**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**
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| 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***
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| 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)
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**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.’ |
| Qualcomm | Option 1-A. Not different from the legacy UE procedure/behavior. |
| Huawei | Option 1-A.Option 1-A is same as TN, and it has been captured in the spec e.g. by the sentence quoted by Ericsson above. We can use same wording for NTN.  |
| LGE | For clarification, the above options should be considered together with priority. For example,For intra-frequency and inter-frequency of lower or equal priority, 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.AndFor inter-frequency of higher priority, UE shall start the detection, measurement and evaluation on neighbour cells prior to S/R criteria evaluation.If the options intend the above example, both options are fine to us. |
| ZTE | We support option 1-A. |
| Apple | Option 1-A. RAN2 agreed that 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. |
| CATT | Support option 1-A. |
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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 1-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 1-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 fineProposal 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 .’ |
| Qualcomm | To us, it seems proposals are not much different from each other. It is just that which level of detailed text we want to have in RAN4 spec.Unless companies see a critical issue, we prefer what Ericsson suggests, i.e. easy and plain wording. And the **details can be further clarified during maintenance phase as needed**.* **Time-based conditions:**
	+ 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’
* **Location-based conditions:**
	+ Once distance between UE and serving cell reference location is longer than a configured 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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| Huawei | Generally, we prefer to define requirements **separately** for time triggered measurements, search threshold (e.g. SIntraSearchP, SnonIntraSearchP) triggered measurement and location triggered measurement. UE should then perform the measurement when any trigger condition is met.For time triggered measurement, we prefer to stick to the agreement from last meeting, and the only remaining issue is to define the threshold for applying the requirements, and we support option 2-A. This is in our view the largest time required by UE to complete all the neighbour cell measurement. For search threshold triggered measurement, it is already addressed in Issue 1-5-1-A, and we do not think it needs to be coupled with time triggered measurement in the requirements, which will make the requirements very complicated without clear benefit. For location triggered measurement, we suggest to simply capture the RAN2 agreement in the applicability condition, e.g. following is what we proposed for the requirements:*If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, or the distance between UE and serving cell reference location is larger than [threshold] if the [threshold] is configured and UE has location information, then the UE shall search for and measure inter-frequency layers of higher, equal or lower priority in preparation for possible reselection.* |
| LGE | Our proposal (proposal 4) is based on following RAN2 agreements:

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| RAN2#116-e agreementsFor quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area, regardless of (the distance between UE and serving cell reference location) or (if legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold). |
| RAN2#116-bis-e agreements* For quasi-earth fixed cell, same as legacy, UE shall perform neighbour cell measurements of “higher priority NR inter-frequency or inter-RAT frequencies” regardless of the remaining serving time
* UE may choose not to perform neighbour cell measurements of “NR intra-freq or inter-freq with equal or lower priority, or inter-RAT freq with lower priority”, if (the distance between UE and serving cell reference location is shorter than a threshold) and (legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).
* Location information can be used to determine when to start measurement.

Location-based measurement initiation is only applied if the cell broadcasts location-related parameters (e.g. a threshold) and by implementation the UE has location information. |

So, we think the conditions in RAN2 agreements should capture the RAN4 RRM specifications.If the location based condition in proposal 3(HW) means the condition in above RAN2#116-bis-e agreements, the proposal is fine to us. Also, the issue 2-1-6 can be discussed with location based condition. We think the condition in issue 2-1-6 is also based on RAN2#116-bis-e agreements. But, we think the GNSS margin does not need to be considered. In issue 2-1-6, we provide our detailed views for proposal in the issue 2-1-6. |
| Apple | For requirement applicability of time based reselection, we support Option 1-B, since if the Tdetect,NR\_Intra and K\*Tdetect,NR\_Inter is too long, then it would require network to broadcast the ‘serving cell stop time’ as early as possible before the first slot when the cell is scheduled to stop serving the area. Broadcast of cell stop time in SIB is only applicable to quasi earth fixed cell (not to moving cell), and therefore it would not be so critical to shorten the UE measurement too much and K could be chosen based on UE measurement capability in IDLE/Inactive mode or K could be the carriers with higher priority.We think it might be not necessary to consider the serving cell quality as condition in option 1-A, because RAN2 agreed that for quasi-earth fixed cell, UE should start measurements on neighbour cells before the serving cell stops covering the current area, regardless of (the distance between UE and serving cell reference location) or (if legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold). Thus, UE shall use the measurement speed as legacy reselection to find a neighbor cell before serving cell stop covering the area.Option 4 is like a UE measurement triggering condition rather than a requirement applicability, we are fine with the option 4. |
| CATT | Option 1b is fine for the baseline. For option 3, in general, it is fine and it can be considered. It is included in option 4. For option 4, most parts are fine for us. We want to remove Srxlev > SnonOntraSearchP condition in option 4. In such case, cell shall stop service. We think it can be handled as Srxlev<SnonOntraSearchP. No need to separation.  |
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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.
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| 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”

|  |  |
| --- | --- |
| **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. |
| Qualcomm | For the set of necessary information, please see the tables below.Excerpt from R2-2201884 “Reply LS on NR NTN Neighbor Cell and Satellite Information”

|  |  |
| --- | --- |
| For NTN UE **measurements**, e.g. neighbor cell measurement within- or inter-satellite | For NTN UE **mobility**, e.g. target cell measurement, synchronization, and (conditional) handover within- or inter-satellite |
| * Ephemeris
* Epoch time
* SMTCs
* DL polarization information
* Under RAN1 discussion:
	+ Feeder link delay (i.e., common TA and K\_MAC) of the neighbor cell should also be provided to UE for neighbor cell SMTC adjustment
	+ separate validity timers
* Serving cell stop time and reference location for IDLE mode measurement trigger in NGSO fixed cell
* For IDLE mode measurements, UE autonomously adjusts the SMTCs based on location and ephemeris
 | * Target cell Ephemeris information
* Epoch time of the ephemeris
* Common TA
* Validity timer information for target cell mobility
* DL and UL Polarization information
* K\_offset
* Kmac (to determine UE-gNB RTT and perform RACH to target)
 |
| * **RAN2 assumes all the information needed for measurement and handover would be provided to the UE by the network**. **If** any of the information is **not** available or is not valid, then the **UE would have to acquire the system information of the target or neighbor cell which is not desirable** from handover interruption time point of view.
 |

