clauses. |
| R4-2204722 | Ericsson | ***Proposal 4: Specify the applicability section like***   * ***New sections defined in Rel-17 NTN WI are applicable for UE capable of satellite access node (i.e., GEO/LEO, we can use the capability if RAN2 introduced)*** * ***Existing sections defined are applicable for UE capable of HAPS gNB (not sure there is a capability for UE for HAPS).*** |
| R4-2205374 | Huawei, HiSilicon | **Proposal 7: For those requirements applicable to but not affected by NTN, copy and paste them in separate sections for NTN.** |

**Issue 1-7-1: A spec structure of NTN UE RRM requirements**

Agreements (from RAN4#101-b)

* Section numbers for NTN always end with B, i.e. x.y.zB

Agreements (from RAN4#101-b)

* For those requirements applicable to but not affected by NTN, the following options will be further discussed:
  + Option 1) RAN4 will copy and paste them in separate sections for NTN
  + Option 2) RAN4 will introduce the applicability of the existing requirements in respective requirements
  + Depending on the conclusion of ‘Issue 1-7-1: A spec structure of NTN UE RRM requirements’, the owner of big-draft CR will implement all individual draft CRs in one big CR accordingly.

**Moderator’s WF**

* Requirements for NTN are defined in separate sections from legacy ones and use suffix ‘C’
* FFS on whether and how to differentiate HAPS requirements from GSO/NGSO requirements, if HAPS is explicitly supported and can be explicitly differentiated from other cases.

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| **Company** | **Comments** |
| Xiaomi | Fine with moderator’s WF, regarding the requirements for HAPS, we think it can be defined in NGSO requirements. |
| Ericsson | Support WF. |
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### Issue 1-8: Signalling characteristics

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| R4-2203853 | Qualcomm Incorporated | **Issue 1-8-1: Requirements related to Signalling Characteristics**  **Proposal 2**: For any enhancements on RLM and Link Recovery requirements, RAN4 to strive to complete essential core requirements based on legacy ones unless a critical issue is identified.  **Proposal 3**: RAN4 do not consider the following cases for NTN requirements unless it is confirmed that FR2 NTN requirements are defined in Rel-17 timeframe:   * NR FR2 – NR FR1 HO * NR FR1 – NR FR2 HO * NR FR2 – NR FR2 HO * Uplink spatial relation switch delay |
| R4-2203928 | CATT | **Issue 1-8-1:** Requirements related to Signalling Characteristics  **Proposal 3: Reuse TN RLM and BFD requirements for NTN before having sufficient link level simulation for above modification.**  **Proposal 4: More link simulation study is needed for NTN RLM and BFD.** |
| R4-2204185 | MediaTek inc. | ***Proposal 1:*** *Clarify the applicability of the clause of “NR FR1 - NR FR1 Handover” NTN requirement is for NR NTN FR1 - NR NTN FR1.*  ***Proposal 2:*** *The following NTN HO requirements are not applicable in Rel-17:*   * *NR FR2 – NR FR1 HO* * *NR FR1 – NR FR2 HO* * *NR FR2 – NR FR2 HO* |
| R4-2204722 | Ericsson | **Issue 1-8-1: Requirements related to Signalling Characteristics**  ***Proposal 5: No need to change or add BLER.***  ***Proposal 6: Add scaling factor K on TEvaluate\_out\_SSB and TEvaluate\_in\_SSB.***  *Table 8.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1*   |  |  |  | | --- | --- | --- | | *Configuration* | *TEvaluate\_out\_SSB (ms)* | *TEvaluate\_in\_SSB (ms)* | | ***no DRX*** | ***Max(200, Ceil(10 × P) × K× TSSB)*** | ***Max(100, Ceil(5 × P) × K × TSSB)*** | | ***DRX cycle≤320ms*** | ***Max(200, Ceil(15 × P) × K ×Max(TDRX,TSSB))*** | ***Max(100, Ceil(7.5 × P) × K × Max(TDRX,TSSB))*** | | ***DRX cycle>320ms*** | ***Ceil(10 × P) × K × TDRX*** | ***Ceil(5 × P) × K × TDRX*** | | ***NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length.*** | | |   ***Where, K= [2] for GEO an LEO Earth-fixed satellite; K= [1] for LEO Earth-moving satellite.*** |
| R4-2205374 | Huawei, HiSilicon | **Proposal 8: Define requirements for**   * **NR FR2 – NR FR1 HO, where NTN cell is the target cell** * **NR FR1 – NR FR2 HO, where NTN cell is the source cell**   **Proposal 9: Re-use exiting hypothetical PDCCH parameters and BLER pairs from TN as baseline for NTN. Modifications can be considered if there is clear justification.**  **Proposal 10: Consider the impact of neighbour cell measurement in RLM/BFR evaluation period.** |

**Issue 1-8-1-A: Requirements related to Signalling Characteristics (HO between FR1 and FR2)**

Agreements (from RAN4#101-b)

* Applicability of the following requirements are as below:
  + NR FR2 – NR FR1 HO
    - FFS
  + NR FR1 – NR FR2 HO
    - FFS
  + NR FR2 – NR FR2 HO
    - FFS

**Proposals for RAN4#102**

* NR FR2 – NR FR1 HO
  + Option 1-A: Qualcomm, MediaTek
    - No support
  + Option 1-B: Huawei
    - Support when NTN cell is a target cell
* NR FR1 – NR FR2 HO
  + Option 1-A: Qualcomm, MediaTek
    - No support
  + Option 1-B: Huawei
    - Support when NTN cell is a source cell
* NR FR2 – NR FR2 HO
  + Option 1-A: Qualcomm, MediaTek
    - No support

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | We support to define the mobility requirement for TN-NTN case. According to RAN2 agreements, the same CHO trigger conditions and RRM events can be used within NTN and NTN-TN mobility, and the specific further enhancement for TN-NTN mobility in RRC\_Connected mode is deprioritized. It means that the NTN mobility requirement for NTN-NTN case can be applied to TN-NTN case. RAN4 does not need extra effort to introduce the mobility requirements for TN-NTN case. |
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| Ericsson | No support on HO with FR2 in Rel17. |
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**Issue 1-8-1-B: Requirements related to Signalling Characteristics (RLM and BFR)**

Agreements (from RAN4#101-b)

* The following requirements in Signalling Characteristics are not relevant to NTN.
  + Interruption: no other active cells that can be interrupted by the other cell in NTN
  + SCell activation
  + UL carrier re-configuration
  + NE-DC/NR-DC PSCell addition
  + PSCell change
  + UL spatial relation switch
* For the following requirements, the legacy requirements are reused in NTN.
  + Active BWP switch
  + UE-specific CBW change
  + (Note) Detailed text can be modified to reflect NTN specific updates made by RAN1/2.
* FFS on the following candidates to enhance RLM and Link Recovery requirements.
  + Modification of hypothetical PDCCH formats for SSB and/or CSI-RS based RLM and BFD
  + Modification of BLER\_out/in
  + Introducing an intermediate BLER between BLER\_out and BLER\_in
  + Modification of Evaluation period
* (Note) FR2 RRM requirements are not yet considered.

**Proposals for RAN4#102**

* Proposal 1: For RLM and BFR requirements,
  + Option 1-A: Qualcomm, CATT, Huawei
    - For any enhancements on RLM and Link Recovery requirements, RAN4 to strive to complete essential core requirements based on legacy ones unless a critical issue is identified.
  + Option 1-B: Ericsson
    - Add scaling factor K on TEvaluate\_out\_SSB and TEvaluate\_in\_SSB.

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| Table 8.1.2.2-1: Evaluation period TEvaluate\_out\_SSB and TEvaluate\_in\_SSB for FR1   |  |  |  | | --- | --- | --- | | Configuration | TEvaluate\_out\_SSB (ms) | TEvaluate\_in\_SSB (ms) | | no DRX | Max(200, Ceil(10 × P) × K× TSSB) | Max(100, Ceil(5 × P) × K × TSSB) | | DRX cycle≤320ms | Max(200, Ceil(15 × P) × K ×Max(TDRX,TSSB)) | Max(100, Ceil(7.5 × P) × K × Max(TDRX,TSSB)) | | DRX cycle>320ms | Ceil(10 × P) × K × TDRX | Ceil(5 × P) × K × TDRX | | NOTE: TSSB is the periodicity of the SSB configured for RLM. TDRX is the DRX cycle length. | | |   Where, K= [2] for GEO an LEO Earth-fixed satellite; K= [1] for LEO Earth-moving satellite. |

* Proposal 2: Huawei
  + Consider the impact of neighbour cell measurement in RLM/BFR evaluation period.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Fine with option 1-A |
| Ericsson | Regarding Proposal 1, support Option 1B. Because the beam quality for GEO and LEO Earth-fixed will remain steady even before HO, the evaluation period can be scaled without affecting the results.  Proposal 2 is ok from high level perspective and the detailed requirements depend on SMTC and MG agreements. |
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# Topic #2: Mobility requirements

