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

**Orlando, USA, 18th ‒ 22nd November, 2024**

**Agenda item:** 7.2.6

**Source:** Moderator (Ericsson)

**Title:** Ad-hoc minutes for IMT parameters

**Document for:** Information

# Introduction

This contribution provides ad-hoc minutes for the IMT parameters. In this section, some issues are drawn out that are high priority for discussion during the ad-hoc. In the event that the issues in this section are covered and there is still time, other issues in the other sections will be reviewed.

## Downlink co-existence parameters

**Issue 3-2-1: Observed DL ACIR (Urban macro)**

* Proposals
* Option 1: ACIR offset (from FR1 ACIR) is -12dB (Nokia) for one UE or -9dB for 3 UEs
* Option 2: 24dB (CATT)
* Option 3: 23-24dB (Mediatek)
* Option 4: 22dB (vivo)
* Option 5: 22dB (Qualcomm)
* Option 6: 20-24dB (Ericsson)
* Option 7: Relaxed by 8dB (compared to FR1) (ZTE)
* Option 8: 26dB (Huawei)
* Option 9: 24-25dB (Samsung)

Recommended WF: Conclude DL urban macro ACIR is around 22-24dB

There is no need to reach an agreement on ACIR, so this issue will not be discussed directly, but it can provide background for the ACLR/ACS discussion.

Qualcomm: Will ACIR be documented in TR ?

Samsung: We should document the ACIR in the TR.

ZTE: For DL outdoor ACIR, we have indoor and outdoor. How can we conclude based on outdoor ?

Huawei: Previously we had an average value, if we conclude a range could we give the full range ?

Apple: In the previous study cycle, we had a table capturing all of the values. We quoted the average excluding the highest and lowest.

Nokia: The simulation results in this meeting, only Nokia has 3 UE. The ACLR becomes more stringent with 3UE.

CATT: OK to capture 3UE for TR, but for the reply LS we can only reply one value

Conclusion

For the TR:

For 1 UE: State the range of ACIR is 20-26dB in TR (potentially by means of a table). Excluding the highest/lowest, the range is 22-24dB. Possibly state average.

For 3 UE: State result available from Nokia, separately documented (other companies can add results next meeting)

**Issue 4-2-6: BS ACLR**

* Proposals
	+ Option 1: 36dB (Nokia)
	+ Option 2: 31dB (CATT, Ericsson)
	+ Option 3: 35dB (ZTE, vivo)
	+ Option 4: 30dB (Huawei)
	+ Option 6: 27dB (Qualcomm)
* Recommended WF

Proposal for discussion: Assuming the ACIR is around 22-24dB, then if the DL ACLR is more than around 30-31dB and the UE ACS in the range 23-24dB, then the DL ACLR will not have much impact on the ACIR. So fix DL ACLR to be around 30-31dB.

Nokia: Maybe too low 31dB

Huawei: We propose 30dB, it is already 6dB above the ACIR, and it should be OK if the UE ACS is 24dB. We should give some room for the transmitter side.

ZTE: We propose higher than 32dB. The IBE for 1024QAM needs to be larger than 33dB.

Nokia: We design the BS ACLR and UE ACS together

CATT: If we put UE ACS 24, BS 31dB, ACIR is 23dB

Samsung: Can we put ACLR/ACS in a range in the TR ?

Qualcomm: We will document the results in the TR

Conclusion:

BS ACLR 31dB

UE ACS 24 dB

**Issue 4-3-9: UE ACS**

* Proposals
	+ Option 1: 24dB (Nokia, Qualcomm)
	+ Option 2: 27-30dB (Apple)
	+ Option 3: 23dB (Vivo)
	+ Option 4: 25dB (Ericsson, CATT, Mediatek)
	+ Option 5: 30dB (ZTE)
* Recommended WF

Considering the ACIR seems to be around 22-24dB, and looking at the results, it seems that if UE ACS is around 23-24dB and BS ACLR 30-31dB then the ACIR will be achieved.

## Uplink co-existence parameters

**Issue 3-2-2: Observed UL ACIR (Urban macro)**

* Proposals
* Option 1: ACIR offset (compared to FR1 29dB) of -9dB (Nokia)
* Option 2: 20dB (CATT)
* Option 3: 15-17dB (Mediatek)
* Option 4: 12dB (vivo)
* Option 5: 13dB (Qualcomm)
* Option 6: 11-14dB (Ericsson)
* Option 7: -10dB compared to the current (ZTE)
* Option 8: 25dB (Huawei)

Recommended WF: Many results suggest ACIR around e.g. 13-15dB. CATT and Huawei are considerably higher and ZTE lower.

ZTE: Our proposal is 10dB compared with current ACIR

ZTE: The basic ACLR should be 24dB

**Issue 4-3-4: UE ACLR**

* Proposals
	+ Option 1: 21dB (Nokia)
	+ Option 2: 22-24dB (Apple)
	+ Option 3: 12dB (Vivo)
	+ Option 4: 24dB (Qualcomm)
	+ Option 5: 15dB (Ericsson)
	+ Option 6: 21dB (CATT)
	+ Option 7: 18dB (Mediatek)
* Recommended WF

As pointed out by Qualcomm, the 1% occupied bandwidth requirement is a lower limit on UE ACLR of 24dB. Can we agree 24dB ?

Mediatek: UE ACLR should be relaxed. FR2 ACLR is 17dB

Vivo: We understand the intention, but 24dB come from the UE design perspective and the OBW requirement. However here we are doing a co-existence study. We are OK with 24dB as long as there is a clarification in the LS

Conclusion

UE ACLR 24dB (ACLR corresponding to the 1% OBW requirement)

Capture in LS that the UE ACLR is driven by the OBW requirement and higher than needed for co-existence

**Issue 4-2-9: BS ACS**

* Proposals
	+ Option 1: 36dB (Nokia)
	+ Option 2: 27dB (CATT)
	+ Option 4: 25dB (Vivo)
	+ Option 5: 21dB (Ericsson)
	+ Option 6: 38dB (ZTE)
* Recommended WF

The highest proposed ACIR is 25 dB, and many ACIR are much lower. If UE ACLR is 24dB, could we agree either 21dB or 25dB ACS for the BS ? This will lead to an ACIR that is well above most reported results.

CATT: If we take 25dB BS and 24dB ACLR, then ACIR is 21dB, higher than proposed.

Nokia: The BS provides better performance than the UE. The dominant factor should be on the UE side. Ericsson results should more stringent requirement with higher percentage of indoor UE. Can we agree on 31dB BS ACS.

CATT: If we look back at FR2-1, BS has 1dB better than the UE.

ZTE: For FR1, usually the BS ACS is 10dB higher than UE ACLR.

Apple: On the UE 24dB, based on OBW it should be 23dB.

Nokia: 31dB does not make design difficult, anyhow you will need to meet blocking etc.

Moderator: Is BS ACS based on the minimum needed for co-existence or on a significant higher amount than UE ACLR (regardless of minimum for co-existence)

Minimum for co-existence, not significantly higher than UE: CATT

Higher than UE ACLR: Nokia, ZTE

BS ACS 30dB

Nokia: We discussed BS ACS together with UE ACLR.

## General topic

**Issue 4-1-2: Typical channel bandwidth**

Previous agreement:

* [200MHz] as typical bandwidth, document in TR other bandwidths not precluded
* The note should capture the association of channel bandwidth with maximum transmission power /PSD
* If the practical issues are identified or additional work required for replying LS for 200MHz, RAN4 will consider 100MHz as typical bandwidth
* Proposals
	+ Option 1: 200MHz in LS response, document higher bandwidths in TR (Nokia, Qualcomm, Ericsson, Samsung)
	+ Option 2: 100MHz as typical bandwidth (Apple, vivo)
	+ Option 3: Capture the following additional note in the TR: “Higher channel bandwidths are not precluded. The typical channel bandwidth is associated with the maximum transmission power as it impacts the Power Spectral Density (PSD), when full channel bandwidth is transmitted.” (Ericsson)
	+ Option 4: State in TR that higher channel bandwidths are not precluded, and that in case of coverage issues, more UEs can be considered to be scheduled on the wide bandwidth. (Ericsson)
* Recommended WF
	+ TBA

Apple: Could we tackle first SEM and spurious emissions? These things are connected. Two reasons for 100MHz as typical. First, we have only 500MHz of spectrum. It is not obvious we have a large spectrum allocation. Same as 10GHz. We do not see a compelling reason to say 200MHz. Then practically, it makes it harder to solve SEM etc.

Qualcomm: Regarding the amount of spectrum and how much is allocated, this is not in the SI scope here. For the 7GHz, several companies have proposed 200MHz but 100 was applied with an additional note.

Nokia: 200Mhz should be agreed.

Ericsson: 200Mhz should be used. I do not quick understand Qualcomm proposal.

Qualcomm: Agree on SEM for 200Mhz in this meeting and capture it in the LS.

Apple: SEM and typical bandwidth are coupled.

Huawei: We should not use missing SEM to delay the conclusion on typical bandwidth.

Moderator: we have solution for SEM, which can be based on CA.

Agreement:

* Indicate 200MHz as typical bandwidth to ITU-R for their evaluation in the LS
	+ Assume the SEM of FR1 intra-band CA of 200MHz aggregated bandwidth applicable for 200MHz bandwidth for 15GHz range.
		- 3GPP RAN4 will further discuss and specify the SEM requirements in this frequency range with understanding that the requirement may be relaxed than FR1 intra-band CA with 200MHz aggregated bandwidth.
		- Note: capture this bullet for assumption in the TR
	+ 3GPP may specify the 100MHz, 200MHz as well as other channel bandwidths for the requirements in this frequency range.
		- Note: take 200Mhz as typical value and refer to TR for additional values of bandwidths in LS.

## UE parameters

**Issue 4-3-3: UE Emissions mask**

Previous meeting:

* Option 1: UE SEM given in Section 7.1.2, TR 38.921.
* Option 2: Other options.
* Proposals
* Option 1: UE SEM given in Section 7.1.2, TR 38.921. (CATT, Vivo, Qualcomm, Ericsson)
* Option 2a: TS 38.101-1 6.5.2.2 for 100MHz or 6.5A.2.2 for wider channel bandwidth (Nokia)
* Option 2b: TS 38.101-1 6.5.2.2 for channels up to 100MHz (Apple)
* Option 3: TS 38.101-2 Table 6.5.2.1-1, with FOOB = min(2 BWChannel , 250 MHz + BWChannel) based on ITU-R SM.1539 Table 2 (Mediatek)
* Recommended WF

Skyworks: Why use the FR1 SEM; for some allocations the MPR will be SEM limited and not SEM limited. Small allocaitons will have large MPR.

Mediatek: Related to UE ACLR. If we want to relax ACLR, we need to relax UE SEM.

ZTE: The SEM discussion is not aligned with CBW discussion. Some companies propose re-use SEM, but that is 100MHz channel bandwidth.

Qualcomm: FR1 SEM was derived from LTE SEM with relaxation after 40MHz. We would add a column for 200MHz with same SEM.

Skyworks: Does not make sense to measure in 30kHz bandwidth.

ZTE: We have 3dB relaxation compared with FR1.

Mediatek: Why can’t we consider FR2 emission mask ?

