**3GPP TSG RAN WG1 #102-e R1-20XXXXX**

**e-Meeting, August 17th - 28th, 2020**

**Agenda item:** 8.6.3

**Source:** Moderator (Qualcomm Inc.)

**Title:** FL summary #3 on Coverage Recovery and Capacity Impact for NR RedCap

**Document for:** Discussion/decision

# Introduction

This document captures the RAN1#102-e email discussion [102-e-NR-RedCap-03] under the AI 8.6.3 (Study on Support of Reduced Capability NR Devices: coverage recovery and capacity impact).

[102-e-NR-RedCap-03] Email discussiona/approval – Chao (Qualcomm)

* By 8/20 – high priority
* By 8/26 – medium
* By 8/28 – last check

FL summary #1 was provided in [R1-2007091](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/R1-2007091.zip), and the updated FL summary #2 was provided in [R1-2007153](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/R1-2007153.zip). The following agreements were made via email:

Agreements

For the channel(s) affected by complexity reduction, the following methodology can be used to determine the target performance for coverage recovery

* Step 1: Obtain the link budget performance of the channel based on link budget evaluation
* Step 2: Obtain the target performance requirement for RedCap UEs within a deployment scenario
	+ FFS on the target performance requirement
* Step 3: Find the coverage recovery value for the channel if the link budget performance is worse than the target performance requirement

Agreements:

* Link budget evaluation for RedCap should include at least PDCCH/PDSCH and PUCCH/PUSCH

Agreements:

* For initial access related channels, at least Msg2, Msg3, Msg4 and PDCCH scheduling Msg2/4 are included for link budget evaluation
	+ Other initial access related channels are not precluded

Agreements:

* The impact of small form factor is considered for all the uplink and downlink channels
	+ A 3dB loss of antenna gain is included in link budget calculation for FR1
		- FFS on the application to both FDD and TDD bands or only FDD bands

The following agreements were made in an online (GTW) session:

**Agreements**: Down-selection on the following options for the target performance requirement for RedCap UEs in RAN1#103-e (aim for early in the e-meeting):

* Option 1: The target performance requirement for each channel is identified by a target MCL or MIL or MPL within a reasonable deployment
* Option 3: The target performance requirement for each channel is identified by the link budget of the bottleneck channel(s) for the reference NR UE within the same deployment scenario
	+ Note: The “bottleneck channel(s)” are the physical channel(s) that have the lowest MCL or MIL or MPL
* The details for the target performance requirement are FFS

Agreements: For RedCap UE, adopt the following target data rates for link budget evaluation for FR1 Rural.

* 1 Mbps on DL and 100kbps in UL

Agreements: For RedCap UE, down-selection on the following target data rates for link budget evaluation for FR1 Urban.

* 2 Mbps on DL and 1Mbps in UL

Note: The 2Mbps target data rate in downlink is the scaled value of the 10Mbps in the CE SI by a factor of 0.2

Agreements: For RedCap UEs, the target data rates for link budget evaluation for FR2 are as follows:

* 25Mbps for BW 50MHz/100MHz on DL and 5Mbps in UL
	+ Optionally, 12.5Mbps for BW 50MHz as the target data rate for DL, assuming the same DL PSD as that of BW 100MHz
	+ Note: in case of 50MHz BW, the maximum supported DL data rate is half that of the 100MHz BW in DL

This version of the document contains the medium priority proposals to be discussed till 8/26.

# Evaluation methodology

## Issue #1: FFS on the bands for antenna gain loss

For the following agreement, the application of the 3dB antenna loss to FR1 bands has not been agreed. During the offline discussion, it was proposed to solve the FFS as early as possible since it may have an impact on the link budget analysis.

Agreements:

* The impact of small form factor is considered for all the uplink and downlink channels
	+ A 3dB loss of antenna gain is included in link budget calculation for FR1
		- FFS on the application to both FDD and TDD bands or only FDD bands

Since the majority view is to apply the antenna gain loss to all the FR1 bands including both FDD and TDD, the following proposal is made.

**Moderator’s proposal**

* The antenna gain loss due to the small form factor is applied to all the FR1 bands

Please input your view on the moderator proposal.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Fine with this proposal. |
| vivo | Agree the moderator proposal. |
| Intel | Fine with the FL proposal |
| DOCOMO | Agree with the proposal |
| CMCC | Agree with this proposal. |
| CATT | Agree with the proposal. |
| Samsung | Agree. |
| Spreadtrum | Agree |
| Futurewei | OK |
| Huawei, HiSilicon | OK if adding “For link budget evaluation” and replacing “is applied” by “can be applied”. In our understanding, the proposal here is not to make a decision that the same loss value is applied to all FR1 bands for real hardware of REDCAP UE. |
| ZTE,Sanechips | OK |
| Panasonic  | Agree. |
| OPPO | Agree |
| LG | Agree |

**Summary of the discussion**

All the responses seem okay with the moderator’s proposal and one response also proposes some modifications for clarification. Based on this, the proposal is updated as follows.

