3GPP TSG-RAN WG1 Meeting #109-e Draft R1-2205696

e-Meeting, 9th – 20th May 2022

**Agenda Item: 9.6**

**Title: FL summary for evaluation templates for Rel-18 RedCap SI**

**Source: Moderator (Ericsson)**

**Document for: Discussion, Decision**

# 1 Introduction

This feature lead (FL) summary (FLS) captures the following email discussion related to the Rel-18 study item (SI) on further NR RedCap UE complexity reduction [1, 2, 3].

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| [Post-109-e-R18-RedCap-01] Email discussion for spreadsheet templates during June 13 – 17* Check points: June 17
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The spreadsheet templates will be used for collection of evaluation results which will be used as input to TR 38.865 [4]. The FL has provided draft templates based on the templates used during the Rel-17 RedCap SI [5, 6, 7]. Sections 2 and 3 in this document concern the templates, and Section 4 concerns dates for a potential email discussion for early collection of evaluation results.

The issues in this document are tagged and color coded with High Priority or Medium Priority. The issues that are in the focus of this round of the discussion are furthermore tagged FL2.

Follow the naming convention in this example:

* *eRedCapTemplateFLS-v000.docx*
* *eRedCapTemplateFLS-v001-CompanyA.docx*
* *eRedCapTemplateFLS-v002-CompanyA-CompanyB.docx*
* *eRedCapTemplateFLS-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” a discussion document for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *eRedCapTemplateFLS-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *eRedCapTemplateFLS-v003-CompanyB-CompanyC.checkout*
* CompanyC checks that no one else has created a checkout file simultaneously, and if there is a collision, CompanyC tries to coordinate with the company who made the other checkout (see, e.g., contact list below).
* CompanyC then has 30 minutes to upload *eRedCapTemplateFLS-v003-CompanyB-CompanyC.docx*
* If no update is uploaded in 30 minutes, other companies can ignore the checkout file.
* Note that the file timestamps on the server are in UTC time.

In file names, please use the hyphen character (not the underline character) and include ‘v’ in front of the version number, as in the examples above and in line with the general recommendation (see slide 16 in [R1-2203012](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203012.zip)), otherwise the sorting of the files will be messed up (which can only be fixed by the RAN1 secretary).

To avoid excessive email load on the RAN1 email reflector, please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info in the table below.

**FL2 Question 1-1a: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point of contact** | **Email address** |
| Ericsson | Sandeep Narayanan Kadan Veedu | sandeep.narayanan.kadan.veedu@ericsson.com |
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| FUTUREWEI | Vip Desai | vipul.desai@futurewei.com |
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| Qualcomm | Yongjun Kwak | yongkwak@qti.qualcomm.com |
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| Samsung | Feifei SunSeunghoon Choi | feifei.sun@Samsung.comseunghoon.choi@samsung.com |
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# 2 Template for complexity reduction evaluation

RAN1#109-e made the following agreements related to study of further UE complexity reduction [3].

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| **Evaluation methodology for UE complexity reduction**Agreement:For cost reduction estimation, the detailed cost breakdown for the Rel-15 reference NR devices (as provided in Table 6.1-1 in TR 38.875) is reused.Agreement:For comparison with a Rel-17 baseline when evaluating the potential Rel-18 UE complexity reduction features,* The Rel-17 RedCap UE supports 20 MHz, 1 Rx, 1 layer, DL 64QAM, UL 64QAM, FDD or TDD.
* In addition, optional results for the following comparisons can also be reported:
	+ Results for HD-FDD UEs
	+ Results for UEs with 2 Rx
* In all comparisons, the UEs being compared have the same number of antenna branches, the same number of layers, the same maximum supported modulation order, and the same duplex mode (among HD-FDD, FD-FDD, and TDD).