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

## Open issues summary and Companies views’ collection for 1st round

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

### Issue 2-1: Cell selection and reselection

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| R4-2203793 | Apple | ***Proposal 1: UE initiates the measurement for cell-reselection in IDLE/Inactive mode if the distance between UE and serving cell reference location is longer than a ‘nework-configured threshold + GNSS measurement margin’.***   * ***GNSS measurement margin is 50 meters.***   ***Proposal 2:*** ***current higher priority search delay requirements will apply for UE Idle/Inactive mode for both LEO and GEO scenarios, i.e., K=60 and M\_layers = N\_layers.*** |
| R4-2203855 | Qualcomm Incorporated | **Issue 2-1-4: Higher priority search**  **Proposal 1**: For a higher priority search requirement in NTN, RAN4 does not change K and M\_layers from the legacy higher priority search requirement.  **Issue 2-1-5: Maximum interruption in paging reception**  **Proposal 2**: An additional SSB sample from a target cell that UE is reselecting is added to the maximum interruption period in paging reception if the target cell belongs to a different satellite than the current one. |
| R4-2203930 | CATT | **Issue 2-1-4:** Higher priority search  **Proposal 1: For GEO, the same K=60 can be used. For LEO, we propose to decrease K, such as [5]s.**  **Issue 2-1-5:** Maximum interruption in paging reception  **Proposal 2: We prefer option 1 and propose X = 0, i.e. the interruption time shall not exceed TSI-NR + 2\* Ttarget\_cell\_SMTC\_period ms.** |
| R4-2204236 | Xiaomi | **Issue 2-1-3: Cell Selection/Reselection delay requirements**  Table 4.2.2.3-2: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra for UE configured with *highSpeedMeasFlag-r16* (Frequency range FR1)   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) | | | 0.32 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M4 (3 x M4) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) | | 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) | | Note 1: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16].* | | | |   **Proposal 1: The enhanced cell reselection delay requirements defined for FR1 HST can be applied to NTN scenario.**  **Issue 2-1-4: Higher priority search**  **Proposal 2: RAN4 define the unified requirements of higher priority carrier search for both GEO and LEO, and UE shall search every layer of higher priority at least every Thigher\_priority\_search = (30 \* M\_layers) seconds, where M\_layers is the number of higher priority NR carrier frequencies broadcasted in system information.**  **Issue 2-1-5: Maximum interruption in paging reception**  **Proposal 3: The maximum interruption in paging reception for NTN cell reselection shall not exceed TSI-NR + 2\*Ttarget\_cell\_SMTC\_period + Tsearch ms, where,**   * + **TSI-NR is the time required for receiving all the relevant system information data;**   + **Ttarget\_cell\_SMTC\_period is the periodicity of the SMTC occasions configured for the target NR cell;**   + **Tsearch is the time required to search the target intra/inter-frequency cell.** |
| R4-2204296 | OPPO | **Proposal 1: The current measurement period for higher priority cell search could be reused for NTN.** |
| R4-2204522 | LG Electronics UK | **Higher priority search**  ***Proposal 1.*** If the reference location is broadcasted, UE chooses the value of K with considering the distance between reference location and UE location where set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}].  ***Proposal 2.*** If the remaining service time is broadcasted, UE chooses the value of K with considering the remaining cell service time information where the set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}].  **Measurement in Idle/inactive mode**  ***Proposal 4***: Following condition for intra-frequency measurement should be captured in RRM specification.  - Measurement of intra-frequency NTN cell   * + - When cell stop time is only broadcasted       * UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if Srxlev and Squal condition are met.     - When serving cell reference location is only broadcasted       * UE shall start intra-frequency measurement if the distance between UE and serving cell reference location is longer than a threshold. (The threshold is one of the location-related parameters broadcasted by network)       * UE may choose not to perform intra-frequency measurement if the distance between UE and serving cell reference location is shorter than a threshold and Srxlev/Squal condition is met.     - When both cell stop time and serving cell reference location are broadcasted       * UE shall be able to detect, measure, and evaluate intra-frequency measurement before the serving cell stops covering the current area, regardless of if the distance between UE and serving cell reference location or Srxlev and Squal condition are met.   ***Proposal 5***: Following condition for inter-frequency / inter-RAT frequency measurement should be captured in RRM specification.  - Measurement of inter-frequency / inter-RAT frequency NTN cell   * + - When cell stop time is only broadcasted       * If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority and UE shall be able to detect, measure, and evaluate equal or lower priority inter-frequency / inter-RAT frequency layer before the serving cell stops covering the current area.       * If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.     - When serving cell reference location is only broadcasted       * If Srxlev > SnonOntraSearchP and Squal > SnonIntraSearchQ and the distance between UE and serving cell reference location is shorter than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher priority.       * If Srxlev ≤ SnonOntraSearchP and Squal ≤ SnonIntraSearchQ or the distance between UE and serving cell reference location is longer than a threshold, then UE shall search for and measure inter-frequency / inter-RAT frequency layer of higher, equal, or lower priority in preparation for possible reselection.     - When both cell stop time and serving cell reference location are broadcasted       * FFS (need to wait RAN2 conclusion) |
| R4-2204724 | Ericsson | **Issue 2-1-3: Cell Selection/Reselection delay requirements**  ***Proposal 1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra can use enhancement for HST as start point as base line for LEO and GEO scenarios.***  Table 4.2.2.3-2: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra for UE configured with *highSpeedMeasFlag-r16* (Frequency range FR1)   |  |  |  |  | | --- | --- | --- | --- | | DRX cycle length [s] | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) | | | 0.32 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M4 (3 x M4) | | 0.64 | 5.12 (8) | 0.64 (1) | 1.92 (3) | | 1.28 | 8.96 (7) | 1.28 (1) | 3.84 (3) | | 2.56 | 58.88 (23) | 2.56 (1) | 7.68 (3) | | Note 1: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *[intraRAT-MeasurementEnhancement-r16].* | | | |   ***Proposal 2:******Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra can use relaxation for UE fulfilling low mobility criterion for GEO and LEO Earth-fixed scenarios. Similar signalling can be defined.***  Table 4.2.2.9.3-1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | DRX cycle length [s] | Scaling Factor (N1) | | Tdetect,NR\_Intra [s] (number of DRX cycles) | Tmeasure,NR\_Intra [s] (number of DRX cycles) | Tevaluate,NR\_Intra  [s] (number of DRX cycles) | |  | FR1 | FR2Note1 | | 0.32 | 1 | 8 | 11.52 x N1 x M2 x K1 (36 x N1 x M2 x K1) | 1.28 x N1 x M2 x K1 (4 x N1 x M2 x K1) | 5.12 x N1 x M2 x K1 (16 x N1 x M2 x K1) | | 0.64 |  | 5 | 17.92 x N1 x K1 (28 x N1 x K1) | 1.28 x N1 x K1 (2 x N1 x K1) | 5.12 x N1 x K1 (8 x N1 x K1) | | 1.28 |  | 4 | 32 x N1 x K1 (25 x N1 x K1) | 1.28 x N1 x K1 (1 x N1 x K1) | 6.4 x N1 x K1 (5 x N1 x K1) | | 2.56 |  | 3 | 58.88 x N1 x K1 (23 x N1 x K1) | 2.56 x N1 x K1 (1 x N1 x K1) | 7.68 x N1 x K1 (3 x N1 x K1) | | Note 1: Applies for UE supporting power class 2&3&4. For UE supporting power class 1 or 5, N1 = 8 for all DRX cycle length.  Note 2: M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1. If high layer signalling *smtc2-LP-r16* is configured, for cells indicated in the *pci-List* parameter in *smtc2-LP-r16*, the SMTC periodicity corresponds to the value of higher layer parameter *smtc2-LP-r16*; for the other cells, the SMTC periodicity corresponds to the value of higher layer parameter *smtc*.  Note 3: K1 = 3 is the measurement relaxation factor applicable for UE fulfilling the *cellEdgeEvaluation* [2] criterion. | | | | | |   **Issue 2-1-4: Higher priority search**  ***Proposal 3: For GEO, support Option 1: K 60 and M\_layers = N\_layers (same as the current requirement); for LEO, the cell residence duration for a UE should differ between Earthing-moving and Earthing-fixed, but we're fine with Option 2a to keep the number uniform.***  **Issue 2-1-5: Maximum interruption in paging reception**  ***Proposal 4: The maximum interruption in paging reception for NTN cell reselection shall not exceed***   * ***TSI-NR + 2\*Ttarget\_cell\_SMTC\_period, when the target cell is already known.*** * ***TSI-NR + Tsearch, when the target cell is not already known. Where, Tsearch = [5]Trs.***   2.1.5 Measurement relaxation with paging  ***Proposal 5: Scaling factor M1 and M2 on measurement relaxation with paging shall be updated in NTN.***   * ***M1=[2] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second, for serving cell measurement, upon more than one SMTC.*** * ***M2= [2] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second, for intra-frequency and inter-frequency cell measurement, upon more than one SMTC.*** |
| R4-2205375 | Huawei, HiSilicon | **Issue 2-1-3: Cell Selection/Reselection delay requirements**  **Proposal 1: Re-use the number of samples from TN baseline requirements.**  **Proposal 2: RAN4 to consider define additional requirements based on sample numbers from TN HST requirements, subject to NW indication and UE capability.** Scaling due to multiple SMTC and multiple Doppler **Proposal 3: Possible scaling due to e.g. multiple SMTC, different Doppler shift should be considered similar in CONNECTED state.**  **Issue 2-1-4: Higher priority search**  **Proposal 4: RRM requirements are defined based on single NTN deployment scenario, i.e. serving and neighbour satellites are of same type (GEO or LEO).**  **Proposal 5: M\_layers = N\_layers, which is the configured high priority carriers for measurement. K is based on system information and details FFS.**  **Issue 2-1-5: Maximum interruption in paging reception**  **Proposal 6: The maximum interruption in paging reception for NTN cell reselection shall not exceed TSI-NR + 2\*Ttarget\_cell\_SMTC\_period + X\*Tsearch [ms]. X=1 when following conditions are met, X=0 otherwise.**   * **time span between SIB broadcasting cell stop time and the cell stop time is less than Ttrigger, and** * **time span between the time when serving cell is below search threshold and the cell stop time is less than Ttrigger** |

**Issue 2-1-3: Cell Selection/Reselection delay requirements**

Agreements (from RAN4#101-b)

* Same cell Selection/Reselection delay requirements will apply for UE Idle/Inactive mode for LEO and GEO scenarios
  + The requirements shall be based on LEO scenario assumptions

Agreements (from RAN4#101-b)

* The above agreement also applies to TN cells when UE is in NTN NR Idle/Inactive mode, i.e. when UE is monitoring paging channel from NTN cell.
* (note) The above doesn’t stop further enhancement/relaxation due to certain reasons, e.g. similar manner in present specification: reselection with relaxed measurement criterion besides of normal reselection requirement.

**Proposals for RAN4#102**

* Proposal 1: Xiaomi, Ericsson, Huawei
  + The enhanced cell reselection delay requirements (Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra) defined for FR1 HST can be applied to NTN scenario.
  + The above is subject to NW indication and UE capability.
* Proposal 2: Ericsson
  + Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra can use relaxation for GEO and LEO Earth-fixed scenarios, same as low mobility criterion in TN system. Similar signalling can be defined.
* Proposal 3: Huawei
  + Possible scaling due to e.g. multiple SMTC, different Doppler shift should be considered similar in CONNECTED state

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Option 1, for earth-moving LEO scenario, the UE camp in the serving cell from 6s to 138s according to different cell size, which is similar to FR1 HST scenario. |
| Ericsson | We support Proposal 1. It shall be the baseline with respect to agreements in last meeting, no signaling and capability are needed.  Support Proposal 2, it is aligned with Issue 3-3-1. First and foremost, we can agree on GEO.  Hundreds of seconds of duration time is expected for LEO Earth-fixed, we believe LEO Earth-fixed can be relaxed as well, but it can be FFS with more studies on how long duration time can apply relaxation.  Generally, support Proposal 3, we will continue studies on it. |
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**Issue 2-1-4: Higher priority search**

Agreements (from RAN4#101-b)

* The current T\_higher\_priority\_search can be modified as (K \* M\_layers) seconds for NTN UE requirement. And E-UTRAN carrier won’t be included in the definition of M\_layers.
* For GEO,
  + Option 1: K 60 and M\_layers = N\_layers (same as the current requirement)
  + Option 2: Modify K and/or M\_layers (< N\_layers)
    - Option 2a: Fixed value
    - Option 2b: Based on system information (e.g. reference location, remain service time) and UE assist information (e.g. UE location), K and M\_layers can be differently determined.
* For LEO,
  + Option 1: K 60 and M\_layers = N\_layers (same as the current requirement)
  + Option 2: Modify K and/or M\_layers (< N\_layers)
    - Option 2a: Fixed value
    - Option 2b: Based on system information (e.g. reference location, remain service time) and UE assist information (e.g. UE location), K and M\_layers can be differently determined.
* (Note) It should be also addressed how the requirement applies if UE can’t know whether target measurement cells are TN, GEO, LEO earth moving, or LEO earth fixed.

**Proposals for RAN4#102**

* Proposal 1: Higher priority search delay requirements for GEO
  + Option 1-A: Apple, Qualcomm, CATT, Ericsson, OPPO
    - The current higher priority search delay requirements will apply for UE Idle/Inactive mode for GEO scenarios, i.e., K=60 and M\_layers = N\_layers
  + Option 1-B: Xiaomi
    - K=30
  + Option 1-C: LGE
    - If the reference location is broadcasted, UE chooses the value of K with considering the distance between reference location and UE location where set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}].
    - If the remaining service time is broadcasted, UE chooses the value of K with considering the remaining cell service time information where the set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}]
  + Option 1-D: Huawei
    - M\_layers = N\_layers
    - K is based on system information
* Proposal 2: Higher priority search delay requirements for LEO
  + Option 2-A: Apple, Qualcomm, OPPO
    - The current higher priority search delay requirements will apply for UE Idle/Inactive mode for LEO scenarios, i.e., K=60 and M\_layers = N\_layers
  + Option 2-B1: CATT
    - K=[5]
  + Option 2-B2: Xiaomi
    - K=30
  + Option 2-C: LGE
    - If the reference location is broadcasted, UE chooses the value of K with considering the distance between reference location and UE location where set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}].
    - If the remaining service time is broadcasted, UE chooses the value of K with considering the remaining cell service time information where the set of K value can be defined as, [{10, 20, 30, 40, 50, 60, 120, 240 360}]
  + Option 2-D: Ericsson, Huawei
    - M\_layers = N\_layers
    - K is based on system information
* Proposal 3: requirement applicability
  + Option 3-A: Huawei
    - RRM requirements are defined based on single NTN deployment scenario, i.e. serving and neighbour satellites are of same type (GEO or LEO).