Excerpt from R2-2201883 “Reply LS on Multiple SMTCs for NR NTN”

|  |
| --- |
| (Q1) Would there be **any association information between SMTC and Cell/SSB-IDs and/or Satellite**?(A1) The association between SMTC and satellite is **left to network implementation**. The **association between SMTC and the Cell** will be signalled in newly introduced SMTC list (SSB-MTC4List-r17). For each SMTC, this list includes a list of cells that are following the signalled offset in SSB-MTC4List-r17. **Existing SSB-MTC is still the baseline** SMTC configuration. RAN2 has **not made any decision** on **whether to provide a list of cells the satellite is serving** in the system information. RAN2 will further provide update, if needed.(Q2) Would there be any **dynamic mechanism enabling/disabling or activating/deactivating the configured SMTCs** for one measurement object?(A2) RAN2 has agreed that there is **no dynamic mechanism** to activate and deactivate a configured SMTC.(Q3) Would the **legacy SMTC lengths be re-used for NTN SMTC configuration**, i.e. no additional NTN specific new SMTC lengths?(A3) **Yes**(Q4) Would configuring **multiple SMTCs overlapping with each other in the time domain** for the same measurement object be allowed? If yes, would the SMTCs be allowed to be activated concurrently?(A4) Yes. **All the configured SMTCs may overlap in time domain** for the same measurement object and can be used in parallel. There will be **optional UE capability reporting whether UE is able to use 4 SMTCs in parallel**. RAN2 has decided that it is **essential** for UEs to support **2 SMTCs in parallel**.(Q5) Whether and how would a **valid time information of SMTC** be defined?(A5) RAN2 has **not decided** on whether validity timer for SMTC configuration is defined. RAN2 will further provide update, if needed.(Q6) Would the **periodicities of multiple SMTCs** configured by an MO be identical?(A6) With newly introduced signaling (SSB-MTC4List-r17), **only offset will be signalled differently**, and periodicity and duration of the multiple SMTCs are identical for an MO.(Q7) RAN4 would also like ask for clarification on the interpretation of “**in parallel**” in the LS R2-2109219 below, e.g. does it mean **multiple SMTCs can be activated and in use simultaneously** and the SMTCs can overlapping with each other?(A7) **Yes**. See response to Q4. |

Although we believe this implies all the necessary information listed should be made available to UE for measurements and mobility, to be safe, we would like to support Option 2 “Requirements are applied with an explicit extra delay” except this below.Regarding the explicit extra delay, * 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,
	+ when configured **multiple SMTCs** on the same frequency **are mutually exclusive** in the time domain,
		- measurement period is scaled up proportionally to the number of SMTCs.
	+ 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.

Regarding exact information about “availability of valid target satellite information,” a list of parameters listed in Reply LS (R2-2201884) shall be used for measurement and mobility requirements. |
| Huawei | **Discuss what exact information should be included in the side condition:**We understand this is provided by RAN2 in the reply LS R2-2201884. The required information can be different for measurement and mobility (HO), and different for idle and connected modes. **Share your views on the following options in detail:**We support option 1. Based on RAN2 reply LS R2-2201884, RAN2 assumes all the information needed for measurement and handover would be provided to the UE by the network, so we do not think RAN4 needs to define requirements for the case when they are not. |
| MTK | Support Option 1 because we believe the necessary information should be the necessary conditions to apply requirements.  |
| LGE | We think RAN4 defines the RRM requirements only when the ephemeris validity timer is running as like the proposal 4. But, clear UE behavior on measurement and reporting should be defined when the validity timer is expired. So we propose, UE stops RRM measurement and reporting before acquiring the updated ephemeris information after validity timer is expired to reduce the RRM performance impact. |
| ZTE | **Share your views on the following options in detail:**We support option 1. Valid target satellite information should be side condition for applying requirements. |
| Apple | We support proposal 6 and proposal 4, since in reply LS RAN2 also thought it’s not desirable to let UE to acquire the SI of neighbor cell for HO, and it’s most likely network would provide such essential information to UE for HO and measurement.We agree with the moderator’s suggestion on [[Define “availability of valid target satellite information as side condition]], and if the side condition is not met, we think option 1 shall be adopted based on our reason for proposal 6.* + If the side condition is not met,
		- Option 1: Requirements are not applied, i.e. extra delay won’t be explicitly defined
 |
| CATT | Our understanding of side condition is: when side condition is met, the requirements are applied. When side condition is not met, the requirements are not applied. But for the neighbour/target cell’s timing information, they are two different requirements with/without this information. If without these information, Option 2: Requirements are applied with an explicit extra delay can be supporte.  |
|  |  |

