TSG-RAN Working Group 4 meeting #101-ER4-2120060

Electronic Meeting, 1st - 15th November 2021

**Source:** Ericsson

**Title:** WF on the RedCap RF

**Agenda item:** 8.20.2

**Document for:** Approval

# Introduction

During RAN4#101-E meeting a way-forward on RedCap UE is created based on the discussion in 1st round [1].

# Way-Forward

## Agreement from GTW and 1st round

Issue 1-1: PC5 support

Agreement:

*PC5 will be supported in Rel-17, if n46 and n96 is agreed to be supported in Rel-17.*

Issue 1-2: PC2 support

Agreement: Support *PC2 RedCap UE based on operator request.*

* Use 1 Tx as baseline
* Further discussion whether the antenna isolation assumptions for existing 2Tx requirements is valid for RedCap.
* Issue 1-3: UE architecture for FR1 RedCap UE

Agreement: to define the Tx RF requirements for RedCap

* Use 1 Tx as baseline
* 2Tx is kept open for discussion

**Issue 2-2: n79**

*Start to add n79 in RedCap UE support next meeting.*

**Issue 2-3: n91 to n94**

Agreement: n91 to n94 can be supported by RedCap UE.

## Operating bandn47, n46 ,n96 and SUL band

From 1st round discussion, some companies think there are specification impacts and thus according to RAN WF, the bands are not considered in Rel-17. Other companies think no need to consider the specification impact and thus the bands are supported. Some company just show support the bands without arguments. One company thinks the n47 should be discussed separately. The RAN WF covers all WGs, so the feedback on specification impact is a general issue.

*Moderator suggest to considering the below options for further discussion relating to RAN4 RF:*

*Issue 2-1-1: Specification impact of introducing n47, n46 ,n96*

* 1. *According to WID, the 1RX needs to be specified for each FR1 band and thus these appl to n47, n46 ,n96.*
  2. *According to WID, the 1RX does not apply to n47, n46, n96.*
  3. *According to WID, 1RX apply to n47 , n46 and n96*

*Issue 2-1-2: Companies understanding on RAN WF* [RP-212634.zip](http://3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_93e/Docs/RP-212634.zip) *based on understanding of issue 2-1-1.*

1. *Not considered support for Rel-17 RedCap UE with option a.*
2. *Consider support for Rel-17 with option a but without specification work*
3. *Consider support for Rel-17 with option a with specification work*
4. *Consider support for Rel-17 with option b*

*Issue 2-1-3: For SUL band*

1. *Consider support for Rel-17 without specification work and not consider the 1 RX REFSENS for SUL band [Huawei?]*
2. *Not considered support for Rel-17 RedCap UE and need specification work for 1 RX/HD-FDD specification impact. [Ericsson, ]*

*Way forward for issue 2-1-1, 2-1-2 and 2-1-3:*

* RAN4 follow the RAN WF RP-212634.zip.

## FR1

**Issue 3-1: 1RX FDD REFSESN scaling factor based on 2 RX FDD REFSENS**

*From 1st round discussion, 6 companies favor option 3 (3 dB) and 5 company are fine with option 2 (2.5 dB but with exception of 3 dB). 2 companies favor the option 1 (2.5 dB) but ok to compromise to option 2.*

*Recommendations for 2nd round: continue to discuss below two options.*

Option 1: 2.5 dB with exception of 3dB for some bands

Option 1a: TDD delta is 2.5dB per agreement and FDD delta is 2.5dB for 5M and 3dB for 10M/15M/20M BWs.

Option 1b: 3 dB relaxation for the REFSENS with single RX antenna port for the channel bandwidth in a FDD band where there is restriction of RB allocation in the UL configuration.

Option 3: 3 dB

Companies could further providing their view on the tentative agreement below and see if it can be agreeable.

Agreement:

Option 1a: TDD delta is 2.5dB per agreement and FDD delta is 2.5dB for 5M and 3dB for 10M/15M/20M BWs.