**Moderator’s suggestion**

* Share your views on each proposal.

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| **Company** | **Comments** |
| Xiaomi | In last meeting, it was agreed the same cell reselection requirements will be specified for LEO and GEO cases. And we think this agreement applied to higher priority carriers. In addition, UE does not know whether target measurement cells are TN, GEO, LEO earth moving, or LEO earth fixed. So, we propose to define the same search requirements for higher priority carrier for GEO and LEO case.  Agreements (from RAN4#101-b)   * Same cell Selection/Reselection delay requirements will apply for UE Idle/Inactive mode for LEO and GEO scenarios   + The requirements shall be based on LEO scenario assumptions |
| Ericsson | Proposal 1:  Option 1-A  Proposal 2:  We can support K< 60, however, the actual number should be as straightforward as feasible; we see no meaningful need to have a lot of flexibility. We suggest keep FFS.  Proposal 3:  Support Option 3-A in current WI. |
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**Issue 2-1-5-A: Maximum interruption in paging reception**

Agreements (from RAN4#101-b)

* Option 1: The maximum interruption in paging reception for NTN cell reselection shall not exceed TSI-NR + 2\*Ttarget\_cell\_SMTC\_period + X\*Tsearch [ms], where,
  + T\_SI-NR is the time required for receiving all the relevant system information data;
  + Ttarget\_cell\_SMTC\_period is the periodicity of the SMTC occasions configured for the target NR cell;
  + Tsearch is the time required to search the target intra/inter-frequency cell.
  + X = 0 or 1. How to determine the value is FFS.
* Option 2: TSI-NR + Y\*Ttarget\_cell\_SMTC\_period + X\*Tsearch [ms]
  + When X≠0，Y=0 or 1

**Proposals for RAN4#102**

* The maximum interruption in paging reception for NTN cell reselection shall not exceed
  + Proposal 1: TSI-NR + 2\*Ttarget\_cell\_SMTC\_period
    - Option 1-A: CATT
      * Always
    - Option 1-B: Qualcomm
      * if the target cell belongs to the same satellite as the current one
    - Option 1-C: Huawei
      * when the following conditions are not met
        + time span between SIB broadcasting cell stop time and the cell stop time is less than Ttrigger, and
        + time span between the time when serving cell is below search threshold and the cell stop time is less than Ttrigger
    - Option 1-D: Ericsson
      * when the target cell is already known
  + Proposal 2: TSI-NR + 2\*Ttarget\_cell\_SMTC\_period + Tsearch
    - Option 2-A: Xiaomi
      * Always
    - Option 2-B: Qualcomm
      * if the target cell belongs to a different satellite than the current one
    - Option 2-C: Huawei
      * when the following conditions are met
        + time span between SIB broadcasting cell stop time and the cell stop time is less than Ttrigger, and
        + time span between the time when serving cell is below search threshold and the cell stop time is less than Ttrigger
  + Proposal 3: Ericsson
    - TSI-NR + Tsearch when the target cell is not already known. Where, Tsearch = [5]Trs

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | The requirement is about the **maximum interruption** in paging receptioin, thus, the worst case should be considered, e.g. the UE starts the measurements on neighbour cells at the time when serving cell stops covering the current area. In this worst case, the additional interruption time due to cell search on target cell should be considered, and if the target cell is known, Tsearch is 0, otherwise, Tsearch = [1]Trs or [3]Trs for intra-frequency cell or inter-frequency cell, respectively. |
| Ericsson | We support Option 1-D in Proposal 1 and Proposal 3   * Proposal 1 Option 1-D: TSI-NR + 2\*Ttarget\_cell\_SMTC\_period, when the target cell is already known * Proposal 3: TSI-NR + Tsearch when the target cell is not already known. Where, Tsearch = [5]Trs   We’d like to keep requirements in Proposal 1 under the assumption of known target cell.  Meanwhile, we suggest to keep simplicity of definition and in line with the definition of Tsearch in HO which contains AGC settling and PSS/SSS detection. The time length can be longer than Tsearch in HO and the effect is same to ‘TSI-NR + 2\*Ttarget\_cell\_SMTC\_period + Tsearch’ but with more clarity. |
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**Issue 2-1-5-B: Measurement with paging reception**

**Proposals for RAN4#102**

* Proposal 1: Ericsson
  + Scaling factor M1 and M2 on measurement relaxation with paging shall be updated in NTN.
    - M1=[2] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second, for serving cell measurement, upon more than one SMTC.
    - M2= [2] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second, for intra-frequency and inter-frequency cell measurement, upon more than one SMTC.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Prefer not to consider measurement relaxation in Rel-17 NTN. |
| Ericsson | Support Proposal 1.  In current requirements, one SMTC is assumed to be between two consecutive POs. There are two issues invalidate the scaling factors M1 and M2 and corresponding DRXs: SMTC is increased to 2 and optional 4; UE-based solution or UE-assistance solution in idle mode is inevitable in RAN2.  The density of SMTCs and distance between SMTCs and POs are more complicated accordingly. With same rule, the Scaling factor M1 and M2 and corresponding DRXs shall be scaled also. |
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**Issue 2-1-6: UE initiated measurement for cell (re)selection**

**Proposals for RAN4#102**

* Proposal 1: Apple
  + UE initiates the measurement for cell-reselection in IDLE/Inactive mode if the distance between UE and serving cell reference location is longer than a ‘nework-configured threshold + GNSS measurement margin’.
    - GNSS measurement margin is 50 meters.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | In my understanding, the only location based cell reselection is not supported in RAN2. The measurement for cell reselection should consider the combination of the condition of location and RSRP. |
| Ericsson | Hysteresis of location in RRC is configurable. What effect does an exact GNSS margin have on RRM? |
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### Issue 2-2 HO and CHO

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| R4-2203793 | Apple | **Issue 2-2-1: Timeline for NTN CHO**  ***Proposal 3: for time+RRM based NTN CHO, the CHO delay shall be defined as:***   * ***DCHO\_NTN = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution, where***   + ***TRRC is the RRC procedure delay.***   + ***TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover. (same as legacy TN TEvent\_DU)***   + ***Tmeasure:***     - ***If T1 is earlier than the timing when UE identified target cell met RRM condition, Tmeasure is time from the end of TEvent\_DU until the timing when UE identified target cell met RRM condition.***     - ***Otherwise, Tmeasure is time from the end of TEvent\_DU until T1.***   + ***TCHO\_execution is the UE execution preparation time for conditional handover. (same as legacy TN TCHO\_execution)***   + ***Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.*** * ***If T2 is earlier than the end the Tmeasure, no CHO requirement should be applied.***   ***Proposal 4: for location+RRM based NTN CHO, the CHO delay shall be defined as:***   * ***DCHO\_NTN = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution, where***   + ***TRRC is the RRC procedure delay.***   + ***TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover. (same as legacy TN TEvent\_DU)***   + ***Tmeasure:***     - ***If distance condition is met earlier than the timing when UE identified target cell met RRM condition, Tmeasure is time from the end of TEvent\_DU until the timing when UE identified target cell met RRM condition.***     - ***Otherwise, Tmeasure is time from the end of TEvent\_DU until distance condition is met.***   + ***TCHO\_execution is the UE execution preparation time for conditional handover. (same as legacy TN TCHO\_execution)***   + ***Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.*** |
| R4-2203855 | Qualcomm Incorporated | **Issue 2-2-1: Timeline for NTN CHO**  **Proposal 3**: A side condition of ’3200Tc’ in measurement time of conditional handover requirement shall be modified. FFS on the exact value and whether any other side condition is necessary. |
| R4-2203930 | CATT | **Issue 2-2-1:** Timeline for NTN CHO  **Proposal 3: The requirements of NTN CHO are defined as: DCHO = TRRC + TEvent\_DU + Tmeasure + TCHO\_execution + Tinterrupt. Where:**   * TRRC is the RRC procedure delay. * TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover and time (or location) condition have met (i.e. at T1 or after T1 for time based on CHO). * Tmeasure is the measurements time. * TCHO\_execution is the UE execution preparation time for conditional handover. * Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.   **Issue 2-2-3:** Measurement Prioritization during CHO  **Proposal 4: Measurement prioritization during CHO depends on NW implementation, i.e. no enhancement.** |
| R4-2204236 | Xiaomi | **Issue 2-2-1: Timeline for NTN CHO**  **Proposal 4：The timeline for NTN CHO is defined as the time between the end of the last TTI containing the RRC command and the start the transmission of the new uplink PRACH, which can be expressed as follows:**  **DCHO = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution**  **Where:**   * + **TRRC is the RRC procedure delay.**   + **TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until the later of the time when a measurement condition exists at the measurement reference point and the time when a timer/time or location condition (if configured) exists.**   + **Tmeasure is the measurements time delay which is the time from the end of TEvent\_DU until UE executes a handover to a target cell and interruption starts. For timer/time based CHO, Tmeasure is within the time duration of [T1, T2]. For location based CHO, the starting point of Tmeasure is after the Tlocation.**   + **TCHO\_execution is the UE execution preparation time for conditional handover. For timer/time based CHO, Tmeasure is within the time duration of [T1, T2].**   + **Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.**   + **For timer/time based CHO, T1 is the earliest point in time when the UE can perform CHO to the candidate target cell, and T2 is the end point of the time window.**   + **For location based CHO, Tlocation is the time when location event trigger.** |
| R4-2204296 | OPPO | **Issue 2-2-1: Timeline for NTN CHO**  **Proposal 2: Support option 1, Tmeasure is the time from the end of TEvent\_DU until UE executes a handover to a target cell and interruption starts.**  **Proposal 3: From RAN4 perspective, the timer-based CHO delay requirements are only applicable when Tmeasure + Tinterrupt + TCHO\_execution > [T2-T1].**  **Proposal 4: For location-based CHO, CHO shall only be carried out when “*condEvent L4*” is met and requirements can be reused by replacing legacy condition with “*condEvent L4*”.**  **Issue 2-2-3: Measurement Prioritization during CHO**  **Proposal 5: Measurement prioritization during CHO is not considered and UE can only measure target cells when the condition is met.** |
| R4-2204418 | Intel Corporation | ***Time based conditional handover***  **Proposal 1: For time-based CHO, the delay includes the timer value and the time difference between serving and neighbour cell SSBs.**  ***Location based conditional handover***  **Proposal 2: Do not define test cases for location-based CHO delay requiremetns.** |
| R4-2204724 | Ericsson | **Issue 2-2-1: Timeline for NTN CHO**  ***Proposal 6: In Option 1, We suppose several points:***   * ***Tinterrupt + TCHO\_execution can be later than T2 which are not impacted by expiry of serving cell.*** * ***With respect to the agreement: CHO shall not be carried out before T1, TRRC can be earlier than T1 because not RRC signaling will be received after T1.*** * ***TEvent\_DU + Tmeasure shall be in [T1, T2].***   **Issue 2-2-3: Measurement Prioritization during CHO**  ***Proposal 7: We support Option2, when UE is configured with C (location and RRM) or D (time and RRM) for CHO, UE only: measures the SMTC window which the target cell belongs to.*** |
| R4-2205228 | Nokia, Nokia Shanghai Bell | **Proposal 1: TEvent\_DU is the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until the later of the time when a measurement condition exists at the measurement reference point and the time when a time or location condition (if configured) exists.**  **Proposal 2: Adopt the NTN CHO timeline depicted in Figure below.**  **Proposal 3: The time difference between the source and target cell should be included in Tmeasure.**  **Proposal 4: Wait for RAN2 decision on how to handle CHO failures.** |
| R4-2205375 | Huawei, HiSilicon | **Issue 2-2-1: Timeline for NTN CHO**  **Proposal 7: Existing CHO delay requirements for TN can be re-used for NTN, except that the definition of TEvent\_DU should include the time when both measurement and time (or location) conditions are met.**  **Proposal 8: Remove the requirements for the case “undetectable cell becomes detectable again” for NTN CHO.**  **Issue 2-2-3: Measurement Prioritization during CHO**  **Proposal 9: When UE is configured with C (location and RRM) or D (time and RRM) for CHO, UE only measures the SMTC window and frequency layer which the target cell belongs to, if the condition for location or time is met.** |

