3GPP TSG-RAN WG4 Meeting # 100-e R4-211xxxx

Electronic Meeting, 16-27 August 2021

**Source:** Sony

**Title:** WF on RedCap REFSENS in FR1

**Agenda item:** 9.20.2.3

**Document for:** Approval

1. Background

The WI is to specify a UE feature and parameter list with lower end capabilities, relative to Release 16 eMBB and URLLC NR to serve the three use cases: connected industries (wireless sensors), video surveillance (smart cities) and wearables use cases [1]. The WI was discussed in RAN4 #99-e [2] and further discussed in RAN4 #100-e [3].

This tdoc is a WF on RedCap REFSENS in FR1 and is the outcome of the discussion, based on the following contributions to RAN4 #100-e.

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [R4-2112385](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112385.zip) | RedCap UE REFSENS requirements | Apple |
| [R4-2112890](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112890.zip) | Considerations on RF receiver for RedCap FR1 | Sony |
| [R4-2112912](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112912.zip) | Discussion on RedCap UE requirements | ZTE Corporation |
| [R4-2112985](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112985.zip) | Views on RedCap REFSENS requirements | vivo |
| [R4-2113101](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113101.zip) | Rx requirements for FR1 Redcap UE | Xiaomi |
| [R4-2113408](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113408.zip) | Discussion on RF requirements for RedCap UE | Huawei, HiSilicon |
| [R4-2114075](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114075.zip) | RedCap UE Rx requirements for FR1 | Nokia, Nokia Shanghai Bell |
| [R4-2114341](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114341.zip) | RF impact analysis on R17 RedCap | Ericsson |

1. Discussion

## Sub-topic 4-1: REFSENS for 1 RX RedCap UE

Possible options discussed:

* + Option 1: Reuse the constant gain adjustment of LTE Cat-1bis 2Rx to 1 Rx REFSENS [Apple]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Duplex Mode | 1Rx and 2Rx REFSENS difference (dB) | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| FDD | 2.5 | 3 | 3 | 3 |
| TDD | 2.5 | 2.5 | 2.5 | 2.5 |

* + Option 2: Apply 2.5 dB for FD-FDD and TDD. [Sony, ZTE]
  + Option 3: Apply 3 dB for FD-FDD and 2.5 dB for TDD [Xiaomi]
  + Option 4: Constant 3dB gain relaxation [ Vivo, Huawei, Ericsson]

Moderator recommendation [3]: *Down-selection from option 1, 2 and 4*

Proposal 1 Issue 4-1:

Option 1: Reuse the constant gain adjustment of LTE Cat-1bis 2Rx to 1 Rx REFSENS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Duplex Mode | 1Rx and 2Rx REFSENS difference (dB) | | | |
| 5 MHz | 10 MHz | 15 MHz | 20 MHz |
| FDD | 2.5 | 3 | 3 | 3 |
| TDD | 2.5 | 2.5 | 2.5 | 2.5 |

Option 2: Apply 2.5 dB for FD-FDD and TDD.  
 Option 4: Constant 3dB gain relaxation.

## Sub-topic 4-2: RX RedCap UE in HD-FDD mode

Possible options discussed:

* + Option 1: [Apple]
    - For all NR FDD bands, the 5MHz REFSENS requirements defined for full-duplex operation can be reused for half-duplex operation.
    - 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 2: Relaxation of 0.8 dB of 2 RX REFSENS of NR FDD band[ ZTE]
  + Option 3: Reuse the 2 RX REFSENS of NR FDD band [Xiaomi]
  + Option 4: [Ericsson]
    - Consider the ΔIM modification in Table 1 for 2 RX antenna port REFSENS for RedCap UE operating in HD-FDD mode.
  + Option 5: FFS [Vivo]

Moderator recommendation [3]: *Recommendations for 2nd round:*

*Issue 4-2-a: For the RedCap UE only support HD-FDD, should UE report* *HD-FDD capability to network (e.g in the case duplexer is replaced with switch?), if so, should RAN4 specify different REFSENS than FD-HDD?*

*Issue4-2-b: For the RedCap UE support both FD-HDD and HD-FDD, should UE report HD-FDD and FD-HDD capability to network (e.g in the case duplexer is kept?), if so, should RAN4 specify different REFSENS than FD-HDD?*

*Based on the outcome of discussion, the down selection could be from option 1, 2,3, 4*

Proposal 2 Issue 4-2a: Introduce capability to signal <HD-FDD only> capability  
Option 1. Yes   
Option 2. No

Proposal 3 Issue 4-2b: Introduce capability to signal <better HD-FDD performance>  
Option 1. Yes  
Option 2. No

Proposal 4 Issue 4-2: Different requirements specified for HD-FDD than for FD-FDD  
Option 1: If capability <better HD-FDD performance> is signaled  
Option 2: If capability <better HD-FDD performance> or if capability < HD-FDD only> is signaled  
Option 3: If capability < HD-FDD only> is signaled   
Option 3: No

## Sub-topic 4-3: 1 RX RedCap UE in HD-FDD mode

Possible options discussed:

* + Option 1: Relaxation of 1.7 dB of 2 RX NR FDD band REFSENS[Sony, ZTE, Xiaomi]
  + Option 2: [Ericsson]
    - Consider the ΔIM modification in Table 1 for 2 RX antenna port REFSENS for RedCap UE operating in HD-FDD mode.
    - Consider adjusting diversity gain from 3 dB additionally for 1 RX antenna port REFSENS for RedCap UE operating in HD-FDD mode.
  + Option 3: FFS [Vivo]

Moderator recommendation [3]: *Down-selection from option 1, 2, 3, also possibly depend on the issue 4-1 and issue 4-2 if common scaling factor is agreed.*

Proposal 5 Issue 4-3:   
Option 3: FFS (depending on outcome of Issue 4-2, Proposal 2)

## Sub-topic 4-4: Uplink Configuration for RedCap UE

Possible options discussed:

* + Option 1: UL configuration for HD-FDD REFSENS requirements is specified with full allocation.
  + Option 2: The uplink configuration for reference sensitivity of 1Rx and HD-FDD mode could reuse the uplink configuration for reference sensitivity of 2Rx with the channel bandwidth of 5MHz, 10MHz, 15MHz, and 20MHz.
  + Option 3: FFS

Moderator recommendation [3]: *Down-selection from option 1, 2*

Proposal 6 Issue 4-4:  
Option 1: UL configuration for HD-FDD REFSENS requirements is specified with full allocation.  
Option 2: The uplink configuration for reference sensitivity of 1Rx and HD-FDD mode could reuse the uplink configuration for reference sensitivity of 2Rx with the channel bandwidth of 5MHz, 10MHz, 15MHz, and 20MHz.

1. Conclusion
2. Reference
3. RP-211574, “Revised WID on support of reduced capability NR devices”, *Ericsson*
4. R4-2108005, “WF on RedCap”, *Ericsson*
5. R4-2114742, “Email discussion summary for [100-e][142] NR\_RedCap”, *Moderator (Ericsson)*