**Issue 3-2: 1 RX HD-FDD REFSENS scaling factor**

*From 1st round discussion, 8 companies support the option 1 or 1a. 3 companies support the option 2. More discussion is needed in 2nd round.*

* Proposals
  + Option 1: 1.7 dB tightening based on 2 RX FDD REFSENS. [Sony, Vivo, ZTE, Vivo, Xiaomi, Oppo]
    - Option 1a: 0.8 dB tightening based on 1 RX FDD REFSENS (based on issue 3-1) [Ericsson]
  + Option 2: band dependent scaling factor
    - For 5MHz channel BW

|  |  |  |
| --- | --- | --- |
| FD-FDD 5MHz REFSENS | HD-FDD REFSENS Tightening | Bands |
| ≤ -99 dBm | 0 dB | n1, n18, n24, n30, n65, n66, n70, n74 |
| > -99 dBm and ≤ -98 dBm | 0.5 dB | n2, n5, n7, n28, |
| > -98 dBm | 0.8 dB | n3, n8, n12, n13, n14, n20, n25, n26, n71 |

* + - For wider BW
      * *HD-FDD REFSENS for channel BW wider than 5 MHz can be calculated by REFSENS(5MHz) + 10log10(n x NRB/25), where NRB is the maximum transmission bandwidth configuration with n=1 for 15kHz SCS and n=2 for 30kHz SCS*
  + Option 3: TBA
* Recommended WF

From GTW session;

* Agreement: Compared to 1Rx FDD REFSENS, apply 0.8 dB tightening for REFSENS requirement for 1Rx HD-FDD REFSENS as baseline in general, and check band by band whether the additional tightening or relaxation is needed for a certain band.

**Issue 3-3: 2 RX HD-FDD REFSENS scaling factor**

*From 1st round discussion, 5 companies support option 1. 2 companies are ok with option 2 but also fine with option 1. 3 companies support option 3 which is the no relaxation compared to FD-FDD and two of the companies open to discuss other options also. 3 companies support the option 4. Seems option 1 and option 4 could be further discussed if companies are willing to make compromise after 1st round and further discussion on the option 1 and option 4.*

* Proposals
  + Option 1: 0.8 dB tightening based on 2 RX FDD REFSENS
  + Option 4a: Band depended scaling factor
    - For 5MHz channel BW

|  |  |  |
| --- | --- | --- |
| FD-FDD 5MHz REFSENS | HD-FDD REFSENS Tightening | Bands |
| ≤ -99 dBm | 0 dB | n1, n18, n24, n30, n65, n66, n70, n74 |
| > -99 dBm and ≤ -98 dBm | 0.5 dB | n2, n5, n7, n28, |
| > -98 dBm | 0.8 dB | n3, n8, n12, n13, n14, n20, n25, n26, n71 |

* + - For wider BW
      * *HD-FDD REFSENS for channel BW wider than 5 MHz can be calculated by REFSENS(5MHz) + 10log10(n x NRB/25), where NRB is the maximum transmission bandwidth configuration with n=1 for 15kHz SCS and n=2 for 30kHz SCS*
  + Option 4b: Band depended scaling factor [Qualcomm]
    - 2x HD-FDD REFSENS can only be tightened from the 2x NR FD-FDD REFSENS by the difference of the band dependency factors given in Table 2.2-1, which is min (0.8dB, NR FD-FDD BDFactor).
* Recommended WF
  + From GTW session;
* Agreement: Compared to 2Rx FDD REFSENS, apply 0.8 dB tightening for REFSENS requirement for 2Rx HD-FDD REFSENS as baseline in general, and check band by band whether the additional tightening or relaxation is needed for a certain band.