Apple: FR2 mask is relaxed compared to FR1

Qualcomm: As far as the SEM is concerned, it should come from regulation not made up by us.

Apple: In fR1, we take it from regulation

* Option 1: UE SEM given in Section 7.1.2, TR 38.921. (CATT, Vivo, Qualcomm, Ericsson)
* Option 2a: TS 38.101-1 6.5.2.2 for 100MHz or 6.5A.2.2 for wider channel bandwidth (Nokia)
* Option 2b: TS 38.101-1 6.5.2.2 for channels up to 100MHz (Apple)
* Option 3: TS 38.101-2 Table 6.5.2.1-1, with FOOB = min(2 BWChannel , 250 MHz + BWChannel) based on ITU-R SM.1539 Table 2 (Mediatek, Samsung, Huawei)

Option 1: Take table from SM.1539 Table 2, with FOOB = min(2 BWChannel , 250 MHz + BWChannel) based on ITU-R SM.1539 Table 2 (Mediatek, Samsung, Huawei)

* Clarify we are following ITU-R recommendation, (it is not related to FR1/FR2, no mention of FR1/FR2 in the LS)

Option 2: Take FR1 mask based on 100MHz CBW (Apple)

Option 3: UE SEM given in Section 7.1.2, TR 38.921

* add column for 200MHz
* Remove 30kHz measurement bandwidth and every row is 1MHz

Note: Option 1 is as follows:

Table 7.1.2-1: Spectrum emission mask for 6.425 - 7.125 GHz and 10.0 - 10.5 GHz

|  |  |
| --- | --- |
|  | Spectrum emission limit (dBm) / Channel bandwidth |
| ΔfOOB(MHz) | 20MHz | 25MHz | 30 MHz | 40MHz | 50MHz | 60MHz | 70MHz | 80MHz | 90MHz | 100MHz | Measurement bandwidth |
| ± 0-1 | -10 | -10 | -10 | -10 |  |  |  |  |  |  | 1 % channel bandwidth |
| ± 0-1 |  |  |  |  | -21 | -21 | -21 | -21 | -21 | -21 | 30 kHz |
| ± 1-5 | -7 | -7 | -7 | -7 | -7 | -7 | -7 | -7 | -7 | -7 | 1 MHz |
| ± 5-6 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 | -13 |  |
| ± 6-10 |  |  |  |  |  |  |  |  |  |  |  |
| ± 10-15 |  |  |  |  |  |  |  |  |  |  |  |
| ± 15-20 |  |  |  |  |  |  |  |  |  |  |  |
| ± 20-25 | -25 |  |  |  |  |  |  |  |  |  |  |
| ± 25-30 |  | -25 |  |  |  |  |  |  |  |  |  |
| ± 30-35 |  |  | -25 |  |  |  |  |  |  |  |  |
| ± 35-40 |  |  |  |  |  |  |  |  |  |  |  |
| ± 40-45 |  |  |  | -25 |  |  |  |  |  |  |  |
| ± 45-50 |  |  |  |  |  |  |  |  |  |  |  |
| ± 50-55 |  |  |  |  | -25 |  |  |  |  |  |  |
| ± 55-60 |  |  |  |  |  |  |  |  |  |  |  |
| ± 60-65 |  |  |  |  |  | -25 |  |  |  |  |  |
| ± 65-70 |  |  |  |  |  |  |  |  |  |  |  |
| ± 70-75 |  |  |  |  |  |  | -25 |  |  |  |  |
| ± 75-80 |  |  |  |  |  |  |  |  |  |  |  |
| ± 80-85 |  |  |  |  |  |  |  | -25 |  |  |  |
| ± 85-90 |  |  |  |  |  |  |  |  |  |  |  |
| ± 90-95 |  |  |  |  |  |  |  |  | -25 |  |  |
| ± 95-100 |  |  |  |  |  |  |  |  |  |  |  |
| ± 100-105 |  |  |  |  |  |  |  |  |  | -25 |  |

Option 2a is as follows:

Table 6.5A.2.2.1-1: General NR CA spectrum emission mask

|  |  |  |
| --- | --- | --- |
| ΔfOOB(MHz) | Spectrum emission limit(dBm) | MBW(MHz) |
| ± 0 - 1  | -13 | Min(0.01\*BWchannel\_CA, 0.4) |
| ± 1 - 5 | -10 | 1MHz |
| ± 5 – BWchannel\_CA | -13 | 1MHz |
| ±BWchannel\_CA- BWchannel\_CA+5 | -25 | 1MHz |

Option 2b is as follows:

Table 6.5.2.2-1: General NR spectrum emission mask

|  |  |  |
| --- | --- | --- |
| ΔfOOB (MHz) | Channel bandwidth (MHz) / Spectrum emission limit (dBm) | Measurement bandwidth |
| 3 | 5 | 10, 15, 20, 25, 30, 35, 40, 45 | 50, 60, 70, 80, 90, 100 |
| ± 0-1 | -13 | -13 | -13 |  | 1 % of channel BW |
| ± 0-1 |  |  |  | -24 | 30 kHz |
| ± 1-5 | -10 | -10 | -10 | 1 MHz |
| ± 5-6 | -25 | -13 |  |
| ± 6-10 |  | -25 |  |
| ± 5-BWChannel |  |  | -13 |
| ± BWChannel-(BWChannel+5) |  |  | -25 |

Option 3 is as follows:

Table 6.5.2.1-1: General NR spectrum emission mask for frequency range 2.

|  |  |
| --- | --- |
|  | Spectrum emission limit (dBm) / Channel bandwidth |
| ΔfOOB(MHz) | 50MHz | 100MHz | 200MHz | 400MHz | 800 MHz | 1600 MHz | 2000 MHz | Measurement bandwidth |
| ± 0-5 | -5  | -5 | -5 | -5 | -5 | -5 | -5 | 1 MHz  |
| ± 5-10 | -13 | -5 | -5 | -5  | -5 | -5 | -5 | 1 MHz |
| ± 10-20 | -13 | -13 | -5 | -5  | -5 | -5 | -5 | 1 MHz |
| ± 20-40 | -13 | -13 | -13 | -5 | -5 | -5 | -5 | 1 MHz |
| ± 40-80 | -13 | -13 | -13 | -13 | -5 | -5 | -5 | 1 MHz |
| ± 80-100 | -13 | -13 | -13  | -13  | -13 | -5 | -5 | 1 MHz |
| ± 100-160 |  | -13 | -13 | -13 | -13 | -5 | -5 | 1 MHz |
| ± 160-200 |  | -13 | -13 | -13 | -13 | -13 | -5 | 1 MHz |
| ± 200-400 |  |  | -13  | -13  | -13 | -13 | -13 | 1 MHz |
| ± 400-800 |  |  |  | -13  | -13 | -13 | -13 | 1 MHz |
| ± 800-1600 |  |  |  |  | -13 | -13 | -13 | 1 MHz |
| ± 1600-3200 |  |  |  |  |  | -13 | -13 | 1 MHz |
| ± 3200-4000 |  |  |  |  |  |  | -13 | 1 MHz |
| NOTE 1: Void |

**Issue 4-3-5: Spurious emission**

Previous meeting:

FFS if RAN4 to adopt the UE general spurious emissions defined in TS 38.101-1 clause 6.5.3.1

* Proposals
	+ Option 1: Spurious emissions up to 100 MHz channel bandwidth is defined in TS 38.101-1 clause 6.5.3.1. For wider channel bandwidth such as 200 MHz, TS 38.101-1 clause 6.5A.3 is referred (Nokia)
	+ Option 2: -30dBm/MHz (according to the ITU-R SM.329-13 Category B spurious emissions requirements) (Apple)
	+ Option 3: TS 38.101-1 clause 6.5.3.1 (CATT, Vivo, Qualcomm, Mediatek, Ericsson)
* Recommended WF

Apple: Option 2/3 are the same

R&S: 38.101 stops at 26GHz, not twice the fundamental

Apple: The definition of spurious emissions is agnostic to bandwidth

CATT:

Conclusion

-30dBm/MHz from channel bandwidth + Foob to 26GHz

## BS parameters

**Issue 4-2-3: BS Emissions mask**

Previous agreement:

For the reply, refer to the following table as basis

* [category B] and category A
* Table 6.1.2-1: Wide Area BS operating band unwanted emission limits for 6.425 - 7.125 GHz and 10.0 - 10.5 GHz for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter 3dB point, Df | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits  | Measurement bandwidth |
| 0 MHz £ Df < 50 MHz | 0.05 MHz £ f\_offset < 50.05 MHz | $$-7dBm-\frac{7}{50}\left(\frac{f\_{offset}}{MHz}-0.05\right)$$ | 100 kHz  |
| 50 MHz £ Df <min(100 MHz, Dfmax) | 50.05 MHz £ f\_offset <min(100.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz  |
| 100 MHz £ Df £ Dfmax | 100.5 MHz £ f\_offset < f\_offsetmax  | -13 dBm | 1MHz  |

* [Table 6.1.2-2: Wide Area BS operating band unwanted emission limits for 6.425 - 7.125 GHz and 10.0 - 10.5 GHz for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter 3dB point, Df | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits | Measurement bandwidth |
| 0 MHz £ Df < 50 MHz | 0.05 MHz £ f\_offset < 50.05 MHz | $$-7dBm-\frac{7}{50}\left(\frac{f\_{offset}}{MHz}-0.05\right)$$ | 100 kHz  |
| 50 MHz £ Df <min(100 MHz, Dfmax) | 50.05 MHz £ f\_offset <min(100.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz  |
| 100 MHz £ Df £ Dfmax | 100.5 MHz £ f\_offset < f\_offsetmax  | -15 dBm  | 1MHz  |

]

* Proposals
	+ Option 1: Reply Category A and Category B OBUE (Qualcomm, Nokia)
	+ Option 2: Do not include category B OBUE in reply (Ericsson, Samsung, Huawei, Nokia)
		- Option 2a: Mention in LS and TR that CEPT has not yet decided emissions limits (Ericsson)
	+ Option 3: Capture category B OBUE in the TR (ZTE)
* Recommended WF

Nokia: Last time we said Cat B FFS. We are OK to not reply Category B

ZTE: No strong opinion on category B, but could you clarify the status in Europe

Ericsson: It has not yet been define in Europe

Huawei: Why mention CEPT in the LS ? Would be OK in TR but not the LS

Ericsson: We think it good to add since we sent category B for 4 and 8GHz.

