**3GPP TSG RAN WG4 Meeting #97-e R4-200XXXX**

**Electronic Meeting, 2-13 Nov., 2020**

**Agenda item:** 10.24.1, 10.24.4

**Source:** Moderator (SoftBank Corp.)

**Title:** Email discussion summary for [97e][127] NR\_FR2\_FWA\_Bn257\_Bn258

**Document for:** Information

# Introduction

A new WI for FR2 FWA UE with maximum TRP of 23dBm for band n257 and n258 was approved in RAN#87-e meeting. This work item is to introduce the requirements on FWA UE, which maintains the max EIRP of 43dBm and max TRP of 23dBm upper power limitation, and to study and specify corresponding RF requirements for such kind of UE type. The RF part and RRM/Demod part are planed to be completed by #97-e (this meeting) and #98-e, respectively.

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: the following topics are discussed.
  + Tx/Rx requirements
    - Peak EIRP
    - MBR
    - MPR
    - Beam Correspondence
    - REFSENS
  + Others
    - Power class definition
* 2nd round: TBA

# Topic #1: Tx/Rx requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014264 | Qualcomm Incorporated | Observation 1: Based on range of EIRP values discussed during PC5 technical discussion, it would be beneficial for the network if PC5 peak EIRP requirement is specified as 30.x dBm |
| R4-2014832 | MediaTek Inc. | Proposal1: n257 and n258 Peak EIRP is 28.4 dBm for FR2 FWA UE with maximum TRP of 23dBm.  Proposal2.a: n257 REFSENS for 50MHz channel BW is -92.5 dBm for FR2 FWA UE with maximum TRP of 23dBm.  Proposal2.b: n258 REFSENS for 50MHz channel BW is -92.6 dBm for FR2 FWA UE with maximum TRP of 23dBm.  Proposal3: 0.7dB MBR per band for both peak and spherical EIRP/EIS shall be applied.  Proposal4: If beam correspondence is required, both BC bit-0 and bit-1 requirement for new FWA UE” shall be applied. |
| R4-2015085 | Nokia, Nokia Shanghai Bell | Observation 1: The beam correspondence tolerance requirement has been introduced specific to the early handheld device with relatively large beam width support, thus, it cannot be simplify applied to FWA.  Proposal 1: bit-0 (BC tolerance requirement) shall not be allowed for FWA.  Proposal 2: It is proposed the multiband relaxation of FWA UE is at most the one for PC3.  Proposal 3: Only one power class is specified based on antenna array size of N=16; the peak EIRP shall be better than 30 dBm. |
| R4-2015347 | OPPO | Observation 1: Results submitted under 8 antenna elements assumption are similar which is within +/- 1dB difference.  Observation 2: Results submitted under 16 antenna elements assumption are divergent which achieves +/- 2dB difference due to ability of some parameters are different.  Observation 3: Lowest values from 16 elements are similar to the 8 elements based on the results submitted.  Observation 4: It is possible to define requirements based on 8 antenna elements and also cover the different implementations of 16 elements.  Proposal 1: It is proposed to define requirements based on the average of 8 antenna element results for peak EIRP and REFSENS.  Observation 6: FR2 UEs are still at the early phase, no much changes has been observed comparing to the situation when R15 requirements were discussed.  Proposal 3: It is proposed to define both bit-0 and bit-1 for the beam correspondence.  Observation 7: MBR has changed to per-band basis is a compromise between UE implementation restrictions and specification maintenance.  Proposal 4: It is proposed to follow same multi-band relaxation approach in Rel-16 for this new UE type. |
| R4-2015809 | Sony, Ericsson | Observation 1: Both 8 and 16 element arrays can be feasible for the new FWA device, but the 16 element arrays can take advantage of the 20 dBi allowed antenna gain and provide better performance.  Observation 2: 16 elements array is a feasible solution for the new FWA device considering the difference in ERIP/EIS between 85% and 100%.  Observation 3: The reduced freedom in physical spacing when optimizing a multi-band antenna performance is one of the factors that contribute to the PC3 MBR budget.  Observation 4: The MBR for the new FWA PC should be smaller than PC3.  Observation 5: The SNR condition for FWA devices is likely to be good and stable, and thus an FWA device should obtain a good RSRP estimation.  Observation 6: The degradation due to the phase shifter errors have been included in the peak EIRP and spherical coverage requirement.  Observation 7: The beam correspondence depends on the SNR condition. Therefore, it is questionable whether it is useful for the network to know a UE BC capability with bit-1 or bit-0.  Proposal 1: Set minimum peak EIRP = 32 dBm for new FWA UE in the band n257 and n258.  Proposal 2: Adopt 0.5 dB for peak and spherical coverage relaxation per band for the MBR of FWA PC.  Proposal 3: Define only BC bit 1 requirement for new FWA UE. |
| R4-2015887 | Intel Corporation | Observation 1: Based on the proposed data in Table 1, it is reasonable to use the average of all proposed values as a compromise for the minimum peak EIRP requirement. At ~29 dBm, the average value is over 6dB higher than the PC3 requirement.  Proposal 1: As a compromise, use 29dBm (average of all proposed values) for the n257/n258 minimum peak EIRP requirement of the new FWA with 23dBm max TRP.  Proposal 2: As a compromise, use -92.6dBm (average of all proposed values) for the n257/n258 minimum peak EIS requirement of the new FWA with 23dBm max TRP.  Observation 2: Both 0.5dB and 0.7dB are reasonable MBR options for the new FWA with 23dBm max TRP. However, we should first agree on the minimum peak EIRP and EIS requirements before choosing the relaxation value. |
| R4-2016529 | Huawei, HiSilicon | Observation 1: When Tx power is lower than 30dBm, we can see 64QAM is generally not possible for uplink transmission on 28GHz.  Proposal 1: define min peak EIRP for FR2 new FWA UE as in table 2.   |  |  | | --- | --- | | Operating band | Min peak EIRP (dBm) | | n257 | 30.4 | | n258 | 30.7 | | NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance | |   Proposal 2: define min peak EIRP for FR2 new FWA UE as in table 3.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Operating band | REFSENS (dBm) / Channel bandwidth | | | | | 50 MHz | 100 MHz | 200 MHz | 400 MHz | | n257 | -93.4 | -90.4 | -87.4 | -84.4 | | n258 | -93.7 | -90.7 | -87.7 | -84.7 | | NOTE 1: The transmitter shall be set to PUMAX as defined in clause 6.2.4 | | | | |   Proposal 3: For new FR2 FWA UE, specify the multi-band relaxation requirement per band as 0.7dB for both peak and spherical requirement. Define both bit 0 and bit 1 beam correspondence requirement for the new FWA UE.  Proposal 4: Define MPRnarrow=7dB for the new FWA UE, other MPR requirement reuse the values defined for PC3. |