**Moderator’s updated proposal**

* For link budget evaluation, the antenna gain loss due to the small form factor can be applied to all the FR1 bands

Please input your view if you have any concern on the updated proposal.

|  |  |
| --- | --- |
| **Company** | **Comments** |
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|  |  |

**Updated on 8/27:**

Agreements**:**

* For link budget evaluation, the antenna gain loss due to the small form factor can be applied to all the FR1 bands

## Issue #2: scenario and frequency for link level evaluation

**Question 3: Should the link level coverage evaluation for the RedCap study consider only the scenario and frequency agreed in the RAN1-101e?**

Regarding **Question #3**, most responses seem to support the scenario and frequency agreed in RAN1-101-e meeting. Several responses also indicated the 4GHz Urban scenario should be also discussed although it has lower priority than 2.6GHz. One response pointed out that other scenario and frequency should not be precluded if company has interest to evaluate it.

Considering the above summary, the moderator proposes to close the discussion on the scenario and frequency for link level evaluation

## Issue #3: other common LLS parameters

**Question 7: For the common LLS parameters, can the RedCap study adopt the CE agreement on the number of gNB TX and RX chains, channel model, delay spread and antenna correlation? If not, what modifications are needed?**

Regarding **Question #7**, most responses seems to agree to align with the CE SI assumptions if applicable, and several responses indicate that there are a few additional assumptions not covered in the CE agreements and also some parameters such as the number of antennas and BW need to be adapted for the RedCap.

**Moderator’s proposal**

* For RedCap coverage evaluation, the Rel-17 CE SI agreements on gNB antenna configuration, channel model and delay spread are reused with the following revision and/or addition

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Channel model | TDL-C | TDL-A |
| Delay spread | 300ns | 30ns |
| UE velocity | 3 km/h | 3 km/h |
| Antenna correlation | Low | Low |
| # gNB Tx chains | 4 | 2 |
| # gNB Rx chains | 4 | 2 |

* For RedCap coverage evaluation, adopt the following table for the reference NR UE.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | Urban: 4 and Rural: 2 | 2 |
| UE BW | Urban: 100 MHz (273 PRBs)Rural: 20 MHz (106 PRBs) | 100 MHz (66 PRBs) |

* For RedCap coverage evaluation, adopt the following table for the RedCap UE.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | 1 or 2 | 1 or 2 |
| UE BW | Urban: 20 MHz (51 PRBs)Rural: 20 MHz (106 PRBs) | 50 MHz (32 PRBs) or 100 MHz (66 PRBs) |

Please input your view on the moderator’s proposal.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Fine with this proposal |
| vivo | For gNB Tx and Rx chains in FR1, there are two options provided in CE SI (RAN1#101-e agrement), as follows~~[~~gNB modeling in LLS for TDL:* Option 1: 2 or 4 gNB receive chains in LLS ~~(as starting point)~~. FFS: correlation

In Option 1, both 2 or 4 gNB receiver chains are considered. We suggest to align with that in CE, companies can report the number of Tx/Rx chains in evaluation. |
| Intel | Fine with this proposal |
| DOCOMO | While we still prefer to include 4GHz case in Issue #2, we can live with the conclusion from moderator.In that sense, we can agree with the proposal. |
| CMCC | Agree with this proposal. |
| CATT | Agree with the comments from vivo that the number of gNB Tx/Rx chains (2 or 4) can be reported by companies. |
| Samsung | OK |
| Furturewei | OK |
| Huawei, HiSilicon | Regarding the UE BW for FR1, suggest the following for clarification, because there are both FDD and TDD for Rural in CE SI.* Urban: 20 MHz (51 PRBs@30kHz SCS TDD, 106 PRBs@15khz SCS FDD )
* Rural: 20 MHz (106 PRBs@15khz SCS FDD)

And considering the deployment frequency of RedCap UE in Urban scenario include not only TDD band but also FDD band, therefore we suggest also adding “106 PRBs@15kHz SCS FDD” for 20MHz in Urban scenario. |
| ZTE,Sanechips | We have similar view as Vivo and CATT regarding FR1 gNB TX/RX chain number. In fact, it seems the 4/4 is for urban scenario , for rural 2/2 is suggested.  |
| Panasonic  | Fine with the proposal. |
| Qualcomm | For FR2, it may also make sense for include CDL-A channel. It was also one of the channels in the CE agreement from RAN1#101-e. In this case, the gNB and UE antenna structure assumptions need to be agreed. We can reuse the same CE assumptions, i.e., * Number of UE antenna elements: 8, one panel:(M, N, P) = (2,2,1 or 2)
* Number of antenna elements for BS: 128, (M, N, P, Mg, Ng) = (8, 8, 2, 1, 1)
 |
| OPPO | OK |
| LG | Fine with the proposal.  |

**Summary of the discussion**

Most of the responses seem okay with the moderator’s proposal and several responses have a preference not to fix the number of gNB Tx/Rx chains but left to be reported by companies. One response proposes to include FDD bands for Urban scenario, and another response proposes to include CDL-A channel also for FR2.

Based on the responses to Question #3 in FL summary #2 in [R1-2007153](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/R1-2007153.zip), most companies think the scenario and frequency agreed in the RAN1-101e meeting are sufficient for link level evaluation. To reduce the simulation efforts, the agreed scenario and frequency will be used as the baseline and companies are encouraged to perform link level evaluation for the scenario and frequency agreed in the RAN1-101e meeting. The evaluation for other scenario and frequency are not precluded and company could also bring the evaluation results.

