**3GPP TSG-RAN WG4 Meeting #113 R4-24xxxxx**

**Orlando, US, 18th – 22nd November, 2024**

**Agenda item:** 7.23.5

**Source:** Moderator (Huawei)

**Title:** Adhoc minutes for [113][308] NR\_LPWUS

**Document for:** Information

### Sub-topic 1-1 On dynamic range for LP-WUS

#### **Issue 1-1: Concept of LP-WUS power boosting**

* Proposals
  + Proposal 1: EPRE ratio can be used for the LP-WUS power boosting concept.
    - ***The LP-WUS power boosting is the difference between the average power of LP-WUS REs (which occupy certain REs within a NR transmission bandwidth configuration and the average power NR REs) when both LP-WUS and NR are transmitted at the same time in the NR carrier.*** (CATT)
    - The case when there is no NR REs allocation should be covered.(Nokia)
  + Proposal 2: Adopt following definition rather than introduce EPRE ratio. (ZTE, Ericsson, Nokia)
    - ***The LP-WUS RB power dynamic range (or LP-WUS power boosting) is the difference between the average power of LP-WUS REs (which occupy certain REs within a NR transmission bandwidth configuration) and the average power over all REs (from both LP-WUS and the NR carrier containing the LP-WUS REs)*.**
  + Proposal 3: An NB-IoT-like approach to defining power boosting could serve as a baseline, offering flexibility in declaration. Additionally, the option for a single-value declaration should also be permitted, accommodating different scenarios. (Huawei)
    - ***The LP-WUS RB power dynamic range is the difference between the average power of LP-WUS REs (which occupy certain REs within a NR transmission bandwidth configuration) and the average power over all REs (from both LP-WUS and the NR carrier containing the LP-WUS REs). If a single power booting value is to be declared irrespective of channel bandwidth, the difference in per-RE power ratios between the average power of LP-WUS REs (within the NR transmission bandwidth configuration) and the average power NR REs (excluding LP-WUS REs) could alternatively be used.***
  + Proposal 4: RAN4 should use LP-WUS power boosting concept rather than “dynamic range” as definition for this requirement. The power boosting concept and RE dynamic range concept for LP-WUS be separated. (vivo)
* Adhoc WF
  + “The LP-WUS power boosting is the difference between the average power of LP-WUS REs (which occupy certain REs within a NR transmission bandwidth configuration) and the average power over all REs (from both LP-WUS and the NR carrier containing the LP-WUS REs)” is considered as starting point for the definition.
    - FFS whether other cases can be additionally considered. E.g. single value declaration.

#### **Issue 1-2: How to comprehend the de-boost on the NR transmission power**

* Proposals
  + Proposal 1: LP-WUS power boosting does not change the total maximum transmit power of BS. (CATT)
    - There is no power boosting for the case where all RBs are used by LP-WUS and 0 RBs for NR, i.e., SCS 30kHz and CBW 5MHz.
    - For the cases where there would be RB(s) allocated to NR, x dB NR power degradation is allowed.
  + Proposal 2: The average power over all REs should be fixed and when the power boost of WUS is enabled with or w/o the NR signal at the same time: (Ericsson)
    - The WUS signal should be transmitted always with x dB above the average power.
    - There is no NR signal de-boosting in normal transmission.
    - The NR de-boosting transmission power is for the testing purpose only and whether to de-boost NR signal transmission power should be up to network implementation.
* Adhoc WF
  + FFS the behaviour of de-boosting

#### **Issue 1-3: Core requirement for LP-WUS power boosting**

* Proposals
  + Proposal 1: Power boosting level is declared via enumerations of allowed NR power degradation, SCS, power boosting level and minimum supported channel bandwidth (no less than the corresponding minimum allowed channel bandwidth). (CATT)
    - Introduce a minimum LP-WUS power boosting level e.g. 3dB.
    - No need to cap the LP-WUS power boosting.

|  |  |  |  |
| --- | --- | --- | --- |
| Allowed NR power degradation (dB) | SCS (kHz) | Power boosting level (dB) | Minimum allowed channel bandwidth (MHz) |
| 2 | 15 | 3 | 5 |
| 2 | 15 | 6 | 15 |
| 2 | 15 | 9 | 20 |
| 2 | 30 | 3 | 10 |
| 2 | 30 | 6 | 25 |
| 2 | 30 | 9 | 40 |

* + Proposal 2: Power boosting level shall be specified as 0dB and BS manufacturers should be allowed to declare the supported LP-WUS power boosting level. (Nokia)
    - No need to cap the LP-WUS power boosting.
    - No need to preclude small CBW for LP-WUS power boosting.
  + Proposal 3: Power boosting level is up to BS manufacture declaration. Other configurations are relating to the LP-WUS power boosting concept. (Huawei)
    - No need to preclude small CBW for LP-WUS power boosting if an NB-IoT-like power boosting declaration is adopted. But the smallest supported channel bandwidth should be explicitly declared if using the alternative single-value declaration.
  + Proposal 4: Power boosting level is up to BS manufacture declaration. (ZTE, CMCC)
    - No need to introduce a minimum or maximum LP-WUS power boosting level
    - No need to preclude small CBW if minimum LP-WUS power boosting level is not defined
  + Proposal 5: Limit the power boosting only for OOK-1. (Ericsson)
    - Exclude the narrow bandwidth (less and equal than 5 MHz ) for power boosting of LP-WUS and manufacture declares the min channel bandwidth to support the power boosting of LP-WUS
* Adhoc WF
  + Option 1: Leave the power boosting level to manufacturer declaration
  + Option 2: If the manufacturer declares power boosting, the minimum LP-WUS power boosting level should be X (>0) dB for Y MHz CBW

#### **Issue 1-4: On applicable BS type for LP-WUS feature**

* Proposals
  + Proposal 1: Not to set restriction on applicable BS types to support LP-WUS. (CMCC, CATT)
* WF
  + Drop the discussion, there was an agreement in last meeting that:
    - *Non-AAS, AAS could be considered for LP-WUS feature.*

#### **Issue 1-5: Requirement type(s) for LP-WUS**

* Proposals
  + Proposal 1: RAN4 to define conducted (i.e., BS type 1-C) and radiated (i.e., BS type 1-H, BS type 1-O, and BS type 2-O) requirements for LP-WUS. (Nokia, Qualcomm)
  + Proposal 2: RAN4 to focus on defining conductive requirements for supported BS types. (CATT, Huawei, ZTE)
* Adhoc WF
  + FFS

### Sub-topic 1-2 Other considerations apart from power boosting for LP-WUS

#### **Issue 1-6: General consideration on other requirements**

* Proposals
  + Proposal 1: Define a set of the BS Tx requirements for LP-WUS. (CMCC)
  + Proposal 2: RAN4 to determine whether a full set, simplified set of BS Tx requirements or just dynamic range requirement should be specified for LP-WUS. (Huawei)
  + Proposal 3: First focus on the power boosting and transmit signal quality requirements that clearly need to be defined, then work on other Tx requirements when their need become clear. (Nokia)
  + Proposal 4: No new RF requirements is identified for OOK-1. No other new RF requirement than the dynamic range or potential EVM requirement for OOK-4 is identified for LP-WUS. (Ericsson)
* Adhoc WF
  + Discuss on whether transmit signal quality should be defined
    - FFS whether equivalent EVM requirement could be considered,
      * E.g. NR needs to pass 64QAM EVM test with LP-WUS embedded in the NR carrier
  + FFS whether no other new RF requirements than the dynamic range or potential transmit quality requirement identified for LP-WUS