## Open issues summary

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

### Sub-topic 1-1 Peak EIRP

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Minimum peak EIRP value**

* Proposals
  + Option 1: 27.3dBm (OPPO)
  + Option 2: 28.4dBm (MediaTek)
  + Option 3: 29dBm (Intel)
  + Option 4: 30.x dBm (QC, Nokia, Huawei)
  + Option 5: 32 dBm (Sony, Ericsson)
* Recommended WF
  + Collect company's views in the 1st round. We had already discussed the assumption of the number of antenna elements (N) in RAN4#95e and #96e meeting, but we could not reach the consensus about it. Then it needs to seek the min. peak EIRP value considering the performance of both N=8 and N=16.
  + Furether compromises (or ideas) for determining it are welcome since RF related discussion should be completed in this meeting.

### Sub-topic 1-2 MBR

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2: MBR value**

* Proposals
  + Option 1: 0.7dB (MediaTek, Intel)
  + Option 2: 0.5dB (Sony, Ericsson, Intel)
  + Option 2: at most the one for PC3 (Nokia)

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| --- | --- | --- |
| **Band** | **MBP,n (dB)** | **MBS,n (dB)** |
| n257 | 0.7 | 0.7 |
| n258 | 0.6 | 0.7 |

* Recommended WF
  + Collect the company's views or compromises for detemining the values in the 1st round.

### Sub-topic 1-3 MPR

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3: MPR value and configuration**

* Proposals
  + Option 1: MPRnarrow=7dB and other MPR requirement reuse PC3 values
* Recommended WF
  + Collect company's opinion whether Option 1 is acceptable or not in the 1st round.