**Issue 2-2-1: Timeline for NTN CHO**

Agreements (from RAN4#101-b)

* Option 1: The timeline for NTN CHO is defined as the time between the end of the last TTI containing the RRC command and the start the transmission of the new uplink PRACH, which can be expressed as follows:
  + DCHO = TRRC + TEvent\_DU + [Tmeasure] + Tinterrupt + TCHO\_execution, where
    - TRRC is the RRC procedure delay.
    - TEvent\_DU is the delay uncertainty which is
      * Option 1-1-1: the time from either when the UE successfully decodes a conditional handover command or T1, whichever comes second until a condition exists at the measurement reference point which will trigger the conditional handover.
      * Option 1-1-2: the time from when the UE successfully decodes a conditional handover command until the later of the time when a measurement condition exists at the measurement reference point and the time when a time or location condition (if configured) exists.
      * Other options are not precluded.
    - Tmeasure is the measurements time delay, and the exact definition is
      * Option 1-2-1: the time from the end of TEvent\_DU until UE executes a handover to a target cell and interruption starts.
      * Option 1-2-2: time uncertainty between RSRP trigger event and T1/T2 for time-based CHO or between RSRP trigger event and location event trigger for location-based CHO
      * Option 1-2-3: for time-based CHO, Ttime is added to DCHO: Ttime is the delay between UE successfully decodes the command until T1 which is configured by the network; only after T1 does the UE monitors the event triggering CHO. If T1 is before RRC decoding completion, Ttime = 0.
      * Other options are not precluded.
      * FFS whether the timing differences between serving and target cells are included in Tmeasure
    - TCHO\_execution is the UE execution preparation time for conditional handover.
    - Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH. FFS on whether to add an additional delay due to system information reading from a target cell when UE does not have a valid target’s cell information by the time when UE transmits PRACH toward the target cell, which will be determined when RAN2 response LS is received.
  + For time-based CHO (in combination with the existing R16 CHO measurement):
    - CHO shall not be carried out before T1. Here, T1 is defined by RAN2 and represents the earliest point in time when the UE can perform CHO to the candidate target cell.
    - CHO shall not be carried out after T2. Here, T2 is defined by RAN2 and represents the end of the time window.
    - Exact position of T1 in time is FFS
    - FFS on if ‘T2-T1’ is less than ‘Tmeasure + Tinterrupt + TCHO\_execution’, the requirement is not applied.
      * Needs RAN2 confirmation on whether UE should complete the CHO during [T1, T2].
  + For location-based CHO (in combination with the existing R16 CHO measurement):
    - FFS: CHO shall not be carried out when condEvent L4 is not met.
    - (Note) condEvent L4: Distance between UE and the PCell’s reference location becomes larger than absolute threshold1 AND the distance between UE and the Conditional reconfiguration candidate becomes shorter than absolute threshold2
* Option 2: DCHO = TRRC + Ttime + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution+ Tdiff, where
  + Ttime is the time duration from UE successfully decode the CO command to the time point configured by the network as the starting point of UE monitoring the triggering of CHO, which is T1.
  + Tdiff is the absolute timing difference in ms, between serving and target cells. FFS whether it can be included in Tmeasure.
  + TEvent\_DU is the delay uncertainty which is the time from T1, to the time instance where a condition exists at the measurement reference point which will trigger the conditional handover.
* Other detailed side conditions need to be further checked, e.g. ±[3200]Tc in 6.1.4.2.2 Measurement time.

**Proposals for RAN4#102**

* DCHO\_NTN = TRRC + TEvent\_DU + Tmeasure + Tinterrupt + TCHO\_execution, where
  + TRRC is the RRC procedure delay.
  + TEvent\_DU:
    - Option 1-A: Apple
      * the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover. (same as legacy TN TEvent\_DU)
    - Option 1-B: CATT
      * the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until a condition exists at the measurement reference point which will trigger the conditional handover and time (or location) condition have met (i.e. at T1 or after T1 for time based on CHO).
    - Option 1-C: Xiaomi, Nokia, Huawei
      * the delay uncertainty which is the time from when the UE successfully decodes a conditional handover command until the later of the time when a measurement condition exists at the measurement reference point and the time when a timer/time or location condition (if configured) exists.
  + Tmeasure:
    - Option 2-A: Apple
      * For Time-based CHO (in combination with the existing R16 CHO measurement)
        + If T1 is earlier than the timing when UE identified target cell met RRM condition, Tmeasure is time from the end of TEvent\_DU until the timing when UE identified target cell met RRM condition.
        + Otherwise, Tmeasure is time from the end of TEvent\_DU until T1.
      * For Location-based CHO (in combination with the existing R16 CHO measurement)
        + If distance condition is met earlier than the timing when UE identified target cell met RRM condition, Tmeasure is time from the end of TEvent\_DU until the timing when UE identified target cell met RRM condition.
        + Otherwise, Tmeasure is time from the end of TEvent\_DU until distance condition is met.
    - Option 2-B: CATT
      * the measurements time
    - Option 2-C: Xiaomi, OPPO
      * the measurements time delay which is the time from the end of TEvent\_DU until UE executes a handover to a target cell and interruption starts.
      * For timer/time based CHO, Tmeasure is within the time duration of [T1, T2].
      * For location based CHO, the starting point of Tmeasure is after the Tlocation.
      * For timer/time based CHO, T1 is the earliest point in time when the UE can perform CHO to the candidate target cell, and T2 is the end point of the time window.
      * For location based CHO, Tlocation is the time when location event trigger.
    - Option 2-D: Nokia
      * The time difference between the source and target cell should be included
  + TCHO\_execution:
    - the UE execution preparation time for conditional handover. (same as legacy TN TCHO\_execution)
  + Tinterrupt is the time between when the UE starts to execute the conditional handover to the target cell and the time the UE starts transmission of the new PRACH.
* Requirement/Test applicability and Others
  + For Time-based CHO (in combination with the existing R16 CHO measurement)
    - (Intel) the delay includes the timer value and the time difference between serving and neighbour cell SSBs
    - (Ericsson) Tinterrupt + TCHO\_execution can be later than T2 which are not impacted by expiry of serving cell.
    - (Ericsson) CHO shall not be carried out before T1, TRRC can be earlier than T1 because not RRC signaling will be received after T1.
    - (Ericsson) TEvent\_DU + Tmeasure shall be in [T1, T2]
    - (Apple) If T2 is earlier than the end the Tmeasure, no CHO requirement should be applied.
    - (OPPO) The timer-based CHO delay requirements are only applicable when Tmeasure + Tinterrupt + TCHO\_execution > [T2-T1].
  + For Location-based CHO (in combination with the existing R16 CHO measurement)
    - (OPPO) CHO shall only be carried out when “condEvent L4” is met and requirements can be reused by replacing legacy condition with “condEvent L4”.
    - (Intel) Do not define test cases for location-based CHO delay requirements
  + General
    - (Huawei) Remove the requirements for the case “undetectable cell becomes detectable again” for NTN CHO.
    - (Qualcomm) A side condition of ’3200Tc’ in measurement time of conditional handover requirement shall be modified. FFS on the exact value and whether any other side condition is necessary.

**Moderator’s suggestion**

* Share your views. Options are not mutually exclusive.

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| **Company** | **Comments** |
| Xiaomi | For TEvent\_DU:  Support option 1-C, the delay uncertainty between the time when legacy RSRP event trigger and the time when a timer/time or location event trigger can be considered in TEvent\_DU.  For Tmeasure:  We think the legacy Tmeasure definition can be reused, but some clarification is needed, e.g. For timer/time based CHO, Tmeasure is within the time duration of [T1, T2]. For location based CHO, the starting point of Tmeasure is after the Tlocation.  For TCHO\_execution:  We think the legacy TCHO\_execution definition can be reused, but some clarification is needed, e.g. For timer/time based CHO, TCHO\_execution is within the time duration of [T1, T2]. |
| Ericsson | TEvent\_DU:   * Support Option 1-C   Test applicability and Others   * TEvent\_DU + Tmeasure shall be in [T1, T2].TEvent\_DU can checked from test perspective. But TEvent\_DU can be skipped if prerequisite is to check time condition with [T1, T2] .   General:  Suggest keeping it and looking for a replacement for 3200Tc. |
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**Issue 2-2-3: Measurement Prioritization during CHO**

Agreements (from RAN4#101-b)

* The following three options will be further discussed in RAN4#102 e-meeting.
  + Option 1:
    - Measurement prioritization during CHO depends on NW implementation, i.e. no enhancement.
  + Option 2:
    - When UE is configured with C (location and RRM) or D (time and RRM) for CHO, UE only:
      * measures the SMTC window which the target cell belongs to
      * measures frequency layer which the target cell belongs to
    - If the condition for location or time is met,
      * condition may be a time or location (e.g. T1 or location) configured by NW.
      * condition may be T2-T1< 2 \* SMTC periodicity
    - (Note) T1 or location thread signaled by network may leave long time till serving cell expire time, in these cases, priority is not very urgent.

