**3GPP TSG-RAN WG4 Meeting #112bis R4-241xxxx**

**Hefei China, 14th – 28th Oct, 2024**

**Agenda item:** 6.23.5

**Source:** vivo

**Title:** WF for LP-WUS UE RF

**Document for:** Approval

# Introduction

This is WF for Rel-19 LP-WUS UE RF.

# Topic #1: General and system parameters

### Sub-topic 1-1 General

**Issue 1-1-1: draft skeleton for LP-WUS RF TR 38.774**

Agreements:

* + **the draft skeleton for TR 38.774 in R4-2415778 is endorsed.**

**Issue 1-1-2: Consideration on RAN1 LS R4-2414909**

Agreements:

no specific RF work related to RAN1 LS.

**Issue 1-1-3: MDR value for RF requirements**

**Agreement:**

* 1% MDR. Same for requirements and conformance testing.

**Issue 1-1-4: FAR assumption for MDR evaluation**

**Agreement:**

* Use </=1% FAR as evaluation assumption for RF

### Sub-topic 1-2 System parameters

**Issue 1-2-1: Channel raster for LP-WUR**

Agreement:

* **FFS whether new channel raster is needed for LP-WUR.**

**Issue 1-2-2: considerations on LP-WUS allocation**

Agreement:

* **RAN4 to assume PRB grid alignment between LP-WUS and NR.**
* **RAN4 to assume the LP-WUS RBs can be flexibly allocated within the wider NR carrier.**

**Issue 1-2-3: number of RBs for LP-WUS with 15kHz SCS**

**Agreement:**

* **Follow RAN1 agreement for number of RBs for LP-WUS with 15KHz SCS, i.e., 11RBs.**

# Topic #2: REFSENS, ASCS and ACS requirements

### Sub-topic 2-1 SNR simulation and values

**Issue 2-1-1: Alignment of FR1 SNR calculation/definition in simulation**

**Agreement:**

* **SNR is defined as the ratio of average energy of the LP-WUS signal per sub carrier over the average energy of Noise per sub carrier, over all the LP-WUS RBs.** 
  + **Consider the sub-carriers allocated to LP-WUS excluding Guard RBs.**

**Issue 2-1-2: FR1 SNR reference point**

**Agreement:**

* similar SNR reference point as MR, i.e., baseband

**Issue 2-1-3: Target FR1 SNR value for LP-WUS/WUR**

**Agreement:**

**RAN4 can further discuss target SNR for OOK-based and OFDM-based receivers.**

**Issue 2-1-5: Link level simulation assumption for FR2 LP-WUR**

**Agreement:**

**RAN4 can further discuss simulation assumption for FR2 LP-WUS next meeting.**

### Sub-topic 2-2 NF and REFSENS requirements

**Issue 2-2-1: Baseline architecture for FR1 OFDM-based LP-WUS**

**Agreement:**

**use zero-IF receiver as a baseline RF architecture for OFDM based LP-WUR.**

**Issue 2-2-3: REFSENS, NF, IM, SNR aspects for FR1 OOK-based and OFDM-based LR**

**Agreement:**

Collect input on REFSENS with values for each element（NF, IM, SNR） in the table next meeting. The value for each element can be discussed.

Encourage companies to also input the justification for each element.

**Issue 2-2-10: Baseline architecture for FR2 OOK-based and OFDM-based LP-WUR**

**Agreement:**

Companies to study baseline architecture for FR2 LP-WUS.

### Sub-topic 2-3 ASCS simulation and requirements

**Issue 2-3-1: ASCS requirements value**

**Agreement:**

* Confirm ASCS RF requirements is needed for LP-WUS/WUR.

**Issue 2-3-2: Required number of guard RB for ASCS**

Agreements:

* RAN4 further discuss required guard RBs for ASCS requirements.

**Issue 2-3-3: Whether Test case for ASCS should be defined in RAN4**

Agreements:

* + **Detailed test case for ASCS should be defined.**

### Sub-topic 2-4 ACS simulation and requirements

**Issue 2-4-1: Phase noise for simulation assumption**

**Agreement:**

Phase noise can be considered in LLS simulation analysis.

Number of guard RBs will be further discussed until Feb meeting. Encourage companies to provide simulation results with phase noise modelling.

**Issue 2-4-4: ACS requirements value**

Potential WF in ad-hoc:

Assume same interference level (absolute level) as MR as starting point. Reduced interference level can also be considered in the evaluation.

**Issue 2-4-5: Required guard RB for ACS requirements**

WF:

* RAN4 further discuss the required number of guard RBs for ACS requirements

**Issue 2-4-6: dynamic range for ACS requirement in case 2**

WF:

* RAN4 further discuss whether **to relax dynamic range for ACS requirement in case 2 while keep the same wanted signal level as MR.**

**Issue 2-4-7: Test parameters for LP-WUR ACS case**

WF

* + Further discuss test parameters **for LP-WUS** ACS

**Issue 2-4-8: whether limit ADC bit for ACS requirements**

WF

No limiting to a specific ADC bit for ACS requirements.