### Issue 1-7: RRM Spec Documentation

|  |  |  |
| --- | --- | --- |
| 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. Update:We suggest to use ‘satellite access’ rather than NTN. NTN is a very broad term and we also have HAPS. For example, in draft CR, we can use ‘8.1C Radio Link Monitoring for Satellite Access’ |
| Qualcomm | Support WF. Regarding HAPS, we do not want to explicitly mention the term and categorize it as NGSO because we don’t think all of the necessary side information for NGSO listed in Issue 1-7-1 is also necessary for HAPS. In summary, it is okay with us to not explicitly preclude HAPS in the requirement spec, but we do want to avoid using detailed satellite or unmanned aerial vehicle types. If companies have concerns about terms of GSO and NGSO, we are open to alternative terms if any. |
| Huawei | Fine with moderator’s WF. |
| MTK | Fine with moderator’s WF. |
| LGE | Fine with first bullet in moderator’s WFIn RAN4 RRM specification, the suffix ‘A’ is used for CCA requirement such as 4.2A, 5.1A and so on. The suffix ‘B’ is used in 8.6.2B and 8.11B. So, for consistency and readability, the suffix ‘C’ could be used for NTN RRM specification.Also, some terminologies are needed to be clarified such as UE (or NTN UE), intra-frequency (NTN intra- frequency) and inter-frequency (NTN inter frequency) for consistency and readability. |
| ZTE | Fine with moderator’s WF. |
| Apple | Fine with moderator’s WF. |
| CATT | Fine with moderator’s WF |

### Issue 1-8: Signalling characteristics

|  |  |  |
| --- | --- | --- |
| 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.

|  |  |
| --- | --- |
| **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. |
| Ericsson | No support on HO with FR2 in Rel17. |
| Qualcomm | We believe TN-NTN handover in the same FR is not precluded. Here, the point is TN-NTN HO in different FRs which is most likely FR2-TN and FR1-NTN in Rel-17. We do not think this is a real use case. If this is limited to cell selection/reselection between FR2-TN and FR1-NTN, perhaps it is okay with us. At least, we do not want to consider Connected mode mobility between different FRs at this point in time. |
| Huawei | We can compromise to option 1-A for Rel-17. |
| MTK | Support Option 1A for the above cases |
| Intel | We also support option 1A for all the mentioned cases. |
| Xiaomi2 | We are fine to not support the HO for above cases. And we would like to confirm that the FR1 TN – FR1 NTN and FR1 NTN - FR1 TN HO cases should be supported in this release. |
| Apple | We can support option 1-A for all issues under this topic. |
| CATT | All for option 1-A for Rel-17. |

**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.

|  |  |
| --- | --- |
| **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.  |
| Qualcomm | Okay with Option 1-B if the parameter K is made configurable which will be more future proof. And if this is acceptable, we want to see K < 1 as well for LEO. |
| Huawei | For proposal 1, support option 1-A. We do not see strong motivation to further relax the RLM/BFR requirements compared to TN.Support proposal 2, Based on GTW agreement on Monday, neighbor cell measurement may impact L1 measurement in the serving cell, and this can be similar as FR2 TN case.  |
| MTK | Prefer to Option 1-A |
| Intel | We support option 1A in proposal 1. Option 1B and proposal 2 are also acceptable to us. |
| Apple | Support Option 1-A.  |
| Nokia | Could the proponent of Option 1-B provide the technical reason behind K= [2] for GEO an LEO Earth-fixed satellite? K is FFS. Further analysis is needed on how to define the range of K for different satellites. |
| CATT | Support option 1-A. |

# 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

|  |  |  |
| --- | --- | --- |
| 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 = 2Note 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 = 2Note 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.  |
| Qualcomm | Given that this is the last official meeting for Core requirement, we do want to focus on critical issues that require tightened requirements rather than relaxing requirement. With this in mind, Proposal 1 is acceptable to us for earth-moving LEO. |
| Huawei | Support proposal 1. To clarify, our proposal is to define baseline requirements for cell reselection based on TN requirements for non-HST, and define additional requirements based on TN requirements for HST, and the application of the additional requirements is subject to NW indication and UE capability.On proposal 2, we suggest to merge it with Issue 3-2-1.Support proposal 3, measurement in idle mode are also subject to multiple SMTC and different Doppler shifts. |
| Intel | We are also fine with proposal 1. Proposal 3 can be discussed after multiple SMTC issues are concluded. |
| ZTE | We can support option 1. |
| Apple | Support option 1 for LEO as baseline requirement(RAN4 agreed LEO and GEO share the same Idle/Inactive requirement based on LEO scenario assumptions), as we also proposed for Issue 1-5-1-B. |
| CATT | We propose to separate GEO and LEO. For GEO, P1 enhancement as HST is not needed while P2 can be accepted. For LEO, there is no evidence of P1 and P2. Open to discussion for LEO.  |
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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-AProposal 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. |
| Qualcomm | Proposal 1: Support Option 1-AProposal 2: Support Option 1-A. We do not think ‘Higher priority search’ is anyway not much applicable for LEO measurement cells. To us, the scenario, if configured and used, is when a higher priority target measurement carrier is TN or GEO irrespective of satellite type that UE is monitoring paging channel from. Therefore, we don’t think any change is really necessary compared to TN or GSO cases. Besides, anyway, the thresholds and carriers are controllable by NW.Proposal 3:We are not sure if we can explicitly preclude mixed satellite cases. If this is agreeable to the group, it is okay to us. |
| Huawei | On proposal 1 (GEO) and 2 (LEO), suggest M\_layers = N\_layers and K is based on system information, but we can compromise to option 1-A if majority companies prefer to use TN value 60s.Support proposal 3 for Rel-17 to simplify the requirement definition, but we are open to other views if mixed satellite scenario is considered for deployments. If proposal 3 is not agreeable, we would need to consider the scenario where serving and neighbour cells are with different satellite types, and different neighbour cells are with different satellite types. |
| Intel | Regarding proposal 3 first, we support it. Then for both GEO and LEO, we don’t see the need of specifying new K value. We support option 1-A in both cases. |
| LGE | We support option 1-C, 1-D, 2-C and 2-D. Note that the set of K values in our proposal is an example value. For flexibility, we think value of K can determined by system information (i.e. distance between UE and reference location and remaining service time). |
| ZTE | We support 1-A and 2-A for GEO and LEO. |
| Xiaomi2 | We have one question for clarification, how does UE know the NTN NW deployment, e.g. GEO, LEO earth moving, or LEO earth fixed? If we define different requirements for GEO and LEO, how does UE apply these requirements? |
| Apple | We support option 1-A for proposal 1 and option 2-A for proposal 2. We think last meeting’s agreement may be still applied for higher priority search, otherwise the requirement would be very complicated for different satellite types and needs to differentiate the conditions of whether UE knows target satellite type or not. On the other hand, the mobility requirement is not so sensitive for higher priority search before reselection measurement initialization since anyway the serving cell quality is still good, e.g., in HST scenario, we didn’t shorten this higher priority search delay either.For proposal 3: we can support option 3-A as baseline for simplicity. |
| CATT | For GEO P1: option 1-A.For LEO P2: we propose to use value <60. UE stays in the cell is much smaller than 60s. No meaning for maintain 60s requirements. We propose [5] because if dwelling time is about 10s~20s, UE can search for higher layers not once time. but we are open for other proposed value.  |