**Proposals for RAN4#102**

* Option 1: CATT, OPPO
  + Measurement prioritization during CHO depends on NW implementation, i.e. no enhancement
* Option 2-A: Ericsson
  + When UE is configured with C (location and RRM) or D (time and RRM) for CHO, UE only measures the SMTC window which the target cell belongs to.
* Option 2-B: Huawei
  + When UE is configured with C (location and RRM) or D (time and RRM) for CHO, UE only measures the SMTC window and frequency layer which the target cell belongs to, if the condition for location or time is met

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Fine with option 2-B |
| Ericsson | Support Option2 A or Option 2 B. when there are multiple times (t1, t2) and locations threhold(l1) dimensioned by neighbor cells, UE needs to arrange measurement mechanism togetherwith multiple times (t1, t2) and locations threhold(l1). But UE doesn’t need to keep measuring and prepare HO another cell which t2 is later than target cell’s t2, or UE doesn’t need to keep measuring and prepare HO to another cell which location fulfills l1 later than later than target cell. |
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# Topic #3: Measurement procedure requirements

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

## Open issues summary and Companies views’ collection for 1st round

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

### Issue 3-1: Multiple SMTCs and Measurement Gap

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| R4-2204185 | MediaTek inc. | **Issue 3-1-4: Measurement with multiple SMTCs**  **Item-1: Scheduling restriction**  ***Observation 1****: For the scheduling restriction-based solution (Option 1 and Option 2), serving cell needs to know the UE receiving timing of other satellites in symbol-level.*  ***Proposal 3:*** *For both intra- and inter- frequency measurements of cells belonging to a different satellite than the serving cell, the UE uses measurement gaps. For intra- frequency measurements, no measurement gaps is needed for the cells belonging to the same satellite as serving cell. (Option 3a)*  **Item-2: Scaling factor**  **Issue 3-1-8: Measurement requirements and with multiple satellites**  ***Proposal 4:*** *For LEO, support Option 1 if SSBs are from only one LEO satellite in one SMTC. For the SMTC containing SSBs from multiple LEO satellites, the CSSF should be further extended by the number of LEO satellite within this SMTC.* |
| R4-2203795 | Apple | **Issue 3-1-4: Measurement with multiple SMTCs**  **Item-1: Scheduling restriction**  ***Proposal 3: Scheduling restriction is always allowed for measurement of cells belonging to a different satellite than the serving cell if not fully confined within MG. No scheduling restriction for measurement of cells belonging to serving cell.***  **Item-2: Scaling factor**  ***Proposal 4: based on network configuration on one MO, UE uses multiple SMTCs simultaneously within SMTC periodicity and the delay scaling factor of this MO could be determined by***  ***Proposal 5: For intra-frequency MO without MG and inter-frequency MO without MG,***   * ***The maximum number of SMTCs simultaneously used by UE within SMTC periodicity per measurement object for the same ssbFrequency shall meet both of following conditions,***    + ***smaller than or equal to the SMTC number indicated in UE capability, and***   + ***guarantee the total scheduling restriction length less than or equal to [25%] of the SMTC periodicity length.***   ***Proposal 6: when the UE supported SMTC number in real specific scenario is smaller than in the UE capability report, FFS if network could indicate a SMTC pattern to UE or let UE reports such SMTC usage pattern to network.***  **Item-4: Requirements when the number of configured SMTCs per Frequency layer is beyond UE capability**  ***Proposal 7: UE is not expected to be configured with more SMTCs than its capability.***  **Item-5: Fully or partially colliding SMTCs**  ***Proposal 8: For requirement simplicity, RAN4 assumes SMTCs on the same frequency do not overlap for requirement design in this release.***  **Issue 3-1-6: Measurement Gap**  ***Proposal 9: In R17 RRM, maximal number of concurrent MG in NTN is 2 for per-UE MGs or for per-FR1 MGs.***  ***Proposal 10: for intra-frequency MO with MG and inter-frequency MO with MG, the maximum number of SMTCs simultaneously used by UE within SMTC periodicity per measurement object for the same ssbFrequency shall meet both of following conditions:***   * ***smaller than or equal to the SMTC number indicated in UE capability, and*** * ***guarantee these SMTCs can be contained in active measurement gaps.*** |
| R4-2203857 | Qualcomm Incorporated | **Issue 3-1-4: Measurement with multiple SMTCs**  **Proposal 1**: In FR1 FDD NTN, scheduling restriction is not defined.  **Proposal 2**: For the measurement of multiple SMTCs configured on the same frequency, the measurement period is scaled up proportionally to the number of SMTCs.  **Issue 3-1-6: Measurement Gap**  **Proposal 3**: For NTN measurement gap, RAN4 adopts a subset of outcome of Concurrent MG feature with the following conditions:   * Enhancement related to positioning application is excluded * Enhancement related to FR2 is excluded * If needed, legacy measurement gap patterns #24 and 25 are allowed for a single measurement gap based NTN UE measurement. |
| R4-2203932 | CATT | **Issue 3-1-1:** The maximum number of SMTCs per Frequency layer  **Proposal 1: It can be concluded that UE should support 2 SMTC in parallel per frequency layer, and it is optional to support up to 4 SMTC in parallel per frequency layer based on UE capability.**  **Issue 3-1-2:** Capability on the number of Measurement Cell Groups  **Proposal 2: There is no capability on the number of measurement cell groups.**  **Issue 3-1-3:** Capability on the number of Measurement Carriers/Cells/SSBs  **Proposal 3: Optional requirements on the number of target satellites UE needs to monitor is 4, with respect to UE’s capability.**  **Issue 3-1-4:** Measurement with multiple SMTCs  **Proposal 4: No scheduling restriction is defined for intra frequency measurement with multiple SMTCs.**  **Proposal 5: Scaling factor can be number of inter frequency layer for inter frequency measurement. If a measurement frequency is configured with multiple SMTCs with different offset values of MG, the measurement frequency is treated as multiple independent measurement frequencies in terms of measurement period/interval and CSSF.**  **Proposal 6: UE is not expected to be configured with more SMTCs than its capability. It will be UE implementation if the number of configured SMTCs per Frequency layer is beyond UE capability**  **Proposal 7: UE should be capable to measure two SMTC on same frequency in parallel regardless fully or partially colliding SMTCs, and optional to measure 4 SMTC on same frequency in parallel based on UE capability.**  **Issue 3-1-6:** Measurement Gap  **Proposal 8: RAN4 should discuss measurement requirements based on SMTC window is alignment with MG, and UE only using one MG to measure at one time if multiple MGs are overlapped.** |
| R4-2204240 | Xiaomi | **Measurement requirements with multiple SMTCs**  **Proposal 2: The measurement requirements with multiple SMTCs is defined assuming UEs support 2 SMTCs in parallel.**  **Gapless measurement with multiple SMTCs**  **Proposal 3: Two SMTC occasions in parallel are defined as colliding (overlapping) if the 2 SMTCs are partially overlapping in time domain or the minimum distance is less than 5ms.**  **Proposal 4: For gapless measurement, if SMTCs in parallel are colliding (overlapping), the delay requirement for measurement without gap should be extended by a scaling factor of 2.**  **Gap-based measurement with multiple SMTCs**  **Proposal 5: For gap-based measurement, UE is expected to be configured with 2 independent gap patterns for the measurements on 2 SMTCs in parallel.**  **Proposal 6: Two gap occasions are defined as colliding (overlapping) if the two gap occasions are partially overlapping in time domain or the minimum distance is less than 5ms.**  **Proposal 7: For gap-based measurement, if gap occasions are colliding (overlapping), the delay requirement for measurement with gap should be extended by a scaling factor of 2.** |
| R4-2204420 | Intel Corporation | ***Multiple SMTC and measurement gaps***  ***SSB contained in the SMTC-s***  **Proposal 1: Specify that the NTN UE is not required to correctly measure on the target SSB if the SSB is not contained completely in the SMTC window(s).**  ***SMTC selection***  **Proposal 2: In the case where the network configures more SMTC configurations than the maximum number supported by UE, the UE chooses feasible number of SMTC windows from the configured ones and which to choose is up to UE implementation.**  **Observation 1: Clarification from RAN2 is needed on whether per-UE indication of feasible SMTC configurations among all is feasible to solve the misalignment of number of SMTC-s between UE capability and network configuration.**  ***Scheduling restrictions***  **Observation 2: RAN4 should consider the scheduling restrictions:**  **Option 1: the UE is required to measure on the target neighbour cell with configured timing offsets and receive/transmit on the serving cell at the same time**  **Option 2: specify scheduling restrictions to avoid such complexity**  **Option 3: measurement gaps are used on the target neighbour cells**  ***SSB contained in the MG-s***  **Proposal 3: For both intra- and inter- frequency measurements, the UE uses measurement gaps to measure the SMTC windows; the UE is not required to correctly measure the SSB-s unless the SSB-s are completely contained in the measurement gaps.**  **Observation 3: The UE could choose the SMTC configurations according to the measurement gap configurations to boost chance in getting the SSB-s correctly.**  ***UE capability of simultaneous scheduling and measurements***  **Proposal 4: Introduce UE capabilities to indicate to the network whether the UE is able to receive/transmit in the serving cell while measure on the target cell which is an intra- frequency or inter-frequency neighbour cell.** |
| R4-2204545 | LG Electronics UK | **Issue 3-1-4: Measurement with multiple SMTCs**  **Scheduling restriction**  ***Proposal 1.*** For NTN, due to the propagation delay difference and misalignment of frame boundary, scheduling restriction for all symbols within SMTC windows which are not associated serving cell ID should be applied. And no scheduling restriction for SMTC window with associated serving cell should be applied.  **SSB fully or partially contained SMTC**  ***Proposal 2***: RAN4 can assume that SSBs are fully contained within SMTC.  **Requirements when the number of configured SMTCs per Frequency layer is beyond UE capability**  ***Proposal 3***: The measurement requirements depending on capability supporting number of SMTC should be defined.  **Fully or partially colliding SMTCs**  ***Proposal 4***: Based on the capability supporting the number of SMTCs, UE should be able to perform measurement with overlapped SMTC in parallel and configured SMTC simultaneously.  **Measurement gap**  ***Proposal 5***: For the requirements with measurement gap,   * + Option 1: RAN4 should wait clear conclusion of RAN2 NTN measurement gap issues.   + Option 2: RAN4 only defines intra-frequency measurement without measurement gap in Rel-17.   **Measurement for Elevation angle related issue**  ***Observation 1:*** If NW configures SMTC/MG without knowledge of elevation angle, UE may try to measure/detect/evaluate the undetectable/unmeasurable satellite that is below horizon or located at low elevation angle.  ***Proposal 6:*** To restrict the SMTC/MG configuration for low elevation satellite, the report of UE assistant information (propagation delay difference) could be deferred until the satellite is located at the lowest elevation angle. |
| R4-2204723 | Ericsson | **Issue 3-1-3: Capability on the number of Measurement Carriers/Cells/SSBs**  ***Proposal 1: The number of SSB beams UE needs to monitor per NTN carrier is [8]. The number must be fixed regardless of how the SSBs are assigned to different SMTCs. This number shall be minimal SSB beams capability UE can support, not relevant to SSB number per SMTC.***  **Issue 3-1-4: Measurement with multiple SMTCs**  Item-1: Scheduling restriction  ***Proposal 2:***   1. ***Scheduling restriction shall occupy full SMTC if at least one of LEO in the SMTC. For GEO, Scheduling restriction may be limited to [m] symbols before and after SSB symbols*** 2. ***Total scheduling restriction shall be limited, e.g. restricting number SMTC containing LEO. The detailed solution can be continued after issues on measurements on SMTC are clearer.***   Item-2: Scaling factor:  ***Proposal 3:***  ***In connected mode.***   * ***Scaling factor is maximal number of LEO in each overlapped SMTCs or one SMTC, if LEO satellites cannot be handled by UE simultaneously.*** * ***Otherwise, e.g. one LEO in one SMTC and total 4 SMTCs, scaling factor is 1.*** * ***The criteria to handle Doppler shift simultaneously can be determined by UE’s capability, assuming that ephemeris data is known by UE and situation of Doppler shift also is known.***   ***In idle mode, scaling factor can be 1+ [0.5]\* (number of SMTCs-1) for simplification purpose.***  Item-3: SSBs fully or partially contained SMTC  ***Observation 1:***   * ***In connected mode, SSB is contained by SMTC fully. No requirements are expected for SSB outside of SMTC.*** * ***In idle mode, it depends on how UE-based SMTC solution operates. but at least, certain SSBs may be outside of SMTC configured by network. RAN4 shall identify the differentiation on measurement delay from spec.***   Item-4: Requirements when the number of configured SMTCs per Frequency layer is beyond UE capability  ***Proposal 4:***   * ***In connected mode, UE is not expected to be configured with more SMTCs than its capability. But if it is configured, the solution can be same to idle mode.*** * ***In idle mode, UE can be configured with more SMTCs than its capability.***    + ***Option 1: UE may measure all configured SMTCs through extra measurement delay which is represented by a scaling factor = ratio (SMTC configured by network/SMTC supported by UE)***   + ***Option 2: UE may only measure SMTCs which number is same to its capability. The choice can be UE’s implementation or pre-defined.***   + ***One of possibilities is that UE can perform Option1 to get the full picture of all SMTCs and turn to Option2 aiming to particular SMTCs, it’s UE’s implementation, but longer measurement time is expected from specification point of view.***   Item-5: Fully or partially colliding SMTCs  ***Proposal 5: Measurement can be performed concurrently when SMTC number is 2, regardless fully or partially contained SMTC.***  ***Proposal 6: RAN4 can decide if concurrent measurement can be used for fully or partially contained SMTC when SMTC number is more than 2. The answer is relevant to Item2-scaling factor, but concurrent measurements are allowed on fully or partially colliding SMTCs, despite of Doppler issue.***  **Issue 3-1-6: Measurement Gap**  ***Proposal 7: In Rel-17, proper SMTC and MG configuration can deal with the offset between SMTC and MG. Enhancement can be further studied.***  ***Proposal 8: Proximity condition for overlapping For FR1 is 4ms, which refers to concurrent MG WI.*** |
| R4-2205230 | Nokia, Nokia Shanghai Bell | **Issue 3-1-4: Measurement with multiple SMTCs**  **Proposal 1: Whether a UE can perform measurements on cells from other NGSO satellites in parallel with normal operation should be a UE capability.**  **Proposal 2: For UEs not being able to perform measurements in parallel with normal operation scheduling restrictions shall apply.**  **Proposal 3. For UEs not able to perform measurements in parallel with normal operation it is not required to measure SSB’s outside the measurement gaps and SMTCs.**  **Proposal 4: UE is not expected to be configured with more SMTCs than its capability.** |
| R4-2205377 | Huawei, HiSilicon | **Issue 3-1-4: Measurement with multiple SMTCs**  **Proposal 1: Re-use same principle in NT to determine whether a measurement is performed with MG or without MG.**  **Issue 3-1-8: Measurement requirements and with multiple satellites**  **Proposal 2: For LEO, scheduling restriction is allowed for intra-frequency measurement outside MG. FFS whether to define UE capability for supporting intra-frequency measurement without scheduling restriction.**  **Measurement period**  **Scaling factor (without considering SMTC overlapping)**  **Proposal 3: Define requirements assuming UE can support parallel measurement of 2 SMTCs outside MG, i.e. measurement period is not scaled if two SMTCs do not overlap. FFS on scaling in case of 4 SMTCs per carrier for capable UE.**  **Proposal 4: For LEO, define requirements assuming UE can measure 1 satellite in each SMTC, i.e. measurement period is scaled if UE is required to measure more than one satellites per SMTC. FFS whether to define UE capability for supporting parallel measurement of more than 1 satellites in an SMTC.**  **Timing of SSB and SMTC**  **Proposal 5: UE is only required to measure SSBs that fall in SMTC windows.**  **SMTC overlapping**  **Proposal 6: Define requirements assuming UE measures in only one SMTC when SMTCs on the same carrier overlap, i.e. measurement period is scaled if two SMTCs on the same carrier overlap.**  **More SMTC than UE capability**  **Proposal 7: Requirements do not apply if number of configured SMTCs per carriers is beyond UE capability for CONNECTED mode. FFS for IDLE/INACITVE mode.**  **Issue 3-1-6: Measurement Gap**  **Proposal 8: UE is only required to measure in SMTC windows that fall in MGs for measurement with MG.**  **Proposal 9: Maximal number of MGs is 2 (same as concurrent MGs).**  **Proposal 10: FFS on the proximity condition and collision handling between MGs.**  **Measurement capability**  **Proposal 11: RAN4 not to further discuss UE measurement capability on max number of SMTCs or number of cell groups per carrier (since there are already agreements in RAN2).**  **Proposal 12a: Define the following common measurement capability requirements for all scenarios:**   * **the number of NTN carriers UE needs to monitor is 3 including serving CC** * **the number of NTN and TN carriers UE needs to monitor is 7 including serving CC**   + **Requirements do not apply to VSAT UE** * **the number of SSB beams UE needs to monitor per carrier is 8**   **Proposal 12b: Define the following addition measurement capability requirements for LEO**   * **(baseline) the number of target satellites UE needs to monitor per carrier is 2 including serving LEO satellite** * **(optional) the number of target satellites UE needs to monitor per carrier is [4] including serving LEO satellite** |

