**3GPP TSG-RAN WG4 Meeting #94bis-e DRAFT R4-2005181**

Online, 20 Apr - 01 May 2020

**Source:** Huawei

**Title:** [7to24] TP to TR 38.820: Rx IMD

**Agenda Item:** 9.2.6.4.

**Document for:** Approval

# Introduction

The BS requirements section for the TR is almost complete however it has been noticed that some Rx requirements have been currently been missed. One of these is RX IMD.

The TP was revised after comments in the 1st round of RAN4#95e Bis

Ericsson: No new technical information. Also, this we can handle in the WI per specific spectrum later in the WI.

It’s not clear what actions are required here? The TP is intended to fill in the missing section in the technical report at a similar level of detail to the other parameters? Is the proposal that this section is voided?

Nokia: Blocking interferer levels are absolute power for conducted requirements in FR1, they should remain absolute power in 7-24GHz using the same delta on the conducted REFSENS value.

This was the intention of the text, have attempted to clarify that FR1 conducted is absolute in 1 paragraph, if this si not sufficient then could you please point out how this can be clarified.

# Discussion

The RX IMD requirements generally is offset from and follows the RX in-band blocking requirement, in TR 38.817 it is described how the FR2 RX IMD levels are generated from this principle.

The delta between the general blocking level and the RX IMD level is between 8 to 9dB (depending on RAT), it was agreed that for NR FR2 the delta would be 8dB (the UTRA/MSR level).

For FR1 the E-UTRA delta of 9dB was used.

Clearly for 7 to 24 GHz the absolute levels will depend on the analysis done of in-band blocking, however once this is known it is reasonable to assume that the RX IMD will follow the same methodology used for FR1 and FR2 NR and that the RX IMD interferers will be offset by approx. 8 to 9dB from the in-band blocking interferer.

# 3. TP to TR 38.821 v 2.0.0

#### < START OF CHANGE>

#### 7.4.2.1 Rx requirements overview

Summary of the conducted and radiated Rx requirements specified in Rel-15 for the NR BS is presented in this clause. More detailed elaboration on the motivation on selected requirements is provided in dedicated clauses below.

All the findings captured for the conducted requirements in table 7.4.2.1-1 and related clauses below are considered to be applicable to the (sub)-range of the 7 – 24 GHz for which the conducted requirements will be found to be feasible during related WI.

While radiated requirements are considered to be applicable to the whole 7 – 24 GHz range, their definitions, values and levels may differ across the 7 – 24 GHz range.

Table 7.4.2.1-1: Overview of conducted Rx requirements for NR BS in 7 – 24 GHz range

|  |  |  |  |
| --- | --- | --- | --- |
| Rx requirement | | Conclusions from SI | Items to be completed in related WI |
| Reference sensitivity level | | Based on BW of FRC and NF assumptions.  Indicative noise figure values was concluded in the SI where for 10, 15 and 20 GHz example frequencies, the NF value of 7, 8 and 9 dB respectively. | CBW and reference measurement channels to be confirmed.  Frequency specific NF assumptions to be confirmed. |
| Dynamic range | | Requirement will have to be re-calculated to account for an updated NF, IM and the supported set of NRB and SCS. Required SNR for the wanted signal to be re-simulated.  For the derivation of the requirement: reuse the 95% throughput threshold, reuse the 16QAM-based FRC (if possible). | Value(s) of the NF, IM and required SNR. Consider capturing this aspect by demodulation requirements as for FR2. |
| In-band selectivity and blocking | ACS |  |  |
| In-band blocking | As the 7 to 24 GHz specification has to deal with all the BS types and implementation architectures the in-band blocking level should be set based on the wanted signal to interferer level in the same way as the FR2 levels. The conducted requirement can then be extracted by using the same delta on the conducted REFSENS value. As there are no existing conducted requirements to maintain equivalence to and the 7 to 24 GHz range will primarily consider beam forming systems it is suitable to derive the OTA requirements 1st and then apply the same methodology to the conducted. | Over the 7 to 24 GHz range it is possible there are multiple in-band blocking deltas covering different bands |
| Out-of-band blocking | General out-of-band blocking | The interferer level is -15 dBm below 7.125 GHz. | Range above 7.125 GHz to be concluded in the WI. |
| Co-location | The necessity of the co-location blocking requirement can be analysed by understanding the isolation, the aggressor power, as frequency increases. As none of these parameters could be agreed in the SI the need for co-location blocking requirement cannot be accurately analysed. | Need to establish antenna port isolation for specific band in WI. |
| Receiver spurious emissions | |  | In certain regions, receiver spurious emission limit will be specified during the WI based on applicable regional regulations. |
| Receiver intermodulation | | For conducted RX IMD levels were reused from E-UTRA.  The RX IMD requirement for 7 - 24 GHz must be consistent with the methodology used for sensitivity.  The blocking interferer levels (and hence RX IMD interferer levels) are absolute power levels. | Requirement to be concluded in the WI. |
| In-channel selectivity | | BS class specific requirements will have to be re-calculated to account for an updated NF and the supported set of NRB and SCS. Required SNR for the wanted signal to be re-simulated.  For the derivation of the requirement: reuse the 95% throughput threshold, reuse the QPSK-based FRC. | BS class specific conducted requirements to be considered in the WI phase: Value(s) of the NF, required SNR for wanted signal. ICS for the interferer to be verified. |