**Issue 3-4: UL configuration for REFSENS requirements**

*From 1st round discussion, 8 companies are fine with option 2, 4 companies support option 1. 2 companies concern that there is no need to limit UL configuration for HD-FDD otherwise the DL thought may be limited at HD-FDD case. Seems network could be aware about the HD-FDD UE and does not refer to UL configuration for the de-sense of HD-FDD case. further discussion in 2nd round and see if companies could compromise considering the network may not refer to UL configuration for scheduling limitation as this is HD-FDD case.*

*Tentative agreements:*

* + Option 2: uplink configuration for reference sensitivity of 1Rx in FD-FDD mode, 1Rx and 2Rx in HD-FDD mode could reuse the uplink configuration for reference sensitivity of 2Rx in FD-FDD mode with the channel bandwidth of 5MHz, 10MHz, 15MHz, and 20MHz.
* Recommended WF
  + Option 2

**Issue 3-5: Dual mode RedCap UE support (HD-FDD and FD-FDD )**

*From 1st round discussion, 7 companies support option 1. 3 companies support option 2. One company notifies RAN4 group that HD-FDD only device is currently defined in RAN1. Moderator view is that such dual mode device is not for cost reduction to fulfill the WID objective and thus it could be deprioritized in RAN4 if no consensus reached.*

* Proposals
  + Option 1: No considered in Rel-17.
  + Option 2: supported in Rel-17.
    - FD-FDD requirements is applicable to UE supporting both FD-FDD and HD-FDD modes.
    - Only define signaling to distinguish UE with FD-FDD capability and UE with HD-FDD only capability, for example HD-FDD only mode indication
  + Option 3: Deprioritize dual mode RedCap device in Rel-17
* Recommended WF
  + Option 3

## FR2

Issue 4-1: FR2 RedCap UE priority

Agreement: Postpone the priority discussion, focus other discussion first.

**Issue 4-2: Use case for FR2 RedCap UE (Multiple choice)**

*Agreement:*

* *Consider all three use cases in FR2 RedCap UE*
* *Industry sensor*
  + *FFS whether FR2 PC5 as starting point*
* *video surveillance*
  + *FFS whether use FR2 PC5 as starting point*
* *wearables use case.*
  + *FFS whether to reuse FR2 PC3 or defining the new power class*
* *Other use cases are not precluded*
* *For the above use cases*
  + *Use n261, n257, n258 as example bands for discussion*
  + *Other bands will be introduced in the release independent way*

**Issue 4-3: New power class and UE type for RedCap UE (Multiple choice)**

* Proposals: considering the below options with combining the issue 4-6- and issue 4-7
  + Option 1: Define new power class for FWA UE for industry sensor [Nokia, Ericsson]

|  |  |
| --- | --- |
| UE Power class | UE type |
| 1 | Fixed wireless access (FWA) UE |

* + Option 2: Define new power class for FWA UE for Video surveillance [Nokia]

|  |  |
| --- | --- |
| UE Power class | UE type |
| 2 | Fixed wireless access (FWA) UE |

* + Option 3: Define new power class for wearable UE [Nokia, Sony]

|  |  |
| --- | --- |
| UE Power class | UE type |
| 3 | Wearable UE |

* + Option 4: TBA
* Recommended WF
  + TBA

**Issue 4-4-1: UE architecture associated with the different use case RedCap FR2 UE**

*Agreement: To define the RF requirements, assume one antenna panel for industry sensor and video surveillance as the starting point*

* *If the difficulty to meet the requirement of use cases, two panels can be considered*

**Issue 4-4-2: UE architecture associated general views on RedCap FR2 UE**

*From 1st round discussion, Most company are ok with option 1, 2 and 3. This would mean that basically the TX performance would be allowed to be changed compared with the current FR2 NR UE specification.*

*Tentative agreements:*

* + - 1. *FFS on Allowing the single polarization in FR2 RedCap UE*

**Issue 4-5: Max TRP**

*From 1st round discussion, majority view is 23 dBm as a starting point. some company also ok to further discussion on this. One company mentions the MPR is calculated related to the 23 dBm TRP for current FR2.*

*Tentative agreements:*

*23 dBm max TRP as a starting points for all FR2 RedCap UE except the wearable*

*For wearables use case, the max TRP:*

* + Option 1: 23 dBm
  + Option 2: less than 23 dBm
  + Option 3: TBA

**Issue 4-6: Min peak EIRP (Multiple choice)**

*From 1st round discussion seems most companies fine with option 1. Reusing the NR FR2 PC5 for video surveillance could be checked if it would be agreeable. Some companies want to further discuss this issue.*