Conclusion:

* + Do not include category B OBUE in reply
		- Mention in TR that regional regulation corresponding to category B is not yet decided
		- Mention in LS that regional regulation corresponding to category B is not yet decided

**Issue 4-2-7: Spurious emission**

Previous agreement:

For the reply, refer to the following table as basis

* [category B] and category A
* Table 2.2.2.3-1: BS spurious emission limits for 14800 to 15350 MHz for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Limit | Measurement Bandwidth | Note |
| 30 MHz – 1 GHz | -13 dBm | 100 kHz | Note 1 |
| 1 GHz – 2nd harmonic of the upper frequency edge of the DL operating band | 1 MHz | Note 1, Note 2 |
| NOTE 1: Bandwidth as in ITU-R SM.329, s4.1NOTE 2: Upper frequency as in ITU-R SM.329, s2.5 table 1. |

* Table 2.2.2.3-2: BS spurious emission limits for 14800 to 15350 MHz for Category B

|  |  |  |
| --- | --- | --- |
| Spurious frequency range | Limit | Measurement bandwidth |
| 30 MHz – 1 GHz | -36 dBm | 100 kHz |
| 1 GHz – 18 GHz | -30 dBm | 1 MHz |
| 18 GHz – 2nd harmonic of the upper frequency edge of the DL operating band | -20 dBm | 10 MHz |

* Proposals
	+ Option 1: Reply Category A and Category B spurious emissions (Nokia)
	+ Option 2: Do not include category B spurious emissions in reply (Ericsson, Samsung, Huawei, Nokia)
		- Option 2a: Mention in LS and TR that CEPT has not yet decided emissions limits (Ericsson)
	+ Option 3: Capture category B spurious emissions in the TR (ZTE)
* Recommended WF

Apple: Spurious emission requirements category B cannot be ignored as it is identified globally

Nokia: The same view; we had category B as FFS last time, we are not proposing to include it.

Conclusion:

Reply that SM.329 applies

**Issue 4-2-8: Blocking response**

* Proposals
	+ Option 1: ΔfOBUE 100MHz (Qualcomm, ZTE)
	+ Option 2: Define requirement as follows (ZTE):

| Frequency range of interfering signal(MHz) | Wanted signal mean power(dBm) | Interferer RMS field-strength | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36 [-15dBm] | CW |
| 12750 to FUL,low – 1500 | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |
| FUL,high + 1500 to 2nd harmonic of the upper frequency edge of the *operating band* | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |

* Recommended WF

ZTE: One issue is TX, one is RX. We use the CW power level this way as we have OOBB requirements for FR1 and FR2. So we borrow the FR1/FR2 current requirements

Ericsson: We need to remove dBm

Conclusion:

* + ΔfOBUE and ΔfOOB 100MHz
	+ Define requirement as follows, where interferer is defined in radiated way
		- FFS how to define the requirements for 1-H

| Frequency range of interfering signal(MHz) | Wanted signal mean power(dBm) | Interferer RMS field-strength for OTA requirements (voltage/meter) | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36  | CW |
| 12750 to FUL,low – 100 | EISREFSENS + 6 dB | 0.1 | CW |
| FUL,high + 100 to 2nd harmonic of the upper frequency edge of the *operating band* | EISREFSENS + 6 dB | 0.1 | CW |

----------- The remaining is copied from the moderator summary for reference and in case there would be time to handle other issues --------

# Topic #1: General aspects

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2417874 | CATT | TP with editorial clarification on the scope |
| R4-2418258 | Nokia | Proposal 1: Spurious emissions up to 100 MHz channel bandwidth is defined in TS 38.101-1 clause 6.5.3.1. For wider channel bandwidth such as 200 MHz, TS 38.101-1 clause 6.5A.3 is referred.Proposal 2: Emission mask up to 100 MHz channel bandwidth is defined in TS 38.101-1 clause 6.5.2.2. For wider channel bandwidth, TS 38.101-1 clause 6.5A.2.2 is referred.Proposal 3: Blocking and spurious response up to 100 MHz channel bandwidth is specified in clause 7.6 of TS 38.101-1. For wider channel bandwidth, the aggregated channel bandwidth of NR intra-band contiguous CA with bandwidth class C in clause 7.6A.2.1, 7.6A3.1 and 7.7A.1 is referred.Observation 1: No additional clarification is needed for channel bandwidth wider than 100 MHz for BS.Proposal 4: 200 MHz is communicated to WP5D as the typical maximum channel bandwidth for 14800 – 15350 MHz in the LS reply.Proposal 5: It is proposed that the NF=11 dB is mentioned in the TR as the typical value and 13 dB is the worst value including margins such as temperature or product variation, etc.Proposal 6: The ACLR and ACS for 14800 to 15350 MHz should be relaxed for 9 dB compared to the current ones specified in FR1, i.e., 21 dB ACLR and 24 dB ACS. |
| R4-2418397 | Ericsson | **Proposal 1:** Based on outcome of beamforming modelling evaluation, the current modelling approach remains effective for its intended purposes. Modifying the existing beamforming model is not necessary, as the variations observed are insignificant and do not justify the complexity of updating the model. **Proposal 2:** Capture simulation assumption, simulation results and corresponding conclusion in TR 38.922.**Proposal 3:** In the LS response to ITU-R WP 5D answer that the current array antenna model approach remains effective for its intended purpose and include a reference to TR 38.922 for proper reference to technical background information. + Text proposal for 38.922 on MIMO modelling |
| R4-2418997 | Ericsson | Draft reply LS |

## Open issues summary

### Sub-topic 1-1

**Issue 1-1-1: Scope TP in R4-2417874**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
* Recommended WF
	+ TBA

**Issue 1-1-2: Draft LS in R4-2418997**

* Proposals
	+ Option 1: Agree the LS
	+ Option 2: Revise the LS
	+ Option 3: Not agree the LS
* Recommended WF
	+ LS is revised during the meeting in order to send on schedule
	+ Tables from the draft LS on IMT parameters are added in the Annexes of this summary for information and a basis for discussion/checking if needed

# Topic #2: Corrections for 4400-4800 and 7125-8400MHz frequency ranges

This topic handles proposed corrections for the frequency ranges for which the parameters, LS response and TR text were already agreed.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2417534 | Nokia | Text proposal updating duplexing text for 4400-4800 |
| R4-2417535 | Nokia | Editorial TP for 7125-8400 |
| R4-2418607 | Qualcomm, Nokia, Ericsson | TP on impact of higher channel bandwidth on SEM and emissions |
| R4-2418994 | Ericsson | Editorial TP on 7125-8400 section |
| R4-2419419 | NEC | TP to reduce AAS emissions limits by 9dB (scaling) |

## Open issues summary

### Sub-topic 2-1 Correction TPs

Sub-topic description: Update TPs to the TR

**Issue 2-1-1: Editorial TP R4-2417534 for 4400-4800**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
* Recommended WF
	+ TBA

**Issue 2-1-2: Editorial TP R4-2417535 for 7125-8400**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
	+ Option 4: Merge the TP
* Recommended WF
	+ TBA

**Issue 2-1-3: Editorial TP R4-2418994 for 7125-8400**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
	+ Option 4: Merge the TP
* Recommended WF
	+ TBA

**Issue 2-1-4: TP RP-2418607 on impact of higher channel bandwidth on SEM and emissions**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
	+ Option 4: Merge the TP
* Recommended WF
	+ TBA

**Issue 2-1-5: TP RP-2419419 on AAS emissions scaling**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
	+ Option 4: Merge the TP
* Recommended WF
	+ TBA

# Topic #3: 15GHz co-existence simulations

This topic deals with the co-existence study for 15GHz. The topic compares the simulations results on ACIR

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2419413 | Samsung | Skeleton for simulation results for 15GHzModerator note: To be revised with results |
| R4-2417536 | Nokia | **Observations from simulation results:**1) The average and 5%-tile downlink throughput losses of the victim UE in all simulated cases are limited to around 5% with downlink ACIR offset of -12 dB.2) The average throughput losses for FR1 like UE are higher than those for FR2 like UE with the use of beamforming at the FR2 like UE, while the 5%-tile throughput losses for FR1 like UE are lower than those for FR2 like UE.3) The average and 5%-tile uplink throughput losses in all simulated cases are limited to around 5% with an uplink ACLR offset of -9 dB.4) The average throughput losses for FR1 like UE are similar to those for FR2 like UE with the use of beamforming at the FR2 like UE, while the 5%-tile throughput losses for FR1 like UE are lower than those for FR2 like UE at larger ACIR offsets.5) The 99.99%-tile received blocking signal power levels are less than -48 dBm and -46 dBm, respectively, in un-coordinated operation with FR1 like UE and coordinated operation with FR2 like UE. |
| R4-2417537 | Nokia | **Observations from simulation results:**1) The average and 5%-tile downlink throughput losses of the victim UE in all simulated cases are limited to around 5% with downlink ACIR offset of -9 dB.2) The throughput losses for FR1 like UE are higher than those for FR2 like UE with the use of beamforming at the FR2 like UE, except the 5%-tile throughput losses at larger ACIR offsets.3) The average and 5%-tile uplink throughput losses in all simulated cases are limited to around 5% with an uplink ACLR offset of -9 dB.4) The throughput losses for FR1 like UE are higher than those for FR2 like UE with the use of beamforming at the FR2 like UE.5) The 99.99%-tile received blocking signal power levels are less than -39 dBm and -43 dBm, respectively, in un-coordinated operation with FR1 like UE and coordinated operation with FR2 like UE. |
| R4-2317538 | Nokia | TP on simulation assumptions (editorial) |
| R4-2417740 | Apple | Observation 1: Based on the DL co-existence simulation results the UE ACS can be around 27-30dBObservation 2: Based on the UL co-existence simulation results the UE ACLR can be around 22-24dB. **(Moderator note: BS ACLR/ACS assumed to be 45dB)** |
| R4-2417875 | CATT | **Observation: No coverage issue is observed with the BS array size 3072 (16\*24, SA size 4).****Proposal 1: RAN4 to take BS array size as 3072 (16\*24, SA size 4) in the reply.****Proposal 2: RAN4 to set DL ACIR as 24dB and UL ACIR as 20dB for the frequency range 14.8GHz – 15.35GHz.** |
| R4-2417903 | Mediatek | **Observation 1: Outage rate is approximately 4~6%, regardless of channel bandwidth and BS antenna size. This is attributed to the use of single omni-directional antenna for the UE and full-BW PUSCH transmission with a fixed maximum UE output power of 23dB.**Observation 2: For a channel bandwidth of 100MHz, the maximum required DL ACIR value does not exceed 24dB, and the maximum required UL ACIR value does not exceed 17dB.Observation 3: For a channel bandwidth of 200MHz, the maximum required DL ACIR value does not exceed 23dB, and the maximum required UL ACIR value does not exceed 15dB. |
| R4-2418175 | vivo | **Observation 1:** The required the ACIR for UL is 12 dB and 22 dB for DL.**Proposal 1:** Take the following value for the ACS/ACLR in the LS reply* BS ACS = 25 dB and BS ACLR = 35 dB
* UE ACS = 23 dB and UE ACLR = 12 dB
 |
| R4-2418610 | Qualcomm | **Proposal 1: RAN4 to consider 200 MHz as a baseline in the adjacent channel coexistence framework.** **Observation 1: No coverage issues (DL and UL) are observed with the agreed BS AAS configuration (3072 antenna elements, 16\*24 URA with 4 elements per subarray) and 200 MHz channel bandwidth.** **Proposal 2: RAN4 to consider 3072 as total number of antenna elements and 200 MHz channel bandwidth since no coverage issues were observed.** **Observation 2: To meet the throughout threshold target, ACIR values of 22 dB and 13 dB were observed for downlink and uplink, respectively, based on the latest agreed parameters.** **Observation 3: Large antenna arrays at the BS enables feasible adjacent channel coexistence via directing the wanted signal to the target destination and reducing the adjacent channel interference.** **Observation 4: Due to the regulatory occupied bandwidth requirement, required UE ACLR is technically equal to 24 dBc.****Proposal 4: RAN4 to consider BS (UE) ACLR as 27 dB (24 dB), while UE ACS as 24 dB.****Observation 5: During the normative work, different assumptions and accompanying ACIR values can be discussed within RAN4.**  |
| R4-2418992 | Ericsson | In the previous sections we made the following observations:[Observation 1 ACIR requirements are in similar ballpark when considering 100 or 200 MHz, both in Uplink and Downlink.](#_Toc181979375)[Observation 2 UL coverage could be challenging and multiple UEs can be scheduled to address coverage issues.](#_Toc181979376)[Observation 3 Indoor users are the driving force that decide the ACIR requirements in UL.](#_Toc181979377)Based on the discussion in the previous sections we propose the following:[Proposal 1 The additional information in Channel Bandwidth should be updated with the following text in the TR – “](#_Toc181979378)*[Higher channel bandwidths are not precluded. The typical channel bandwidth is associated with the maximum transmission power as it impacts the Power Spectral Density (PSD), when full channel bandwidth is transmitted.”](#_Toc181979378)*[Proposal 2 RAN4 to adopt 200 MHz as typical channel bandwidth, and also state in TR that higher channel bandwidths are not precluded, and that in case of coverage issues, more UEs can be considered to be scheduled on the wide bandwidth.](#_Toc181979379)[Proposal 3 RAN4 to keep both options 20% and 0% Indoor users for co-existence simulations, and ACIR requirements should be derived considering 0% Indoor Users as the worst-case.](#_Toc181979380)[Proposal 4 RAN4 to consider BS ACLR as 31 dB and BS ACS as 21 dB as a starting point for discussions.](#_Toc181979381)[Proposal 5 RAN4 to consider UE ACLR as 15 dB and UE ACS as 25 dB as a starting point for discussions.](#_Toc181979382)[Proposal 6 RAN4 to remove non-AAS BS architecture sections from the LS template.](#_Toc181979383) |
| R4-2418993 | Ericsson | Observation 1 The DL scenario is feasible from a coverage perspective for all the combination of parameters under study – BS array size of 3072/ 4096 AEs, CBW of 100/ 200 MHz and Indoor probability of 20%/ 0%.Observation 2 DL ACIR requirements are 20-21 dB with Indoor probability 20% and 24 dB with indoor probability 0%.Observation 3 DL ACIR requirements are on the lower side when 20% Indoor probability is considered with larger antenna size.Observation 4 The UL scenario is feasible from a coverage perspective for all the combination of parameters under study – BS array size of 3072/ 4096 AEs, CBW of 100/ 200 MHz and Indoor probability of 20%/ 0%.Observation 5 A percentage of users of 4.3% is in outage in UL considering the above-mentioned assumptions and indoor probability 20%. For users in challenging coverage conditions, it should be possible to schedule more users at the same time in the bandwidth, to concentrate the UL transmission power in a fraction of the bandwidth and improve the PSD.Observation 6 UL ACIR requirements are in the range 11-12 dB with indoor probability 20% and 14 dB with indoor probability 0%.Observation 7 UL ACIR requirements are on the lower side when 20% Indoor probability, as the Indoor Users decide the requirements. |
| R4-2419213 | ZTE | **Observation 1**: based on the FR1 like UE assumption, then DL ACIR requirement could be relaxed around 8dB in Urban macro scenario.**Observation 2**: based on the FR1 like UE assumption, for non-co-located deployment, even with the existing FR1 ACIR requirements under the 20% indoor deployment, it is still challenging to meet the 5% throughput loss criteria in Urban macro scenario. If the indoor deployment is assumed as 0%, then ACIR requirement could be relaxed more than 10dB.  |
| R4-2419237 | Huawei, HiSilicon | Observation 1: the average and 5%-tile DL throughput losses of the victim UE are below 5% with downlink ACIR >= 26 dB.Observation 2: the average and 5%-tile UL throughput losses of the BS are below 5% with uplink ACIR >= 25 dB. |
| R4-2419415 | Samsung | Observation 1: It is observed that the throughput loss is comparable enough for both average and edge cases as expected.Proposal 1: Corresponding ACIR requirements should be determined for urban macro scenarios. |

