3GPP TSG-RAN WG1 Meeting #102-e Tdoc R1-20xxxxx

e-Meeting, August 17th – 28th, 2020

**Agenda Item: 8.6**

**Title: FL summary for RedCap evaluation templates**

**Source: Moderator (Ericsson, Apple, Qualcomm)**

**Document for: Discussion, Decision**

# 1 Introduction

This is the FL summary for Phase 1 in the following RAN1#102-e post-meeting email discussion:

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| [102-e-Post-NR-RedCap-01] Email discussion/approval – Johan (Ericsson)/Hong (Apple)/Chao (Qualcomm)Phase 1 (9/10-10/29): template for evaluations, including:* cost reduction estimates
* power saving estimates
* coverage recovery and capacity impact simulation results

Phase 2 (9/30-10/21)* Initial collection of the above evaluation results
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The discussion document and draft templates are stored in this working directory:

<https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/drafts/8.6/PostPhase1/>

# 2 Template for cost reduction evaluation

The first draft template is provided in [RedCapCostTemplate-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/drafts/8.6/PostPhase1/RedCapCostTemplate/RedCapCostTemplate-v000.xlsx). The template for cost reduction evaluation has three tabs for **FR1 FDD**, **FR1 TDD** and **FR2 TDD**, respectively. On each tab, the details can be collapsed or expanded using the little buttons with numbers or plus/minus signs on them, highlighted in the figure below.



The individual cost reduction techniques are listed on the upper part of each tab and the combinations of multiple cost reduction techniques are listed further down on each tab. The combinations of multiple cost reduction techniques are preceded by the key word **Combination**. If all possible combinations were listed, there would be very many combinations to evaluate. Instead of listing all possible combinations, a small number of combinations is selected, where the intention is that the selected combinations are relevant, representative and can give insights into what cost reduction that can be expected also for many of the combinations that are not included in the list.

The cost breakdowns for the **Reference** devices are given in Column B on each tab, although the tilde (~) signs are excluded to facilitate mathematical operations on the data. Contributing companies can enter their cost estimates in one of the following columns (Column C and onwards). For simplicity, but somewhat differently compared to the approach used in some of the tables in TR 36.888, all numbers are ***cost estimates rather than cost reduction estimates***.

For example, looking at the figure above where the Reference cost for FFT/IFFT is 4% of the baseband (BB) cost, if a cost reduction technique would be estimated to result in 25% cost reduction in FFT/IFFT, then ***the cost estimate to enter on that row in the company’s column would not be 25% but instead be 75% of 4%, i.e. 3%***. This lower cost will then be reflected in the totals “BB: Total” and “RF+BB: Total”.

Below, the first question concerns collection of results for individual cost reduction techniques, and the second questions concerns combinations of multiple cost reduction techniques.

**Question 2-1: Can the spreadsheet be used to collect the cost reduction evaluation results for the *individual* cost reduction techniques? If not, what other aspects need to be added?**

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| **Company** | **Comments** |
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**Question 2-2: Can the spreadsheet be used to collect the cost reduction evaluation results for the *combinations* of multiple cost reduction techniques? If not, what other aspects need to be added?**

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# 3 Template for power saving evaluation

The first draft template is provided in [RedCapPowerTemplate-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/drafts/8.6/PostPhase1/RedCapPowerTemplate/RedCapPowerTemplate-v000.xlsx). In current TR 38.840, TDD was assumed for power saving evaluation in FR1/FR2. It can be reused for Redcap study item to simplify the power reduction evaluation for reduced number of blind decoding and CCEs. Regarding the performance metrics, at least power saving gain and the corresponding PDCCH block rate should be evaluated. With these considerations in mind, three tabs were created in template as follows:

* **Tab-3:** Power saving gain – FR1, TDD, 1 RX
* **Tab-4:** Power saving gain – FR1, TDD, 2 RX
* **Tab-5:** Power saving gain – FR2, TDD, 1 RX
* **Tab-6:** Power saving gain – FR2, TDD, 2 RX
* **Tab-7:** PDCCH blocking rate evaluations

For the Tab-7, i.e. PDCCH blocking rate, “approximately” was added in front of “25%” and “50%”. The reason is that since the BD limit for FR1 (30 kHz SCS) is 36, 25% reduction in BDs is 27. However, if the UE is monitoring only 2 DCI sizes, then we will not be able to get 27 (no. of BDs = no. of DCI sizes \* total no. of PDCCH candidates for all ALs). Similarly, “approximately” is added in front of “50%” for the case where three or four DCI format sizes are monitored by UE.

Still on Tab-7, there are a few optional assumptions e.g. 3-symbols CORESET configuration, 2 slots delay toleration. The template was organized as follows to collect results:

* The first table in Tab-7 is for the combination of the non-optional assumptions, where there is no need to describe anything in the ’Comments’ column
* The second table is for all combinations that include some optional assumptions, where companies need to describe what settings they have used in the Comments column.