Based on the scenario and frequency agreed in RAN1-101e meeting, only FDD band 700MHz is considered for Rural scenario, which uses 15kHz SCS. Therefore, the moderator thinks the definition of number of PRB in the UE BW is clear. A clarification is not needed.

**Moderator’s updated proposal**

* For RedCap coverage evaluation, the Rel-17 CE SI agreements on gNB antenna configuration, # gNB Tx/Rx chains, channel model and delay spread are reused with the following revision and/or addition

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Channel model | TDL-C | TDL-ACDL-A(optional) |
| Delay spread | 300ns | 30ns |
| UE velocity | 3 km/h | 3 km/h |
| Antenna correlation | Low | Low |
| # gNB Tx chains | 2 or 4 | 2 |
| # gNB Rx chains | 2 or 4 | 2 |

* For RedCap coverage evaluation, adopt the following table for the reference NR UE.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | Urban: 4 and Rural: 2 | 2 |
| UE BW | Urban: 100 MHz (273 PRBs)Rural: 20 MHz (106 PRBs) | 100 MHz (66 PRBs) |

* For RedCap coverage evaluation, adopt the following table for the RedCap UE.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | 1 or 2 | 1 or 2 |
| UE BW | Urban: 20 MHz (51 PRBs)Rural: 20 MHz (106 PRBs) | 50 MHz (32 PRBs) or 100 MHz (66 PRBs) |

Please input your view if you have any concern on the updated proposal.

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| --- | --- |
| **Company** | **Comments** |
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**Updated on 8/27:**

Agreements:

* For RedCap coverage evaluation, the Rel-17 CE SI agreements on gNB antenna configuration, # gNB Tx/Rx chains, channel model and delay spread are reused with the following revision and/or addition

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Channel model | TDL-C | TDL-ACDL-A(optional) |
| Delay spread | 300ns | 30ns |
| UE velocity | 3 km/h | 3 km/h |
| Antenna correlation | Low | Low |
| # gNB Tx chains | 2 or 4 | 2 |
| # gNB Rx chains | 2 or 4 | 2 |

* For RedCap coverage evaluation, adopt the following table for the reference NR UE.

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | Urban: 4 and Rural: 2 | 2 |
| UE BW | Urban: 100 MHz (273 PRBs)Rural: 20 MHz (106 PRBs) | 100 MHz (66 PRBs) |

* For RedCap coverage evaluation, adopt the following table for the RedCap UE.
	+ Other UE BWs are not precluded

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| # UE Tx chains | 1 | 1 |
| # UE Rx chains | 1 or 2 | 1 or 2 |
| UE BW | Urban: 20 MHz (51 PRBs)Rural: 20 MHz (106 PRBs) | 50 MHz (32 PRBs) or 100 MHz (66 PRBs) |

## Issue #4: channel specific LLS parameters

**Question 8: For the channel specific LLS parameters other than target data rates, can the RedCap study reuse the link-level simulation assumptions adopted by the Rel-17 CE SI? If not, what modifications are needed?**

Regarding **Question #8**, most responses seems to support reusing the CE agreements for the RedCap in general with some changes on the TBS, MCS, and MIMO layers. It is also noted that the evaluation of Msg2 is not supported in the Rel-17 CE SI, and therefore the moderator proposes to discuss and decide the evaluation assumptions for Msg2.

**Moderator’s proposal**

* For RedCap coverage evaluation, reuse the Rel-17 CE SI agreements on channel specific parameters with the following revision and/or addition
	+ TBS/PRB/MCS of PDSCH/PUSCH for the RedCap UE are based on the agreed target data rates and reported by companies
	+ Adopt the following table for Msg2

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Payload size | 9 bytes |
| PDSCH duration | 12 OS |
| DMRS configuration | Type I, 3 DMRS symbol, no multiplexing with data |
| Number of PRBs | 3 |
| Waveform  | CP-OFDM |
| HARQ configuration  | No retransmission |

Please input your view on the moderator’s proposal.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We suggest revising –“TBS/PRB/MCS of PDSCH/PUSCH for the RedCap UE are based on the agreed target data rates and reported by companies” to “TBS/PRB/MCS of PDSCH/PUSCH for the RedCap UE are based on the agreed target data rates or message sizes and reported by companies”.This revision is to cover Msg3 and Msg4. |
| Vivo | We are fine with the FL proposal. |
| Intel | We are fine with the FL proposal. |
| DOCOMO | Agree with the proposal. Also fine with the update from Ericsson. |
| CMCC | Fine with Ericsson’s version. |
| CATT | Fine with the proposal. Also fine with the update from Ericsson. |
| Samsung | OK |
| Huawei, HiSilicon | We are fine with the FL proposal except the payload size and PRB numbers of msg2. In current specs, the size of Msg2 is varying according to the number of concurrent Ues within one Msg2 occasion, and 9 bytes is the minimum Msg2 size for one RAR of only one UE. In case of N RAR of N Ues aggregated in one Msg2, its size is 9\*N bytes. Up to 64 preambles can be multiplexed in one RO, thus the payload size of msg2 ranges from 9 bytes to 9\*64 bytes depending on the preamble configuration. It seems not the most probable case that only single UE’s RAR is contained in one Msg2 for REDCAP Ues plus legacy Ues. Therefore, we suggest a larger payload size for Msg2, e.g. 36/72 bytes (4/8 RARs) and the number of PRB is reported by companies accordingly, assuming MCS0.**Proposal**: Payload size: 36 bytes or 72 bytes Number of PRBs: reported by companies assuming MCS0 |
| ZTE,Sanechips | For Msg2, as long as companies agree to fix the MCS, each companies can report the assumed payload size. |
| Panasonic  | Fine with the proposal and the update from Ericsson  |
| Qualcomm | Agree, however, since we only have 1 meeting left for SI, may be better to agree on specific TBS/PRB/MCS to avoid any possible misalignment. |
| OPPO | Agree with the proposal. |
| LG | We are fine with the proposal. Also fine with Ericsson’s revision. |