* Proposals:
  + Option 1: for industry sensor use case, use requirements for NR UE power class 5 as a starting point
  + Option 2: for video surveillance use case, use requirements for NR UE power class 5 as a starting point
  + Option 3: for wearable use case use requirements for NR UE power class 3 as a starting point.
  + Option 4: for wearable use case, min Peak ERIP in the order of 13.5dBm (at 26GHz)
  + Option 5: TBA

**Issue 4-7: Spherical coverage**

*From 1st round discussion, most companies seems ok with option 1. Some companies think more discuss is needed around this aspect. One company think for industry sensor the beam should be wider.*

*Tentative agreements:*

* 85th percentile with one antenna panel (video surveillance use case)
* 50th percentile with one antenna panel(wearable use case)

*For industry sensor use case:*

* Option 1: spherical coverage @20%-title
* Option 2 – 50th–70th percentile with one antenna panel
* Option 3: TBA
* Recommended WF
  + TBA

**Issue 4-8: 1 RX branch REFSENS**

From GTW session, seems companies are not sure about the reducing RX branching meaning and how to map to the polarization. More discussion is needed for 2nd round.

* Proposals:
  + Option 1: specify 1 Rx branch for RedCap UEs in FR2. [Nokia, Ericsson, Huawei, xiaomi]
  + Option 2: REFSENS requirements for RedCap UEs are specified based on the RF architecture and other assumptions for the RedCap UE power classes.[Nokia]
  + Option 3: TBA
* Recommended WF
  + TBA

## FR2 work for next RAN4 meeting

*The RF parameter discussed in section 2.4 will further help to settle the FR2 RedCap UE RF requirement, though not discussed in first round what Ran4 will do about the RF parameters, companies could provide further opinion on the simulation needed to further discussion on RF requirement.*

*Issue 5: Spherical coverage simulation*

* Companies are encouraged to provide spherical coverage simulation considering the RF parameters and UE architecture discussed in section 2.4.
* Simulation assumption: Based on the NR FR2 simulation [2][3].

# References

1. R4-2119733, Email discussion summary for [100-e][142] NR\_RedCap, Ericsson
2. R4-1801202 “WF on EIRP CDF for spherical coverage”, *Samsung MediaTek*
3. R4-1714355 “WF on spherical coverage in FR2”, *Samsung, Apple, LGE, Intel, Oppo, Xiaomi, Vivo, MediaTek*