Table 7.4.2.1-2: Overview of radiated Rx requirements for NR BS in 7 – 24 GHz range

|  |  |  |  |
| --- | --- | --- | --- |
| OTA Rx requirement | | Conclusions from SI | Items to be completed in related WI |
| OTA sensitivity | | The OTA sensitivity requirement is a minimum sensitivity requirement for FR1 and ensures correct operation of the receiver including the integral antenna. OTA sensitivity is a declared parameter, the minimum sensitivity over an associated range of angle of arrivals (RoAoA) are declared (the declaration also allows for the RoAoA to be redirected by non-real time means but this distinction is not needed for simple analysis). | Confirm if minimum sensitivity can be supplied by OTA REFSENS requirement. |
| OTA reference sensitivity level | | The 7 to 24GHz BS is expected to require beam forming and whilst there may be conducted requirements there is no legacy so there is no need to provide equivalence between OTA and conducted requirements. As such the FR2 type of OTA REFSENS requirement may be used even if conducted specifications are specified.  Indicative noise figure values was concluded in the SI where for 10, 15 and 20 GHz example frequencies, the NF value of 7, 8 and 9 dB respectively. | The appropriate NF and ranges of expected antenna gain can be agreed when the exact operating bands are known. |
| OTA dynamic range | | For FR1-like (sub)-range: reuse FR1 approach of deriving the OTA requirement.  For FR2-like (sub)-range: further investigation will be required to decide if the OTA dynamic range requirement in the FR2-like (sub)-range of 7 – 24 GHz range can be skipped.  Value(s) of the NF, IM and required SNR to be reused from the conducted requirement for 7 – 24 GHz.  For the derivation of the requirement: reuse the 95% throughput threshold, reuse the 16QAM-based FRC (if possible). | Evaluations for the FR2-like (sub)-range. |
| OTA in-band selectivity and blocking | OTA ACS |  |  |
| OTA in-band blocking | In-band requirements dependent on the sensitivity requirements, as the sensitivity is used as a metric of the receiver performance under interference conditions. The in-band blocking requirement for 7 to 24 GHz must therefore be consistent worth the methodology used for sensitivity.  The delta value for the 7 to 24 GHz range would be expected to be between the FR1 and FR2 values (52.7 to 27 dB), however the precise values would have to be found by blocking simulation once the operating frequencies are known and co-existence simulation parameters have been defined. | Over the 7 to 24 GHz range it is possible there are multiple in-band blocking deltas covering different frequency ranges.  To be concluded in WI when system scenarios, specific frequency bands are defined, and proper co-existence studies are performed. |
| OTA out-of-band blocking | General out-of-band blocking | The interferer level is 0.36 V/m below 7.125 GHz and 0.1 V/m above 24.125 GHz. | The interferer signal within the range 7.125 to 24.125 GHz is defined in the WI. |
| Co-location |  | Need to establish antenna port isolation for specific band in WI. A new concept of injecting the interferer signal is required. |
| OTA receiver spurious emissions | |  | In certain regions, receiver spurious emission limit will be specified during the WI based on applicable regional regulations. |
| OTA receiver intermodulation | | The RX IMD requirement for 7 - 24 GHz must be consistent with the methodology used for sensitivity.  The RX IMD is closely related to the in-band blocking, for both FR1 and FR2 the RX IMD levels have been between 8 to 9 dB lower than the in-band blocking levels. It is likely that the same will be found in the 7 - 24 GHz frequency range once operating frequencies are known and co-existence simulation parameters have been defined.  The blocking interferer levels (and hence RX IMD interferer levels) are absolute power levels. | Requirement to be concluded in WI. |
| OTA in-channel selectivity | | For FR1-like sub-range: reuse FR1 approach for deriving the BS class specific OTA requirement, based on offsetting the conducted requirement.  For FR2-like sub-range: reuse FR2 approach for deriving wanted and interferer levels based on offsetting the declared sensitivity EISREFSENS\_50M.  For the derivation of the requirement: reuse the 95% throughput threshold, reuse the QPSK-based FRC. | BS class specific radiated requirements to be considered in the WI phase: Required ICS level for FR2-like interferer. |