**Issue 3-1-1: The maximum number of SMTCs per Frequency layer**

**Proposals for RAN4#102**

* Proposal 1: CATT
  + UE should support 2 SMTC in parallel per frequency layer, and it is optional to support up to 4 SMTC in parallel per frequency layer based on UE capability.
  + Optional requirements on the number of target satellites UE needs to monitor is 4, with respect to UE’s capability
  + UE should be capable to measure two SMTC on same frequency in parallel regardless fully or partially colliding SMTCs, and optional to measure 4 SMTC on same frequency in parallel based on UE capability.
* Proposal 2: Xiaomi
  + The measurement requirements with multiple SMTCs are defined assuming UEs support 2 SMTCs in parallel.
* Proposal 3: Huawei
  + RAN4 not to further discuss UE measurement capability on max number of SMTCs or number of cell groups per carrier (since there are already agreements in RAN2).
* Proposal 4: Apple
  + The maximum number of SMTCs simultaneously used by UE within SMTC periodicity per measurement object for the same ssbFrequency shall meet both of following conditions,
    - smaller than or equal to the SMTC number indicated in UE capability, and
    - guarantee the total scheduling restriction length less than or equal to [25%] of the SMTC periodicity length.

**Moderator’s suggestion**

* Share your views. It is moderator’s understanding that the number of SMTCs per frequency layer that UE can support is effectively the same as the number of satellites UE can monitor.

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| **Company** | **Comments** |
| Xiaomi | Option 2, since it is essential for UEs to support 2 SMTCs in parallel. And the measurement requirements for 4 SMTCs in parallel would be extremely complicated by considering the overlapping cases. Considering the work load and this is the last core meeting, the measurement delay requirement with multiple SMTCs is defined assuming UEs support 2 SMTCs in parallel. |
| Ericsson | We don’t see too many controversies among proposals.  2 is mandatory in any case, 4 is optional.  Regarding Moderator’s suggestion, we guess the number of satellites UE can monitor is per frequency? |
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**Issue 3-1-3: Capability on the number of Measurement Carriers/Cells/SSBs**

Agreements (from RAN4#101-b)

* Define the following common measurement capability requirements for all scenarios:
  + the number of NTN carriers UE needs to monitor is [3] including serving CC
  + the number of NTN and TN carriers UE needs to monitor is X (>[3]) including serving CC
    - FFS for VSAT UE
  + the number of SSB beams UE needs to monitor per NTN carrier is [8] (it also depends how many SMTC those SSBs are located in, e.g., if 8SSBs belongs to 4 SMTCs but UE can only support 2 SMTC, then cannot directly say 8SSBs are supported)
* Define the following addition measurement capability requirements for LEO
  + Minimal requirements on the number of target satellites UE needs to monitor is [2] including serving LEO satellite if applicable.
  + Optional requirements on the number of target satellites UE needs to monitor is FFS, with respect to UE’s capability.

**Proposals for RAN4#102**

* Proposal 1: Ericsson
  + The number of SSB beams UE needs to monitor per NTN carrier is [8]. The number must be fixed regardless of how the SSBs are assigned to different SMTCs. This number shall be minimal SSB beams capability UE can support, not relevant to SSB number per SMTC.
* Proposal 2: Huawei
  + Define the following common measurement capability requirements for all scenarios:
    - the number of NTN carriers UE needs to monitor is 3 including serving CC
    - the number of NTN and TN carriers UE needs to monitor is 7 including serving CC
      * Requirements do not apply to VSAT UE
    - the number of SSB beams UE needs to monitor per carrier is 8
  + For LEO,
    - (baseline) the number of target satellites UE needs to monitor per carrier is 2 including serving LEO satellite
    - (optional) the number of target satellites UE needs to monitor per carrier is [4] including serving LEO satellite

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Fine with Huawei’s first bullet:   * + Define the following common measurement capability requirements for all scenarios:     - the number of NTN carriers UE needs to monitor is 3 including serving CC     - the number of NTN and TN carriers UE needs to monitor is 7 including serving CC       * Requirements do not apply to VSAT UE     - the number of SSB beams UE needs to monitor per carrier is 8 |
| Ericsson | To our understanding, [4] LEO satellite(including serving one) is based on this assumption: one SMTC contains one LEO. However, a scaling factor can be utilized for multiple satellites in a single SMTC. On other hand, if 1 SMTC contain 3 LEO with scaling factor, there still have 3 other SMTCs which UE cannot measure.  We suggest [6] to take flexible mapping between satellite and SMTC into account. |
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**Issue 3-1-4A: Measurement with multiple SMTCs (Item-1: Scheduling restriction)**

Agreements (from RAN4#101-b)

* Option 1: Scheduling restriction is always allowed for measurement of cells belonging to a different satellite than the serving cell if not fully confined within MG. No scheduling restriction for measurement of cells belonging to serving cell.
* Option 2: Same as Option 1, but only for the case where either serving or target measurement cells is LEO. Otherwise, no scheduling restriction is defined.
* Option 3: For both intra- and inter- frequency measurements, the UE uses measurement gaps; the UE is not required to measure the SSB-s unless the SSB-s are completely contained in the measurement gaps.
* Option 4: Please add yours, if any.

**Proposals for RAN4#102**

* For measurements of SMTC associated with serving cell:
  + No scheduling restriction is defined
* For measurements of SMTC not associated with serving cell (if not fully confined within MG):
  + Option 1: Qualcomm, CATT
    - No scheduling restriction is defined
  + Option 2-A: Apple
    - Scheduling restriction is needed
  + Option 2-B: LGE
    - Scheduling restriction is needed for all symbols within SMTC windows
  + Option 2-C: Ericsson
    - Scheduling restriction shall occupy full SMTC if at least one of LEO in the SMTC. For GEO, Scheduling restriction may be limited to [m] symbols before and after SSB symbols
    - Total scheduling restriction shall be limited, e.g. restricting number SMTC containing LEO. The detailed solution can be continued after issues on measurements on SMTC are clearer.
  + Option 3-A: MediaTek
    - SMTC shall be within MG
  + Option 3-B: Huawei
    - Re-use same principle in NT to determine whether a measurement is performed with MG or without MG.
    - For LEO, scheduling restriction is allowed for intra-frequency measurement outside MG. FFS whether to define UE capability for supporting intra-frequency measurement without scheduling restriction.
  + Option 4-A: Nokia
    - Whether a UE can perform measurements on cells from other NGSO satellites in parallel with normal operation (no scheduling restriction) should be a UE capability
    - For UEs not being able to perform measurements in parallel with normal operation scheduling restrictions shall apply.
    - For UEs not able to perform measurements in parallel with normal operation it is not required to measure SSB’s outside the measurement gaps and SMTCs.
  + Option 4-B: Intel
    - Introduce UE capabilities to indicate to the network whether the UE is able to receive/transmit in the serving cell while measure on the target cell which is an intra- frequency or inter-frequency neighbour cell.