**Summary of the discussion**

Based on the discussion, it seems the main concern is on the Msg2 payload. The proposal to fix the MCS is acceptable to the moderator. The Ericsson’s update seems also okay to everyone.

**Moderator’s updated proposal**

* For RedCap coverage evaluation, reuse the Rel-17 CE SI agreements on channel specific parameters with the following revision and/or addition
	+ TBS/PRB/MCS of PDSCH/PUSCH for the RedCap UE are based on the agreed target data rates or message sizes and reported by companies
	+ Adopt the following table for Msg2

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| PRBs/TBS/MCS | MCS is fixed to zero. Companies to report the used number of PRBs and corresponding TBS value |
| PDSCH duration | 12 OS |
| DMRS configuration | Type I, 3 DMRS symbol, no multiplexing with data |
|  |  |
| Waveform  | CP-OFDM |
| HARQ configuration  | No retransmission |

Please input your view if you have any concern on the updated proposal.

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| --- | --- |
| **Company** | **Comments** |
| Futurewei | Suggest to have a specific TBS size to avoid misalignment corresponding to the target data rates in agreement (example 2 Mbps for Urban). To match these, a fixed TBS size of 1128 may be listed. In addition, we suggest not to limit the MCS used to that of MCS 0 Table 5.1.3.1-1 but rather could use other MCS indices or different tables such as 5.1.3.1-3. Companies should report the MCS and PRBs used corresponding to the TBS. |
| ZTE,Sanechips | It's better to specify the MCS used for the simulation so the result can be compared between different sources. |
|  |  |

**Updated on 8/27:**

Agreements:

* For RedCap coverage evaluation, reuse the Rel-17 CE SI agreements on channel specific parameters with the following revision and/or addition
	+ TBS/PRB/MCS of PDSCH (except for Msg2)/PUSCH for the RedCap UE are based on the agreed target data rates or message sizes and reported by companies
	+ Adopt the following table for Msg2 evaluation
		- Note: the TBS scaling is not precluded in the table entry “PRBs/TBS/MCS”

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| PRBs/TBS/MCS | MCS is fixed to zero. Companies to report the used number of PRBs and corresponding TBS value |
| PDSCH duration | 12 OS |
| DMRS configuration | Type I, 3 DMRS symbol, no multiplexing with data |
| Waveform  | CP-OFDM |
| HARQ configuration  | No retransmission |

## Issue #5: LB template and performance metric

**Question 9: For link budget template, should the RedCap study reuse/align the link budget template with the CE SI? If not, what modifications are needed?**

Regarding **Question #9**, most responses seems to be okay to reuse/align the link budget template with the CE SI although 8 responses have a preference on Option 1. One response also indicates the antenna array gain should be reflected also in the link budget when the array gains for all the DL channels are different and required to evaluate.

It is noted that the CE SI has made the following agreements on LB template, antenna array gain and performance metric. Therefore, the following proposal is made.

Agreements (for both FR1 & FR2):

* For the definition of antenna array gain, adopt option 1, i.e. Antenna array gain is included in the link budget template, where there are four antenna gain components
	+ Note: the four components are illustrated below – the figure is for illustration purpose only
	+ FFS which component(s) are NOT part of the definition of antenna array gain



Agreements:

* Adopt single link budget template for both FR1 and FR2 based on IMT-2020 self-evaluation with rows for MIL, MCL, MPL, and necessary revisions, including adding/removing/revising/simplifying some parameters
	+ [For LLS based methodology, ]coverage bottleneck(s) identification is performed using at least [MCL and] MIL.
	+ [MCL values can also be considered to compare channels with similar antenna (and antenna array) gain]

**Moderator’s proposal**

* For RedCap coverage analysis, the agreements in the Rel-17 CE SI regarding link budget template, antenna array gain and performance metrics are reused.

Please input your view on the moderator’s proposal.

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are fine with this proposal. |
| Vivo | We checked the agreements made in this meeting, and the definition for MCL, MIL and MPL are given as follows. For MCL definition, the UE antenna gain is not included in the metric, and the coverage reduction due to UE antenna gain loss is not reflected in MCL metric. Therefore, MCL is not preferred in coverage analysis for RedCap, regardless of what the agreements made in CE SI.* For TDL Option 1
	+ Definition of MCL
		- Total transmit power – Receiver sensitivity + gNB antenna gain (component 2)
	+ Definition of MIL
		- Total transmit power – Receiver sensitivity + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain
	+ Definition of MPL
		- Further discussion offline the definition using below as a starting point:
			* Total transmit power – Receiver sensitivity + gNB antenna array gain (component 2+3+4 for TDL option 1) + UE antenna gain – (8) Cable, connector, combiner, body losses (Tx side) – (20) Receiver implementation margin + (21a/b) H-ARQ gain – (25a/b) Shadow fading margin + (26) BS selection/macro-diversity gain – (27) Penetration margin + (28) Other gains – (12) Cable, connector, combiner, body losses (Rx side)
	+ Note: whether/how to use the above definitions is to be discussed
 |
| Intel | We are supportive to the FL proposal |
| DOCOMO | Agree with the proposal |
| CMCC | Fine with the proposal.We prefer using MPL to reflect the realistic deployment. |
| CATT | We are fine with the FL proposal. For MCL, the UE antenna efficiency loss can be additionally considered for RedCap Ues. |
| Samsung | OK |
| Spreadtrum | Share the similar view with vivo |
| Futurewei | OK |
| Huawei, HiSilicon | Share the similar view as CMCC, for LLS in RedCap SI, MPL is preferred for coverage bottleneck(s) identification, because MPL can reflect the actual coverage performance considering a reasonable network deployment. Echo Vivo’s view, MCL in CovEnh SI does not contain antenna radiation loss. It can be removed from REDCAP LLS evaluation. |
| ZTE,Sanechips | OK with the proposal. UE antenna efficiency loss can be additionally considered. |
| Panasonic  | Fine with the proposal. |
| OPPO  | Fine with the proposal. |
| LG | We are fine with the proposal  |

**Summary of the discussion**

Based on the discussion, it seems the main concern is on the performance metric, e.g. MCL/MIL/MPL for link budget analysis. By reading the CE agreement, it seems there is no agreement or dis-agreement to use MCL or MPL as the performance metric. Considering this may also be related to the discussion of the target performance requirement for coverage recovery, e.g. if option 3 is adopted then only the relative performance metric is concerned and there is no difference between MPL and MIL. Therefore, the moderator proposes to continue discussion the performance metric in RAN1-103 e-meeting

**Moderator’s updated proposal**

* For RedCap coverage analysis, the agreements in the Rel-17 CE SI regarding link budget template and antenna array gain are reused.
	+ Continue to discuss and decide the performance metric in RAN1-103 e-meeting

Please input your view if you have any concern on the updated proposal.

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| **Company** | **Comments** |
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**Updated on 8/27:**

Agreements**:**

* For RedCap coverage analysis, the agreements in the Rel-17 CE SI regarding link budget template and antenna array gain are reused.
	+ Continue to discuss and decide the performance metric in RAN1-103 e-meeting

## Issue #6: SLS parameters

**Question 11: For evaluating the impact of network capacity and spectrum efficiency, can the RedCap study use the assumption in TR 38.802, Table A.2.1-1 as the starting point?**

Regarding **Question #11**, most responses seems to support to use the assumption in TR 38.802, Table A.2.1-1 as a starting point. One response indicates a preference to the methodology of ITU-2020 self-evaluation and use the assumption in TR 37.910. Several responses also pointed out that the scenario, traffic model and the percentage of RedCap UEs should be clarified also. One response proposes to de-prioritize the SLS for now.

**Question 12: Can the system level evaluation focus on the downlink capacity and down-prioritization of the uplink capacity?**

Regarding **Question #12**, most responses seems to be okay with prioritize the downlink, and 4 responses also pointed out that uplink capacity should also be evaluated to see potential impact from complexity reduction techniques and reduced antenna efficiency. One response proposes to de-prioritize the SLS for now.

In the moderator’s view, the assumption in TR 38.802, Table A.2.1-1 is also the baseline for the IMT-2020 self-evaluation, which includes a long list of parameters and some of them may not be relevant to the RedCap study. It is preferable to have a simple assumption for SLS evaluation with agreements only on key parameters such as scenario, ISD, traffic model, and percentage of RedCap Ues. Other parameters can be reported by companies.

Regarding the scenario, dense Urban for FR1 was proposed in all the four contribution [3, 4, 18, 32], and the rural scenario for FR1 is also proposed in the two contributions [4, 18]. For FR2, only one contribution proposed to consider indoor hotspot. Considering the simulation efforts, the moderator proposes to consider at least the dense Urban for FR1 and indoor hotspot for FR2.

Regarding the inter-BS distance for dense Urban, one contribution [3] has a preference to 500m, and one contribution has a preference on 200m. The moderator proposes to further discuss the value and make a down-selection if needed.

For traffic pattern, one contribution [4] proposes to consider full buffer while two contributions [3, 32] propose to consider the burst traffic for evaluation. Additionally, the contribution [32] proposes to consider the realistic traffic model, e.g. using FTP traffic model 3 for normal Ues and the IM traffic model for RedCap Ues, which has been agreed in power saving evaluation for RedCap. The moderator proposes to further discuss and make a down-selection if needed.

For the percentage of RedCap, a different ratio of 0, 25%, 50%, 75% and 100% is considered in [4], while it is assumed in [32] that up to 50% of total users in the system can be RedCap users. The moderator proposes to further discuss and make a down-selection if needed.

**Moderator’s proposal**

* For SLS based capacity evaluation, use the assumption in TR 38.802, Table A..2.1-1 as the baseline.
* For calibration purposes, the following settings can be used:

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Layout | Single layerMacro layer: Hex. Grid | Single layerIndoor floor: (12BSs per 120m x 50m)Candidate TRP numbers: 3, 6, 12 |
| Inter-BS distance | [200 or 500m] | 20m |
| Scenario and frequency | Dense Urban:* 1. GHz (TDD) (primary choice)

4 GHz (TDD) (secondary choice) | Indoor: 28 GHz (TDD) |
| Frame structure for TDD | For 2.6 GHz: DDDDDDDSUU (S: 6D:4G:4U)For 4 GHz:DDDSUDDSUU (S: 10D:2G:2U) | DDDSU (S: 10D:2G:2U) |
| Channel model | 3Duma | 5GCM office |
| UE distribution | 20% Outdoor in cars: 30km/h,80% Indoor in houses: 3km/h | 100% Indoor: 3km/h  |
| Traffic model | Option 1: Full bufferOption 2: Burst traffic, e.g. FTP traffic model 3 for the reference NR Ues and the IM traffic model for RedCap Ues |
| Traffic load | 10 users per cell for full buffer traffic model25%, 50% and 80% loading (resource utilization) for burst traffic model |
| Percentage of RedCap Ues among total number of UesNote: Other Ues are the reference NR Ues | [0], [25%], [50%], [75%], [100%] |

Please input your view on the moderator’s proposal, including the revision/additional for any parameter.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | It might be good to also include 700 MHz scenario so that the impact from UE antenna reduction, 2 Rx to 1 Rx, on spectral efficiency and capacity is studied.Regarding channel models, we suggest using the ITU channel models according ITU M.2412.* 700 MHz: Rma\_B
* 2.6GHz/4GHz: Uma\_B
* 28 GHz: InH\_B

It would be good to clarify that 10 users per cell include both RedCap and reference NR Ues.Regarding “percentage of RedCap Ues among total number of Ues”, we think it is enough to evaluate [0], [25%], and [50%], as these settings already cover the most likely scenarios. |
| Vivo | 1. For traffic model, we think down-selection should be made. Typically we use non-full buffer traffic model for system performance evaluation, for eMBB and RedCap UE, it is hard to imagine a case with full buffer traffic. Therefore we strongly prefer to adopt option 2.

One clarification for option 2 is that we can reuse the traffic mode from 38.840, copied below for reference. Note that we have following agreement in 8.6.2, therefore it make much sense to keep consistent traffic model across different agenda items for RedCap. Agreements:For power saving evaluation of RedCap Ues:* Reuse the Instant message traffic model from TR 38.840 as baseline. Other ~~Instant~~ traffic models based on FTP model 3 are not precluded and companies to report the mean inter-arrival time and packet size if other ~~instant~~ traffic models are assumed in evaluation.
* FFS: ‘heartbeat’ traffic model

2. On the traffic load, we think “10 users per cell for full buffer traffic model” should be removed since the evaluation should use non-full buffer traffic. We may not need to specify very specific load ratio as it would be difficult to find a traffic arrival rate that perfectly matches the target load ration Suggest we define the low load range (e.g. <30%), medium load range (e.g. 30%~50%) to leave some flexibility. We may not need to evaluate high load scenario as typically it does not happen in an practical deployment as the system will become unstable and user experience cannot be satisfied. 3. For the percentage of RedCaP Ues, we are not sure what is the scenario with 100% redcap Ues in the cell?? Even 75% may not make much sense to us. At least for wearable cases, 50% should be the upper bound which means every person has one smartphone and one wearable device.  |
| DOCOMO | Regarding the traffic model, since non-full buffer traffic model is usually used for SLS, we prefer Option 2.Regarding the percentage of RedCap Ues, up to 50% would be enough considering the coexistence with legacy Ues. |
| CMCC | 1. For Inter-BS distance, we prefer 500m.2. For traffic model, we prefer Option 2: Burst traffic.3. For redcap percentage, we think 0%, 25% and 50% are enough. |
| CATT | For traffic model, we also prefer option 2. |
| Samsung | Traffic model: Option 2 because we think the burst traffic model is aligned with RedCap use cases such as IWSN, surveillance camera, wearable.Percentage of RedCap Ues: 0, 25%, 50% because we think it is a reasonable assumption that up to 50% of total users in the system can be RedCap users. |
| Futurewei | For redcap percentage only 0 and 50%, 25% also ok.Better to prioritize one type of traffic model. |
| Huawei, HiSilicon | For the evaluation of spectrum efficiency, we feel the traffic mode of full buffer is already enough, burst buffer is not suitable for spectrum efficiency evaluation.For the evaluation of network capacity, FTP traffic model 3 can be considered.Regarding vivo’s proposal, not sure why DRX setting is needed here, a clarification is suggested. Additionally, for the sake of workload reduction, suggest that the cases of instant messaging and VoIP are not needed. |
| ZTE,Sanechips | For traffic model, we prefer prioritize burst traffic model.  |
| Panasonic  | In FL’s proposal for question#7 (Issue #3 of Section 2.3), the UE velocity is assumed as 3 km/h for FR1, however, in this proposal, for UE distribution for FR1 is assumed as 20% Outdoor in cars with 30km/h, i.e., UE velocity of 30 km/h. It seems conflict with previous FL’s proposal for question#7.Regarding to number of users of 10 per cell, does it mean a total numbers of non-RedCap (reference) UEs and RedCap UEs? It is good to explicitly mention and clarify the value of total number UEs.Regarding to percentage of RedCap UEs among total number of UEs, if the total UEs are assumed as 10, 25% and 75% are not applicable because the number of RedCap UEs should be integer value. |