# Topic #3: Other RF requirements

### Sub-topic 3-1 IBB, OBB and Intermodulation requirements for UE RF

**Issue 3-1-1: IBB, OBB and NBB requirements**

Agreements

* **Encourage companies to evaluate the IBB/OBB requirements for LP-WUS.**
* **The following proposals can be further discussed:**
  + **Option 1: In order to guarantee the coverage of LP-WUR in blocking scenarios, the interference levels for IBB could be relaxed compared to the values defined for MR. FSS whether OBB could be relaxed.**
* Table 3: Narrow Band Blocking

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Channel Bandwidth (MHz) |
| Pw | dBm | PREFSENS + channel-bandwidth specific value below |
| dB | 16 |
| Puw (CW) | dBm | [-62] |
| Fuw (offset SCS= 15 kHz) | MHz |  |
| NOTE: Fuw shall be rounded to half of SCS | | |

* + **Option 2: In-band blocking requirement for legacy UE could be reused. the OBB requirement for legacy UE in TS 38.101-1 could be reused.**
  + **Other options are not precluded**

**Issue 3-1-3: Intermodulation requirements**

Agreements

* **Encourage companies to evaluate the Intermodulation requirements for LP-WUS.**
* **The following proposals can be further discussed:**
  + **Option 1: If the blocking interferer is relaxed to accommodate the low power design, intermodulation requirement could also be relaxed for LP-WUR.**
* Table 4: Wide band intermodulation parameters

|  |  |  |
| --- | --- | --- |
| Rx parameter | Units | Channel bandwidth (MHz) |
|  |  | 5 |
| Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + 6 dB |
| PInterferer 1 (CW) | dBm | [-59] |
| PInterferer 2 (Modulated) | dBm | [-59] |
| BWInterferer 2 | MHz | 5 |
| FInterferer 1 (Offset) | MHz | -BWChannel/2 – 7.5  /  +BWChannel/2 + 7.5 |
| FInterferer 2 (Offset) | MHz | 2\*FInterferer 1 |

* + **Option 2: For intermodulation test, bandwidth of the interferer should be 5MHz and LP-WUS should be located at edge of the NR carrier. FFS guard RBs for intermodulation requirements.** **Consider the following test parameters:**
* **Table 5 Wide band intermodulation parameters for LP-WUR**

|  |  |  |
| --- | --- | --- |
| Rx parameter | Units | LP-WUS transmission bandwidth configuration (RB)1 |
| 11RB(for 30kHz SCS) |
| Pw in LP-WUS Transmission Bandwidth Configuration, per CC | dBm | REFSENS + 6 dB |
| PInterferer 1 (CW) | dBm | -46 |
| PInterferer 2 (Modulated) | dBm | -46 |
| BWInterferer 2 | MHz | 5 |
| FInterferer 1 (Offset to LP-WUS)2 | MHz | [-7.5-guard RB]  /  [+7.5+guard RB] |
| FInterferer 2 (Offset to LP-WUS)2 | MHz | [-15-guard RB]  /  [+15+guard RB] |
| NOTE 1: LP-WUS is set at edge of the NR carrier without adjacent sub-carrier interference.  NOTE 2: Finterferer (offset to LP-WUS) is the frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the LP-WUS). | | |

* + **Other options are not precluded**

### Sub-topic 3-2 Other Rx requirements

**Issue 3-2-1: spurious response requirements**

Agreements

* **Encourage companies to evaluate the spurious response requirements for LP-WUS.**
* **The following proposals can be further discussed:**
  + **Option 1: spurious response as a remedial measure for blocking tests needs to be considered for LP-WUR.**
* Table 5: Spurious response parameters for LP-WUR

|  |  |  |
| --- | --- | --- |
| RX parameter | Units | Channel bandwidth |
|  |  | 5 MHz |
| Power in transmission bandwidth configuration | dBm | PREFSENS + 6dB |

* Table 6: Spurious response for LP-WUR

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Level |
| PInterferer (CW) | dBm | [-57] |
| FInterferer | MHz | Spurious response frequencies |

* + **Option 2: Reuse the spurious emission requirements from TS 38.101-1 for LP-WUR.**
  + **Other options are not precluded.**

**Issue 3-2-2: Maximum input level requirements**

Agreements:

* + **The same maximum input power of [-25 dBm] could be starting point for LP-WUR.**
  + **FFS whether this value should be scaled-down based on the number of LP-WUS RBs.**

**Issue 3-2-3: Reference channel for LP-WUR requirements**

Agreements:

* + **RAN4 should define reference measurement channel for LP-WUR RF requirements.**
  + **FFS details.**

# Topic #4: Testability issues

### Sub-topic 4-1 Testability for UE RF requirements

**Issue 4-1-1: General framework on LP-WUS testing**

Way forward: FFS

**Issue 4-1-2: Separate RF test case for idle and connection mode**

Way forward: FFS

**Issue 4-1-3: How to get feedback from LP-WUR during the test**

Way forward: FFS

**Issue 4-1-4: detailed Test procedure**

Way forward: FFS

**Issue 4-1-5: UE test mode for LP-WUR**

agreements:

* + a UE test mode for LP-WUR is needed.

**Issue 4-1-6: whether a LS to RAN5 on test issue**

Way forward: FFS