Agreement:* The impact on memory size/cost/complexity (external to the RF and BB parts) from the studied UE complexity reduction features can be considered in the study.
	+ This potential impact will not be included in the quantitative UE complexity reduction estimates.
	+ L2 buffer size assumptions can be based on TS 38.306 clause 4.1.4 (“Total layer 2 buffer size for DL/UL”).
	+ FFS whether/how to capture in the TR

Agreement:For each potential Rel-18 further UE complexity reduction feature, at least the following aspects will be studied:* UE complexity reduction
* Performance impacts [details FFS]
* Network deployment and coexistence impacts [details FFS]
* Specification impacts

**Further UE bandwidth reduction**Agreement:* The following options for further UE bandwidth reduction can be studied:
	+ Option BW1: Both RF and BB bandwidths are 5 MHz for UL and DL.
	+ Option BW3: 5 MHz BB bandwidth only for PDSCH (for both unicast and broadcast) and PUSCH with 20 MHz RF bandwidth for UL and DL. The other physical channels and signals are still allowed to use a BWP up to the 20 MHz maximum UE RF+BB bandwidth.
* In addition, optional results for the following option can also be reported:
	+ Option BW2: 5 MHz BB bandwidth for all signals and channels with 20 MHz RF bandwidth for UL and DL.
* At least the following cases are studied:
	+ The resource allocation spans a bandwidth of maximum 5 MHz (Maximum UE channel bandwidth).
	+ The same option is used for UL and DL.
	+ The same option is used for idle/inactive and connected mode.
	+ It is FFS whether to study other cases.
* Note: As part of study of above options, it is not precluded to indicate that an observation is relevant for UL only or DL only.

Agreement:* For Options BW1,
	+ For 15 kHz SCS, 25 contiguous RBs are assumed to fit within the 5 MHz.
	+ For 30 kHz SCS, 11 contiguous RBs are assumed to fit within the 5 MHz.
	+ Larger number of RBs that fit within 5 MHz can optionally be studied.
* For Options BW2,
	+ For 15 kHz SCS, 25 contiguous RBs are assumed to fit within the 5 MHz.
	+ For 30 kHz SCS, 11 contiguous RBs are assumed to fit within the 5 MHz.
	+ Larger number of RBs that fit within 5 MHz can optionally be studied.
* For Options BW3,
	+ For 15 kHz SCS, 25 contiguous RBs are assumed to fit within the 5 MHz.
	+ For 30 kHz SCS, 11 contiguous RBs are assumed to fit within the 5 MHz.
	+ Larger number of RBs that fit within 5 MHz can optionally be studied.
* Relevant assumptions (e.g., regarding potential scheduling restrictions) should be reported.

**Further UE peak rate reduction**Agreement:* The following options for further UE peak rate reduction can be studied:
	+ Option PR1: Relaxation of the constraint  $(v\_{Layers}^{\left(j\right)}⋅Q\_{m}^{\left(j\right)}⋅f^{\left(j\right)}\geq 4)$ for peak data rate reduction.
	+ Option PR2: Restriction of maximum TBS for PDSCH and PUSCH.
	+ Option PR3: Restriction of maximum number of PRBs for PDSCH and PUSCH.
* At least the following cases are studied:
	+ The studied peak rate reduction applies to both UE-specific (unicast) and common (broadcast) channels.
	+ The resource allocation spans a bandwidth of maximum 20 MHz (maximum UE channel bandwidth).
	+ The same option is used for UL and DL.
	+ The same option is used for idle/inactive and connected mode.
	+ It is FFS whether to study other cases.
* Note: As part of study of above options, it is not precluded to indicate that an observation is relevant for UL only or DL only.

Agreement:* The restricted number of PRBs in Option PR3 is a hardcoded limit.