### Sub-topic 1-4 Beam Correspondence

*Sub-topic description*

There are no objections to define bit-1 requirement, so the issue is as follow:

**Issue 1-3: Whether to define bit-0 requirement**

* Proposals
  + Option 1: Yes (MediaTek, OPPO, Huawei)
  + Option 2: No (Nokia, Sony, Ericsson)
* Recommended WF
  + Collect company's views in the 1st round considering both the technical perspective and the time limitation (RF related discussion should be completed in this meeting). The followings are the technical observations in each option.
    - Option 1:
      * FR2 UEs are still at the early phase, no much changes has been observed comparing to the situation when R15 requirements were discussed. (R4-2015347)
    - Option 2:
      * The beam correspondence tolerance requirement has been introduced specific to the early handheld device with relatively large beam width support, thus, it cannot be simplify applied to FWA. (R4-2015085)
      * The SNR condition for FWA devices is likely to be good and stable, and thus an FWA device should obtain a good RSRP estimation. (R4-2015809)
      * The degradation due to the phase shifter errors have been included in the peak EIRP and spherical coverage requirement. (R4-2015809)
      * The beam correspondence depends on the SNR condition. Therefore, it is questionable whether it is useful for the network to know a UE BC capability with bit-1 or bit-0. (R4-2015809)

### Sub-topic 1-5 REFSENS

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3: REFSENS value**

* Proposals for n257 (50MHz)
  + Option 1: -91.9dBm (OPPO)
  + Option 2: -92.5dBm (MediaTek)
  + Option 3: -93.4dBm (Huawei)
* Proposals for n258 (50MHz)
  + Option 1: -91.9dBm (OPPO)
  + Option 1: -92.6dBm (MediaTek)
  + Option 2: -93.7dBm (Huawei)
* Recommended WF
  + The range among the options is less than 2dB in each band. Collect the company's views, compromises for detemining the value in each band in the 1st round.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Qualcomm | Sub topic 1-1: Can agree to compromise between options 4 and 5  Sub topic 1-3: The justification is insufficient, so we do not agree. PC2 and PC4 have no such special treatment. PC3 MPRs were derived for a UE that had a 23 dBm TRP, one cannot use the argument that PC3 TRPs are lower.  Sub topic 1-4: (Bit 0) PC1 does not have bit0 variant. Defining bit0 for PC5 would be standards regression. |
| Nokia | Sub topic 1-1: Support options 4 or 5  Sub topic 1-2: Option 2.  Sub topic 1-3: Disagree. This new power class is achieved by antenna gain. No additional MPR is needed.  Sub topic 1-4: Option 2 |
| OPPO | **Issue 1-1: Minimum peak EIRP value**  From the previous discussion it is clear that the assumption of UE antenna elements is either 8 or 16, and no conclusion can be achieved. One reason is there are different implementations. Considering RAN4 define minimum requirements, and different kind of UE implementations shall be taken into account. The proposed approach in our paper (Option 1) is to define requirements based on the 8 antenna element assumption (average inputs from companies), then the requirements can accommodate different implementations. Another possible approach might be average all the inputs including 8 antenna elements and 16 antenna elements to derive the requirement (Option 2), this is not preferred, however, to move forward it can be considered as a potential compromise.  Therefore, Option 1 or Option 2 are preferred.  **Issue 1-2: MBR value**  Option 1.  **Issue 1-3: Whether to define bit-0 requirement**  Option 1. FR2 UEs are still at the early phase, no much changes has been observed comparing to the situation when R15 requirements were discussed.  **Issue 1-4: REFSENS value**  Similar comments as Issue 1-1. Prefer Option1, and the Option2 can be considered as compromise to move forward. |
| MediaTek | *Sub-topic 1-1 Peak EIRP* ***Issue 1-1: Minimum peak EIRP value***  Support “Option 2: 28.4dBm” (# average all prior proposed values with respect.) *Sub-topic 1-2 MBR* **Issue 1-2: MBR value**  Prefer “Option 1: 0.7dB” to make it simpler than directly leverage PC3. *Sub-topic 1-4 Beam Correspondence* **Issue 1-3: Whether to define bit-0 requirement**  Support “Option 1: Yes”. BC bit-0/1 shall be applied to different power classed if BC is required.  About “BC tolerance value”, we are okay to revisit it. *Sub-topic 1-5 REFSENS* **Issue 1-3: REFSENS value**   * for n257 (50MHz)   + Support “Option 2: -92.5dBm” (# average all prior proposed values with respect.) * for n258 (50MHz)   Support “Option 1: -92.6dBm” (# average all prior proposed values with respect.) |
| Intel | **Issue 1-1: Minimum peak EIRP value**  Option 1, Option 2 and Option 3 are acceptable to us.  We emphasize once again, as captured in our contribution, that a reasonable compromise is to follow a data driven approach using the average. This yields **29dBm** which is substantially higher than the PC3 requirement.  **Issue 1-2: MBR value**  The three options listed are reasonable. However, we prefer to first agree on Issue 1-1 (min peak EIRP) and Issue 1-5 (min peak EIS) before choosing the MBR value.  **Issue 1-4: Whether to define bit-0 requirement**  Option 1  **Issue 1-5: REFSENS value**  We support Option 1 and Option 2, for both band n257 and n258.  Similar to Issue 1-1, the average is a fair compromise (around -92.5dBm). |
| Samsung | In general, we have the same position with what we shared during the last meeting and offline discussion.  Issue 1-1: Option 2 (28.4dBm, total avg). Option 3 or Option 4 (30.0dBm, N=16 avg) is also acceptable to make a step forward  Issue 1-2: Depending on the 1-1 (0~0.7 dB)  Issue 1-4: Option 2 as PC1  Issue 1-5: Option 2. However, we are fine to take the same approach with EIRP in the end |
| Huawei | Issue 1-1: both Option 4 and Option 5 is OK for us.  To OPPO, Intel, MTK, Samsung: for FR2 HST, PC4(34dBm min peak EIRP) seems OK for you with the same upper limitation of max TRP and max EIRP. We would like to know the reason. Maybe FR2 HST and FR2 FWA could be discussed together.  Our initial proposal is 32dBm, 30.X dBm is our last compromise.  Issue 1-2(MBR): Option 3, follows PC3.  Issue1-3(MPR): introduce 7dB MPRnarrow for FR2 FWA UE.  Issue 1-4(BC): Option 1 follow PC3.  Issue 1-5(refsens): Option 3. |
| Sony | **Issue 1-1: Minimum peak EIRP value**  Option 5: 32 dBm is our preference, but we can accept Option 4 as well.  **Issue 1-2: MBR value**  Option 2: 0.5 dB per band is our preference. The MBR for PC 3 at least partially comes from the fact that the antenna performance is difficult to be optimized on two bands simultaneously within a tight device housing. However, an FWA device could allow a much higher degree of freedom on the integrated antenna optimization, and thus this property should be reflected in the MBR requirement.  However, we can also accept other options of MBR if the peak EIRP is defined not smaller than 30 dBm (option 4 or 5 in issue 1-1).  **Issue 1-4: Whether to define bit-0 requirement**  Option 2: Not defining bit-0 for BC. The moderator's recommended WF has well captured our technical argument. |
| Ericsson | Sub topic 1-1: We prefer Option 5 but can also agree with option 4.  Sub topic 1-2: Option 2. For min peak EIRP larger than 30dBm we can agree with option 1 as well.  Sub topic 1-4: Option 2 |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| R4-2016530 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Others

