**3GPP TSG-RAN WG4 Meeting # 108bis R4-2317280**

**Xiamen, China, October 09 - October 13, 2023**

**Agenda item:** 5.34.3 and 5.34.4

**Source:** Moderator (Huawei)

**Title:** Ad hoc minutes for [108bis][230] Netw\_Energy\_NR

**Document for:** Information

# Introduction

Following topics are suggested to be discussed in ad hoc discussion

* Topic #1: Core: SSB-less SCell operation
	+ Issue 1-2-3: Power difference conditions for scenario 1
	+ Issue 1-6-1: Reference Cell
	+ Issue 1-6-2: Reference Cell indication
	+ Issue 1-6-3: SSB-less Cell indication
	+ Issue 1-4-1: Whether to have L1 measurement on SSB-less SCell
	+ Issue 1-5-1: L3 RRM requirements
* Topic #2: Core: RRM impacts of other objectives
	+ Issue 2-1: RRM impacts of Cell DTX/DRX – general
	+ Issue 2-2: RRM impacts of Spatial and power domain techniques
* Topic #3: Perf: Performance part for NES
	+ Issue 3-1-1: Work plan for NES perf part

# Topic #1: Core: SSB-less SCell operation

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

### Sub-topic 1-2 Feasibility conditions

**Issue 1-2-3: Power difference conditions for scenario 1**

*For* ***reception******power difference*** *conditions, following agreements were reached in RAN4#108 R4-2314381*

|  |
| --- |
| **Issue 1-2-2: Power difference conditions for scenario 1**Proposals:* + Proposal 1: The reception power difference shall be within 6dB. (Apple, MTK, CMCC, Intel, SS, Huawei, Vivo, Ericsson, ZTE, LGE, CATT)
		- Proposal 1a: For a UE using single RF chain, the difference of reception power with the reference cell selected from FR1 inter-band active serving cells is within 6dB (SS, Ericsson)
		- Proposal 1b: (Vivo)
			* The difference of Tx power with the FR1 inter-band active serving cell is within 6dB, and the same UE RF chain is used for the SSB-less SCell
	+ Proposal 2: The reception power difference can be larger than 6dB. (QC, CMCC, SS, Huawei, Ericsson, Nokia, vivo)
		- Proposal 2a: for a UE using dual RF chains, the difference of reception power with the reference cell selected from FR1 inter-band active serving cells is within 6dB+Y, the value of Y is TBD. (SS)
		- Proposal 2b: If UE can support TRS-based AGC adjustment, there is no power difference limitation. (Huawei)
		- Proposal 2c: (QC, LGE)
			* NW provides explicit information about transmit power offset between reference cell and SSBless SCell, where transmit power offset = transmit power of RS on reference Cell – Transmit power of RS on SSBless SCell.
			* If NW provide transmit power offset information, RAN4 does not need to define side condition of AGC for SSBless Scell operation.
		- Proposal 2d: (Ericsson)
			* For a UE using dual RF chains, the maximum power difference UE can handle is 25dB.
			* NW can indicate the power difference between the reference cell and target cell to UE to compensate the AGC gain
			* For a UE using dual RF chains, RAN4 to study whether UE can use TRS transmission in scenario 1 for computing AGC.
		- Proposal 2e: (Nokia)
			* RAN4 to discuss the feasibility and corresponding UE behavior when reception power difference is within 6dB and when reception power difference is larger than 6dB respectively.
		- Proposal 2f: (vivo)
			* The UE is allowed at least one CSI-RS based measurement for AGC adjustment on the SCell before or during the activation of the SCell. Such CSI-RS based measurement can be A-TRS, TRS, CSI-RS for mobility or CSI-RS for pathloss measurements.
 |

* Proposals
	+ Option 1: The difference of the reception power with the FR1 inter-band active serving cell is within 6dB. (CATT, LGE, CMCC, MTK, Xiaomi, Nokia, Huawei, Intel, CTC, Vivo, ZTE, Apple, SS)
		- Option 1a: When Received power difference between SSB-less SCell and reference cell within 6dB, no additional time is needed for AGC adjustment. (Huawei)
		- Option 1b: The difference of Tx power with the FR1 inter-band active serving cell is within 6dB, and the same UE RF chain is used for the SSB-less SCell. (Vivo)
		- Option 1c: The power difference should be within 6dB for single RF chain. (ZTE)
		- Option 1d: Separate UE capability can be considered for power difference condition as per BC basis. (SS)
	+ Option 2: The reception power difference can be larger than 6dB. (LGE, CMCC, Nokia, Huawei, Vivo, SS, QC, Ericsson)
		- Option 2a: If the reception power difference allowed to be larger than 6dB, NW should provide explicit information about transmit power offset between reference cell and SSBless SCell. (LGE)
		- Option 2b: When Received power difference between SSB-less SCell and reference cell less than 25dB, AGC is performed based on TRS/ATRS and additional time is needed for AGC. (Huawei)
		- Option 2c: The UE is allowed at least one CSI-RS based measurement for AGC adjustment on the SCell before or during the activation of the SCell. Such CSI-RS based measurement can be A-TRS, TRS, CSI-RS for mobility or CSI-RS for pathloss measurements. (Vivo)
		- Option 2d: The power difference is relaxed to 25dB for dual RF chain. (ZTE)
		- Option 2e: If A-TRS is adopted then 1) RAN4 does not specify reception power condition for SSBless SCell for inter-band CA operation and 2) the activation delay can be longer than 3ms. (QC, Ericsson)
		- Option 2f: Separate UE capability can be considered for power difference condition as per BC basis. (SS)
* Recommended WF
	+ Moderator: Based on the preproposal from companies, the status of supporting of following two sets of conditions are summarized in following Table (Y: support):
		- Set 1: Power difference shall be within 6dB
		- Set 2: Power difference could be larger than 6dB (can be relaxed to 25 dB or no need to specify the condition)

|  |  |  |
| --- | --- | --- |
| **Companies** | Set 1  | Set 2  |
| CATT | Y |  |
| LGE | Y | Y |
| CMCC | Y | Y |
| MTK | Y |  |
| Xiaomi | Y |  |
| Nokia | Y | Y |
| Huawei | Y | Y |
| Intel | Y |  |
| CTC | Y |  |
| Vivo | Y | Y |
| ZTE | Y | Y |
| Apple | Y |  |
| SS | Y | Y |
| QC |  | Y |
| Ericsson |  | Y |
| Set 1: 13 companies; Set 2: 9 companies: |

Moderator recommendation:

* Inter-band SSB less operation is feasible for reception power difference conditions Set 1 and Set 2, and the requirements can be defined separately.
* UE shall indicate the supported set(s) of reception power difference condition in UE capability.

**Online agreement Tuesday:**

|  |
| --- |
| Session Chair:Both Set 1 and 2 conditions are possible from network deployment perspective, and may have different conditions for different band combinations.* Set 1: The maximum received Power difference can be up to 6dB
* Set 2: The maximum received Power difference can be up to [X] dB, and X is larger than 6.

Agreement:For set 2 condition, TRS/A-TRS is needed for Scell activation * + Make conclusion in this meeting

For set 1 condition:* Further discuss whether TRS/A-TRS is needed and conclude in this meeting.
	+ Option 1: if it is not concluded as feasible to work without TRS/A-TRS for AGC SCell activation in this meeting, the same RAN4 minimal requirements will be applied for set 1 and set 2 conditions.
	+ Other options are not precluded.
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**Ad hoc discussion (Tuesday coffee break):**

**Moderator recommendation:**

* One set of condition (Set 2) and one requirement

ZTE: Object

Huawei: Support. Set 2 with one TRS for AGC.

Nokia: Support single (Set 2).

Ericsson: same as HW Nokia.

Apple: same as HW Nokia.

QC: Support one requirements.

OPPO: Unified requirements. Support.

LGE: Support.

Vivo: support

Samsung: Ok with single set of requirements based on worst case. Can FFS in future release.

ZTE: P-TRS cannot be saved for power saving.

Moderator: One company object to have only one set of requirement.

### Sub-topic 1-4 L1 measurement for SSB-less Scell

*For* ***L1 measurement****, following agreements were reached in RAN4#108 R4-2314381*