## Open issues summary

For this topic, only the simulation results are considered. Proposals on ACLR/ACIR/bandwidth/array size etc. are considered in topic 4.

### Sub-topic 3-1 Further refinement of simulation assumptions

**Issue 3-1-1: Editorial TP Re-2417538 on assumptions**

* Proposals
	+ Option 1: Agree the TP
	+ Option 2: Revise the TP
	+ Option 3: Not agree the TP
	+ Option 4: Merge the TP
* Recommended WF
	+ TBA

### Sub-topic 3-2 ACIR results

**Issue 3-2-1: Observed DL ACIR (Urban macro)**

* Proposals
* Option 1: ACIR offset (from FR1 ACIR) is -12dB (Nokia) for one UE or -9dB for 3 UEs
* Option 2: 24dB (CATT)
* Option 3: 23-24dB (Mediatek)
* Option 4: 22dB (vivo)
* Option 5: 22dB (Qualcomm)
* Option 6: 20-24dB (Ericsson)
* Option 7: Relaxed by 8dB (compared to FR1) (ZTE)
* Option 8: 26dB (Huawei)
* Option 9: 24-25dB (Samsung)

Recommended WF: Conclude DL outdoor ACIR is around 22-24dB

**Issue 3-2-2: Observed UL ACIR (Urban macro)**

* Proposals
* Option 1: ACIR offset (compared to FR1) of -9dB (Nokia)
* Option 2: 20dB (CATT)
* Option 3: 15-17dB (Mediatek)
* Option 4: 12dB (vivo)
* Option 5: 13dB (Qualcomm)
* Option 6: 11-14dB (Ericsson)
* Option 7: 10dB (ZTE)
* Option 8: 25dB (Huawei)

Recommended WF: Many results suggest ACIR around e.g. 13-15dB. CATT and Huawei are considerably higher and ZTE lower.

**Issue 3-2-3: UL coverage:**

* Option 1: No coverage issue (CATT, Qualcomm)
* Option 2: Outage 4-6% (Mediatek)
* Option 3: With 20% indoor, UL coverage may be a challenge, but could be dealt with by scheduling multiple UL UEs (Ericsson)
* Option 4: Coverage challenging for indoor users, but can consider outdoor (ZTE, Ericsson)

Recommended WF:

* Use ACIR results to decide ACLR/ACS.
* Discuss whether to document in the TP (and possibly LS) that multiple UEs may be scheduled in the bandwidth to achieve indoor coverage.

**Issue 3-2-4: Observed Blocking level (Urban macro)**

* Proposals
* Option 1: 99.99th percentile is -48dBm for 1 user scheduled or -39dBm for 3 users scheduled for FR1 like UE (Nokia)
* Option 2: 99th percentile is -63dBm (Ericsson)

**Issue 3-2-5: Documenting results in the TR**

* Proposals
* Option 1: R4-214913 needs to be revised with the results.

Discuss how to align results, considering in particular which of the following assumptions should be caspured in the TR:

1. Deployment scenario

2. Layouts (coordinated vs. un-coordinated for FR1 vs. both)

3. UE types (FR1-like only vs. + FR2-like also vs. both)

4. ACIR reference (relative vs. absolute vs. both)

5. CBW (100MHz vs. 200MHz vs. both)

6. UEs per network (1 vs. 3 vs. both)

7. Indoor ratio (0% vs. 20% vs. both)

# Topic #4: 15GHz parameters for ITU-R response

This topic covers issues and parameters that need to be considered to formulate the LS response.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2419414 | Samsung | TP on UE parameters for the 15GHz range |
| R4-2417539 | Nokia | Proposal 1: To confirm 16x24 array and 4x1 sub-array as the BS antenna array size in urban macro scenario.Proposal 2: The output power for different AAS BS classes in the LS reply on parameters for 14800 to 15350 MHz should be:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Macro urban | Small cell outdoor/Micro urban | Small cell indoor/Indoor urban |
| 7125 to 8400 MHz | Conducted power (before Ohmic loss) per sub-array or element (dBm) (Note 3) | 18 | 16 | N/A |