Agreement:* For Option PR1,
	+ The relaxed constraint is 1 (instead of 4).
	+ Other values for the relaxed constraint that meet the 10-Mbps peak rate target can optionally be studied.
	+ The parameters (, , ) [38.306] can be as in Rel-17 RedCap.
* For Option PR2,
	+ For 15 kHz SCS, the maximum TBS is 10000 bits per TB and per slot.
	+ For 30 kHz SCS, the maximum TBS is 5000 bits per TB and per slot.
* For Option PR3,
	+ For 15 kHz SCS, the maximum number of RBs is 25.
	+ For 30 kHz SCS, the maximum number of RBs is 11.
	+ Other number of RBs that meet the 10-Mbps peak rate target can optionally be studied.
* Note: It is not precluded to report results also for other values.
* Relevant assumptions (e.g., regarding potential limitations of the TBS sum in case of more than one simultaneous TB) should be reported.

**Relaxed UE processing timeline**Agreement:* The following options for relaxed UE processing timeline will be studied:
	+ Option PT1: Relaxation of UE processing time for PDSCH/PUSCH in terms of N1 and N2
	+ Option PT2: Relaxation of UE processing time for CSI in terms of Z and Z’
* UE complexity reduction estimates for relaxed UE processing timeline are only reported for combinations with UE bandwidth reduction or UE peak rate reduction.

Agreement:* In Option PT1, the relaxation factor for N1 and N2 is 2.
* In Option PT2, the relaxation factor for Z and Z’ is 2.
* The combination of Options PT1 and PT2 is also studied.

**Combinations of UE complexity reduction techniques**Agreement:* UE complexity reduction is studied for the following combinations:
	1. Reference case (Rel-17 RedCap UE)
	2. BW1 + PT1 + PT2
	3. BW3 + PT1 + PT2
	4. PR1 + PT1 + PT2
	5. PR3 + PT1 + PT2
* In addition, optional results for the following combinations can also be reported:
1. BW1 + PT1
2. BW3 + PT1
3. PR1 + PT1
4. PR3 + PT1
5. BW2 + PT1 + PT2
6. PR2 + PT1 + PT2
 |

An initial draft template is provided in [eRedCapComplexityTemplate-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapComplexityTemplate-v000.xlsx). It has the following tabs, where the last four tabs are “more optional” than the first two tabs.

1. TDD 1Rx
2. FD-FDD 1Rx
3. HD-FDD 1Rx
4. TDD 2Rx
5. FD-FDD 2Rx
6. HD-FDD 2Rx

On each tab, press “+” or “˗” to expand or collapse the rows and columns on each tab. The values in the “Rel-15 ref” columns come from the corresponding FR1 tabs in the template used in the Rel-17 RedCap SI [5, 6].

The first row on each tab is “Rel-17 RedCap ref” and then follows the individual options (BW1, BW2, BW3, PR1, PR2, PR3) and the combinations (BW1 + PT1, BW1 + PT1 + PT2, etc.). An attempt has been made to sort the options and combinations in the most intuitive way. Whether an option or combination is “more optional” or not is not visible from the template but should be clear from the agreements listed above.

**FL1 High Priority Question 2-1a: Companies are invited to comment on the draft template for collection of complexity reduction evaluation results in** [**eRedCapComplexityTemplate-v000.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapComplexityTemplate-v000.xlsx)**.**

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| **Company** | **Comments** |
| Ericsson | The template sufficiently covers the cases explicitly mentioned in RAN1#109 agreements. Any other cases and assumptions can be separately reported by individual companies in their contributions. |
| Spreadtrum | Thanks for the draft template, we are generally fine with it. Two more comments/suggestions are as follows:* In our understanding, this template **does not need** to collect the results of "**Other Values** (e.g., highlighted in blue below)". Because the results are averaged, this requires companies to evaluate a solution with the same assumption (e.g., for PR1, the relaxed constraint is 1), otherwise, the average cannot reflect the cost reduction. The evaluation of other values can be reported by companies in their contributions rather than presented in the template.

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| Agreement:* For Option PR1,
	+ The relaxed constraint is 1 (instead of 4).
	+ Other values for the relaxed constraint that meet the 10-Mbps peak rate target can optionally be studied.
	+ The parameters (, , ) [38.306] can be as in Rel-17 RedCap.
* For Option PR2,
	+ For 15 kHz SCS, the maximum TBS is 10000 bits per TB and per slot.
	+ For 30 kHz SCS, the maximum TBS is 5000 bits per TB and per slot.
* For Option PR3,
	+ For 15 kHz SCS, the maximum number of RBs is 25.
	+ For 30 kHz SCS, the maximum number of RBs is 11.
	+ Other number of RBs that meet the 10-Mbps peak rate target can optionally be studied.
* Note: It is not precluded to report results also for other values.
* Relevant assumptions (e.g., regarding potential limitations of the TBS sum in case of more than one simultaneous TB) should be reported.
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* In order to avoid some abnormal data (too high or too low) interfering the final evaluation results, we recommend that the results from companies can be challenged before capture to the TR. The results should be clearly clarified by source company. If the clarification is not convinced by the majority, it is not proper to directly include those results into average process.
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| CATT | Generally fine with the template.Since the percentage number is becoming smaller and smaller (e.g. the post data buffering is reduced from 10% to ~0.6% even for the baseline), is it better to use two decimals (e.g. 0.58%) rather than one decimal (e.g. 0.6%) to make the estimation more precise? |
| vivo | We are fine with the template.  |
| LGE | We are okay with the template. |
| Qualcomm | The template looks fine as it is following the methodology used in the Rel-17 RedCap SI and also reflecting the agreements made in RAN1#109-e. |
| DOCOMO | We are fine with the template. |
| Nordic  | We could perhaps have one extra column/row per company per reduction-option to capture relevant assumptions in the Excel. For example, assumption that K0/2,min > 0 or similar. This would better facilitate drawing of conclusions, based on the Excel. We believe that NO average should be taken in the Excel. As it allows companies to put numbers without any justification which may provide biased results. How to average, should be discussed in RAN1#110 meeting.  |
| Samsung | Fine with the template for cost reduction. |
| Huawei, Hisilicon | OK. |
| ZTE, Sanechips | Generally fine and we think the sheet HD-FDD 1Rx, TDD 2Rx, FD-FDD 2Rx and HD-FDD 2Rx should be tagged as ‘optional’ |
| Xiaomi | Generally fine with the template with a little question: Does it mean that both mandatory options and optional solutions should be provided by each company? If not, what value should be filled in the corresponding position for optional solutions that companies is reluctant to evaluate? We think it is more reasonable to separate the evaluation results of mandatory options and optional solutions in different columns/sheets. |
| Nokia, NSB | We are fine with the template. |
| FL2 | Based on the received responses, the “Average” column was removed. Whether/how to do averaging can be discussed in connection to the meeting.Furthermore, it was indicated which tabs and rows that are “more optional” by adding “(opt)”. For cases where a company chooses to not provide results (if any), the corresponding cells can simply be left empty. The spreadsheet is formatted to show two decimal digits for filled out cells.The spreadsheet may become rather cluttered if additional columns or rows are added for comment fields. If a company sees a need to provide some comments in the spreadsheet (rather than just in their contribution), perhaps the Excel comment function (Excel 🡪 Review 🡪 New Comment) can be used for that.**High Priority Proposal 2-1b: Adopt the template in for collection of complexity reduction evaluation results in** [**eRedCapComplexityTemplate-v001.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapComplexityTemplate-v001.xlsx)**.** |
| **Company** | **Y/N** | **Comments** |
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# 3 Template for coverage impact evaluation

RAN1#109-e made the following agreements related to simulation needs and assumptions [3].

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| **Evaluation of coverage impact**Agreement:* Evaluation methodology and assumption in Clause 6.3 in TR 38.875 is reused for coverage evaluation of reference UE and Rel-17 RedCap UE.
	+ Note: It is up to each company whether to reuse the LLS results

Agreement:* For coverage evaluation of Rel-18 RedCap UE, 1 Tx branch is assumed.

 Agreement:* For coverage evaluation of Rel-17 and Rel-18 RedCap UEs, only 1 Rx branch is assumed.
	+ Note: it does not mean that 2Rx is precluded for Rel-18 RedCap UE

 Agreement:* 3dB antenna efficiency loss can be optionally assumed for coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”

Agreement:* At least the option of RF+BB BW reduction to 5MHz is considered for coverage evaluation
	+ FFS whether/which other options are also considered
	+ FFS which DL/UL Channels of all the DL/UL channels are evaluated

Agreement:* The LLS results of the option of “RF+BB BW reduction to 5MHz for all DL/UL channels” can be reused for the coverage evaluation of other BW reduction options, if applicable.

Agreement:* For coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, following parameters are used.

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| Parameters | FR1 values |
| UE bandwidth | Rural: 5 MHz (25 PRBs, 15 kHz SCS)Urban: 5 MHz (11 PRBs or 12 PRBs (optional), 30 kHz SCS) |

* + Note: Rural scenario at 0.7 GHz, Urban scenario at 2.6 GHz, and Urban scenario at 4 GHz (optional) are considered.

 Agreement:* For coverage evaluation in Urban scenario at 4 GHz, DL PSD 33 dBm/MHz is baseline and DL PSD 24 dBm/MHz is optional.

Agreement:* For coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, target data rates are
	+ FR1 Rural: 250 kbps on DL and 25 kbps in UL
	+ FR1 Urban: 500 kbps on DL and 250 kbps in UL
	+ Note: The target data rates are the scaled value in the Rel-17 RedCap SI by a factor of 0.25

 Agreement:* Coverage for the following channels is evaluated for “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”
	+ SIB1
	+ PBCH
	+ PDCCH CSS
	+ [Msg4]
	+ Following channels can be optionally evaluated
		- PUSCH
		- PUCCH 2bits
		- PUCCH 11bits
		- PUCCH 22bits
		- PRACH
		- PDSCH
		- PDCCH USS
		- Msg2
		- Msg3
* Evaluation methodology and assumption in Clause 6.3 in TR 38.875 is reused for coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels” by default, except for, UE bandwidth, cell edge data rate, and small form factor degradation
	+ FFS which evaluation assumption should be updated for the above channels

Agreement:* For SIB1 coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, followings are assumed
	+ Opt1: SIB1 BW is larger than 5MHz, e.g., 48PRB
		- The UE can receive a part of SIB1 PDSCH at a time. Detail assumption of reception scheme (e.g., puncturing the bits transmitted outside UE BW) is reported by each company.
	+ Opt2: SIB1 BW is within 5MHz
	+ A TBS of 1256 bits (other size is not precluded)

Note: whether interleaving mapping is assumed depends on companies’ report Agreement:* For PDCCH CSS coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, following revision are assumed
	+ Opt1: CORESET BW is larger than 5MHz
		- The UE can receive a part of PDCCH at a time. Detail assumption of reception scheme (e.g., puncturing the bits transmitted outside UE BW) is reported by each company.
		- For 15/30kHz SCS, CORESET size is 2 symbols and 48 PRBs, AL is 16.
		- For 30kHz SCS, CORESET size is 2 symbols and 24 PRBs, AL is 8. Other configurations are also not precluded
	+ Opt2: CORESET BW is within 5MHz
		- For 15kHz SCS, CORESET size is 3 symbols and 24 PRBs, AL is 8.
		- For 30kHz SCS,
			* Opt2-1: CORESET size is 3 symbols and 6 PRBs, AL is 2. Other configurations are also not precluded
			* Opt2-2: CORESET size is 3 symbols and 12 PRBs, AL is 4

Agreement:* For at least PDCCH USS coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, following revision are assumed
	+ For 15KHz SCS, CORESET size is 3 symbols and 24 PRBs, AL is 8.
	+ For 30KHz SCS,
		- Opt1: CORESET size is 3 symbols and 6 PRBs, AL is 2 (baseline)
		- Opt2: CORESET size is 3 symbols and 12 PRBs, AL is 4 (optional)

Other configurations are also not precludedAgreement:* Coverage of Msg4 can be optionally evaluated for “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”

 Agreement:* For Msg4 coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, a TBS of 1040 bits is assumed
	+ a TBS smaller than 1040 bits can be optionally evaluated and reported by each company.

Agreement:* For Msg2 coverage evaluation of reference UE, Rel-17 RedCap UE, and Rel-18 RedCap UE, A TBS of 72 bits is assumed.

Agreement:* For PRACH coverage evaluation of “Rel-18 RedCap UE with RF+BB BW reduction to 5MHz for all DL/UL channels”, Format 0 is used for Rural scenario and Format B4 is used for Urban scenario
	+ Format C2 can be used optionally.

**Evaluation of other aspects than coverage impact**Conclusion:* SLS evaluation for network capacity and spectral efficiency is not conducted in Rel-18 RedCap SI.

Agreement:* Following evaluations are not conducted in Rel-18 RedCap SI
	+ Latency
	+ Throughput
	+ Power saving gain

Conclusion:* Evaluation of PDCCH blocking probability is not conducted in Rel-18 RedCap SI

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Initial draft templates are provided in the following spreadsheets, which are based on the templates used during the Rel-17 RedCap SI [5, 6].

1. [eRedCapCoverageTemplate-0.7GHz-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-0.7GHz-v000.xlsx)
2. [eRedCapCoverageTemplate-2.6GHz-11PRBs-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-11PRBs-v000.xlsx)
3. [eRedCapCoverageTemplate-2.6GHz-12PRBs-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-12PRBs-v000.xlsx)
4. [eRedCapCoverageTemplate-4GHz-11PRBs-24dBmPSD-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-24dBmPSD-v000.xlsx)
5. [eRedCapCoverageTemplate-4GHz-11PRBs-33dBmPSD-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-33dBmPSD-v000.xlsx)

The first two spreadsheets listed above are “more mandatory” and the remaining ones are “more optional”. To avoid an excessive number of spreadsheets for combinations of “more optional” assumptions, the FL suggestion is to agree on templates for a limited set of combinations that will hopefully make it possible to do the relevant comparisons. Therefore, it is suggested to agree on templates for 11-PRB and 12-PRB UE bandwidth in the 2.6-GHz scenario, but to assume 11-PRB UE bandwidth for both the 24-dBm/MHz and the 33-dBm/MHz DL PSD case in the 4-GHz scenario. This results in the five spreadsheets listed above.

**FL1 High Priority Question 3-1a: Companies are invited to comment on the FL suggestion to use five spreadsheets corresponding to the following cases:**

1. **Rural 0.7 GHz**
2. **Urban 2.6 GHz, 11-PRB UE BW**
3. **Urban 2.6 GHz, 12-PRB UE BW**
4. **Urban 4 GHz, 11-PRB UE BW, 24 dBm/MHz DL PSD**
5. **Urban 4 GHz, 11-PRB UE BW, 33 dBm/MHz DL PSD**