**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. |
| Qualcomm | Proposal 1: Support Option 1-B.Proposal 2: Support Option 2-B.We agree that there can be cases where we can further optimize the interruption requirements. However, given the time left and differences between options and proposals do not look not much significant, we do not want to make it more complicated compared to the legacy requirements. |
| Huawei | We think the question is when the additional time Tsearch is needed and how long it is.On when Tsearch is needed, we support option 1-C. Basically the intention is same as option 1-D, i.e. Tsearch is not needed when the target cell is known, and option 1-C is defining when target cell is considered as known.On how long Tsearch is, we are fine to re-use the HO requirements and side conditions as starting point.  |
| Apple | Support option 1-B for proposal 1 and option 2-B for proposal 2. We also agree that the neighbor cell searching time margin shall be considered as extra delay when the satellites between serving and target are different or are of different types. |
| CATT | Support option 1. We don’t think Tsearch is needed for maximum interruption in paging reception. If the target cell in unknown, UE should not stop receiving paging in serving cell.  |
|  |  |

**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. Update:Answer to QC: we don’t want new ‘measurement relaxation’ in NTN. ‘Measurement relaxation’ are historical texts to describe existing M1 and M2 which are scaling factor to protect POs when DRX cycle is short.The intention of the proposal is to protect POs for the cases where UE is configured with multiple SMTCs, considering that choices of current M1, M2 and corresponding DRX cycles corresponds to one SMTC. It’s natural to scale M1 and M2 with SMTC increment in NTN, otherwise reselection requirements for NTN is too stringent compared to TN. Another reason for allowing relaxation (scaling up) is that the SMTC can be shifted and it may overlap with the PO. The UE should still monitor paging but is allowed to extend the measurement period. We can also state in the spec that the UE shall monitor paging even when one or more configured SMTCs overlap with the PO. In this case the UE is allowed to extend the measurement period e.g. by number of DRX cycles corresponding to number of POs overlapped with SMTCs.Bracket in proposal is an example,M1=[2.5] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second M2= [2] if SMTC periodicity (TSMTC) > 20 ms and DRX cycle ≤ 0.64 second It can be a fixed number when more than one SMTC or a number scaling with SMTC number UE measured.  |
| Qualcomm | Based on our reading of the analysis and figures depicted in “R4-2204724” the intent of the proposal is not really about requirement relaxation. If this is to protect POs for the cases where UE is configure dwith multiple SMTCs, the poroposal is okay to us in principle. However, we are not sure if the proposed values and conditions really address the issue. It would be appreciated if the proponent of the proposal can elaborate on the proposal and confirm our understanding. |
| Huawei | Suggest FFS, the reason to change from TN requirements is not fully clear to us even after reading proponent’s paper.  |
| Apple | Proposal 1 is not necessary in our view. The SMTC shifting is mainly because satellite moving in NTN scenario, e.g., LEO, and for such measurement on LEO it’s not desirable to let UE have such measurement relaxation. We support to consider legacy measurement without relaxation as baseline. On the other hand, SSB has smaller periodicity than PO cycle, UE can still perform SSB measurement if the target SSB is colliding with PO and UE is not able to simultaneously receive PO and SSB. |
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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? |
| Huawei | We are fine with proposal 1.  |
| LGE | We prefer condition that “longer than a ‘network-configured threshold” instead of “longer than a ‘network-configured threshold + GNSS measurement margin” since the GNSS error can be both positive and negative value. For example, if the actual distance is 100m, the GNSS estimated distance can be [50m 150m]. So ‘adding' the GNSS margin to the threshold may not be appropriate.Also, since the threshold value can configured with considering the GNSS error by NW, we prefer following: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’. |
| Apple | Support proposal 1. Like RSRP measurement, Hysteresis is configured based on network coverage uncertainty but not directly reflect the UE measurement performance. Here, the margin for GNSS measurement serves the same purpose of RSRP reselection measurement margin. We are considering RRM+location triggered reselection, but UE measurement could be triggered by location condition based on RAN2 agreements. 1. Location information can be used to determine when to start measurement.
2. UE may choose not to perform neighbour cell measurements of “NR intra-freq or inter-freq with equal or lower priority, or inter-RAT freq with lower priority”, if (the distance between UE and serving cell reference location is shorter than a threshold) and (legacy Srxlev/Squal condition is met, i.e., serving cell’s Srxlev/Squal is better than a threshold).
3. Location-based measurement initiation is only applied if the cell broadcasts location-related parameters (e.g. a threshold) and by implementation the UE has location information.
 |
| CATT | Fine with P1.  |
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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 ignalling 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. |
| Qualcomm | We don’t have a strong view on this. To us, it is just a matter of text and which parameter will include what. Overall delay should be anyway the same no matter what option we take.For test applicability, as long as the principle does not violate the spirit of RAN2 design, any options are okay with us.Having said that, if we pick options that we prefer,* Tevent\_DU: Option 1-C
* Tmeasure: Option 2-C
 |
| Huawei | We suggest to re-use the TN requirements as much as possible. It is true that the RSRP condition can be met earlier or later than the time or location condition, but for defining requirements we suggest to assume the worst case where RSRP condition is met later, so Tmeasure starts after Tevent\_DU. If this assumption is agreeable, then the only change we need for time or location based CHO is to update the definition of Tevent\_DU, so we prefer * Tevent\_DU: option 1-C
* Tmeasure: option 2-B, which we assume is same as TN