**Moderator’s suggestion**

For GTW discussion, the below is proposed as a baseline:

* For measurements of SMTC associated with serving satellite:
  + No scheduling restriction is defined
* For measurements of SMTC not associated with serving satellite (if not fully confined within MG):
  + Option 1: Qualcomm, CATT
    - No scheduling restriction is defined
  + Option 2: Apple, LGE, Ericsson
    - Scheduling restriction is needed
    - Scheduling restriction shall occupy full SMTC
      * FFS on LEO vs. GEO (Ericsson)
      * FFS on whether and how to limit total scheduling restriction (Ericsson)
  + Option 3: MediaTek, Huawei
    - SMTC shall be within MG
    - SMTC outside MG, for LEO, scheduling restriction is allowed for intra-frequency measurement.
      * FFS whether to define UE capability for supporting intra-frequency measurement without scheduling restriction.
  + Option 4: Nokia, Intel, [Huawei]
    - Whether a UE can perform measurements on cells from other NGSO satellites in parallel with normal operation (no scheduling restriction) should be a UE capability. FFS on detailed capability.
    - For UEs not being able to perform measurements in parallel with normal operation scheduling restrictions shall apply.
    - For UEs not able to perform measurements in parallel with normal operation it is not required to measure SSB’s outside the measurement gaps and SMTCs.

**Agreements (from first round GTW)**

* For measurements of cells belonging to the same satellite as the serving cell:
  + No additional scheduling restrictions will be defined
  + Note: existing scheduling restrictions requirements may apply
* For measurements of cells belonging to different satellite as the serving cell and performed outside the MG:
  + Whether a UE can perform measurements on cells belonging to different satellite as the serving cell in parallel with normal operation (i.e. data/control transmission and/or reception, [and L1 measurements]) of serving cell without scheduling restrictions is up to UE capability.
  + FFS whether the capability applies for intra-frequency and/or inter-frequency measurements
  + For UEs not able to perform measurements in parallel with normal operation of serving cell scheduling restrictions shall apply.

**Moderator’s suggestion after First round GTW:**

For GTW discussion, the below is proposed as a baseline:

* As there was a concern about NGSO vs. GSO on this, can we clarify the agreement below applies when either serving cell or neighbor cell belongs to NGSO?
  + Whether a UE can perform measurements on cells belonging to different satellite as the serving cell in parallel with normal operation (i.e. data/control transmission and/or reception, [and L1 measurements]) of serving cell without scheduling restrictions is up to UE capability.
* Please also share your views on this. It is moderator’s understanding that L1 measurements is included in the normal operation.
  + Whether a UE can perform measurements on cells belonging to different satellite as the serving cell in parallel with normal operation (i.e. data/control transmission and/or reception, [and L1 measurements]) of serving cell without scheduling restrictions is up to UE capability.
* Please also share your views on the following FFS point.
  + FFS whether the capability applies for intra-frequency and/or inter-frequency measurements

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| **Company** | **Comments** |
| Ericsson | We are open to introduce UE’s capability on simultaneous normal operation and measurement or not. But we suggest confirmation by proponents whether the only reason is Doppler shift in LEO. If yes, scheduling restriction isn’t applicable to GEO.  Subsequent question is if UE has the capacity (can deal with Doppler shift between serving cell and neighbour cell), does it mean the UE also can measure 2 neighbour cells in one SMTC? |
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**Issue 3-1-4B: Measurement with multiple SMTCs (Item-2: Scaling factor)**

Agreements (from RAN4#101-b)

* Option 1: When a measurement frequency is configured with multiple SMTCs with different offset values, the measurement frequency is treated as multiple independent measurement frequencies in terms of measurement period/interval and CSSF (Carrier Specific Scaling Factor) which represents the number of measurement carriers that share one cell search/measurement engine.
* Option 2: Different solutions in terms of whether and exact number of scaling factor for the following cases:
  + Whether UE can measure multiple SMTCs within one periodicity, and how many SMTCs can be measured in parallel.
  + If not all of them can be used by UE in parallel, whether or not UE and NW are in-sync in terms of which SMTCs will be in use at a given time
* Option 3: When a measurement frequency is configured with multiple LEO satellites to measure, the number of LEO satellites is accounted in CSSF for connected mode and Kcarrier for idle/inactive mode.
* For all options, there can be more aspects to be taken into account, e.g. fully vs. partially overlapping SMTCs

**Proposals for RAN4#102**

* Proposal 1: Qualcomm
  + For the measurement of multiple SMTCs configured on the same frequency, the measurement period is scaled up proportionally to the number of SMTCs.
* Proposal 2: CATT
  + Scaling factor can be number of inter frequency layer for inter frequency measurement. If a measurement frequency is configured with multiple SMTCs with different offset values of MG, the measurement frequency is treated as multiple independent measurement frequencies in terms of measurement period/interval and CSSF.
* Proposal 3: Huawei
  + Define requirements assuming UE can support parallel measurement of 2 SMTCs outside MG, i.e. measurement period is not scaled if two SMTCs do not overlap. FFS on scaling in case of 4 SMTCs per carrier for capable UE.
  + For LEO, define requirements assuming UE can measure 1 satellite in each SMTC, i.e. measurement period is scaled if UE is required to measure more than one satellites per SMTC. FFS whether to define UE capability for supporting parallel measurement of more than 1 satellites in an SMTC.
* Proposal 4: Apple
  + Based on network configuration on one MO, UE uses multiple SMTCs simultaneously within SMTC periodicity and the delay scaling factor of this MO could be determined by
  + For intra-frequency MO without MG and inter-frequency MO without MG,
    - The maximum number of SMTCs simultaneously used by UE within SMTC periodicity per measurement object for the same ssbFrequency shall meet both of following conditions,
      * smaller than or equal to the SMTC number indicated in UE capability, and
      * guarantee the total scheduling restriction length less than or equal to [25%] of the SMTC periodicity length.
  + When the UE supported SMTC number in real specific scenario is smaller than in the UE capability report, FFS if network could indicate a SMTC pattern to UE or let UE reports such SMTC usage pattern to network.
* Proposal 5: Ericsson
  + In connected mode.
    - Scaling factor is maximal number of LEO in each overlapped SMTCs or one SMTC, if LEO satellites cannot be handled by UE simultaneously.
    - Otherwise, e.g. one LEO in one SMTC and total 4 SMTCs, scaling factor is 1.
    - The criteria to handle Doppler shift simultaneously can be determined by UE’s capability, assuming that ephemeris data is known by UE and situation of Doppler shift also is known.
  + In idle mode, scaling factor can be 1+ [0.5]\* (number of SMTCs-1) for simplification purpose.
* Proposal 6: MediaTek
  + For LEO, support Option 1 if SSBs are from only one LEO satellite in one SMTC. For the SMTC containing SSBs from multiple LEO satellites, the CSSF should be further extended by the number of LEO satellite within this SMTC

**Moderator’s suggestion**

For GTW discussion, the below is proposed as a baseline:

* When UE is configured with multiple SMTCs on the same measurement carrier (not more than UE capability),
  + If SMTCs do not overlap with each other, a scaling factor of measurement period is
    - Option 1: not needed
    - Option 2: proportional to the number of SMTCs
    - Option 3: define UE capability for supporting parallel measurement of more than SMTCs
  + If SMTCs partially overlap with each other, a scaling factor of measurement period is
    - Option 1: not needed
    - Option 2: proportional to the number of overlapping SMTCs
    - Option 3: define UE capability for supporting parallel measurement of more than SMTCs

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| **Company** | **Comments** |
| Xiaomi | * When UE is configured with multiple SMTCs on the same measurement carrier (not more than UE capability),   + If SMTCs do not overlap with each other, a scaling factor of measurement period is     - Option 1: not needed   + If SMTCs partially overlap with each other, a scaling factor of measurement period is     - Option 1: proportional to the number of SMTCs |
| Ericsson | If SMTCs do not overlap with each other, a scaling factor of measurement period is   * Option 1: not needed   If SMTCs partially overlap with each other, a scaling factor of measurement period is   * Option 2: proportional(but no need to directly equal) to the number of SMTCs for LEO, if UE can not deal with Doppler shift in overlapped SMTCs.   Not needed for GEO |
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**Issue 3-1-4C: Measurement with multiple SMTCs (Item-3: SSBs fully or partially contained SMTC)**

Agreements (from RAN4#101-b)

* Wait for further progress from RAN2

**Proposals for RAN4#102**

* Intel
  + Specify that the NTN UE is not required to correctly measure on the target SSB if the SSB is not contained completely in the SMTC window(s).
* LGE
  + RAN4 can assume that SSBs are fully contained within SMTC.
* Ericsson
  + In connected mode, SSB is contained by SMTC fully. No requirements are expected for SSB outside of SMTC.
  + In idle mode, it depends on how UE-based SMTC solution operates. but at least, certain SSBs may be outside of SMTC configured by network. RAN4 shall identify the differentiation on measurement delay from spec.
* Huawei
  + UE is only required to measure SSBs that fall in SMTC windows.

**Moderator’s WF**

* For UE in RRC Connected mode:
  + Option 1: No requirements are expected for SSB outside of SMTC
  + Option 2: UE does not measure SSBs fall outside of SMTC
* For UE in RRC Idle/Inactive mode:
  + FFS: RAN4 shall identify the differentiation on measurement delay from spec.

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| **Company** | **Comments** |
| Xiaomi | * For UE in RRC Connected mode:   + Option 2: UE does not measure SSBs fall outside of SMTC. * For UE in RRC Idle/Inactive mode:   + FFS |
| Ericsson | For UE in RRC Connected mode:  Option 1 or Option2 are Ok.  For UE in RRC Idle/Inactive mode:  RAN2’s studies on UE-based or UE-assisted solution have not been completed, we cannot ensure that SSBs always are in SMTC configured by network. How to define UE-wise SMTC and corresponding measurement requirements are unclear. |
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**Issue 3-1-4D: Measurement with multiple SMTCs (Item-4: Requirements when the number of configured SMTCs per Frequency layer is beyond UE capability)**

Agreements (from RAN4#101-b)

* Option 1: UE is not expected to be configured with more SMTCs than its capability
* Option 2: UE can be configured with more SMTCs than its capability. In such a case, requirements are FFS, e.g. not applicable or based on the worst case
* Different options can be adopted depending on UE RRC state.

**Proposals for RAN4#102**

* For RRC Connected mode:
  + Option 1-A: Apple, CATT, LGE, Nokia, Huawei
    - UE is not expected to be configured with more SMTCs than its capability.
  + Option 1-B: Apple, CATT, LGE, Nokia, Huawei
    - In connected mode, UE is not expected to be configured with more SMTCs than its capability. But if it is configured, the solution can be same to idle mode.
  + Option 1-C: Intel
    - Clarification from RAN2 is needed on whether per-UE indication of feasible SMTC configurations among all is feasible to solve the misalignment of number of SMTC-s between UE capability and network configuration.
* For RRC Idle/Inactive mode:
  + Option 2: Ericsson
    - In idle mode, UE can be configured with more SMTCs than its capability.
      * Option 2-A: UE may measure all configured SMTCs through extra measurement delay which is represented by a scaling factor = ratio (SMTC configured by network/SMTC supported by UE)
      * Option 2-B: UE may only measure SMTCs which number is same to its capability. The choice can be UE’s implementation or pre-defined.
      * One of possibilities is that UE can perform Option1 to get the full picture of all SMTCs and turn to Option2 aiming to particular SMTCs, it’s UE’s implementation, but longer measurement time is expected from specification point of view.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Ericsson | We support Option 1-B.  Regarding Idle/Inactive mode, there are pros and cons of Option 2-A and Option 2-B. |
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**Issue 3-1-4E: Measurement with multiple SMTCs (Item-5: Fully or partially colliding SMTCs)**

Agreements (from RAN4#101-b)

* Option 1: SMTCs on the same frequency do not overlap
* Option 2: Consider cases where MTCs on the same frequency can fully or partially overlap, and define same or different requirements for fully-, partially-, and non-overlapping cases.
* Option 3: Please add yours, if any.