# Annex

### 4.1. Companies views’ collection for issue 2-1-x for 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1-1:  Sub topic 2-1-2:  ….  Others: |
| ~~Qualcomm~~ | **~~Issue 2-1-1~~**~~: Option~~ **~~c~~**~~. 1RX HD-FDD can apply to n47, n46, n96.~~  **~~Issue 2-1-2~~**~~: Option 3 for n47, n46, n96~~ |
| Huawei | **Issue 2-1-1**: **As we comment on the GTW session, there is no Rx requirements’ impact on SUL bands. For FR1 RedCap UE, only impacts on the specification are related to 1Rx REFSENS. Thus, SUL bands can be supported for RedCap UE that has been confirmed by RAN plenary. It isn’t a good judgment to list SUL bands for this discussion in the 2nd round.**  **Issue 2-1-2**: RAN WF RP-212634 is clear enough. I don’t think it’s appropriate to clarify RAN plenary’s agreement in working group. Based on the contributions in this meeting, we don’t know where these options come from. Especially, we didn’t discuss it in the 1st round. |
| Ericsson | **To Huawei, from 1st round discussion, companies have different understanding on the RAN WF and thus it is good to further clarify it. Whether there is specification impact could be discussed in working group based on WID objective analysis, how to treat it may be a different issue. As there are different understanding on SUL band and other bands in 1st round, I am afraid we cannot remove it from discussion. I add a new discussion point and hope it captures your view.**  **Issue 2-1-1: Option a.**  **Issue 2-1-2: Option 1.**  **Issue 2-1-3: Option 2. For SUL band and its band combination, there are bands combination mandating the simultaneous RX and TX meaning the SUL band and NUL band can transmitting simultaneously, seems these bands cannot be supported directly in RedCap UE for FD-FDD? For HD-FDD mode, how about the REFSENS? We have section 3 on the scaling factor.**  Table 5.2C-1: Operating band combination for SUL in FR1   |  |  | | --- | --- | | NR Band combination for SUL | NR Band  (Table 5.2-1) | | SUL\_n24-n992 | n24, n99 | | SUL\_n41-n80 | n41, n80 | | SUL\_n41-n81 | n41, n81 | | SUL\_n41-n832 | n41, n83 | | SUL\_n41-n95 | n41, n95 | | SUL\_n41-n972 | n41, n97 | | SUL\_n41-n98 | n41, n98 | | SUL\_n41-n992 | n41, n99 | | SUL\_n48-n992 | n48, n99 | | SUL\_n77-n802 | n77, n80 | | SUL\_n77-n842 | n77, n84 | | SUL\_n77-n992 | n77, n99 | | SUL\_n78-n802 | n78, n80 | | SUL\_n78-n812 | n78, n81 | | SUL\_n78-n822 | n78, n82 | | SUL\_n78-n832 | n78, n83 | | SUL\_n78-n842 | n78, n84 | | SUL\_n78-n862 | n78, n86 | | SUL\_n79-n802 | n79, n80 | | SUL\_n79-n812 | n79, n81 | | SUL\_n79-n832 | n79, n83 | | SUL\_n79-n84 | n79, n84 | | SUL\_n79-n95 | n79, n95 | | SUL\_n79-n97 | n79, n97 | | SUL\_n79-n98 | n79, n98 | | NOTE 1: If a UE is configured with both NR UL and NR SUL carriers in a cell, the switching time between NR UL carrier and NR SUL carrier is 0 us.  NOTE 2: For UE supporting SUL band combination simultaneous Rx/Tx capability is mandatory. | | |
| Skyworks | **Issue 2-1-1**: it seems to me that we are playing with words here: n46/47/96 are TDD bands like n79 and thus inherently support HD-FDD (at least if FDD considers DL/UL at the same frequency but again this is not different to n79). So in our view if n47/n46/n96 are not pursued (which is fine with us) it should be on the basis of another criteria of additional requirement needed but I fail to see this for n46/n96 at least as FD-FDD is not feasible (like for n79) and BW are compatible already, and REFSENS/MPR/A-MPR requirements can be reused as is. so the only question is whther these uses cases exist or are desirable in R17. We do not have a strong view on this. |
