**3GPP TSG-RAN WG4 Meeting # 109 R4-2318153**

Chicago, US, November 13 – 17, 2023

**Agenda item:** 8.34.6

**Source:** Moderator (Huawei)

**Title:** Topic summary for [109] [147] Netw\_Energy\_NR

**Document for:** Information

# Introduction

The thread [109] [147] is on Rel-18 WI for NR Network energy savings (RP-230566).

In previous meetings, the following WFs were agreed: R4-2306639 (RAN4 #106-bis-e), R4-2310381 (RAN4 #107), R4-2314935 (RAN4 #108), and R4-2317738 (RAN4 #108bis).

The summary covers contributions submitted under the agenda items 8.34.1 BS RF requirements and 8.34.2 BS conformance testing requirements, which includes:

* Topic #1: Feasibility study for SSB-less operation
* Topic #2: RF requirements for Cell DTX
* Topic #3: RF requirements for spatial and power domain techniques
* Topic #4: BS conformance testing requirements

# Topic #1: Feasibility study for SSB-less operation

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **T-doc number** | **Company** | **Proposals / Observations** |
| 2 | [**R4-2318507**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip) | Huawei, Hisilicon | Discussion on BS RF requirement for NES  **Proposal 1:** There is no specific impact on the RF requirements for SSB-less operation for FR1 co-located inter-band CA.  **Proposal 2:** There is no need to define the band combination for SSB-less operation for FR1 co-located inter-band CA. |
| 3 | [**R4-2319111**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319111.zip) | LG Electronics UK | Discussion on RF impact from NES perspective  **Observation 1:** UEs that support inter-band CA have separate RF chains.  **Observation 2:** When configuring a single RF chain to support intra-band contiguous CA, the received power difference should be within 6 dB.  **Observation 3:** We need to clarify upper limitation of the received power difference for SSB-less inter-band CA operation.  **Proposal 1:** Depending on received power difference value, not all inter-band CA band for SSB-less operation can be supported. It is necessary to define band combination for SSB-less inter-band CA based on conclusion of the received power difference in RRM session. |
| 5 | [**R4-2320262**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320262.zip) | Nokia, Nokia Shanghai Bell | On BS RF requirements for NES  Proposal 1: RAN4 RF should not define the band combinations that support SSB-less SCell operation in the specifications. |

## Open issues summary

### Issue 1-1: Whether to define the band combination

*Background:*

*Following conclusion was captured in the* WF R4-2317738 at *RAN#108bis:*

* Tentative agreement:
  + There is no need to define the band combination for SSB-less operation.
* Proposals:
  + Option 1: No need to define the band combination (Huawei, Nokia)
    - Proposal 1: There is no need to define the band combination for SSB-less operation for FR1 co-located inter-band CA. ([R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei)
    - Proposal 2: RAN4 RF should not define the band combinations that support SSB-less SCell operation in the specifications.([R4-2320262](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320262.zip),Nokia)
  + Option 2: need to define the band combination ([R4-2319111](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319111.zip), LGE)
    - Proposal 1: Depending on received power difference value, not all inter-band CA band for SSB-less operation can be supported. It is necessary to define band combination for SSB-less inter-band CA based on conclusion of the received power difference in RRM session.
* Recommended WF
  + Check whether option 1 is agreeable in Rel-18 NES.

LGE: We can agree with Option 1. We need further discuss the feature list and condition to guarantee the NES operation.

Huawei: It can be covered by UE capability.

Agreement: No need to define the band combination

# Topic #2: RF requirements for Cell DTX

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **T-doc number** | **Company** | **Proposals / Observations** |
| 1 | [**R4-2318252**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip) | Fujitsu Limited | Discussion on BS requirements for Network Energy Saving  **Observation 1:** RAN2 agreement about how to configure the feature does not impact the RF specs.  **Proposal 1:** For Cell DTX ON/OFF, the requirement for transmitter transient period is not defined in Rel-18 NES. |
| 2 | [**R4-2318507**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip) | Huawei, Hisilicon | Discussion on BS RF requirement for NES  **Proposal 3**: No new RF requirements are needed for Cell DTX as the switch occurs within the transmission period and frequency range, without causing additional interference. |
| 4 | [**R4-2319799**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip) | Ericsson | Discussion on NES BS RF requirement  **Proposal 1:** The current transient period requirement can enable the cell DTX operation, and it is not necessary to introduce any new requirement or clarification on the existing one for cell DTX for the NES feature. |
| 5 | [**R4-2320262**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320262.zip) | Nokia, Nokia Shanghai Bell | On BS RF requirements for NES  Proposal 2: The existing BS transmitter transient timing period requirements could be used to enable C-DTX/DRX operation; new requirements are not needed. |
| 6 | [**R4-2320341**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip) | ZTE Corporation | Further discussion on RF requirement impacts from NES perspective  **Proposal 1:** for the cell DTX operation, to reuse the TDD ON-OFF transition requirement for it. |

## Open issues summary

### Issue 2-1: RF requirements for Cell DTX

* Proposals
  + Option 1: No need to define RF requirements for cell DTX. ([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu; [R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei; [R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson; [R4-2320262](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320262.zip), Nokia)
    - Proposal 1: For Cell DTX ON/OFF, the requirement for transmitter transient period is not defined in Rel-18 NES.([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu)
    - Proposal 2: No new RF requirements are needed for Cell DTX as the switch occurs within the transmission period and frequency range, without causing additional interference. ([R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei)
    - Proposal 3: The current transient period requirement can enable the cell DTX operation, and it is not necessary to introduce any new requirement or clarification on the existing one for cell DTX for the NES feature. ([R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson)
    - Proposal 4: The existing BS transmitter transient timing period requirements could be used to enable C-DTX/DRX operation; new requirements are not needed.( [R4-2320262](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320262.zip), Nokia)
  + Option 2: Reuse the TDD ON-OFF transition requirement for cell DTX ([R4-2320341](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip), ZTE)
    - Proposal 1: for the cell DTX operation, to reuse the TDD ON-OFF transition requirement for it. ([R4-2320341](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip), ZTE)
* Recommended WF
  + TBA

ZTE: when you have three CCs for CA and want to turn on one CC, is there any transition period needed? We propose to have transient period requirement.

Huawei: This is related to implementation. It is more like internal requirement for the modules. We do not see any benefit to define it a 38.104 requirement. It is different from TDD case.

ZTE: Once we have NES and we will have DTX operation. Without requirements, we may receive some complain.

Agreement:

* No need to define RF requirements for cell DTX.
  + Transient period may be needed on the CC when cell DTX is conducted on that CC
    - It is not expected to capture it in the TS

# Topic #3: RF requirements for spatial and power domain techniques

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **T-doc number** | **Company** | **Proposals / Observations** |
| 1 | [**R4-2318252**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip) | Fujitsu Limited | Discussion on BS requirements for Network Energy Saving  **Observation 2:** The feature for reducing gNB transmission power in some period has already been defined from Rel-15, but there has been no report about the negative impact due to the lack of the requirement for transmitter transient period so far.  **Proposal 2:** For the technique in spatial domain, the requirement for transmitter transient period is not defined in Rel-18 NES.  **Proposal 3:** RAN4 should firstly clarify the necessity of the requirement for transmitter transient period for the technique in power domain. If RAN4 cannot reach consensus, the requirement for transmitter transient period is not defined in Rel-18 NES. |
| 2 | [**R4-2318507**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip) | Huawei, Hisilicon | Discussion on BS RF requirement for NES  **Proposal 4**: No new RF requirements are needed for Spatial and power domain techniques. |
| 4 | [**R4-2319799**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip) | Ericsson | Discussion on NES BS RF requirement  **Proposal 2:** Considering the current agreements in other WGs, it is recommended not to introduce any new RF requirements or clarification on the existing one for spatial and power domain techniques for the NES feature. |
| 6 | [**R4-2320341**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip) | ZTE Corporation | Further discussion on RF requirement impacts from NES perspective  **Proposal 2**: to consider the necessity of switching period of efficient adaption of spatial elements and the DL EVM performance deterioration due to the switching behavior from network side. |

## Open issues summary

### Issue 3-1: RF requirements for spatial domain techniques

* Proposals
  + Option1: No need to define RF requirements for spatial domain techniques([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu; [R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei; [R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson)
    - Proposal 1: For the technique in spatial domain, the requirement for transmitter transient period is not defined in Rel-18 NES.([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu)
    - Proposal 2: No new RF requirements are needed for Spatial and power domain techniques. ([R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei)
    - Proposal 3: Considering the current agreements in other WGs, it is recommended not to introduce any new RF requirements or clarification on the existing one for spatial and power domain techniques for the NES feature. ([R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson)
  + Option2: Define RF requirements for spatial domain techniques ([R4-2320341](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip), ZTE)
    - Proposal 1: to consider the necessity of switching period of efficient adaption of spatial elements and the DL EVM performance deterioration due to the switching behavior from network side. ([R4-2320341](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320341.zip), ZTE)
* Recommended WF
  + Discuss necessity of the requirement and whether option 1 is agreeable.