|  |
| --- |
| **Issue 1-4-1: Whether to have L1 measurement on SSB-less SCell**Proposals* + Proposal 1: L1 measurement on less SCell is not needed. (MTK, CMCC, CATT, Huawei, CTC, ZTE)
		- Proposal 1a: For SSB-less SCell activation, when the conditions about RTD, power imbalance and TRS are met, the L1/L3 measurement can be skipped (CATT)
		- Proposal 1b: No L1/L3 measurement on the inter-band SSB-less SCell (MTK)
		- Proposal 1c: When RTD, power difference conditions are ensured and CSI-RS based L1 measurement is not configured, L1 measurement on SSB-less SCell is not needed. (CMCC)
		- Proposal 1d: No new measurement requirement is specified for L1 or L3 measurements for SSB-less SCell operations. (Intel)
		- Proposal 1e: When CSI-RS based L1 measurement isn’t configured and the conditions of RTD/power difference/QCL indication defined above are fulfilled, L1 measurement on SSB-less SCell can be skipped. (CTC)
		- Proposal 1f: Sharing the L1/L3 measurement results between the SSB-less SCell and reference cell (ZTE)
	+ Proposal 2: CSI-RS based L1 measurement is needed on SSB-less SCell (Apple, CMCC, SS, Huawei, CTC)
		- Proposal 2a: RAN4 to assume no SSB but with CSI-RS resource for L1 measurement on the FR1 inter-band SSB-less SCell (Apple)
		- Proposal 2b: If the conditions are not met but CSI-RS based measurement is supported and configured, L1 measurement needs to be specified for SSB-less SCell operation. (CATT)
		- Proposal 2c: When CSI-RS resources for L1 measurement are configured, the legacy requirements for CSI-RS based L1 measurement can be reused for SSB-less SCell operation. (Huawei, CMCC, SS, CTC)
	+ Proposal 3a: RAN4 needs to discuss the impact on the CSI-RS based L1/L3 measurement requirements due to SSB-less SCell operation. (Nokia)
	+ Proposal 3b: RAN4 can study whether and how to perform RLM/BFD/CBD on the SSBless SCell based on reference Cell measurement. (QC)
 |

**Issue 1-4-1: Whether to have L1 measurement on SSB-less SCell**

* Proposals
	+ Option 1: L1 measurement on less SCell is not needed. (CATT, MTK, CMCC, Huawei, CTC, ZTE, QC)
	+ Option 2: If network configures CSI-RS based L1 measurements to UE, then UE should perform L1 measurements, the legacy requirements can be applied. (CMCC, Huawei, Intel, CTC, ZTE, Samsung)
	+ Option 3: CSI-RS based L1 measurement is needed. (Xiaomi, Apple)
		- Option 3a: For L1-RSRP measurement for SCell, two searchers are assumed and measurement period based on CSI-RS needs to be scaled by the number of SCell bands. (Xiaomi)
	+ Option 4: (Nokia)
		- The UE is not required to perform SSB-based L1/L3 measurements on the SSB-less SCells.
		- RAN4 needs to discuss the impact on the CSI-RS based L1/L3 measurement requirements due to SSB-less SCell operation
* Recommended WF
	+ - 13 companies support no RRM impact for L1 measurement for SSB-less operation:
			* Either L1 measurement is not needed or legacy L1 measurement requirements can apply when it is configured by NW.
		- 2 companies support CSI-RS based L1 measurement shall be configured for the SSB-less cell.

Companies please check whether following is agreeable:

* + - When RTD, power difference conditions are ensured and CSI-RS based L1 measurement is not configured, L1 measurement on SSB-less SCell is not needed
		- When CSI-RS based L1 measurement is configured, legacy requirements can apply.

**Ad hoc discussion (Wednesday):**

Moderator recommendation for Ad hoc:

* When CSI-RS based L1 measurement is configured, legacy requirements can apply.
* No RRM spec impact.

### Sub-topic 1-5 L3 measurement for SSB-less SCell

*For* ***L3 measurement****, following agreements were reached in RAN4#108 R4-2314381*

|  |
| --- |
| **Issue 1-5-1: L3 RRM requirements** Proposals* + Proposal 1: L3 measurement is no needed on SSB-less SCell (Appe, CATT, MTK, CMCC, Intel, SS, Huawei, ZTE, CTC)
		- Proposal 1a: For SSB-less SCell activation, when the conditions about RTD, power imbalance and TRS are met, the L3 measurement can be skipped (CATT).
		- Proposal 1b: The UE is not required to perform SSB-based L1/L3 measurements on the SSB-less SCells (Nokia).
	+ Proposal 2: If the conditions are not met but CSI-RS based measurement is supported and configured, L3 measurement needs to be specified for SSB-less SCell operation. (CATT)
		- Proposal 2a: CSI-RS based L3 measurement should be supported for the SSB-less SCell. The known/unknown condition of the SCell can be defined based on the L3 MR of the CSI-RS based L3 measurement. (Vivo)
	+ Proposal 3: (Nokia)
		- RAN4 needs to discuss the impact on the CSI-RS based L1/L3 measurement requirements due to SSB-less SCell operation.
 |

**Issue 1-5-1: L3 RRM requirements**

* Proposals
	+ Option 1: L3 measurement is no needed on SSB-less SCell (CATT, CMCC, MTK, Huawei, Intel, CTC, ZTE, Apple, Samsung, QC)
		- Option 1a: No new measurement requirement is specified for L1 or L3 measurements for SSB-less SCell operations. (Intel).
	+ Option 2: If the conditions are not met but CSI-RS based measurement is supported and configured, L3 measurement needs to be specified for SSB-less SCell operation. (CATT)
		- Option 2a: CSI-RS based L3 measurement should be supported for the SSB-less SCell. The known/unknown condition of the SCell can be defined based on the L3 MR of the CSI-RS based L3 measurement. (Vivo)
	+ Option 3: (Nokia)
		- The UE is not required to perform SSB-based L1/L3 measurements on the SSB-less SCells.
		- RAN4 needs to discuss the impact on the CSI-RS based L1/L3 measurement requirements due to SSB-less SCell operation
* Recommended WF
	+ No RRM impacts on L3 measurement for inter-band SSB-less operation.