| Qualcomm | **Issue 2-1-1**: Removing our initial comments. There are TDD bands as Skyworks mentioned, so why is 1 HD-FDD being discussed here. Do you mean RedCap for TDD bands n47, n46, and n96? If there is consensus, then we could consider defining requirements in release 17, otherwise we are bound by the RAN Plenary decision not to have requirements defined in this release. |
| MediaTek | **Issue 2-1-1**: **option b**. We do not oppose supporting 1RX requirements for the bands. But in our understanding for RAN-P agreement, there shall not be spec change due to support the bands thus the 1RX requirements are out of the WI scope.  **Issue 2-1-2: option 4**.  **Issue 2-1-3:** None of the options. Thanks Ericsson for the good points that for the SUL bands require mandatory simultaneous RX/TX, they shall not be supported by RedCap UE. Others does. |
| ZTE | **Issue 2-1-1**: We have similar question with other companies. Why is it say 1Rx HD-FDD for TDD band? If it is the case, requirements may be needed to be defined. |
| Ericsson | Issue 2-1-1: Sorry for misleading in the options, yes, the n46, n96 and n47 is TDD band and HD-FDD not applied for discussion, the HD-FDD discussion apply to the SUL bands and its combination.  I think companies interpret the RAN WF as a mutual exclusion option below:   * 1. supporting bands without specification update   2. not supporting bands with specification updates.   For companies who supporting these bands without specification update, I hope it is not just ignoring any specification impact analysis. I would like to hear what kind of use case it is without fulfilling the cost reduction technique in the WID objective? How the RAN4 group treat the added 1 RX feature for these bands in future release?  For companies who not supporting these bands with specification impact, we see the use case of these bands more important and want to keep the feature release integrity.  Specifically, for n46 and n96, if no DC and CA for n46 and n96, it is the standalone mode NR-U UE operation, if there is no 1 RX specified, the cost reduction will miss the RF part between NR-U standalone UE and RedCap UE and not sure how use case benefit on it.  For n47, what the use case to have RedCap UE in ITS band? For V2X, 2 RX and HPUE seems more interested than another direction to recuded capability. |
| OPPO | The specification impacts need to be clarified by proponent before saying whether it is supported or not according to RAN conclusion. |
| Huawei | To Ericsson:  Simultaneous Rx/Tx capability (***simultaneousRxTxSUL 38306***)means Receiving signal and transmitting signal simultaneously instead of  “the SUL band and NUL band can transmitting simultaneously” as you comment.  SUL band can’t receive the signal. I don’t understand why we need to specify the REFSENS for SUL bands. For other TDD bands, we just follow the TDD bands’ REFSENS.  I don’t see any necessary changes to enable SUL feature as you raised. |
| MediaTek | We are totally confused actually by this discussion. The RAN plenary agreed that there will be no work on specification updates to support this. RAN4 has just spent 2 weeks of delegates’ time discussing whether specification updates are needed or not, and now the moderator would like delegates do more work for the next meeting, with a view to providing specification updates to indicate that these bands are supported for RedCap.  This is totally contrary to the agreement of RAN plenary, and therefore we object to this proposed Way Forward. RAN4 should never have discussed this issue in the first place in hindsight. |