Agreement:

* No need to define RF requirements for spatial domain techniques
  + Transient period may be needed on the CC when spatial domain techniques are conducted on that CC
    - It is not expected to capture it in the TS

### Issue 3-2: RF requirements for power domain techniques

* Proposals
  + Option1: No need to define RF requirements for power domain techniques([R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei; [R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson)
    - Proposal 1: No new RF requirements are needed for power domain techniques. ([R4-2318507](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318507.zip), Huawei)
    - Proposal 2: Considering the current agreements in other WGs, it is recommended not to introduce any new RF requirements or clarification on the existing one for spatial and power domain techniques for the NES feature. ([R4-2319799](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319799.zip), Ericsson)
  + Option2: Clarity the necessity of the requirement for transmitter transient period for power domain techniques ([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu)
    - Proposal 1: RAN4 should firstly clarify the necessity of the requirement for transmitter transient period for the technique in power domain. If RAN4 cannot reach consensus, the requirement for transmitter transient period is not defined in Rel-18 NES. ([R4-2318252](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318252.zip), Fujitsu)
* Recommended WF
  + Discuss necessity of the requirement and whether option 1 is agreeable.

Fujitsu: we proposed option 2 but can accept option 1.

Agreement:

* No need to define RF requirements for power domain techniques

# Topic #4: BS conformance testing requirements

## Companies’ contributions summary

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| --- | --- | --- | --- |
| **No.** | **T-doc number** | **Company** | **Proposals / Observations** |
| 7 | [**R4-2318508**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318508.zip) | Huawei, Hisilicon | Discussion on conformance testing for NES  **Proposal 1**: No additional BS TAE conformance testing is needed for SSB-less operation for FR1 co-located inter-band CA.  **Proposal 2**: No additional BS EVM conformance testing is needed for network energy savings.  **Proposal 3**: No additional Transmit ON/OFF transient time conformance testing is needed for DTX.  **Proposal 4**: No additional conformance testing is needed for spatial and power domains techniques. |
| 8 | [**R4-2320261**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320261.zip) | Nokia, Nokia Shanghai Bell | On Network energy savings conformance testing  **Observation 1:**  In NR BS test specifications (TS 38.141-1 and TS 38.141-2) there isn’t exist any type of test that would allow to verify energy savings.  **Observation 2:** Currently the BS RF transmitter tests in NR test specifications are designed for measuring the transmitted signal quality (e.g., unwanted emission and EVM measurement).  **Observation 3:** The current BS transmitter OFF power test is not sufficient for testing of energy saving features.  **Observation 4:** Without introduction specific dedicated test, it would not be possible to verify the various features proposed in NES WI can achieve energy savings from the BS side.  **Proposal 1:** It is proposed to consider introduction of new testing for network energy savings for BS conformance testing. |

## Open issues summary

### Issue 4-1: RF conformance testing requirements

* Proposals
  + Option 1: It is proposed to consider introduction of new testing for network energy savings for BS conformance testing. ([R4-2320261](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320261.zip), Nokia)
  + Option 2: No new RF conformance test for NES. ([R4-2318508](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318508.zip), Huawei)
    - Proposal 1: No additional BS TAE conformance testing is needed for SSB-less operation for FR1 co-located inter-band CA.
    - Proposal 2: No additional BS EVM conformance testing is needed for network energy savings.
    - Proposal 3: No additional Transmit ON/OFF transient time conformance testing is needed for DTX.
    - Proposal 4: No additional conformance testing is needed for spatial and power domains techniques.
* Recommended WF
  + TBA

Agreement:

* No additional BS TAE conformance testing is needed for SSB-less operation for FR1 co-located inter-band CA.
* No additional BS EVM conformance testing is needed for network energy savings.
* No additional Transmit ON/OFF transient time conformance testing is needed for DTX.