**Proposals for RAN4#102**

* A condition of SMTC collision
  + Option 1: Xiaomi
    - Two SMTC occasions in parallel are defined as colliding (overlapping) if the 2 SMTCs are partially overlapping in time domain or the minimum distance is less than 5ms.
* UE measurements in overlapped SMTCs
  + Option 1: Apple
    - RAN4 assumes SMTCs on the same frequency do not overlap for requirement design in this release.
  + Option 2: UE performs measurements in overlapped SMTCs
    - Option 2-A: LGE
      * Based on the capability supporting the number of SMTCs, UE performs simultaneous measurement in overlapped SMTCs
    - Option 2-B: Huawei
      * Define requirements assuming UE measures in only one SMTC when SMTCs on the same carrier overlap, i.e. measurement period is scaled if two SMTCs on the same carrier overlap.
    - Option 2-C: Xiaomi
      * For gapless measurement, if SMTCs in parallel are colliding (overlapping), the delay requirement for measurement without gap should be extended by a scaling factor of 2.
    - Option 2-C: Ericsson
      * Measurement can be performed concurrently when SMTC number is 2, regardless fully or partially contained SMTC.
      * RAN4 can decide if concurrent measurement can be used for fully or partially contained SMTC when SMTC number is more than 2.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | * A condition of SMTC collision   If the SMTCs are too close or partial overlapping, UE may not have the capability to perform the measurements continuously or simultaneously, the minimum distance for two SMTC in parallel should be defined, e.g. 5ms.   * UE measurements in overlapped SMTCs   If two SMTC is considered as overlapping, then the measurement delay requirements should be scaled. |
| Ericsson | We think this issue is relevant feasibility of overlapped SMTCs, scaling factor resulted by satellite type can refer to Issue 3-1-4B? Scaling factor can happen in one SMTC or two overlapping SMTCs. |
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**Issue 3-1-6: Measurement Gap**

Agreements (from RAN4#101-b)

* RAN4 to discuss Gap-based measurement including the following aspects in detail based on further progress made by RAN2 NTN and RAN4 Concurrent MG WI before RAN4#102 e-meeting starts:
  + Maximal number of MG
  + Matching between SMTC and MG if applicable
  + Proximity condition for overlapping
  + UE behavior during colliding gap occasion
* RAN4 to discuss how MG deals with unalignment,e.g. edge of SMTC window may cross MGL, due to propagation delay offset/timing error between serving cell and neighbor cell.

**Proposals for RAN4#102**

* Apple
  + In R17 RRM, maximal number of concurrent MG in NTN is 2 for per-UE MGs or for per-FR1 MGs.
  + For intra-frequency MO with MG and inter-frequency MO with MG, the maximum number of SMTCs simultaneously used by UE within SMTC periodicity per measurement object for the same ssbFrequency shall meet both of following conditions:
    - smaller than or equal to the SMTC number indicated in UE capability, and
    - guarantee these SMTCs can be contained in active measurement gaps.
* Qualcomm
  + For NTN measurement gap, RAN4 adopts a subset of outcome of Concurrent MG feature with the following conditions:
    - Enhancement related to positioning application is excluded
    - Enhancement related to FR2 is excluded
    - If needed, legacy measurement gap patterns #24 and 25 are allowed for a single measurement gap based NTN UE measurement.
* CMCC
  + RAN4 should discuss measurement requirements based on SMTC window is alignment with MG, and UE only using one MG to measure at one time if multiple MGs are overlapped.
* Xiaomi
  + For gap-based measurement, UE is expected to be configured with 2 independent gap patterns for the measurements on 2 SMTCs in parallel.
  + Two gap occasions are defined as colliding (overlapping) if the two gap occasions are partially overlapping in time domain or the minimum distance is less than 5ms.
  + For gap-based measurement, if gap occasions are colliding (overlapping), the delay requirement for measurement with gap should be extended by a scaling factor of 2.
* LGE
  + For the requirements with measurement gap,
    - Option 1: RAN4 should wait clear conclusion of RAN2 NTN measurement gap issues.
    - Option 2: RAN4 only defines intra-frequency measurement without measurement gap in Rel-17.
* Ericsson
  + In Rel-17, proper SMTC and MG configuration can deal with the offset between SMTC and MG. Enhancement can be further studied.
  + Proximity condition for overlapping For FR1 is 4ms, which refers to concurrent MG WI.
* Huawei
  + UE is only required to measure in SMTC windows that fall in MGs for measurement with MG.
  + Maximal number of MGs is 2 (same as concurrent MGs).
  + FFS on the proximity condition and collision handling between MGs.

**Moderator’s suggestion**

For GTW discussion, the below is proposed as a baseline:

* NTN UE can support either one MG or two MG subject to UE capability
* For UE supporting one MG
  + Option 1: legacy MG will be used without any change
  + Option 2: there can be changes, e.g. legacy measurement gap patterns #24 and 25 are allowed for a single measurement gap based NTN UE measurement.
* For UE supporting two MGs
  + Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted
    - Modification of MG Colliding/Proximity condition
    - Exclusion of enhancement related to positioning application
    - Exclusion of enhancement related to FR2
  + The following aspects will be additionally introduced
    - FFS

**Agreements (from first round GTW)**

* UE capability for the maximum number of supported MGs
  + NTN UE can support either one MG or two MGs subject to UE capability
  + Note: the decision can be revisited in case it is identified that the agreement contradicts to RAN2 design

**Moderator’s suggestion after First round GTW:**

Please focus on the following bullets.

* For UE supporting one MG
  + Option 1: legacy MG will be used without any change
  + Option 2: there can be changes, e.g. legacy measurement gap patterns #24 and 25 are allowed for a single measurement gap based NTN UE measurement.
* For UE supporting two MGs
  + Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted
    - Modification of MG Colliding/Proximity condition
    - Exclusion of enhancement related to positioning application
    - Exclusion of enhancement related to FR2
  + The following aspects will be additionally introduced
    - FFS

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| **Company** | **Comments** |
| Xiaomi | * NTN UE can support either one MG or two MG subject to UE capability   Agree.   * For UE supporting one MG   Support Option 1: legacy MG will be used without any change   * For UE supporting two MGs   + Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted     - Proximity condition for overlapping: 4ms     - The association between SMTC and MG which is up to RAN2 signalling design.   + The following aspects will be additionally introduced     - Scalling factor due to overlapping MG |
| Ericsson | The maximal number shall wait for RAN2’s agreements.  For UE supporting one MG   * Support Option 1 , * Option 2 are FFS   Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted  Proximity condition for overlapping For FR1 is 4ms |
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**Issue 3-1-9: Others**

Conclusion (from RAN4#101-b)

* Further discussion on the following is not precluded if the whole framework is provided including potential RAN2 impact:
  + To restrict the SMTC/MG configuration for low elevation satellite, the report of UE assistant information (propagation delay difference) could be deferred until satellites are located at the lowest elevation angle.

**Proposals for RAN4#102**

* Proposal: LGE
  + To restrict the SMTC/MG configuration for low elevation satellite, the report of UE assistant information (propagation delay difference) could be deferred until the satellite is located at the lowest elevation angle

**Moderator’s suggestion**

* Based on the conclusion from the previous meeting, we can skip discussions on this because no additional information is provided compared to the last time.

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| **Company** | **Comments** |
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### Issue 3-2: Measurement relaxation

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| R4-2203932 | CATT | **Issue 3-2-1: Measurement Relaxation**  **Proposal 9: Reuse current TN measurement relaxation for NTN UE in GEO.** |
| R4-2204723 | Ericsson | **Issue 3-2-1: Measurement Relaxation**  ***Proposal 9: If measurement relaxation reused here is Chapter 4.2.2.9, 4.2.2.10 in TS 38.133, we agree on measurement relaxation for NTN UE in GEO. For LEO Earth-fixed case, we generally support relaxation to some extent but can be in future studies.*** |

**Issue 3-2-1: Measurement Relaxation**

Agreements (from RAN4#101-b)

* No measurement relaxation for NTN UE in LEO.
* FFS on whether to consider measurement relaxation for NTN UE in GEO.

**Proposals for RAN4#102**

* Proposal: CATT, Ericsson
  + Reuse current TN measurement relaxation for NTN UE in GEO

**Moderator’s WF**

* Agree on the above Proposal

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| **Company** | **Comments** |
| Xiaomi | Prefer not to consider the measurement relaxation in Rel-17 NTN. According to RAN2 agreement, there is no measurement relaxation for cell reselection.   |  | | --- | | Agreements in RAN2#116bis-e:  *Before the stop-time based measurements are triggered, the UE measurements follow Legacy behaviour (i.e., based on Srxlev/Squal) and there is no measurement relaxation.* | |
| Ericsson | Support WF.  With respect to agreements ‘No measurement relaxation for NTN UE in LEO.’, we suggest relaxation can be FFS for LEO Earth-fixed; no measurement relaxation for NTN UE in LEO Earth-moving. |
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### Issue 3-3: Other aspects for Measurement procedure requirement

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| R4-2203932 | CATT | **Issue 3-3-1:** Measurement requirements and serving cell SIB reading time  **Proposal 10: The reading time of essential information for NTN neighbor cell measurement should be accounted in the measurement period measurements, but the time value can’t be decided by now.** |
| R4-2205374 | Huawei, HiSilicon | **Proposal 6: SIBx reading time is not accounted in the measurement period.** |

**Issue 3-3-1: Measurement requirements and serving cell SIB reading time**

Agreements (from RAN4#101-b)

* The following will be discussed in RAN4#102 e-meeting after receiving RAN2 reply LS.
  + The reading time of essential information for NTN neighbor cell measurement should be accounted in the measurement period measurements, if identified as necessary. And the issue will be treated in all relevant requirements commonly.

**Proposals for RAN4#102**

* Option 1: CATT
  + The reading time of essential information for NTN neighbor cell measurement should be accounted in the measurement period measurements, but the time value can’t be decided by now.
* Option 2: Huawei
  + SIBx reading time is not accounted in the measurement period.

**Moderator’s suggestion**

* Share your views.

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| **Company** | **Comments** |
| Xiaomi | Option 2, if UE needs to read SIBs on neighbour cell, the separate requirement for SIB reading should be defined. |
| Ericsson | Support Option 2. |
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# Topic #4: UE Capability

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

## Open issues summary and Companies views’ collection for 1st round

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

### Issue 4-1: NTN UE Capability

**Issue 4-1-0: View collection for NTN UE Capability**

* Moderator’s suggestion
  + Please add any capabilities that you may want to discuss in the second-round. Please be as specific as possible.

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| **Company** | **Comments** |
| Ericsson | * Parallel measurement and normal operation * Parallel measurement of LEO in one SMTC |

# Topic #5: draft CRs

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

## Open issues summary and Companies views’ collection for 1st round

*Provide your comments on the listed draft CRs*

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| **CRs** | **Company** | **Comments** |
| R4-2203854 | Qualcomm Incorporated |  |
| R4-2203929 | CATT |  |
| R4-2204725 | Ericsson | Ericsson :   * Add revision marks * Add suffix on table title. * Delete Inter-RAT |
| R4-2204237 | Xiaomi |  |
| R4-2204421 | Intel Corporation | Ericsson:   * Remove FR2 |
| R4-2204474 | LG Electronics UK |  |
| R4-2205376 | Huawei, HiSilicon | Ericsson:   * Remove FR2 |
| R4-2204241 | Xiaomi |  |
| R4-2204297 | OPPO |  |
| R4-2205378 | Huawei, HiSilicon |  |
| R4-2205958 | Apple |  |

# Recommendations for Tdocs

## 1st round

**New tdocs**

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**Existing tdocs**

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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

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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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

# Annex

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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)