**Question 3-1: Can the power saving gain tabs in the template (i.e. Tab-3/4/5/6/7) be used to collect the evaluation results? If not, what other aspects need to be added?**

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**Question 3-2: Can the PDCCH blocking rate tab in the template be used to collect the evaluation results? If not, what other aspects need to be added?**

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In the RAN1#102-e meeting, PDCCH blocking rate evaluation was discussed and consensus was reached on a few parameters including SCS/BW, CORESET duration, delay toleration. However, company views were still not converged on some important parameters e.g. aggregation level distributions and number of candidates for each AL. It therefore was agreed to leave for company report. However, the assumption should not be too broad to make the results incomparable. To produce comparable evaluation results, it was further recommended by feature leader to limit the AL distribution of [1,2,4,8,16] as one of the following:

* **Configuration 1:** [0.5, 0.4, 0.05, 0.03, 0.02], assuming majority of the UEs are in is good coverage
* **Configuration 2:** [0.1, 0.2, 0.4, 0.2, 0.1]: Majority of the UEs are in medium coverage
* **Configuration 3:** [0.05, 0.05, 0.2, 0.3, 0.4]: Majority of the UEs are in poor coverage
* **Configuration 4:** [0.2, 0.2, 0.2, 0.2, 0.2]: Uniform distribution

**Question 3-3: Can we limit the AL distributions to be one of the four configurations listed above? If not, what other configurations need to be added? It should be noted that it is important to minimize the configurations to ensure the comparable results.**

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| **Company** | **Comments** |
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# 4 Template for coverage recovery evaluation

The first draft template is provided in [RedCapCoverageTemplate-Urban2.6GHz-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/drafts/8.6/PostPhase1/RedCapCoverageTemplate/RedCapCoverageTemplate-Urban2.6GHz-v000.xlsx). The first two tabs (one for the reference UE and the other for RedCap UE) describe where the assumptions come from and the following tabs are used to collect results for the concerned channel and message. On the tabs for collecting results, the first column contains the reference UE case, followed by one or two columns for the RedCap case. One spreadsheet only concerns one scenario, and there would be four spreadsheets for the concerned 4 scenarios, e.g. Urban-2.6GHz, Urban-4GHz, Rural-700MHz and Indoor-28GHz. Currently, only the spreadsheet for Urban-2.6GHz is provided. If it is considered useful, additional spreadsheets would be created for the other three scenarios,

**Question 4-1: Can the spreadsheets be used to collect the coverage recovery evaluation results? If not, what other aspects need to be added?**

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In the RAN1#102-e meeting, it was agreed to reuse the link budget template agreed in the Rel-17 CE SI for coverage recovery evaluation. The link budget template for the Rel-17 CE SI is based on IMT-2020 self-evaluation with necessary revisions including adding/removing/revising/simplifying some parameters. However, the update of the link budget template has not started in the Rel-17 CE SI, and thus it is not desirable to await the agreement in the CE SI before proceeding with coverage analysis for RedCap.

In the template for coverage recovery evaluation, an adapted version of the IMT-2020 self-evaluation template is used, where items related to the “Maximum range” have been deleted. In addition, four rows (i.e. row(40a), (40b), (41a) and (41b)) are added for supporting the calculation of the “Maximum coupling loss”.

**Question 4-2: Can the proposed link budget template be used to perform the coverage analysis? If not, what modifications are needed?**

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In the proposed link budget template, some parameters have been assigned with specific values which are based on the CE SI agreements. It is assumed that company is not required to change the values for these parameters. The parameters that company can declare the values are highlight with orange color.

**Question 4-3: Are the proposed values for the fixed parameters acceptable? If not, please provide the parameters that are needed to be changed and the proposed values?**

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| **Company** | **Comments** |
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For post processing, there could be the following two alternatives.

* **Alt. 1:** Take the average or midpoint for the parameters that the company declare the values and then plug the average value into a link budget.
* **Alt. 2:** Take the average or midpoint for the calculated MIL/MCL/MPL without repeating the link budget calculation.

Alt. 1 may require a common assumption for link level evaluation, e.g. number of Tx chains, #PRBs, etc, while Alt. 2 is more flexible to support different link level evaluation assumptions, but the problem with Alt. 2 is that only the values of the MIL/MCL/MPL can be copied and paste into the TR instead of the whole link budget table.

**Question 4-4: For post processing, can we down-select from the above two alternatives? If not, please provide the other alternative for consideration. If yes, please provide your view on which alternative is preferred.**

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| **Company** | **Comments** |
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# 5 Template for capacity impact evaluation

The first draft template is provided in [RedCapCapacityTemplate-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Inbox/drafts/8.6/PostPhase1/RedCapCapacityTemplate/RedCapCapacityTemplate-v000.xlsx). Six tabs are created for collecting the results for the concerned scenarios each with two tabs for UL and DL, respectively. On each tab, there are 8 tables, where four are used for the non-full buffer traffic and the other four are used for the optional full buffer traffic for different ratios of RedCap UEs in the network.

For the non-full buffer traffic, the performance metric is based on 5% and 50% UPT, and company is required to report the value of resource utilization (RU) for low and medium loading. An SE row is also included in the non-full-buffer table, where we use the “bits/RE” as the performance metric. Note that “bits/RE” has been used as a SE metric in previous 3GPP SI (see e.g. TR 38.802).

For the full buffer traffic, the performance metric is based on the cell average SE.

**Question 5-1: Can the spreadsheet be used to collect the capacity impact evaluation results? If not, what other aspects need to be added?**

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