**Summary of the discussion**

For traffic model, 5 responses support the non-full buffer traffic model, one response supports both by selecting one based on the purpose of the evaluation, and two responses proposes to prioritize one type of traffic model. Therefore, the moderator proposes to make the full buffer traffic model as optional.

Regarding the percentage of RedCap UEs, most responses indicate that 0%, 25% and 50% are enough. Therefore, the moderator proposes to follow the majority view.

Regarding the scenario, one response proposes to include also 700 MHz scenario so that the impact from UE antenna reduction, 2 Rx to 1 Rx, on spectral efficiency and capacity, can be evaluated. In the moderator’s view, the proposal here is to have a baseline assumption for SLS based evaluation. Other scenario and frequency could also be considered for evaluation, but it is not needed to include all the options considering the simulation effort.

For inter-site distance, one response indicates a preference for 500m. If there is no objection, the moderator proposes to remove the 200m option to reduce the simulation efforts.

For traffic load, two companies want to have a clarification on the number of uses of 10 per cell for full buffer simulation.

For the concern on the 30km/h UE velocity addressed by one company, the UE distribution is based on 38.802 where both outdoor and indoor UEs are considered with a different speed. The proposal of 3km/h UE speed for Question #7 is only for link level evaluation. It is okay to have a different assumption on the UE speed for SLS based evaluation.

**Moderator’s updated proposal**

* For SLS based capacity evaluation, use the assumption in TR 38.802, Table A..2.1-1 as the baseline.
* For calibration purposes, the following settings can be used:

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Layout | Single layerMacro layer: Hex. Grid | Single layerIndoor floor: (12BSs per 120m x 50m)Candidate TRP numbers: 3, 6, 12 |
| Inter-BS distance | 500m | 20m |
| Scenario and frequency | Dense Urban:2.6 GHz (TDD) (primary choice) 4 GHz (TDD) (secondary choice)Other scenarios (e.g. Rural 700MHz) are not precluded. | Indoor: 28 GHz (TDD) |
| Frame structure for TDD | For 2.6 GHz: DDDDDDDSUU (S: 6D:4G:4U)For 4 GHz:DDDSUDDSUU (S: 10D:2G:2U) | DDDSU (S: 10D:2G:2U) |
| Channel model | 3Duma | 5GCM office |
| UE distribution | 20% Outdoor in cars: 30km/h,80% Indoor in houses: 3km/h | 100% Indoor: 3km/h  |
| Traffic model | Full buffer (Optional)Non-full buffer traffic, e.g. FTP traffic model 3 for the reference NR UEs and the IM traffic model for RedCap UEs |
| Traffic load | Full buffer traffic (Optional):10 users per cell including both RedCap and reference NR UEsNon-full buffer traffic:Low (e.g. <30%) and medium (e.g. 30%-50%) loading (resource utilization)  |
| Percentage of RedCap UEs among total number of UEsNote: Other UEs are the reference NR UEs | Full buffer traffic (Optional):0, 20%, 50% (i.e. 0, 2 or 5 RedCap UEs per cell)Non-full buffer traffic:0, 25%, 50% |

Please input your view if you have any concern on the updated proposal.

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| **Company** | **Comments** |
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**Updated on 8/27:**

Agreements:

* For SLS based capacity evaluation, use the assumption in TR 38.802, Table A.2.1-1 as the baseline.
* For calibration purposes, the following settings can be used:

|  |  |  |
| --- | --- | --- |
| **Parameters** | **FR1 values** | **FR2 values** |
| Layout | Single layerMacro layer: Hex. Grid | Single layerIndoor floor: (12BSs per 120m x 50m)Candidate TRP numbers: 3, 6, 12 |
| Inter-BS distance | 500m | 20m |
| Scenario and frequency | Dense Urban:2.6 GHz (TDD) (primary choice) 4 GHz (TDD) (secondary choice)Other scenarios (e.g. Rural 700MHz) are not precluded. | Indoor: 28 GHz (TDD) |
| Frame structure for TDD | For 2.6 GHz: DDDDDDDSUU (S: 6D:4G:4U)For 4 GHz:DDDSUDDSUU (S: 10D:2G:2U) | DDDSU (S: 10D:2G:2U) |
| Channel model | 3Duma | 5GCM office |
| UE distribution | 20% Outdoor in cars: 30km/h,80% Indoor in houses: 3km/h | 100% Indoor: 3km/h  |
| Traffic model | Full buffer (Optional)Non-full buffer traffic, e.g. FTP traffic model 3 for the reference NR UEs and the IM traffic model from TR 38.840 for RedCap UEs  |
| Traffic load | Full buffer traffic (Optional):10 users per cell including both RedCap and reference NR UEsNon-full buffer traffic:Low (e.g. <30%) and medium (e.g. 30%-50%) loading (resource utilization)  |
| Percentage of RedCap UEs among total number of UEsNote: Other UEs are the reference NR UEs | Full buffer traffic (Optional):0, 20%, 50% (i.e. 0, 2 or 5 RedCap UEs per cell), 100% (as applicable)Non-full buffer traffic:0, 25%, 50%, [100%] |

**Additional questions for answer:**

Based on the discussion in GTW session, there are two open issues for the above agreement. One is about full buffer traffic model for the evaluation of spectrum efficiency, and the other is about 100% RedCap UE distribution for the non-full buffer traffic model. The following two questions are listed for collecting companies’ view.

**Question 1: Should the full buffer traffic modeling be considered in the system level simulation for the evaluation of spectrum efficiency. If yes, can we remove the “optional” from the full buffer traffic?**

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| **Company** | **Answers (Y/N)** | **Comments** |
| vivo | N | We should not consider full buffer traffic in the SLS, as the full buffer traffic scenario for RedCap UE does not exist so such simulation result does not provide useful information. To evaluate spectrum efficiency due to complexity reduction features, link level simulation can be used by companies.  |
| Samsung | N | We think full buffer traffic cannot reflect the actual traffic for Redcap UEs. |
| Huawei, HiSilicon | Y | The same traffic model in TS 37.910 (self-evaluation of IMT-2020), i.e. full buffer should be reused.* Spectral efficiency is an objective in SID RP-201386,

“The study includes evaluations of the impact to coverage, network capacity and spectral efficiency”.* Spectral efficiency is defined in S5.4 of TS 37.910, please note the denominator is available radio resources.

“As defined in Report ITU-R M.2410, average spectral efficiencyis the aggregate throughput of all users (the number of correctly received bits, i.e. the number of bits contained in the SDUs delivered to Layer 3, over a certain period of time) divided by the channel bandwidth of a specific band divided by the number of TRxPs and is measured in bit/s/Hz/TRxP. ”* Burst buffer will bias the results of spectral efficiency because some available radio resources are not occupied by traffic load. Therefore, burst buffer does not fit in the definition of spectral efficiency.
* Only full buffer was used for spectral efficiency evaluations in TS 37.910
 |
| ZTE,Sanechips |   | We suggest to list full buffer as optional and move on. There is no meaning to continue spending time on this.BTW, from the definition referenced above it seem there’s no requirement that ‘the aggregated throughput of all users’ has to be measured using full buffer model.  |
| FUTUREWEI |  | The objectives were added at the last RAN at the behest of operators that really want to know the impact of allowing RedCap UEs into their system, which may or may not be used for their ~2020 intended purpose. Full buffer has been used for spectral efficiency, and it may be better to continue to trust in the intelligence of the operators and the world community to understand its meaning and use of full buffer results. In any case, it is very important to provide the spectral efficiency data point, rather than foment an impression that the study is incomplete or hiding something.Our feeling on last night’s GTW call was that the balanced way to leave the discussion would have been to say “FFS till the end of the meeting on whether full buffer is mandatory or optional for the spectral efficiency study”, or “FFS till the end of the meeting how to study spectral efficiency”. Given the limited time left and opinions above, the best we may be able to do is encourage the results to be provided. |
| Ericsson | N | We don’t think spectral efficiency can only be evaluated with full buffer traffic. Non-full buffer traffic can also be used for evaluating spectral efficiency. Spectral efficiency in this case can be calculated by aggregated throughputs in the cell divided by the number of resource elements utilized. |

**Question 2: Should the 100% RedCap UE distribution be considered for the non-full buffer traffic? And why?**

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| **Company** | **Answers (Y/N)** | **Comments** |
| vivo | N | We do not think 100% RedCap UE is a realistic assumption.However, to move forward, we can accept that 100% redcap UE can be evaluated only for the industrial sensor use case.  |
| Samsung | N | We think 100% RedCap UEs in a cell is not a reasonable assumption taking into account use cases for RedCap. |
| Huawei, HiSilicon | Y | As commented before, in some scenarios, e.g. IWSN, RedCap UEs are dominating. Additionally, in near future daily life, everybody has one smartphone but can have more than one smart applications, like smart watch, smart glasses etc.. At least, the ratio of number of smart applications over smartphone per person is very highly higher than 1:1. Therefore, current assumption up to 50% RedCap density is not realistic enough. |
| FUTUREWEI | Y | It is very possible that an entity may consider to deploy e.g. video cameras on a dedicated piece of spectrum. In any case, we should not imply or restrict the operators thinking on how these use cases could be used, so 100% may make the study more complete when going from SI to WI.  |
| Ericsson | N | For factory deployments, there are different use cases, e.g., eMBB-like, URLLC-like, IIoT/TSN, sensors, etc. Thus, we don’t think 100% RedCap UE can be justified for factory deployments.But for the sake of progress, we are fine with adding 100% RedCap UE distribution as long as we do not say this is for the industrial sensor use case. |

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