**Ad hoc discussion (Wednesday):**

Moderator recommendation for Ad hoc:

* + No RRM impacts on L3 measurement for inter-band SSB-less operation.

### Sub-topic 1-6 Others

**Issue 1-6-1: Reference Cell**

* Proposals
	+ Option 1: (CMCC)
		- Introduce an optional indication for network to indicate which Cell/CC could be taken as reference cell during the SSB-less SCell operation. (Apple)
		- If network doesn’t indicate the reference cell, UE should first consider the PCell as the reference cell.
	+ Option 2: RAN4 not to restrict the reference cell for SSB-less SCell as PCell. (LGE)
	+ Option 3: Reference cell is a cell from the list of cells provided by NW (Ericsson)
* Recommended WF
	+ The reference cell is not restricted to PCell, and the selection/indication of reference cell will be discussed under other issues.

**Ad hoc discussion (Tuesday coffee break):**

**Agreement:**

The reference cell is not restricted to PCell. And the reference cell shall has SSB.

**Issue 1-6-2: Reference Cell indication**

* Proposals
	+ Option 1: Introduce an optional indication for network to indicate which Cell/CC could be taken as reference cell during the SSB-less SCell operation. (CMCC, Apple, QC)
		- Option 1a: (Apple)
			* Use RRC configuration of the frequency of the SSB to be used for the UE to obtain the timing reference for the inter-band SCell.
			* introduce an indication from network to UE to indicate which inter-band active serving cell or which SSB on inter-band active serving cell can be used as timing source for the SSB-less SCell. RAN4 needs to check with RAN2 for this solution.
			* introduce an indication from network to UE to indicate which inter-band active serving cell or which SSB on inter-band active serving cell can be used as AGC source for the SSB-less SCell.
		- Option 1b: UE capability for SSBless SCell should be defined per band combo where the band combo indicate the bands of reference cell and the SSBless SCell. (QC)
	+ Option 2: Network can inform UE which is reference cell through TCI state where TRS on the SSB-less cell is QCL-C with SSB on the reference serving cell. (Huawei)
		- Option 2a: (Apple)
			* Expand the definition of QCLed-typeC to indicate the RTD between the SSB-less SCell and the inter-band active serving cell is within a small range, e.g., ±260ns. RAN4 needs to check with RAN1 for this solution
			* if T/F information is reused from an inter-band FR1 serving cell, the AGC info of same inter-band FR1 serving cell can also be used for the target SSB-less SCell
	+ Option 3: (Ericsson)
		- RAN4 to agree that reference cell for deriving the coarse timing to be a cell from the list of cells provided by NW. How to select the cell from the list of reference cells can be FFS.
* Recommended WF
	+ Discuss above proposals.

**Ad hoc discussion (Tuesday coffee break):**

Huawei: Compromise to introduce indication from NW to UE.

Ericsson: Ok with indication for multiple reference cells.

ZTE:
QC: To have dedicate reference cell.
Nokia: If no indication, take PCell as reference cell.

Apple: To have dedicate reference cell.

**Ad hoc discussion (Wednesday):**

Nokia: UE will indicate the supporting per BC.

ZTE: CD-SSB/NCD-SSB

Apple: Not sure whether to discuss this in WI.

HW: CD-SSB is by default.

Ericsson: TAG

QC: PCell can also be indicated

Agreement:

* Introduce indication from NW to UE to indicate which cell is the reference cell.
* RAN4 will define “by default cell” as reference cell if the indication is not provided.
* Reference cell means the timing and AGC source of SSB-less Cell.
	+ FFS whether to consider the reference cell and QCL source cell are different.
		- Whether QCL is needed will be discussed in other issue.
* The details of the signalling is up to RAN2.
* If the reference cell is an SCell, it should be activated.
* RAN4 FFS the conditions for reference cell. (e.g. activated SCell)

**Issue 1-6-3: SSB-less Cell indication**

* Proposals
	+ Option 1: If the UE is not provided with SSB configuration (absoluteFrequencySSB) nor SMTC configuration for the SCell, this cell is regarded as SSB-less SCell. (Huawei)
	+ Option 2: RAN4 to agree to introduce NW flag to further indicate in which bands SSB less operation will be configured (Ericsson)
	+ Option 3: UE capability for SSBless SCell should be defined per band combo where the band combo indicate the bands of reference cell and the SSBless SCell. (QC)
* Recommended WF
	+ Discuss above proposals.