We do not see strong need to define other restrictions.  |
| Intel | We could compromise to Huawei proposals.We assume that Tmeasure follows TeventDU and TeventDU covers the uncertainty brought by condition emerging.But we would like to check the group views on agreeing to not specifying test cases for location based CHO delay requirements. |
| Apple | We support:* + Tevent\_DU: Option 1-A
	+ Tmeasure: Option 2-A

For option 1c of Tevent\_DU + option 2c of Tmeasure, if the T1 is start after legacy Tevent\_DU+ Tmeasure, shown as below, then the Tmeasure would be unnecessary in the equation because T1 is the starting of CHO and T1 is also the ending of new Tevent\_DU.In our understanding, we only need to check if the T1 is before or after the timing point when ‘UE identified target cell met RRM condition’, because RAN2 defined that CHO can be executed only between T1 and T2; that is, it makes more sense to check the T1 and the tentative CHO execution timing(‘tentative’ means UE meets the RSRP/RSRQ condition and check if T1 is met).If T2 is earlier than UE identified the RSRP is qualified, then no CHO shall be executed. |
| Nokia | Tevent\_DU: Option 1-CTmeasure: Option 2-D |
| CATT | Tevent\_DU: option 1-B and option 1-C. our understanding, they are similar. The time should be after the point of both of the conditions are met. So option 1-C means “the latter” is fine for us. Tmeasure: it is the same as legacy requirement. For option 2-c, the description is right but unnecessary. Tmeasure is after the end of Tevent\_DU which means the conditions are met. For option 2-A, T1 is earlier than end of Tevent\_DU. no such case of T1 is later than end of Tevent\_DU.  |

**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 hreshold 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 hreshold(l1) dimensioned by neighbor cells, UE needs to arrange measurement mechanism togetherwith multiple times (t1, t2) and locations hreshold(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.Update:We miss ‘the condition for location or time is met’ in Option2-A. The condition shall be fulfilled firstly. |
| Qualcomm | We are not negative to Option 2-B, but want to see the details about how Option 2-B works for the case that is mentioned by Ericsson. |
| Huawei | Support option 2-B.On option 2-A, we think it may be too aggressive. If time or location condition is configured but has not been met, we think it is better for UE to do normal measurement instead of prioritizing the target cell.On the scenarios mentioned by Ericsson, we understand there are multiple target cells for which the time or location conditions are met. We have no strong view, and UE can prioritize measurement for all target cells, or UE can prioritize measurement for the cell which meets the condition first, and either way is fine for us.On option 1, we do not think the measurement prioritization can be left NW implementation, e.g. there is no signaling to enable UE to report NW when the time or location condition for a target cell is met. Even there is, it basically falls back to normal HO with UE reporting and NW reconfiguration, and the benefit of CHO (reduced latency and reduced signalling overhead) is compromised. |
| Nokia | Option 1. |
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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

|  |  |  |
| --- | --- | --- |
| 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*** $\left⌈\frac{NW configured SMTC number per SMTC period}{UE supported SMTC number per SMTC period}\right⌉$***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? |
| Qualcomm | If we are not wrong, the following bullets are already confirmed by RAN2 reply LS.* 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

Regarding the following bullet under Option 1, UE may not always able to measure cells in multiple overlapping SMTCs if those are for LEO because of different Doppler shifts.* 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.
 |
| Huawei | We understand this issue is about UE measurement capability in number of SMTCs per layer. If so, we think RAN4 does not need to further discuss, since RAN2 has made the conclusion: 2 is mandatory and 4 is optional.The number of SMTCs for measurement requirement is another issue and should be discussed in Issue 3-1-4B. On moderator’s suggestion, we have a different view – the number of SMTCs is not necessarily same as number of satellites, e.g. more than one satellites can be measured with an SMTC. |
| MTK | In our understanding, that the number of SMTCs per frequency layer could be different from the number of satellites UE can monitor, e.g. if one SMTC contains signals from 2 satellites. Because the capability of the number of target satellites was agreed in RAN4-101-bis-e (R4-2202637) as* Minimal requirements on the number of target satellites UE needs to monitor is [2] including serving LEO satellite if applicable.

The measurement delay requirement for multiple satellites may need to be scaled up, as disused in issue 3-1-4B. For the number of SMTCs per frequency layer, not very sure which part RAN4 should further clarify.  |
| Intel | According to the RAN2 LS, it is mandatory for the UE to operate with 2 SMTC configurations at the same time while 4 can be the maximum number of those configurations for powerful UE-s.Thus a RAN4 feature group is needed in the feature list to address this issue. Since we are sending the feature list on this Friday so please moderator consider to contact CMCC to facilitate addition. |
| LGE | Based on RAN2 agreements, 2 SMTC is mandatory and 4 SMTC is optional capability. |
| Apple | Proposal 4. We agree the 2SMTC is mandatory capability and 4 is optional. But when assuming SMTC num=2, that doesn’t mean UE has to use 2 SMTCs because that’s up to the different configuration scenarios. If the SMTCs configured per measurement object for specific *ssbFrequency* are for intra-frequency measurement without MG for NTN measurement, RAN4 needs to consider the impact of using multiple SMTCs, e.g., scheduling restriction in SMTCs. In typical SMTC configuration of 20ms, the worst scheduling restriction (due to mixed numerology in FR1) is UE cannot receive or transmit within the whole SMTC window of 5ms, and therefore the total loss due to scheduling restriction is 5/20=25%.That is, we think it makes no sense to let UE support 2SMTCs with scheduling restriction if the SMTC periodicity is 20ms, but UE may still be able to support 2SMTCs when SMTC periodicity is 40ms and above. |
| Nokia | Support Proposal 3 as RAN4 should follow RAN2 agreements.  |
| CATT | We don’t think proposals are very different. Based on RAN2’s feedback, 2 SMTC is mandatory. And 4 is optional depends on UE capability.  |