Proposal 3: Confirm the 36 dBm output power for dense urban BS for coexistence simulation.Proposal 4: Category B spurious emission and spurious emission requirements could be included in the LS reply for 14800 to 15350 MHz.Proposal 5: The ACLR and ACS for 14800 to 15350 MHz should be relaxed for 9 dB compared to the current ones specified in FR1, i.e., 36 dB ACLR and ACS. |
| R4-2417741 | Apple | Proposal 1: The typical channel bandwidth is 100MHz not precluding larger channel bandwidths.Proposal 2: UE spurious emissions follow the ITU-R Category B requirement of -30dBm/MHz (i.e. same requirement as FR1).Proposal 3: UE spectral mask is the same as FR1 mask.Proposal 4: UE noise figure is 13-14dBProposal 5: UE ACLR is 22-24dB.Proposal 6: UE ACS is 27-30dB. |
| R4-2417742 | Apple, Samsung | TP on UE antenna considerations |
| R4-2417743 | Apple | TP on UE antenna options |
| R4-2417876 | CATT | Proposal 1: Set BS ACLR as 31dB for the frequency range 14.8G – 15.35GHz.Proposal 2: Set BS ACS as 27dB for the frequency range 14.8G – 15.35GHz.Proposal 3: Set UE ACLR as 21dB for the frequency range 14.8G – 15.35GHz.Proposal 4: Set UE ACS as 25dB for the frequency range 14.8G – 15.35GHz.Proposal 5: Use 56dB as power dynamic range in the third reply LS.Proposal 6: For emissions marks, UE SEM given in Section 7.1.2 in TR 38.921 can be reused.Proposal 7: For spurious emission, RAN4 to adopt the UE general spurious emissions defined in TS 38.101-1 clause 6.5.3.1.Proposal 8: For blocking and spurious response, RAN4 to consider the blocking characteristic specified in clause 7.6 of TS 38.101-1 for frequency larger than 3300 MHz could be applied. |
| R4-2418176 | vivo | **Proposal 1:** 100MHz is used in the LS reply and larger BWs are recorded in TR. **Proposal 2:** For the signal bandwidth in the 15GHz, it is suggested to quote formula of RBs \* SCS without number of RBs.**Proposal 3：**The power dynamic for 14800 to 15350MHz frequency range is 56 dB**Proposal 4:** For the UE SEM, use the same mask in TR38.921.**Proposal 5:** For the spurious emission, the current requirement in TS 38.101-1 is reused. |
| R4-2418609 | Qualcomm | Proposal 1: RAN4 to agree on TDD as a baseline duplexing for 14800 – 15350 MHz frequency range and capture the following text in TR 38.922. *“Even though FDD is not precluded, most likely TDD will be used in this frequency range. In addition, SBFD is considered as a candidate duplexing method. The core requirements for Rel-19 SBFD work item can be tracked through the list of impacted specs captured in [8].”*Proposal 2: RAN4 to adopt 200MHz is a typical channel bandwidth. Additionally, it should be stated clearly in TR 38.922 that higher channel bandwidths should not be precluded for this frequency range.Proposal 3a: RAN4 to not specify a fixed signal bandwidth but rather mention its dependency on SCS and number of RBs, similar to what was done to 7125-8400 MHz frequency range. Proposal 3b: RAN4 to consider typical 60KHz as typical SCS for this frequency range and NPRB as given for 200MHz is TS 38.104.Observation 1: The impact of modelling near-by users using spherical waves on system level evaluations is not clear in RAN4 and currently being studied in RAN1. Proposal 4: RAN4 to not consider near-field impacts in this frequency range in its correspondence to WP5D. Proposal 5: RAN4 to consider 1536 dual polarized antenna array based on 16\*24 with 4 elements per subarray. Proposal 6: RAN4 to adopt Category A and B SEM masks given in TR 38.921. Proposal 7: For BS ACLR and ACS will be based on the outcome of the adjacent channel coexistence. In addition, RAN4 should make sure that the defined ACLR/ ACS are consistent with the defined ACLR/ACS for FR1 and FR2-1. Observation 2: Based on the agreed simulation parameters for the adjacent channel coexistence work, 21 and 13 dB ACIR were observed for the downlink and uplink ACIR, respectively. Proposal 8: RAN4 to adopt if ΔfOOB = 100 MHz for the definition of in-band and out-of-band blocking. Proposal 9: RAN4 to agree on 23 dBm as UE typical maximum output power in the LS reply and to include in TR that higher power classes are not precluded in the normative phase of this frequency range. Proposal 10: RAN4 to agree on 56 dBm as UE power dynamic range. Proposal 10: RAN4 to consider 13 dB as UE noise figure for the LS reply. Proposal 12: RAN4 to consider UE SEM given in TR 38.921, which is relaxed compared to NR general NR FR1 SEM at the FOOB edge ± 0 – 5 MHz by 3 dB. Proposal 13: RAN4 to consider the UE occupied bandwidth requirement when defining the UE ACLR value, thus, consider UE ACLR equal to 24 dB. Proposal 14: RAN4 to adopt the UE general spurious emissions defined in TS 38.101-1 clause 6.5.3.1.Proposal 15: For UE blocking response, RAN4 to consider the blocking characteristic specified in clause 7.6 of TS 38.101-1 for frequency larger than 3300 MHz could be applied. |
| R4-2418991 | Ericsson | Proposal 1 RAN4 to consider an array architecture with 3072 AEs for Urban Macro in the reply to the LS. The array configuration is of 16x24 and subarrays of dimension 4x1.Proposal 2 The additional information in BS antenna parameter clause should be updated with a note in the TR – “The choice of BS antenna configuration is an example to derive reasonable requirements. This does not limit or preclude from implementing other possible array architectures.”Proposal 3 RAN4 to consider antenna parameters from Table 2.1-1 for the LS response, relevant to 14800 – 15350 MHz frequency range.Proposal 4 The additional information in Duplex Mode should be updated with the following text in the TR – “There is no defined 3GPP band for the 14800 - 15350 MHz frequency range. Similar to the 4400 – 4800 MHz and 7125 – 8400 MHz frequency ranges, RAN4 assumed TDD as a baseline duplexing for the 14800 – 15350 MHz frequency range even though FDD is not precluded. SBFD can be a candidate duplexing method for this frequency range. The core requirements for Rel-19 SBFD work item can be tracked through the list of impacted specs captured in [6].”Proposal 5 The additional information in Channel Bandwidth should be updated with the following text in the TR – “Higher channel bandwidths are not precluded. The typical channel bandwidth is associated with the maximum transmission power as it impacts the Power Spectral Density (PSD), when full channel bandwidth is transmitted.”Proposal 6 RAN4 to adopt 200 MHz as typical channel bandwidth, and also state in TR that higher channel bandwidths are not precluded, and that in case of coverage issues, more UEs can be considered to be scheduled on the wide bandwidth.Proposal 7 RAN4 to not specify a fixed signal bandwidth but rather mention the dependency of signal bandwidth on the SCS and number of RBs.Proposal 8 RAN4 to not state AAS OBUE Category B limits for this frequency range. However, it is important to point out in LS response and TR, that Category B limits are not yet defined by CEPT. RAN4 to follow previous agreements for Table 1B AAS OBUE Category A limits for 7125 to 8400 MHz in LS [10].Proposal 9Proposal 10 Based on co-existence results considering BS array of 3072 AEs and channel bandwidth of 200 MHz and 0% indoor users, BS ACLR corresponds to 31 dB.Proposal 11 RAN4 to not state AAS spurious emission Category B limits for this frequency range. However, it is important to point out in LS response and TR, that Category B limits are not yet defined by CEPT.Proposal 12 RAN4 to follow previous agreements for AAS spurious emission Category A limits with the upper frequency limit defined as 2nd harmonic.Proposal 13 RAN4 to adopt 37 dBm as BS max output power for Dense Urban. Based on co-existence results considering BS array of 3072 AEs and channel bandwidth of 200 MHz and 0% indoor users, BS ACS corresponds to 21 dB.Proposal 14Proposal 15 RAN4 to agree on 56 dB as power dynamic range.Proposal 16 Based on co-existence results considering BS array of 3072 AEs and channel bandwidth of 200 MHz and 0% indoor users, UE ACLR corresponds to 15 dB.Proposal 17 RAN4 to consider UE spurious emission limits from TS 38.101-1, - 36 dBm/ 100 MHz and - 30 dBm / 1 MHz as baseline for discussions.Proposal 18 RAN4 to agree on the UE NF as 13 dB, for both co-existence assumptions and LS response.Proposal 19 Based on co-existence results considering BS array of 3072 AEs and channel bandwidth of 200 MHz and 0% indoor users, UE ACS corresponds to 25 dB. RAN4 to consider Clause 7.6 of TS 38.101-1 with with FDL\_low ≥ 3300 MHz and FUL\_low ≥ 3300 MHz, applicable to this range. |
| R4-2419051 | Mediatek | Proposal 1: RAN4 to consider 13 dB NF for the LS reply and mention that the actual noise figure to be used to define RF requirements should be further studied in the WI phase in the TR.Proposal 2: RAN4 to consider 56dB for 100MHz for PC3 UE.Proposal 3: RAN4 to consider UE SEM given in TS 38.101-2 Table 6.5.2.1-1, with FOOB = min(2 BWChannel , 250 MHz + BWChannel) based on ITU-R SM.1539 Table 2.Proposal 4: RAN4 to consider TS 38.101-1 clause 6.5.3.1 as the UE general spurious emission.Proposal 5: For in-band blocking and out-of-band blocking, desired signal power = REFSENS + 14dB which is relaxed compared to n104 and same as ACS case 1.Proposal 6: Out of band blocker power and frequency offset is same as n104 range 2 and range 3 (TS 38.101-1 Table 7.6.3-4), but for range 3 extend the max frequency from 12.75 GHz to 43.5 GHz or 2 f0.Proposal 7: Use the blocking characteristics of clause 7.6, 7.7, 7.8 of TS 38.101-1 for frequency larger than 3300MHz for other RX blocking requirements. Proposal 8: RAN4 to consider 18dB as the ACLR value and 25dBc as the ACS value. |
| R4-2419214 | ZTE, Sanechips | **Proposal 1**: define BS ACLR requirement as 35dBc;**Proposal 2**: propose to capture the Cat B spectral emission mask in the TR and further discuss its applicability when the band is introduced in the spec.**Proposal 3**: propose to capture the Cat B spurious emission mask in the TR and further discuss its applicability when the band is introduced in the spec.**Proposal 4**: propose to reuse ΔfOBUE = 100 MHz for 15GHz.**Proposal 5**:propose to define BS OTA sensitivity requirement based on the NF and the antenna gain similar 7 and 10GHz;  $ EIS\_{REFSENS}=P\_{kT}+10\*log\_{10}\left(BW\right)+NF+IM+SNR-G (dBm)$Where: - BW is the configured bandwidth of the FRC, - NF is the noise figure, - IM is implementation margin not related to antenna array, - SNR is the required SNR to reach 95% throughput, and - G is the antenna gain including RF losses and 3dB off peak margin.**Proposal 6**: to define the OOBB requirement for 15GHz BS as following

| Frequency range of interfering signal(MHz) | Wanted signal mean power(dBm) | Interferer RMS field-strength | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36 [-15dBm] | CW |
| 12750 to FUL,low – 1500 | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |
| FUL,high + 1500 to 2nd harmonic of the upper frequency edge of the *operating band* | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |

**Proposal 7**:propose to define BS ACS requirement as 38dBc.**Proposal 8**: define UE ACS requirement around 30dBc for 15GHz.  |
| R4-2419399 | Mediatek | General TP on UE antennas and digital beamforming |
| R4-2419416 | Samsung | **<BS and system parameters>****Observation 1: As maximum channel bandwidth for 15 GHz, 200 MHz could enable to enjoy a larger contiguous bandwidth on the higher frequency range than FR1.****Observation 2: At the same time, larger than 200 MHz channel bandwidth would be limited considering the legacy services around the frequency range of 15 GHz.****Proposal 1: RAN4 should confirm 200 MHz as typical channel bandwidth for 15 GHz.****Observation 3: Category B for both emission mask and spurious emission for the new frequency range would be meaningless before WRC-27 where to confirm the frequency ranges with their requirements.****Proposal 2: It is preferred to remove category B unless otherwise requested from ITU-R.****<UE antenna parameters>****Observation 4: Since RAN4 has agreed to FR1-like UE type already, there is no outstanding issue even if the existing requirements in TS 38.101-1 or TR 38.921 are taken for the 15 GHz range.****Proposal 3: It would be good to remove FFS for UE parameters of emission mask, spurious emission, blocking and spurious response.****Observation 5: As agreed in the last meeting, it is good for RAN4 to have 1Tx omnidirectional as only one UE antenna model for the LS from the perspective of both feasibility and ITU-R sharing studies.****Observation 6: From the antenna gain perspective, the peak gain of combined two Tx antennas does not show better performance, but rather drops compared to the single beam case with normal FR1-like antennas.****Proposal 4: It would be meaningless for RAN4 to discuss the number of necessary Tx antennas for the better antenna gain at this frequency range.****Proposal 5: For antenna array parameters, the LS can have the same table with the simulation assumptions in the TR.**+ table of parameters |
| R4-2419417 | Samsung | TP on antenna characteristics |
| R4-2419688 | Huawei | **Proposal 1**: For the LS reply on 15 GHz BS parameters, confirm BS antenna array size of 3027 (while the size of 4096 is also acceptable as alternative).**Proposal 2**: For the LS reply on 15 GHz BS parameters, provide Category A limits only for the emission mask. **Proposal 3**: For the LS reply on 15 GHz BS parameters, provide Category A limits only for the spurious emissions.**Proposal 4**: For the LS reply on 15 GHz BS parameters, define ACLR as 30 dB.  |

## Open issues summary

### Sub-topic 4-1 General issues

This topic considers general issues that apply to both BS and UE.

**Issue 4-1-1: Duplex Mode**

Previous agreement:

* TDD as a baseline.
* Suggestion for TR text found in R4-2411521 which can be further discussed
* Proposals
	+ Option 1: Capture the following text in the TR (Qualcomm):

*“Even though FDD is not precluded, most likely TDD will be used in this frequency range. In addition, SBFD is considered as a candidate duplexing method. The core requirements for Rel-19 SBFD work item can be tracked through the list of impacted specs captured in [8].”*

* + Option 2: Capture the following text in the TR (Ericsson):

*“There is no defined 3GPP band for the 14800 - 15350 MHz frequency range. Similar to the 4400 – 4800 MHz and 7125 – 8400 MHz frequency ranges, RAN4 assumed TDD as a baseline duplexing for the 14800 – 15350 MHz frequency range even though FDD is not precluded. SBFD can be a candidate duplexing method for this frequency range. The core requirements for Rel-19 SBFD work item can be tracked through the list of impacted specs captured in [6].”*

* Recommended WF
	+ TBA

**Issue 4-1-2: Typical channel bandwidth**

Previous agreement:

* [200MHz] as typical bandwidth, document in TR other bandwidths not precluded
* The note should capture the association of channel bandwidth with maximum transmission power /PSD
* If the practical issues are identified or additional work required for replying LS for 200MHz, RAN4 will consider 100MHz as typical bandwidth
* Proposals
	+ Option 1: 200MHz in LS response, document higher bandwidths in TR (Nokia, Qualcomm, Ericsson, Samsung)
	+ Option 2: 100MHz as typical bandwidth (Apple, vivo)
	+ Option 3: Capture the following additional note in the TR: “Higher channel bandwidths are not precluded. The typical channel bandwidth is associated with the maximum transmission power as it impacts the Power Spectral Density (PSD), when full channel bandwidth is transmitted.” (Ericsson)
	+ Option 4: State in TR that higher channel bandwidths are not precluded, and that in case of coverage issues, more UEs can be considered to be scheduled on the wide bandwidth. (Ericsson)
* Recommended WF
	+ TBA

**Issue 4-1-3: Typical signal bandwidth**

* Proposals
	+ Option 1: Typical signal bandwidth is given by a formula of RBs \* SCS without number of RBs. (Qualcomm, Ericsson, vivo)
* Recommended WF
	+ TBA

**Issue 4-1-4: Sub-carrier spacing**

* Proposals
	+ Option 1: Consider 60kHz as typical SCS (Qualcomm)
* Recommended WF
	+ TBA

**Issue 4-1-5: SINR operating range**

* Proposals
	+ Option 1: Reuse the approach from previous LS, i.e. refer to “SINR operating range and mapping function” -> No proposal on this, but it needs to be agree for the LS
	+ Option 2: Consider corrections proposed in CR to TR 38.803 in R4-2417593.

**Issue 4-1-6: Near field impacts**

* Proposals
	+ Option 1: RAN4 to not consider near-field impacts in this frequency range in its correspondence to WP5D. (Qualcomm)

### Sub-topic 4-2: BS related parameters

This sub-topic considers BS parameters

**Issue 4-2-1: BS output power**

Previous agreement:

* Do not mention average output power

**Issue 4-2-2: Power dynamic range**

Previous agreement: 0dB

**Issue 4-2-3: Emissions mask**

Previous agreement:

For the reply, refer to the following table as basis

* [category B] and category A
* Table 6.1.2-1: Wide Area BS operating band unwanted emission limits for 6.425 - 7.125 GHz and 10.0 - 10.5 GHz for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter 3dB point, Df | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits  | Measurement bandwidth |
| 0 MHz £ Df < 50 MHz | 0.05 MHz £ f\_offset < 50.05 MHz | $$-7dBm-\frac{7}{50}\left(\frac{f\_{offset}}{MHz}-0.05\right)$$ | 100 kHz  |
| 50 MHz £ Df <min(100 MHz, Dfmax) | 50.05 MHz £ f\_offset <min(100.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz  |
| 100 MHz £ Df £ Dfmax | 100.5 MHz £ f\_offset < f\_offsetmax  | -13 dBm | 1MHz  |

* [Table 6.1.2-2: Wide Area BS operating band unwanted emission limits for 6.425 - 7.125 GHz and 10.0 - 10.5 GHz for Category B

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency offset of measurement filter 3dB point, Df | Frequency offset of measurement filter centre frequency, f\_offset | Basic limits | Measurement bandwidth |
| 0 MHz £ Df < 50 MHz | 0.05 MHz £ f\_offset < 50.05 MHz | $$-7dBm-\frac{7}{50}\left(\frac{f\_{offset}}{MHz}-0.05\right)$$ | 100 kHz  |
| 50 MHz £ Df <min(100 MHz, Dfmax) | 50.05 MHz £ f\_offset <min(100.05 MHz, f\_offsetmax) | -14 dBm | 100 kHz  |
| 100 MHz £ Df £ Dfmax | 100.5 MHz £ f\_offset < f\_offsetmax  | -15 dBm  | 1MHz  |

]

* Proposals
	+ Option 1: Reply Category A and Category B OBUE (Qualcomm, Nokia)
	+ Option 2: Do not include category B OBUE in reply (Ericsson, Samsung, Huawei)
		- Option 2a: Mention in LS and TR that CEPT has not yet decided emissions limits (Ericsson)
	+ Option 3: Capture category B OBUE in the TR (ZTE)
* Recommended WF

**Issue 4-2-4: Noise figure**

Previous agreement:

* 8 dB for Wide-Area BS
* 13 dB for Medium Range BS
* 16 dB for Local Area BS

**Issue 4-2-5: Sensivitity**

Previous agreement:

For LS: “To be specified”

For TR: Define based on NF and antenna gain

Option 1 (ZTE): define BS OTA sensitivity requirement based on the NF and the antenna gain similar 7 and 10GHz;

 $ EIS\_{REFSENS}=P\_{kT}+10\*log\_{10}\left(BW\right)+NF+IM+SNR-G (dBm)$

Where:

- BW is the configured bandwidth of the FRC,

- NF is the noise figure,

- IM is implementation margin not related to antenna array,

- SNR is the required SNR to reach 95% throughput, and

- G is the antenna gain including RF losses and 3dB off peak margin.

**Issue 4-2-6: ACLR**

* Proposals
	+ Option 1: 36dB (Nokia)
	+ Option 2: 31dB (CATT, Ericsson)
	+ Option 3: 35dB (ZTE, vivo)
	+ Option 4: 30dB (Huawei)
	+ Option 6: 27dB (Qualcomm)
* Recommended WF

**Issue 4-2-7: Spurious emission**

Previous agreement:

For the reply, refer to the following table as basis

* [category B] and category A
* Table 2.2.2.3-1: BS spurious emission limits for 14800 to 15350 MHz for Category A

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Limit | Measurement Bandwidth | Note |
| 30 MHz – 1 GHz | -13 dBm | 100 kHz | Note 1 |
| 1 GHz – 2nd harmonic of the upper frequency edge of the DL operating band | 1 MHz | Note 1, Note 2 |
| NOTE 1: Bandwidth as in ITU-R SM.329, s4.1NOTE 2: Upper frequency as in ITU-R SM.329, s2.5 table 1. |

* Table 2.2.2.3-2: BS spurious emission limits for 14800 to 15350 MHz for Category B

|  |  |  |
| --- | --- | --- |
| Spurious frequency range | Limit | Measurement bandwidth |
| 30 MHz – 1 GHz | -36 dBm | 100 kHz |
| 1 GHz – 18 GHz | -30 dBm | 1 MHz |
| 18 GHz – 2nd harmonic of the upper frequency edge of the DL operating band | -20 dBm | 10 MHz |

* Proposals
	+ Option 1: Reply Category A and Category B spurious emissions (Nokia)
	+ Option 2: Do not include category B spurious emissions in reply (Ericsson, Samsung, Huawei)
		- Option 2a: Mention in LS and TR that CEPT has not yet decided emissions limits (Ericsson)
	+ Option 3: Capture category B spurious emissions in the TR (ZTE)
* Recommended WF

**Issue 4-2-8: Blocking response**

* Proposals
	+ Option 1: ΔfOBUE 100MHz (Qualcomm, ZTE)
	+ Option 2: Define requirement as follows (ZTE):

| Frequency range of interfering signal(MHz) | Wanted signal mean power(dBm) | Interferer RMS field-strength | Type of interfering signal |
| --- | --- | --- | --- |
| 30 to 12750 | EISREFSENS + 6 dB | 0.36 [-15dBm] | CW |
| 12750 to FUL,low – 1500 | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |
| FUL,high + 1500 to 2nd harmonic of the upper frequency edge of the *operating band* | EISREFSENS + 6 dB | 0.1 [-30dBm] | CW |

* Recommended WF

**Issue 4-2-9: ACS**

* Proposals
	+ Option 1: 36dB (Nokia)
	+ Option 2: 27dB (CATT)
	+ Option 4: 25dB (Vivo)
	+ Option 5: 21dB (Ericsson)
	+ Option 6: 38dB (ZTE)
* Recommended WF

**Issue 4-2-10: BS antenna parameters**

Previous agreement:

For Urban Macro:

Agreement:

* Make assumption that reply can say that array size is [3072 (16\*24, SA size 4)], and the TR will document that other arrays are possible.
* Double check the coverage and [3072] before making final decision on reply
	+ If coverage issues is found for [3072], minimum array size [4096] to achieve coverage could be discussed

For Dense Urban:

Agreement:

* Dense urban antenna parameters Same as urban macro, mechanical tilt can differ in reply

For Indoor scenario:

Agreement:

* For reply LS : Antenna configuration without sub-array assumption: 4x4
* Simulation: Not prioritized

For output power for different BS class:

Agreement:

* For wide area BS, 46dBm for TRP for dual polarization;
* For dense urban BS, [36dBm]for TRP for dual polarization;
* For Indoor: 23dBm per polarization
* Proposals on array size Urban Macro
	+ Option 1: Confirm array size (Nokia, Qualcomm, Ericsson, Huawei, CATT)
* Recommended WF
	+ Check Annex B antenna characteristics that remaining parameters are all agreeable

Proposals on sub-array and array power:

Option 1: 18dBm per sub-array for macro urban, 16 for small cell per sub-array (Nokia)

Option 2: 36dBm output power for dense urban (Nokia)

Option 3: 37dBm for BS max output power for dense urban (Ericsson)

**Issue 4-2-11: Additional note on BS antenna parameter clause in TR**

* Proposals:
	+ Option 1: The additional information in BS antenna parameter clause should be updated with a note in the TR – “The choice of BS antenna configuration is an example to derive reasonable requirements. This does not limit or preclude from implementing other possible array architectures.” (Ericsson)

**Issue 4-2-12: Non-AAS BS**

* Proposals:
	+ Option 1: Remove non-AAS BS architectures from the LS template (Ericsson)

### Sub-topic 4-3: UE related parameters

This sub-topic considers UE parameters

**Issue 4-3-1: UE output power**

Previous agreement:

23dBm, mention other power classes possible in TR

**Issue 4-3-2: Power dynamic range**

Proposals from previous meeting

* Option 1: 56dB for 100MHz assuming 23dBm
* Option 2: 56dB for 200MHz assuming 23dBm
* Proposals
	+ Option 1: 56dB (Qualcomm, Ericsson, Mediatek for 100MHz)
* Recommended WF

**Issue 4-3-3: Emissions mask**

Previous meeting:

* Option 1: UE SEM given in Section 7.1.2, TR 38.921.
* Option 2: Other options.
* Proposals
* Option 1: UE SEM given in Section 7.1.2, TR 38.921. (CATT, Vivo, Qualcomm, Ericsson)
* Option 2a: TS 38.101-1 6.5.2.2 for 100MHz or 6.5A.2.2 for wider channel bandwidth (Nokia)
* Option 2b: TS 38.101-1 6.5.2.2 for channels up to 100MHz (Apple)
* Option 3: TS 38.101-2 Table 6.5.2.1-1, with FOOB = min(2 BWChannel , 250 MHz + BWChannel) based on ITU-R SM.1539 Table 2 (Mediatek)
* Recommended WF

**Issue 4-3-4: ACLR**

* Proposals
	+ Option 1: 21dB (Nokia)
	+ Option 2: 22-24dB (Apple)
	+ Option 3: 12dB (Vivo)
	+ Option 4: 24dB (Qualcomm)
	+ Option 5: 15dB (Ericsson)
	+ Option 6: 21dB (CATT)
	+ Option 7: 18dB (Mediatek)
* Recommended WF

**Issue 4-3-5: Spurious emission**

Previous meeting:

FFS if RAN4 to adopt the UE general spurious emissions defined in TS 38.101-1 clause 6.5.3.1

* Proposals
	+ Option 1: Spurious emissions up to 100 MHz channel bandwidth is defined in TS 38.101-1 clause 6.5.3.1. For wider channel bandwidth such as 200 MHz, TS 38.101-1 clause 6.5A.3 is referred (Nokia)
	+ Option 2: -30dBm/MHz (according to the ITU-R SM.329-13 Category B spurious emissions requirements) (Apple)
	+ Option 3: TS 38.101-1 clause 6.5.3.1 (CATT, Vivo, Qualcomm, Mediatek, Ericsson)
* Recommended WF

**Issue 4-3-6: Noise figure**

Previous agreement:

* For LS to ITU, noise figure is [13]dB.
* The common understanding is that the current co-existence simulation work is not changed due to noise figure of 13dB.

Option 1: 13dB (Qualcomm, Ericsson, Mediatek)

 Option 1a: Mention in TR that actual noise figure would be further studied in the WI phase (Mediatek)

Option 2: 13-14dB (Apple)

Option 3: In TR, mention 11dB as typical and 13dB as worst (Nokia)

**Issue 4-3-7: Sensitivity**

Previous agreement:

* Capture it as “To be specified” in the LS reply

**Issue 4-3-8: Blocking and spurious response**

Previous meeting:

* FFS if RAN4 to consider the blocking characteristic specified in clause 7.6 of TS 38.101-1 for frequency larger than 3300 MHz could be applied.
* Proposals
	+ Option 1: Blocking and spurious response up to 100 MHz channel bandwidth is specified in clause 7.6 of TS 38.101-1. For wider channel bandwidth, the aggregated channel bandwidth of NR intra-band contiguous CA with bandwidth class C in clause 7.6A.2.1, 7.6A3.1 and 7.7A.1 is referred. (Nokia)
	+ Option 2: The blocking characteristic specified in clause 7.6 of TS 38.101-1 for frequency larger than 3300 MHz could be applied. (CATT, Qualcomm)
	+ Option 3: For in-band blocking and out-of-band blocking, desired signal power = REFSENS + 14dB which is relaxed compared to n104 and same as ACS case 1. Out of band blocker power and frequency offset is same as n104 range 2 and range 3 (TS 38.101-1 Table 7.6.3-4), but for range 3 extend the max frequency from 12.75 GHz to 43.5 GHz or 2 f0. Use the blocking characteristics of clause 7.6, 7.7, 7.8 of TS 38.101-1 for frequency larger than 3300MHz for other RX blocking requirements. (Mediatek)

**Agreement:**

* For wider channel bandwidth, the aggregated channel bandwidth of NR intra-band contiguous CA with bandwidth class C in clause 7.6A.2.1, 7.6A3.1 and 7.7A.1 is referred.
	+ For the blocking requirements, FFS on whether to relax the blocking requirements in 15GHz frequency range.

**Issue 4-3-9: ACS**

* Proposals
	+ Option 1: 24dB (Nokia, Qualcomm)
	+ Option 2: 27-30dB (Apple)
	+ Option 3: 23dB (Vivo)
	+ Option 4: 25dB (Ericsson, CATT, Mediatek)
	+ Option 5: 30dB (ZTE)

**Issue 4-3-10: FR1 like or FR2 like UE**

Previous agreement:

* LS
	+ Only one UE antenna model to be captured.
	+ 1Tx omnidirectional antenna UE, understood as the worst case (highest ACIR values) assumptions for sharing studies and not on deployment, coverage, implementation, or requirement aspects.
* TR
	+ Additional UE antenna models could be captured.

**Issue 4-3-11: Text proposals on UE antenna characteristics:**

* Discuss whether the following text proposals on UE antenna characteristics can be agreed / merged:
	+ R4-2417742 (Apple, Samsung)
	+ R4-2417743 (Apple)
	+ R4-2419399 (Mediatek)
	+ R4-2419417 (Samsung)
* Recommended WF:
	+ TP#1: General considerations on UE RF design options (based on R4-2417742 with input from R4-2419399)
	+ TP#2: UE RF FR1-like design options (based on input from R4-2417743, R4-2419399 and R4-2419417)

# Topic #5: Other aspects

This topic covers the additional questions on MIMO modelling and on ACLR modelling

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2417540 | Nokia | TP capturing that ITU-model is valid |
| R4-2417545 | Spark | TP describing ZF and MMSE beamforing and simulation results |
| R4-2417546 | Spark | TP on services in nearby bands, array performance in other bands and modelling of PA behaviour. |
| R4-2417877 | CATT | Skeleton for TP on adjacent channel modelling |
| R4-2417878 | CATT | Observation 1: Evaluation may be interesting for a channel bandwidth 100 MHz ~ 400 MHz at 15GHz for the cases where spatial sensitivity of ACLR is observed for 5MHz channel bandwidth at 2GHz.Observation 2: The current coexistence simulation assumes the worst-case scenario in terms of spatial ACLR by applying a uniform ACIR value, which is the basis for defining the minimum ACIR requirement.Observation 3: In M2101 downlink simulation methodology, no multi-user spatial beam-forming is considered.Observation 4: With sufficient number of snapshots for one simulated scenario and ideally paired UEs for co-scheduling, multi-user spatial beam-forming does not improve the assessment of interference and accuracy of studies.Proposal 1: RAN4 to reply WP5D that the current coexistence methodology is sufficient without a need of taking into account spatial ACLR.Proposal 2: RAN4 to reply WP5D that no multi-user spatial beam-forming is needed for assessing AAS implementation with a sufficient number of snapshots for one simulated scenario and ideally paired UEs for co-scheduling. |
| R4-2418395 | Ericsson | **Observation 1:** Since array correlation is difficult to measure for an AAS base station with many transceivers it is more practical to measure the directivity response and convert it to array correlation via a directivity/correlation evaluation.**Observation 2:** For adjacent spectrum sharing studies towards other services, it is essential to capture relevant AAS BS characteristics. Therefore, simulation models should capture relevant assumptions on RF parameters such as array antenna model including decorrelation effects, BS output power, ACLR and RF filter suppression.**Observation 3:** It can be seen from measurement results that unwanted emission below the carrier edge experience beamforming due to array factor. The grating lobe response is supressed but clearly visible outside the carrier.**Observation 4:** From measurement results it can be noticed that the gap between peak EIRP and TRP reduce as function of frequency offset, hence the directivity drops and correlation rolls-off moving away from the carrier centre frequency. **Observation 5:** Based on measured characteristics parameter values for a piece-wise linear model for the array correlation can be established. Based on the presented information and observations we propose following to progress the work:**Proposal 1:** Capture technical background information relevant for modelling array antenna gain outside the carrier in TR 38.922.**Proposal 2:** In the LS response to ITU-R WP 5D include reference to TR 38.922 for proper reference to technical background related to additional information.  |
| R4-2418608 | Qualcomm | Observation 1: WP5D is currently investigating whether it is needed or not to consider multi-user beamforming techniques impact on top of the AAS model (i.e., ITU-R M.2101). Observation 2: RAN4 is expected to provide its technical response on the impact of multi-UE beamforming techniques impact on system level studies to WP5D and capture its findings in TR 38.922. Observation 3: From Monte-Carlo studies, similar IMT BS gain above the horizon is observed when zero forcing is considered at the BS IMT when compared to the case without zero forcing beamforming. Observation 4: The IMT BS radiation pattern is nearly identical when considering the methodology given in Annex A and the modified methodology based $w\_{n,m}$ and $ν\_{n,m}$ from ITU-UR M.2101 when constructing the channel matrix $H\_{k}$.Proposal 1: RAN4 to reply to WP5D that it is sufficient to adopt the legacy AAS model based on ITU-R Recommendation M.2101 since the performance when ZF beamforming is considered is similar to the performance without ZF beamforming technique. Thus, the difference between M.2101 model and the ZF precoder scheme is minor, and therefore M.2101 should be used for WRC-27 study cycle.+TP on MIMO modelling and simulation results |
| R4-2419215 | ZTE | Moderator summary: The correlation level has little impact on co-existence but implies additional simulation effort, and does not need to be considered for sharing studies. |
| R4-2419238 | Huawei | **Proposal 1:** The simulation methodologies and results based on R4-2416281 in #112bis 3GPP RAN4 meeting is provided in the **Annex** to facilitate the work to put all the simulation methodologies and results with corresponding assumptions in a dedicated subclause in TR 38.922.**Proposal 2:** ITU-R M.2101 methodology is the most suitable and sufficient modelling in NLOS condition for coexistence study between BS and UE. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 5-1 ACLR model and MIMO model

**Issue 5-1-1: MIMO model**

Previous agreement:

* It is agreed to put all the simulation methodologies and results with corresponding assumptions in the TR.
* M.2101 methodology is sufficient for LOS channel
* Proposals
	+ Option 1: RAN4 to reply WP5D that no multi-user spatial beam-forming is needed for assessing AAS implementation with a sufficient number of snapshots for one simulated scenario and ideally paired UEs for co-scheduling. (ZTE)
	+ Option 2: RAN4 to reply to WP5D that it is sufficient to adopt the legacy AAS model based on ITU-R Recommendation M.2101 since the performance when ZF beamforming is considered is similar to the performance without ZF beamforming technique. Thus, the difference between M.2101 model and the ZF precoder scheme is minor, and therefore M.2101 should be used for WRC-27 study cycle. (Qualcomm)
	+ Option 3: ITU-R M.2101 methodology is the most suitable and sufficient modelling in NLOS condition for coexistence study between BS and UE. (Huawei)
	+ Option 4: In the LS response to ITU-R WP 5D answer that the current array antenna model approach remains effective for its intended purpose and include a reference to TR 38.922 for proper reference to technical background information. (Ericsson)
	+ Option 5: MU MIMO based ZF BF does not need to be considered for the pure LOS case, and Rec. ITU-R M.2101 methodology remains valid for performing sharing and compatibility studies in WP5D. (Nokia)
* Recommended WF
	+ Reply to the ITU-R that M.2101 is sufficient and suitable
	+ Merge the TPs in R4-2418397 (Ericsson), R4-2417540 (Nokia), R4-2417545 (Spark), R4-2418608 (Qualcomm), R4-2419238 (Huawei)

Nokia: it is suitable for LOS.