### 4.2 Companies views’ collection for issue 3-x in 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Qualcomm | **Issue 3-1:** Option 1a. Keep 2.5dB for 5M FDD and 3dB for 10/15/20M FDD as with Cat1Bis if no resolution in RAN4#101-e.  **Issue 3-2:** Option 2. QC prefers option 2 (2RX FD-FDD to1RX HD-FDD) (relaxation); QC can compromise to Apple   |  |  |  |  | | --- | --- | --- | --- | | FD-FDD 5MHz REFSENS | 1RX HD-FDD REFSENS Relaxation (5MHz) | 1RX HD-FDD REFSENS Relaxation (10, 15, 20MHz) | Bands | | ≤ -99 dBm | 2.5 dB | 3.0 dB | n1, n18, n24, n30, n65, n66, n70, n74 | | > -99 dBm and ≤ -98 dBm | 2.0 dB | 2.5 dB | n2, n5, n7, n28, | | > -98 dBm | 1.7 dB | 2.2 dB | n3, n8, n12, n13, n14, n20, n25, n26, n71 |   **Issue 3-3:** Option 4b. QC proposal has slightly more REFSENS tightening than Apple proposal. QC can compromise to Apple’s proposal. Move n74, n65, n66 to 0dB tightening. And move n2, n5, n7, n28 to 0.5dB tightening to refine the options.   |  |  |  | | --- | --- | --- | | FD-FDD 5MHz REFSENS | HD-FDD REFSENS Tightening | Bands | | ≤ -99 dBm | 0 dB | n1, n18, n24, n70, n91, n92, n93, n94 | | > -99 dBm and ≤ -98 dBm | 0.4 dB | n74 | | > -99 dBm and ≤ -98 dBm | 0.5 dB | n65, n66 | | > -98 dBm | 0.8 dB | n2, n3, n5, n7, n8, n12, n13, n14, n20, n25, n26, n28, n30, n71 |   **Issue 3-4:** Option 2.  **Issue 3-5:** Option 1. |
| Huawei | **Issue 3-1:** Option 1a  **Issue 3-2:** Option 1  **Issue 3-3:** Option 1  **Issue 3-4:** Option 2.  **Issue 3-5:** Option 1. |
| Sony | Issue 3-1: Option 1 or 1a  Issue 3-2: Option 1 or 1a for simplicity. In principle band dependency relaxation could be discussed but a lot more work is needed. In that case it may be better to start to define REFSENS from start instead (like how it was done in NB1).  Issue 3-3: Option 1 for simplicity. In principle band dependency relaxation could be discussed but a lot more work is needed.  Issue 3-4: Option 2.  Issue 3-5: Option 1. |
| Xiaomi | Issue 3-1: Option 1b  Issue 3-2: Option 1 and Option 1a are OK.  Issue 3-3: Option 1. Support define a constant value to simplify the Spec.  Issue 3-4: Option 2.  Issue 3-5: Option 1. |
| Ericsson | Issue 3-1. We are fine with tentative agreement which is 1a.  Issue 3-4: Option 2.  Issue 3-5: Option 1. |
| MediaTek | Issue 3-1: Our preference is option 3. But we are ok to compromise to the agreement.  Issue 3-2: Option 2. The option does not violate the agreement.  Issue 3-3: Option 4a.  Issue 3-4: Option 2. |
| Apple | Issue 3-1: Our preference is option 3. But we can also accept tentative agreement.  Issue 3-2: Option 2.  Issue 3-3: Option 4a.  Issue 3-4: Option 1 is our preference. But if majority companies prefer Option 2, we can accept that as well. |
| ZTE | **Issue 3-1:** We propose option 1, but we can comprise to Option 1a. i.e. fine with the tentative agreement  **Issue 3-2:** Option 1 or 1a for simplicity. In our understanding, option 1 and 1a are the same meaning.  **Issue 3-3:** Option 1 for simplicity.  **Issue 3-4:** Option 2.  **Issue 3-5:** Option 1. |
| OPPO | **Issue 3-1:** Our preference is option 3. But we can also accept tentative agreement.  **Issue 3-2:** Option 1  **Issue 3-3:** Option 1  **Issue 3-4:** Option 2.  **Issue 3-5:** Option 1. |