**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.  |
| Qualcomm | Proposal 2 is okay with us. |
| Huawei | Support proposal 2, which also includes proposal 1.To Ericsson: our assumption on the last bullet is 2 SMTC (baseline for Issue 3-1-1) and 2 satellites per SMTC (advanced UE capability in parallel receiving from multiple satellites). We are open to discuss other values like 6.  |
| MTK | Fine with Proposal 2. |
| Apple  | Fine with proposal 2. |
| CATT | Fine with P2. |
|  |  |

**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? Update:We prefer MTK’s proposal: “cells belonging to different satellite as the serving cell” can be clarified as “when either serving cell or neighbor cell belongs to NGSO”.  |
| Qualcomm | We propose to further clarify that 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.

For the second issue, [] can be removed. |
| Huawei | * 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?

Yes, we are fine with the suggested applicability. * Please also share your views on this. It is moderator’s understanding that L1 measurements is included in the normal operation.

Agree that L1 measurements is included in the normal operation.* Please also share your views on the following FFS point.

We think both intra- and inter-frequency measurement are applicable, and this is why we suggest to phrase the main bullet as “measurement outside MG”. |
| MTK | * To our understanding, the concern is from Doppler shift in LEO, thus “cells belonging to different satellite as the serving cell” can be clarified as “when either serving cell or neighbor cell belongs to NGSO”
* We are fine to remove [] to confirm L1 measurements.
* Scheduling restriction is mainly due to intra-frequency measurement, while UE is required to perform data reception on the serving CC. For inter-frequency without gap, more clarification would be needed, because not very clear to us why a UE can support the inter-frequency without gap but it would still need scheduling restriction.
 |
| Intel | * 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?

Yes. There is no need to differentiate between NGSO and GSO regarding UE capability. Are we specifying enhanced requirements only for the cases when either cell is NGSO? Lets not complicate things to much.* Please also share your views on this. It is moderator’s understanding that L1 measurements is included in the normal operation.

Agree that L1 measurements is included in the normal operation.* Please also share your views on the following FFS point.

We think both intra- and inter-frequency measurement are applicable, and we agree to phrase the main bullet as “measurement outside MG”. |
| LGE | For ‘cells belonging to different satellite as the serving cell’, we think it means either serving or neighbor cells belongs to NGSO. And for L1 measurement, after checking, we are fine to remove [ ]. And we think capability applies for intra-frequency and/or inter-frequency measurements |
| Xiaomi2 | * 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.

[Xiaomi]: yes, UE can perform measurements on cells belonging to different satellite as the serving cell. And the NTN deployment type is transparent to UE.* 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.

[Xiaomi]: Agree L1 measurement is included in the normal operation.* Please also share your views on the following FFS point.
	+ FFS whether the capability applies for intra-frequency and/or inter-frequency measurements

[Xiaomi]: the intra-frequency and inter-frequency measurement is applicable if this capability is applied to the measurement outside MG.  |
| Apple | 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?* We agree with QC’s view, as long as either serving cell or neighbor cell belongs to NGSO, the following applies:
	+ 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.
	+ Fine to remove [] for L1 measurement, and we assume this L1 measurement represents for RLM/CBD/BFD/L1-RSRP
* Please also share your views on the following FFS point.

We think firstly we need to discuss if NTN considers feature of “intra-frequency without MG”. If yes, then agree with Huawei. |
| Nokia | From the above agreement, the satellite should include 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.
 |

**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 $\left⌈\frac{NW configured SMTC number per SMTC period}{UE supported SMTC number per SMTC period}\right⌉$
	+ 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 GEOUpdate:With respect to Issue 3-1-4A, define UE capability for supporting parallel measurement of more than 1 satellites in an SMTC.If UE can support parallel measurement of more than 1 satellites in an SMTC, it’s unclear to us why scaling factor is needed for overlapped SMTC, UE’s computation complexity? |
| Qualcomm | * 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
		- Oaky with Option 1 (not needed) and Option 2 (proportional to the number of SMTCs)
	+ If SMTCs partially overlap with each other, a scaling factor of measurement period is
		- Okay with Option 2.
* For GEO, the same view as above.
 |
| Huawei | * + If SMTCs do not overlap with each other, a scaling factor of measurement period is

If only 2 SMTCs are considered, no scaling is needed.If more than 2 SMTCs are considered, scaling factor = 2.* + If SMTCs partially overlap with each other, a scaling factor of measurement period is

If only 2 SMTCs are considered, scaling factor = 2.If more than 2 SMTCs are considered, FFS. There can be many cases e.g. SMTC1 and SMTC2 are overlapping, but SMTC3 and SMTC4 do not overlap with any other SMTCSMTC1 and SMTC2 are overlapping, SMTC3 and SMTC4 are overlapping…In addition to the scaling due to multiple SMTCs, we suggest to also define scaling due to multiple Doppler frequencies:* + 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.
 |
| MTK | When UE is configured with multiple SMTCs on the same measurement carrier (not more than UE capability),* Case 1: If SMTCs do not overlap with each other, a scaling factor of measurement period is
	+ Fine with Option 1 (not needed) and Option 2 (proportional to the number of SMTCs)
* Case 2: If SMTCs partially overlap with each other, a scaling factor of measurement period is
	+ Fine with Option 2.

However, for LEO, we observed that the relationship between SMTCs are time-vary, so the relationship could be dynamically switching between Case 1 and Case 2. Thus it would be more preferable to have a common solution for both cases. I.e. support Option 2 for the both cases. And agree with Huawei’s suggestion on measurement period is scaled if UE is required to measure more than one satellites per SMTC. |
| LGE | If SMTCs do not overlap with each other, a scaling factor of measurement period is- support option 1.If SMTCs partially overlap with each other, a scaling factor of measurement period is- support option 2. |
| Apple | * 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 or Option 2 based on different SMTC periodicity configuration, e.g., 2 SMTCs (5ms+5ms) with scheduling restriction if the SMTC periodicity is 20ms, then it would be desirable to scale the measurement period to allow UE only measure 1SMTC per 20ms.
		- Without scheduling restriction consideration, option 1 is fine.
	+ If SMTCs partially overlap with each other, a scaling factor of measurement period is
		- Option 2: proportional to the number of overlapping SMTCs. And same as above bullet, the scheduling restriction cap and SMTC periodicity shall also be considered. Like in the following figure, SMTC 1 overlapped with SMTC 2, SMTC 3 overlapped with SMTC 4, after we picked SMTC1 and SMCT3 for first measurement cycle, and SMTC2 and SMCT4 for 2nd measurement cycle, we also need to consider if 2 SMTCs in a measurement cycle would cause scheduling restriction greater than a threshold, e.g., 25%; if total scheduling restriction is greater than this threshold, we need to do further scaling.
		- Without scheduling restriction consideration, option 2 is fine.

 |

**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.  |
| Qualcomm | * For UE in RRC Connected mode:
	+ Option 1: No requirements are expected for SSB outside of SMTC
* For UE in RRC Idle/Inactive mode:
	+ UE can measure SSBs outside of SMTC. The way we see RAN2 discussion, SMTC information provided in RRC Idle/Inactive mode is used only to obtain initial SMTC window positions in time. And the obtained SMTC window positions can be adjusted UE autonomously, i.e. effectively floating SMTC windows. Therefore, we don’t need to differentiate whether SSBs are within SMTC or not.
 |
| Huawei | For UE in RRC Connected mode, support Option 2On option 1, is UE still expected to measure SSB outside SMTC? For example, do we need to consider it in scheduling restriction?For UE in RRC Idle/Inactive mode, FFS.We understand that UE based solution is considered by RAN2 for idle/inactive mode, but we are not sure at this stage whether it means UE is expected to measure SSB outside SMTC. |
| MTK | * For UE in RRC Connected mode:
	+ Option 1: No requirements are expected for SSB outside of SMTC

For UE in RRC Idle/Inactive mode: FFS |
| Intel | Regarding connected mode, option 2 is better and we need to specify that the UE is not required to measure SSB outside SMTC.Regarding idle/inactive modes, we slightly prefer not to have new behaviour but it kind of subjects to RAN2 discussion. |
| LGE | In connected mode, option 1 is preferred. In idle mode, further discussion is needed. |
| Apple | * For UE in RRC Connected mode:
	+ Option 1: No requirements are expected for SSB outside of SMTC
* For UE in RRC Idle/Inactive mode:
	+ FFS
 |
| CATT | * For UE in RRC Connected mode:
	+ Option 1: No requirements are expected for SSB outside of SMTC
* For UE in RRC Idle/Inactive mode:
	+ FFS
 |

**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.  |
| Qualcomm | Support Option 1-B.Prefer Option 2-B. |
| Huawei | For UE in RRC Connected mode, support Option 1-AFor UE in RRC Idle/Inactive mode, FFS and open to both option 2-A and 2-B. One question for option 2-B is how to define the requirements. |
| Intel | Regarding connected mode, we support option 1-A. we are not sure about connected mode following idle mode behaviour since the UE needs to cope with scheduling from time to time.Regarding idle mode, we support 2-B to leave it to UE implementation. |
| LGE | We support option 1-B based on option 1-A. In idle mode, option 2-B is preferred. |
| Apple | * For RRC Connected mode:
	+ Both Option 1-A and Option 1-B are fine to us.
* For RRC Idle/Inactive mode:
	+ Option 2-A. The cons of 2-B we see is UE may not measure some SMTCs throughout the all time and network cannot determine which SMTCs would be ignored by UE.
 |
| CATT | RRC Connected mode, support Option 1-ARRC Idle/Inactive mode, option 2-B. FFS: how to choose SMTCs.  |
|  |  |

**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. |
| Qualcomm | Support Option 2-B. For the SMTC collision condition, if needed, we can consider a value of [X] between SMTCs, and X can be determined later. |
| Huawei | * A condition of SMTC collision

Agree to define the condition based on proximity, but prefer to keep the exact value TBD.* UE measurements in overlapped SMTCs

Support option 2-B, and this sub-issue seems addressed in Issue 3-1-4B. |
| MTK | Support Option 2-B*.* |
| Intel | Before we go into this discussion, we would like to clarify on one issue: is every SMTC configuration corresponding to a certain SSB burst from a certain cell and this mapping is guaranteed by RRC? If so, does UE measure in one of the SMTC windows to only look for the corresponding SSB? |
| LGE | In case SMTCs are overlapped, scaling factor for requirements could be used |
| Apple | * A condition of SMTC collision
	+ Fine to define the proximity condition, same view as HW that value could be TBD
* UE measurements in overlapped SMTCs
	+ Option 1 and option 2-B.
 |
| CATT | UE measurements in overlapped SMTCs: option 1.  |