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015085 | Nokia, Nokia Shanghai Bell | Proposal 3: Only one power class is specified based on antenna array size of N=16; the peak EIRP shall be better than 30 dBm. |
| R4-2015347 | OPPO | Observation 5: Defining one power class for this new type of UE can benefit the market from avoid of fragmentation.  Proposal 2: It is proposed to define one single power class signaling. |

## Open issues summary

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

### Sub-topic 2-1 Power class definition

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Whether to define multiple power classes.**

* Proposals
  + Option 1: Single power class is defined.
* Recommended WF
  + Collect the company's views for defining single power class (PC5).

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |
| Qualcomm | Sub topic 2-1: Option 1: Single power class |
| Nokia | Sub topic 2-1: Option 1 |
| OPPO | **Issue 2-1: Whether to define multiple power classes.**  Option 1. Defining one power class for this new type of UE can benefit the market from avoid of fragmentation |
| MediaTek | *Sub-topic 2-1 Power class definition*  **Issue 2-1: Whether to define multiple power classes.**  Prefer to define one power class like other UE types. |
| Intel | **Issue 2-1: Whether to define multiple power classes.**  Our preference is Option 1 (single power class) |
| Samsung | Option 1 as proposed by companies |
| Huawei | The real market segment is FR2 HST and FR2 FWA on min peak EIRP definition. We don’t understand how we can define one power class for 28dBm and 32dBm min peak EIRP? |
| Sony | **Issue 2-1: Whether to define multiple power classes.**  Option 1: Single power class is defined. |
| Ericsson | Issue 2-1: Option 1 |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |