3GPP TSG-RAN WG4 #102-e R4-22xxxx

Electronic meeting, 12st February – 3rd March 2022

Source: Ericsson

Title: WF on other conducted RF requirements

Agenda Item: 10.5.2.3

Document for: Approval

# Introduction

This Way Forward captures agreements and discussion for the FR1 RF requirements other than OOB gain and ACRR (which are handled in a separate WF)

# Discussion

Definition of upper power limit as per carrier or per passband

For the BS, the output power limit is defined per carrier. The concept of a carrier is not defined in the repeater specification. However, defining the output power limit per passband may not allow for a sufficiently large TX power for a repeater supporting a large passband bandwidth.

Output power upper limit (e.g. 24dBm 38dBm) is per carrier or per passband width:

* Option 1: per carrier
  + Proponents of this option please clarify how the carrier bandwidth and position is defined in the repeater core/conformance specifications
* Option 2: per passband
* Option 3: Per carrier, assuming the nominal channel bandwidth min(100MHz, passband)
* Option 4: As a PSD limit in dBm/MHz

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| **Company** | **Comment** |
| Ericsson | The repeater specification needs to be able to enable compliance to core requirements and conformance testing independent of how the gNB and UE would be configured with carriers in a deployed network. Our understanding is that the only way to achieve this is to assume a nominal carrier bandwidth in the repeater specification. This does not imply that the repeater could not be operated with other bandwidths than the nominal configured at the gNB/UE.  We also understand the concern that the power limits may not be suitable if the passband is wide and is likely to contain several carriers.  We have added two further options that may help resolve the dilemma. One is to define a power limit per carrier based on an assumed nominal bandwidth. The other is to define a PSD limit. We have a slight preference for option 4 over option 3. |
| Huawei | This has come up in the drafting of the output power section TP. We agree that it is difficult to use the concept of carrier for a repeater so do not agree with option 1 however option 3 or 4 seems like a good compromise. Option 4 is perhaps more flexible as it completely removes the concept of a carrier. However if the passband is less than the assumed BW used to calculate the PSD level (e.g. 100MHz) then it is perhaps restrictive. What is the suggested value i.e. what carrier BW do we regard as nominal? As we already have the concept of nominal BW agreed then perhaps option 3 is the better choice. |
| CMCC | Both option 1 and option 4 are OK for us. But option 1 is preferred.  Our understanding is that when we define 24dBm or 38 dBm output power upper limit, it is per carrier rather than per passband. If we finally define output power per passband (option 2), we need to scale the output power limit. For option 3, I’m afraid we will reduce the output power limit for the scenario when repeater’s passband is larger than 100MHz, which will limit the coverage of repeater.  The reason for option 1 is to be aligned with gNB/UE core requirements and E-UTRA repeater spec. our understanding of the passband is that it will include integral multiple carriers since it only amplifies the carriers transmitted by gNB/UE. So we just list the core output power requirements as per carrier and when the repeater’s passband is larger than one carrier i.e. 100MHz, then output power will be increased by scaling factor, i.e. number of carrier of one passband in dB. In addition to, in conformance part, we need to test the output power for the whole passband.  For option 4, we just don’t know the unit for 24dBm/38dBm output power limit? 24dBm per 100MHz or 20MHz or 10MHz? maybe option 1 seems more reasonable and more clearly. |
| Nokia, Nokia Shanghai Bell | Option 4 would have challenging for uplink as UE can concentrate all transmission power even into a single PRB.  Option 1 would have challenging without any reference channel bandwidth.  Given the nominal channel bandwidth is already agreed to be used for other requirements, it could be used also here. Therefore, higher total power would be allowed for wider than 100 MHz transmissions. Our preference is option 3. |
| NEC | We support the definition per carrier. However, if option 1 means a single output power limit for all channel bandwidth, we do not support such option. Our preference is per carrier definition but limits depend on the channel bandwidth. Current values (e.g. 24dBm 38dBm) shall be applied to the nominal channel bandwidth. Limits for other channel bandwidth shall be scaled in proportion to the ratio to the nominal channel bandwidth. It may be equivalent to option 3, but if option 3 assumes a single fixed limit which is applied to all channel bandwidth we do not support option 3. If option 3 implies a limit is defined for the nominal channel bandwidth and another limit is applied to another bandwidth, it may be same as what we propose. If the rated output power is defined only to the nominal channel bandwidth and it is applied to other bandwidths, we cannot satisfy the output power requirements which is defined as a difference to the rated power when the repeater transmits the channel whose bandwidth is not equal to the nominal channel bandwidth. Our proposal may be equivalent to option 4. Considering BS requirements, LTE FDD repeater requirements in 3GPP and regulatory requirements defines the output power requirements per channel, it would be better to keep the NR repeater output power requirement consistent with or similar to other requirements. Therefore, we prefer defining output power per channel and applying scaling rather than defining the PSD limit requirements. For option 2, we do not support this option because the output power could be limited much smaller than the BS output of the same class.  Although the repeater cannot get the information on the carriers and bandwidths, it is still true that the repeater receives, amplifies, and transmits the carriers transmitted by BS/UE. UE/BS receives the carriers transmitted by the repeater. We feel it is reasonable to introduce the concept of the carrier in the repeater spec. We do not see any issue to define the core requirement with carrier. For conformance requirements, we think, in any way, we need a concept of carrier in test conditions. We do not see any issue to have a concept of carrier in repeater conformance specification, either. |

Definition of channel bandwidth for ACLR

For the ACLR requirement, a channel bandwidth is required.

* Option 1: Define a nominal bandwidth min(100MHz, passband)
* Option 2: Depending on agreement for the upper power limit, define the bandwidth is the same as the carrier size
  + Proponents of this option please clarify how the carrier bandwidth and position is defined in the repeater core and conformance specifications

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| **Company** | **Comment** |
| Ericsson | Similar to above, in our understanding to define core requirements and enable conformance testing an assumption needs to be made on the bandwidth for requirement and test definition purposes. This does not prevent operation with other bandwidths. We think that option 1 is a reasonable way to achieve an assumption. |
| Huawei | Did we not agree this last meeting? maybe it was in square brackets? We are ok with option 1 and it matches our view on the upper power limits above. |
| CMCC | We prefer option 2. If majority support option 1, we are also OK.  The reason to define the same bandwidth as carrier size is that it would be aligned with the definition in NR spec or E-UTRA repeater spec and is much clearly.  if passband will include integral multiple carriers, in the ACLR conformance testing, the testing carrier is the lowest or highest carrier in the passband. This is very similar to multiple carriers cases for gNB.  if passband only include one carrier, in the ACLR conformance testing, the testing carrier is the whole passband. We could also say the testing carrier is the lowest or highest carrier in the passband.  So the same approach as gNB could be reused and we use carrier size for repeater ACLR/CACLR/ACRR.  To Huawei, in last meeting, it’s in bracket and during the first round discussion, some companies propose some concerns. In addition to, considering this issue is very similar to output power issue as above, so moderator suggest to discuss this issue. |
| Nokia, Nokia Shanghai Bell | We prefer option 1 to align with other requirements. |
| NEC | We prefer option 2. If the concept of “carrier” is agreed for the power limit, it is straightforward to define the ACLR with the carrier. What would be the core requirement when the repeater handles the carrier whose bandwidth is not equal to the nominal bandwidth? For conformance requirements, we will have the carrier bandwidth and position of the input signal as test conditions in any way. |

Protection of the FDD BS receiver

* Define an optional requirement based on 30dB CL assumption.
  + -96dBm/100kHz for WA
  + -91dBm/100kHz for MR
  + -88dBm/100kHz for LA
* The repeater can declare the limit that it supports. if repeater declares that it does not support above requirements, increased the requirement is -53dBm/MHz, which implies an increased CL (73dB) is required.

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| **Company** | **Comment** |
| Huawei | This is agreement already I guess but just to add to the discussion the 2nd declaration is covered in the BS specification a different (and probably more flexible) way with the following note:  “The current state-of-the-art technology does not allow a single generic solution for co-location with other system on adjacent frequencies for 30dB BS-BS minimum coupling loss. However, there are certain site-engineering solutions that can be used. These techniques are addressed in TR 25.942 [4].”  This allows for allowable coupling to be declared so the appropriate site eng. solution can be selected – it seems more flexible? |
| Ericsson | To Huawei: The note you refer to is in the context of co-location requirements towards another band where the other band is adjacent and hence within the Fobue. Or did I miss something?  Here the requirement is for protection of the BS receiver in the own FDD band. The BS requirement is just the -96/91/88 dBm values. The repeater spec has a relaxed requirement. The proposal here is to add the option to declare that the repeater fulfils the same requirement as a BS and hence could be co-located like a BS. |
| CMCC | In generally, this proposal is OK for us. But maybe we don’t need to limit the declaration only for -53dBm/MHz? other declaration is also allowed when they meet the corresponding CL to reflect the diversity of repeater art of technology?  If majority support the proposal, it’s OK for us. |
| Nokia, Nokia Shanghai Bell | We are ok with the proposal. |

Applicable scenarios for co-existence related spurious emissions requirements

* Co-existence spurious emission requirements are applicable for both DL and UL.
* Repeater declares separately co-existence support at the BS side and the UE side.

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| **Company** | **Comment** |
| Huawei | It seems these are agreements? We have no wish to change agreements but looking at the 2nd bullet as both sides will be in the same geographical area then they will have the same requirement so the 2nd bullet seems somewhat unnecessary but if its already agreed ok. |
| Ericsson | One example where the two sides could be different “geographical areas” would be an inside/outside where one side is outdoors on the outside of a wall and the other side indoors on the inside of a wall. It may be then that the outside part could possibly be co-located or in the same geographical area but the inside part would not be. |
| CMCC | Suggest to retain the second part considering the case proposed by Ericsson. |
| Nokia, Nokia Shanghai Bell | We are ok with separate declarations. There can be different classes and therefore different requirements so separate declaration is fine. |

Lower power limit for EVM

* The lower power limit for EVM is a requirement, not a declaration.
* The lower power limit will be an absolute PSD level
* 50% EVM and 2dB IM assumed
* No limit on the repeater gain for meeting EVM within the power limits in the core specification
  + FFS for conformance
* The lower power limits are agreed as follows (depending on modulation and repeater class):

**Table : x.x-1 Minimum input power for EVM**

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| class | Minimum input power spectral density (dBm/MHz) | |
| Up to 64 QAM | 256QAM  note 1 |
| WA | -82 | -75 |
| MR | -77 | -70 |
| LA | -74 | -67 |
| Note 1: 256 QAM is optional by manufacturers declaration | | |

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| **Company** | **Comment** |
| Huawei | Ok – if its agreed to use the 2dB IM I will carry that agreement over to the FR2 radiated. |
| CMCC | OK |

Inside passband emissions

* For DL inside OBUE, adopt the same class specific OBUE as for the BS
* For UL inside OBUE
  + for WA, reuse BS OBUE requirements.
  + for LA, reuse UE SEM requirements but further discuss which frequency offset ranges would be captured:
    - Option 1: the whole range
    - Option 2: less than channel bandwidth i.e. -10dBm/MHz and -13dBm/MHz.
    - Option 3: larger than channel bandwidth i.e. -25dBm/MHz

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| **Company** | **Comment** |
| Huawei | Why not the whole range? |
| CMCC | For UL, if we assume amplification gain is larger than 76dB, amplified noise is larger than -25dBm. So our preference is to only reuse -10dBm and -13dBm. But not -25dBm  -114dBm/MHz+13dB NF + 76dB gain = -25dBm/MHz |

Input IMD

* 1MHz measurement bandwidth for FR1 input IMD
* Discussion on testing points for input IMD is postponed for conformance part.
* General input IMD requirement is applicable for both DL and UL.

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| **Company** | **Comment** |
| CMCC | Support the proposal |
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