### 4.3 Companies views’ collection for issue 4-x in 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Qualcomm | Issue 4-3: We would like to combine 4-6 and 4-7 here. It is meaningful to capture the proposed power classes as a package along with min peak EIRP and spherical coverage.  Issue 4-5: FFS on TRP for wearable  Issue 4-6: See note on 4-3. OK with option 1 and 2  Issue 4-7: See note on 4-3. Further deployment consideration is needed for industry sensor case – specifically what is coverage expectation with one antenna panel. In our view, a robust beam code book can be maintained if coverage angles are confined to a cone not exceeding a half-angle of 45 degrees (around normal to each panel), which leaves 85% of the sphere uncovered by a refined beam. Specifying a 70th or 50th %ile requirement with a single panel will mean significantly relaxed spherical coverage requirements.  Issue 4-8: Cannot agree to single pol. receiver in redcap UE until certain deployment conditions are understood. For example, will the gNB only use single pol Tx for DL? If dual-chain Tx is used by gNB, how to ensure that there is no relative time delay in the chains? Artefacts from pol-diversity+frequency-diversity (like delay) cannot be resolved by single pol receivers and will degrade DL tput. |
| MediaTek | **Issue 4-3:** Option4, it depends, if we actually leverage current normal NR power class 1/2/3/4/5 requirements in the end, maybe we no need to have specific power class for “RedCap UE”. Because, these power classes don’t limit UE type actually.  **Issue 4-4-2:** from RAN4 requirement perspective, RAN4 actually didn’t limit UE use single or dual polarization even normal NR device, although we believe the typical case would be dual-polarization. Hence, we think the discussion intention would be like “RedCap UE requirement can be defined based on single polarization UE.”. In this case, this will also affect EIRP/spherical requirement for example. We need to discuss them together.  Issue 4-5: Prefer Option1, because max TRP is defined based on regulatory, like a max allowed value. Although we don’t have strong view.  Issue 4-6: Does starting point mean if we reduce something (like antenna element, polarization), the impact on corresponding requirements will also be changed? For example, if the RedCap UE refer to a normal NR power class (as starting point) is 20 dBm peak EIRP based on 4 antenna element assumption, if we agree the RedCap UE antenna element assumption from 4 to 2, and then the requirement starting point would be 20-6=14 dBm?  Issue 4-8: Can we have a clear definition on “1 Rx branch” firslty, like discussion in GTW? For example, “1 Rx branch” only means “single baseband RX (rank 1)”, not relative to UE polarization. |
| Sony | Issue 4-3: Agree with Qualcomm it should be combined with 4-6 and 4-7.  Issue 4-4-2: Consequences of single polarization, if allowed, needs more investigation.  Issue 4-5: 23dBm for video surveillance and industrial sensors. FFS on TRP for wearable. (Agree with Qualcomm regarding basis for MPR).  Issue 4-6: Option 2. Video surveillance could maybe re-use existing PC5 (untouched). If anything is changed in an existing PC e.g. number of antenna elements or number of branches it will affect peak EIRP and REFSENS estimation and it is thus a new PC. For wearable use case is may not be realistic to assume the same peak EIRP as existing PC3.  Issue 4-7: Industrial sensor use case need to be investigated further. Probably spherical coverage should be no worse than 50%-tile but it also depends on the EIRP drop (from peak) specified at this point.  Issue 4-8: Agree with Qualcomm. Single pol receiver needs further investigation. |
| Xiaomi | Issue 4-3: Agree to define new power class for new use cases, whether need define three kind of new power class depends on other MOP requirements.  Issue 4-4-2: according to current scope for reduced minimum number of Rx branches in the WID   * + - For frequency bands where a legacy NR UE is required to be equipped with a minimum of 2 Rx antenna ports, the minimum number of Rx branches supported by specification for a RedCap UE is 1. The specification also supports 2 Rx branches for a RedCap UE in these bands.   It seems the scope also applies to FR2 from 2Rx to 1Rx.  Support to define the FR2 RedCap UE requirement based on single polarization UE.  Issue 4-5: support further study  Issue 4-6: Option 1, Option 2 are OK.  Issue 4-7: support further study  Issue 4-8: Option 1 |
| Ericsson | Issue 4-3: Ok with defining the new power class with considering of the 4-6 and 4-7.  Issue 4-4-2: ok to further investigation on single polarization, modified the tentantive WF.  Issue 4-5: ok with option 3  Issue 4-6: Option 1 and 2. Option 5 for wearables. Open to discussion on wearables,  Issue 4-7: fine with option 3 to further study. The spherical coverage is key use-case related RF parameter and the beam should be wider as the installation place is not predicable. (sensors may be installed in a place without choice)  Issue 4-8: Option 1 and option 3 are fine with us. This seems to connecting the issue 4-4-2, thus it may need to be further investigated. |
| ZTE | We have a question for clarification for the use case, are all the three use cases disucssed in parallel in the following meetings, or only focus on only one? Only two meetings are left in Rel-17. |
| Ericsson | To ZTE, we see most likely the video surveillance could be reused from PC5 NR FR2 UE, for wearables and industry sensor, it would need more investigation, but there is no real priority between them from 1st round discussion. According to WID, reducing the RX branch is an objective to fulfill but meantime there are some key parameter may need adjusted to fit the use case. |
| OPPO | **Issue 4-3: New power class and UE type for RedCap UE (Multiple choice)**  Option 4, depends on power definitions, but maybe industry sensor and surveillance can use same power class definition.  **Issue 4-4-2: UE architecture associated general views on RedCap FR2 UE**  RAN4 doesn’t limit UE implementation but define requirements based on UE architecture assumption. Not sure how to limit UE polarization and how it impact requirements.  **Issue 4-5: Max TRP**  Regulatory dependent. If no other requirements then can reuse 23dBm, i.e. Option 1.  **Issue 4-6: Min peak EIRP (Multiple choice)**  For clarification, what is the meaning of “starting point”? Is it from UE form factor point of view or others?  **Issue 4-7: Spherical coverage**  *Option 3,* FFS.  **Issue 4-8: 1 RX branch REFSENS**  *Option 3,* FFS. |

### 2.5.1 Companies views’ collection for issue 5 in 2nd round

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| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Ericsson | Supporting the WF and thus work can be progressed on FR2 RedCap UE. |