#### < NEXT CHANGE>

#### 7.4.2.8 RX IMD

##### 7.4.2.8.1 RX IMD for FR1 and FR2

The blocking requirements capture the selectivity of the receiver, whilst the receiver intermodulation given the two interferers condition would capture the linearity of the receiver.

For FR1 both blocking and RX IMD levels were reused from E-UTRA, for FR2 the in-band blocking requirements were investigated with blocking simulations. For RX IMD more limited simulations were performed however the interferer RX IMD interferer levels were a very similar and 8 – 10 dB lower than the in-band blocking levels (under the same assumptions). A level of 8 dB below the in-band blocking levels was agreed for FR2.

For FR1 the conducted blocking interferer levels (and hence RX IMD interferer levels) are absolute power levels, for OTA these absolute power levels are offset by the difference between conducted reference sensitivity and OTA REFSENS (i.e. ΔOTAREFSENS).

For FR2 the blocking interferer levels (and hence RX IMD interferer levels) are offset from the declared sensitivity value EISREFSENS\_50M.

In addition to the level the interferer signal type and BW is also important. For FR1 a CW and a modulated interferer are used with the modulated signals BW being 5 or 20 MHz DFT-s-OFDM NR signal dependent on the wanted signal BW. For FR2 a CW and modulated signal are also used with the modulated signal BW being 50 MHz DFT-s-OFDM NR signal.

##### 7.4.2.8.2 RX IMD for 7 to 24GHz

The RX IMD is closely related to the in-band blocking, for both FR1 and FR2 the RX IMD levels have been between 8 to 9 dB lower than the in-band blocking levels. It is likely that the same will be found in the 7 - 24 GHz frequency range once operating frequencies are known and co-existence simulation parameters have been defined.

As with the blocking the in-band interference requirements are dependent on the sensitivity requirements, as the sensitivity is used as a metric of the receiver performance under interference conditions. The RX IMD requirement for 7 - 24 GHz must therefore be consistent with the methodology used for sensitivity. The proposed metrics for sensitivity are identified in clause 7.4.2.2.

As the 7 - 24 GHz specification has to cover all BS types it has been suggested in clause 7.4.2.4.2 that the in-band blocking level is set based on the wanted signal to interferer level in the same way as the FR2 levels. As the RX IMD levels are offset from the blocking levels the same approach can be used for RX IMD.

The interferer signal definition are the same for FR1 and FR2 with the exception of the modulated signal BW, this will depend on the BW’s defined for the operating band and may vary in the 7 - 24 GHz range.

#### < END OF CHANGE>