**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 adoptedProximity condition for overlapping For FR1 is 4msUpdate:* For UE supporting two MGs
* Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted
* Concurrent MG shall use priority rule to deal with overlapped MG, it is suitable for MGs with different periodicity. But in NTN, MGs are configured with same periodicity and different offsets in most cases. In this case priority rule of MG is unrealistic.
	+ If one MG for legacy(TN), the other MG for NTN
		- priority rule by R17 concurrent MG item can be applied.
	+ If two MGs for NTN
		- Sharing rule in concurrent MG item can be applied.
		- In concurrent gap session, the proposal for sharing rule is as follow:
			* Request RAN2 to reserve some RRC signalling for different sharing factors.
			* The signalling design may consider sharing ratios 0%, 25%, 50%, 75% and 100% for both per UE gap and per FR gap
			* Rel-17 requirements will only consider sharing ratios 0% and 100%.
			* The requirements for other sharing factors are FFS in later releases.
			* FFS whether the resume scheduling on those dropped gaps as well as the impact to other intra-frequency measurements(Please note that RAN4 concurrent gap session had already agreed that data scheduling is assumed, but we think this issue should be revisited in NTN)
 |
| Qualcomm | * For UE supporting one MG
	+ Eitehr option is okay
* For UE supporting two MGs
	+ Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted
		- For modification of MG Colliding/Proximity condition, if needed, we can consider a value of [X] between MGs, and X can be determined later.
		- Exclusion of enhancement related to positioning application
		- Exclusion of enhancement related to FR2
 |
| Huawei  | * For UE supporting one MG
	+ Option 2
* For UE supporting two MGs
	+ Fine with Moderator’s suggestion
 |
| MTK | For UE supporting one MG* Support Option 1 ,

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
	+ Scalling factor due to overlapping MG
 |
| LGE | Based on GTW agreements, depending on capability, one or two MG could be configured. For Rel-17 NTN, we prefer to define requirements with MGs in case there is no overlapping between MGs since priority solution of Rel-17 MG enhancement when MGs are overlapped is not clear to apply NTN case |
| Xiaomi2 | * For UE supporting one MG
	+ Either option is fine to us.
* For UE supporting two MGs
	+ Except the following aspects, outcome of on R17 concurrent MG item will be directly adopted
		- For modification of MG Colliding/Proximity condition, if needed, we can consider a value of [X] between MGs, and X can be determined later.
		- Exclusion of enhancement related to positioning application
		- Exclusion of enhancement related to FR2
 |
| Apple | * For UE supporting one MG
	+ Support option 1.
* For UE supporting two MGs
	+ Agree with MTK
 |

**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** |
| LGE | We think there are energy efficiency and RRM performance issue, if SMTC/MG is configured without considering the elevation angle. So, we think the report of UE assistant information (propagation delay difference) could be deferred until the satellite is located at the lowest elevation angle.For clarification, we are fine to ask RAN2 about the elevation and SMTC/MG related issue. If RAN2 does not consider elevation angle to configure SMTC/MG, RAN4 will continue to discuss our proposal as a baseline. We also open to discuss other methods to resolve the above elevation angle related issue. |
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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.

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| 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. |
| Huawei | FFS, suggest to align companies’ understanding on the RAN2 agreement quoted by Xiaomi, i.e. whether it means no relaxation as in TN is considered. |
| Apple  | Fine with Xiaomi’s proposal. |
| Nokia | Support the recommended WF. |
| CATT | Support Recommended WF. |
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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. |
| Huawei | Option 2. |
| MTK | Support Option 1. In our understanding, it is for the “serving” SIB reading time to acquire the necessary information for measurement, e.g. ephemeris, rather than reading neighbor cell’s SIB. In Option 2, it will be ambiguous that UE is required to fulfill the measurement requirement even when the SIB info is not yet decoded/available by the UE. Serving cell SIB reading is more frequently than TN and UE needs to update it from time to time. |
| Apple | We disagree with option 1 and 2. RAN2 agreed in their LS that,RAN2 assumes all the information needed for measurement and handover would be provided to the UE by the network. If any of the information is not available or is not valid, then the UE would have to acquire the system information of the target or neighbor cell which is not desirable from handover interruption time point of view.RAN2 thought it’s not desirable to let UE to acquire the SI of neighbor cell for HO, and it’s most likely network would provide such essential information to UE for HO and measurement. Thus, we propose: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. |
| CATT | Our proposal 1 means: if there is no information for measurement, UE needs to do the SIB reading and measurement then. It should be counted into the measurement whole procedure time.  |
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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
 |
| Huawei | * Support enhanced (e.g. TN HST) Idle/Inactive mode cell reselection requirements for LEO
* (GTW agreement) Perform measurements on cells belonging to different satellite as the serving cell in parallel with normal operation of serving cell without scheduling restrictions.
* Perform measurements on more than one (suggest 2) neighbor cells belonging to different satellites in parallel without scaling.
* Measurement for more than 2 (suggest 4) LEO satellites per carrier
* (GTW agreement) support 2 MGs
 |
| Intel | * Support performing measurements on different numbers of target cells within multiple SMTCs on a single carrier (RAN2 mandated 2 and made 4 optional)
* Support different numbers of parallel measurement gaps
* Support performing measurements on cells belonging to different satellite as the serving cell at the same time with normal operations in serving cell
 |

# 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

Huawei: to Ericsson, FR2 was included considering cell reselection from NTN cell to an FR2 TN cell, but we are fine to remove if all companies have the same view. |
| R4-2204241 | Xiaomi |  |
| R4-2204297 | OPPO |  |
| R4-2205378 | Huawei, HiSilicon |  |
| R4-2205958 | Apple |  |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
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**Existing tdocs**

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

## 2nd round

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

Contact information

|  |  |  |  |
| --- | --- | --- | --- |
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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)