CATT: last meeting, we agreed that it is sufficient for LOS. But if we reply for only LOS, the further question would be what is sufficient for NLOS. We would like to cover both LOS and NLOS.

Agreement:

* Reply to the ITU-R that M.2101 is sufficient and suitable for LOS channel.

**Issue 5-1-2: Adjacent channel**

* Proposals
	+ Option 1: RAN4 to reply WP5D that the current coexistence methodology is sufficient without a need of taking into account spatial ACLR. (CATT)
	+ Option 2: Capture technical background information relevant for modelling array antenna gain outside the carrier in TR 38.922. In the LS response to ITU-R WP 5D include reference to TR 38.922 for proper reference to technical background related to additional information. (Ericsson)
	+ Option 3: Capture information on (i) adjacent services and (ii) radiation patter for adjacent frequencies for AAS BS as captured in the TP R4-2417546
* Recommended WF
	+ Merge R4-2417877, R4-2418395, R4-2417546
	+ Discuss what to reply in the LS

Agreement:

* For adjacent channel, in the LS response to ITU-R WP 5D include reference to TR 38.922 for proper reference to technical background related to additional information.

# Worksplit for TP and WF

Already completed TPs and WFs are highlighted in green. The TPs highlighted in yellow should be allocated this meeting for merging correction TPs. The remaining TPs in white should only be allocated at RAN4#113 if all parameters are agreed (otherwise, incremental agreements are captured in the WF).

The WF for 113 should all be allocated.

|  |  |
| --- | --- |
| **Item** | **Company** |
| TP for 4GHz parameters | Ericsson  |
| TP for 8GHz BS parameters | Huawei |
| TP for 8GHz UE parameters | Apple |
| TP for 15GHz BS RF parameters | CATT |
| TP for 15GHz BS Antenna parameters | ZTE |
| TP for 15GHz UE RF parameters | Samsung |
| TP for 15GHz UE Antenna parameters | MTK |
| TP for 15GHz simulation parameters | Nokia (including further revisions at RAN4#112 etc.) |
| TP for 15GHz simulation results | Samsung |
| TP for other issues (MIMO modelling) | Nokia/Spark |
| TP for other issues (Adjacent channel modelling) | CATT |
| TP on BS antenna model | Ericsson |
| RAN4#110bis WF on 4GHz | Ericsson |
| RAN4#110bis WF on 8 and 15GHz  | CATT |
| RAN4#111 WF | Ericsson |
| RAN4#112 WF on 8GHz BS parameters | Huawei |
| RAN4#112 WF on 8GHz UE parameters | Vivo |
| RAN4#112 WF on 15GHz BS parameters | ZTE |
| RAN4#112 WF on 15GHz UE parameters | Qualcomm |
| RAN4#112bis WF on 15GHz BS parameters | ZTE |
| RAN4#112bis WF on 15GHz UE parameters | Qualcomm |
| RAN4#113 WF on 15GHz BS parameters | ZTE |
| RAN4#113 WF on 15GHz UE parameters | Qualcomm |
| RAN4#112 WF on other issues (MIMO) | Nokia/Spark |
| RAN4#112bis WF on other issues (MIMO) | Nokia/Spark |
| RAN4#113 WF on other issues (MIMO) | Nokia/Spark |

# 7 Annex A: IMT parameters (For information):

**IMT technology-related and deployment-related parameters for bands between 14800 and 15350 MHz**

**Table 1: IMT technology related parameters in 14800 – 15350 MHz**

|  |  | **IMT**  |
| --- | --- | --- |
| **No.** | **Parameter** | **Base station(AAS)** | **Mobile station** |
| **1** | **Duplex Method** | TDD |
| **2** | **Channel bandwidth (MHz)** | 200 MHz typical (Note 1)  |
| **3** | **Signal bandwidth (MHz)** | Signal bandwidth = NRB × SCS × 12Will be derived from Channel Bandwidth, see [1], § 5.3.2. |
| **4** | **Transmitter characteristics** |  |
| 4.1 | Power dynamic range (dB) | 0 dB | TBD |
| 4.2 | Spectral mask (dB) | Category A: (Note 2,3)See table 1A (Wide Area BS) (ΔfOBUE = 100 MHz)[Category B] | TBD |
| 4.3 | ACLR  | TBD | TBD |
| 4.4 | Spurious emissions | Category A: (Note 2,3)See table 2A (Wide Area BS) [Category B] | See [2], § 6.5.3. |
| 4.5 | Maximum output power | See Item No. 1.13 in Table 4 for typical values | 23 dBm typical (Note 1) |
| **5** | **Receiver characteristics** |  |
| 5.1 | Noise figure (dB) | 8 dB (Wide Area BS)13 dB (Medium Range BS)16 dB (Local Area BS)For BS class definitions, see [1], § 4.4 | TBD |
| 5.2 | Sensitivity (dBm) | To be specified | To be specified |
| 5.3 | Blocking response  | TBD | TBD |
| 5.4 | ACS  | TBD | TBD |
| 5.5 | SINR operating range (dB) | See below “SINR operating range and mapping function”  |

Note 1: Refer to [3] for more information on other values for channel bandwidth and maximum output power.

Note 2: Base station Operating band unwanted emissions define all unwanted emissions in the supported downlink operating band plus the frequency ranges extending ΔfOBUE above and ΔfOBUE below each band. Base station Unwanted emissions outside of this frequency range are limited by the spurious emissions requirement.

Note 3: Category B limits have not yet been defined by ECC SE21 CEPT.

References used in the Table:

[1] 3GPP TS 38.104 v.18.7.0, “NR; Base Station (BS) radio transmission and reception”

[2] 3GPP TS 38.101-1 v.18.7.0, “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”

[3] 3GPP TR 38.922, “Study on International Mobile Telecommunications (IMT) parameters for 4400 - 4800 MHz, 7125 - 8400 MHz and 14800 - 15350 MHz”.

TABLE 1A

AAS BS Spectral mask (Operating band unwanted emissions limits) for 14800 - 15350 MHz operation (Category A)

| **Frequency offset of measurement filter ‑3dB point from the carrier frequency, Δf** | **Basic limits** | **Measurement Bandwidth** |
| --- | --- | --- |
| 0 MHz £ Df < 50MHz | $$2dBm-\frac{7}{50}\left(\frac{f\\_offset}{MHz}-0.05\right)$$ | 100 kHz |
| 50 MHz £ Df < min(100 MHz, Dfmax) | -5 dBm | 100 kHz |
| 100 MHz £ Df £ Dfmax | -4 dBm | 1 MHz |
| NOTE: Dfmax is equal to f\_offsetmax minus half of the bandwidth of the measuring filter, where f\_offsetmax is the offset to the frequency ΔfOBUE = 100 MHz outside the downlink operating band. |

TABLE 2A

AAS BS Spurious emissions for 14800 - 15350 MHz operation (Category A)

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency range | Limit | Measurement Bandwidth | Note |
| 30 MHz – 1 GHz | -13 dBm | 100 kHz | Note 1 |
| 1 GHz – 2nd harmonic of the upper frequency edge of the DL operating band | 1 MHz | Note 1, Note 2 |
| NOTE 1: Bandwidth as in ITU-R SM.329, s4.1NOTE 2: Upper frequency as in ITU-R SM.329, s2.5 table 1. |

# 8 Annex B: Antenna characteristics (For information)

**Table 4:** **Beamforming antenna characteristics for IMT in 14800 to 15350 MHz**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Macro suburban** | **Macro urban** | **Dense Urban** | **Small cell indoor/Indoor urban** |
| **1** | **Base station Antenna Characteristics** |
| 1.1 | Antenna pattern  | Table 3 | N/A |
| 1.2 | Element gain (dBi) (Note 2) | 6.4 | 6.4 | 6.4 | 5 |
| 1.3 | Horizontal/vertical 3 dB beam width of single element (degree)  | 90º for H65º for V | 90º for H65º for V | 90º for H65º for V | 90º for H90º for V |
| 1.4 | Horizontal/vertical front‑to‑back ratio (dB) | 30 for both H/V | 30 for both H/V | 30 for both H/V | 30 for both H/V |
| 1.5 | Antenna polarization  | Linear ±45º polarized sub-array | Linear ±45º polarized sub-array | Linear ±45º polarized sub-array | Linear ±45º polarized sub-array |
| 1.6 | Antenna array configuration (Row × Column) (Note 4) | 16x24  | 16x24 | 16x24 | 4x4 |
| 1.7 | Horizontal/Vertical radiating sub-array or element spacing (Note 5) | 0.5 of wavelength for H, 2.8 of wavelength for V | 0.5 of wavelength for H, 2.8 of wavelength for V | 0.5 of wavelength for H, 2.8 of wavelength for V | 0.5 of wavelength for H, 0.5 of wavelength for V |
| 1.7a | Number of element rows in sub-array | 4 | 4 | 4 | N/A |
| 1.7b | Vertical element separation in sub-array ($d\_{v,sub}$) | 0.7 of wavelength for V | 0.7 of wavelength for V | 0.7 of wavelength for V | N/A |
| 1.7c | Pre-set sub-array down-tilt (degrees) (Note 6) | 3 | 3 | 3 | N/A |
| 1.8 | Array Ohmic loss (dB) (Note 2) | 2 | 2 | 2 | 2 |
| 1.9 | Conducted power (before Ohmic loss) per sub-array or element (dBm) (Note 3) | TBC | TBC | TBC | TBC |
| 1.10 | Base station horizontal coverage range (degrees) | ±60 | ±60 | ±60 | ±90 |
| 1.11 | Base station vertical coverage range (degrees) (Note 1) | 90-100 | 90-100 | 90-100 | 0-180 |
| 1.12 | Mechanical down-tilt (degrees) | 6 | 6 | 6 | N/A |
| 1.13 | Base station output power/sector (e.i.r.p.) (dBm) (Note 7) | TBC | TBC | TBC | TBC |

Note 1: The vertical coverage range is given in global coordinate system, i.e., 90° being at the horizon. This range includes the mechanical down-tilt given in row 1.12.

Note 2: The element gain in row 1.2 includes the loss given in row 1.8 and is per polarization.

Note 3: Conducted power values are per polarization.

Note 4: 16 × 24 means there are 16 rows and 24 columns of radiating sub-arrays

Note 5: For the case of 4 elements per sub-array, dv will be 2.8 wavelengths.

Note 6: The pre-set sub array down-tilt is a fixed design parameter for a base station. It is envisaged as a passive fixed (non-varying) electrical tilt within the sub-array elements.

Note 7: The base station e.i.r.p per sector is calculated as total power (including power from two orthogonal polarizations).

Note 8: Mechanical down-tilt is handled by a coordinate system transformation described in 3GPP TR 36.814 section A.2.1.6.2.

Note 9: $θ\_{etilt}$ and $φ\_{escan}$ is the BS array antenna beam steering direction used in Table 3, they should be set so that the beam steering direction is within the vertical and horizontal coverage ranges in row 1.11 and row 1.10, respectively.