**Ad hoc discussion (Wednesday):**

Moderator recommendation:

* + Option 1: If the UE is not provided with SSB configuration (absoluteFrequencySSB) nor SMTC configuration for the SCell, this cell is regarded as SSB-less SCell.
	+ Option 2: Introduce indication from NW to UE to indicate which cell is the SSB-less cell.

FFS:

If the UE is not provided with SSB configuration (absoluteFrequencySSB) nor SMTC configuration for the SCell, this cell is regarded as SSB-less SCell.

Note: update the wording in RAN4 requirements for inter-band SSB-less.

# Topic #2: Core:

#  RRM impacts of other objectives

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

## Open issues summary

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

### Sub-topic 2-1 Cell DTX/DRX (Obj#2)

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1: RRM impacts of Cell DTX/DRX – general**

* Proposals
	+ Option 1: RRM requirements will not be impacted by cell DTX/DRX. (CMCC, Huawei, MTK, Nokia, Ericsson, Vivo)
		- Option 1a: For Cell DTX/DRX, no RRM requirement impacts on CSI-RS based measurement. This can be revised if RAN1 concluded the impact on more CSI-RS because of cell DTX/DRX. (MTK)
		- Option 1b: The CSI-RS based L3/L1/RLM/BFD measurements are not impacted by cell DRX/DTX and existing requirements still apply. (Nokia, MTK)
		- Option 1c: (Ericsson)
			* There is no impact to CSI-RS based measurement in Cell DTX/DRX.
			* RAN4 not to study the DCI-based Cell DTX/DRX activation/deactivation delay requirement since RAN1 had already discussed it.
		- Option 1d: For cell DTX/DRX, the impact to RRM requirements is not necessary. By gNB implementation, adjustment of CSI-RS measurement period by RRC is always possible, and therefore no impact to spec is needed. UE assumes CSI-RS occasions are still available if the CSI-RS periodicity/offset configuration indicates the availability of CSI-RS during cell DTX in-active period. (Vivo)
	+ Option 2: to indicate RAN1 that: (Apple)

Based on network configuration, Rel-18 UE supporting cell DTX does not expect to receive and/or process the following signals/channels from the gNB, during non-active periods of cell DTX:

* + - PRS
		- CSI-RS configured by measObjectNR (for RRM)
		- CSI-RS associated with RLM, BFD, CBD
		- Periodic/Semi-persistent CSI-RS for beam measurement

TRS is not impacted by non-active period of cell DTX.

* + Option 3: RAN4 is to discuss the interruption requirements due to changes in Cell DTX/DRX configurations. (Intel)
	+ Option 4: RAN4 to discuss how to mitigate the impact to SCell activation delay due to cell DTX/DRX. In the best case, the SCell activation delay shall not be interrupted or extended by the non-active periods of cell DTX/DRX. (Nokia)
* Recommended WF
	+ Moderator:

Based on submitted contributions, at least following can be agreed:

* + - There is no RRM impact to CSI-RS based measurement of Cell DTX/DRX.

FFS on option 2/3/4 during the meeting.

**Ad hoc discussion (Wednesday):**

Moderator recommendation:

* No RRM impact to CSI-RS based measurement of Cell DTX/DRX.

### Sub-topic 2-2 Spatial and power domain techniques (Obj#3)

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-2: RRM impacts of Spatial and power domain techniques**

* Proposals
	+ Option 1: There is no RRM impacts for spatial and power domain adaptation. (CMCC, Huawei)
* Recommended WF
	+ Agree on option 1.

**Ad hoc discussion (Wednesday):**

Moderator recommendation:

* There is no RRM impacts for spatial and power domain adaptation.

# Topic #3: Perf: Performance part for NES

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

## Open issues summary

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

### Sub-topic 3-1 Work plan for NES perf part

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 3-1-1: Work plan for NES perf part**

* Proposals
	+ Option 1: Agree on work plan for RRM performance part for NES in R4-2315646. (Huawei)
* Recommended WF
	+ Check whether work plan in R4-2315646 is agreeable.

**Ad hoc discussion (Wednesday):**

Moderator recommendation:

* Agree on the work plan in R4-2315646.