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| **Company** | **Comments** |
| Ericsson | Based on the templates for PDCCH CSS/USS (2.6 GHz and 4 GHz), our understanding is that for 11-PRB UE BW the CORESET configuration (3 symbols and 12 PRBs, AL 4) can be evaluated. In this case, a part of the 12-PRB CORESET needs to be punctured.Typo: Row 3 of the 4 GHz spreadsheets should be revised to 4.0. |
| Spreadtrum | Fine with the FL suggestion. In addition, we share the same understanding as Ericsson for 11-PRB UE BW. |
| CATT | Fine with the suggestion. |
| vivo | We are generally fine with the five spreadsheets. One suggestion is for each spreadsheet title, it is better to mention which scenario is baseline and which scenario is optional. For example, 1. eRedCapCoverageTemplate-0.7GHz (M)-v000.xlsx2. eRedCapCoverageTemplate-2.6GHz (M)-11PRBs (M)-v000.xlsx3. eRedCapCoverageTemplate-2.6GHz (M)-12PRBs (O)-v000.xlsx4. eRedCapCoverageTemplate-4GHz (O)-11PRBs (M)-24dBm (M)PSD-v000.xlsx5. eRedCapCoverageTemplate-4GHz (O)-11PRBs (M)-33dBmPSD (O)-v000.xlsx |
| LGE | We are okay with the FL suggestion. |
| Qualcomm | We are fine with FL suggestion. |
| DOCOMO | Support FL suggestion. |
| Samsung | General fine. For Ericsson’s point, we think it is good to clarify the assumption for 11 PRB for CORESET.  |
| Huawei, Hisilicon | According to the agreement, DL PSD 33 dBm/MHz is baseline and DL PSD 24 dBm/MHz is optional.Agreement* For coverage evaluation in Urban scenario at 4 GHz, DL PSD 33 dBm/MHz is baseline and DL PSD 24 dBm/MHz is optional.

Since the only difference between 4th case and 5th case is the DL PSD assumption, the results reported in two cases are expected to be aligned, i.e. the results in the 4th case can be post-processed by reducing 9dB for DL channels based on the results of 5th case.Is it a correct understanding? If so, the expected alignment can be mentioned in the excel file of 4th case. |
| ZTE, Sanechips | We are OK with the FL assignment and also agree optional sheet can be tagged. For example,1. [eRedCapCoverageTemplate-0.7GHz-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-0.7GHz-v000.xlsx)
2. [eRedCapCoverageTemplate-2.6GHz-11PRBs-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-11PRBs-v000.xlsx)
3. [eRedCapCoverageTemplate(O)-2.6GHz-12PRBs-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-12PRBs-v000.xlsx)
4. [eRedCapCoverageTemplate(O)-4GHz-11PRBs-24dBmPSD-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-24dBmPSD-v000.xlsx)
5. [eRedCapCoverageTemplate(O)-4GHz-11PRBs-33dBmPSD-v000.xlsx](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-33dBmPSD-v000.xlsx)
 |
| Xiaomi | Fine. Don’t see the need to evaluate the CORESET configuration of “3 symbols, 6 PRBs, AL2” for UE BW with 12 PRBs in Urban scenario@2.6GHZ. |
| Nokia, NSB | We are OK with the FL proposal. |
| FL2 | Based on the received responses, a typo was fixed on row 3 in the 4-GHz spreadsheets, and “Opt” was added in the in file names for the “more optional” scenarios in the updated versions in Proposal 3-7a.Regarding Huawei’s suggestion to derive the 24-dBm/MHz results from the 33-dBm/MHz results, the FL’s understanding is that these two cases may differ in other ways than the DL PSD, for example channel bandwidth (to compensate for the difference in DL PSD), possibly even in the reference case. Since different companies might make different assumptions for these aspects, it seems appropriate to collect results for both 24 and 33 dBm/MHz. |

Each spreadsheet has one tab for each channel. Compared to the Rel-17 templates [5, 6], some updates have been made:

* The first tabs are for PBCH, PDCCH CSS and SIB1, and the following tabs are for the “more optional” channels.
* The more informational tabs in the beginning of the Rel-17 templates have been removed for simplicity.
* On the “PUCCH 2 bits” tabs, the performance targets have been clarified.
* The rows related to calculation of MCL and MPL have been excluded, since the study will focus on MIL.
* The last row is a Comments field where potential additional assumptions can be declared by each company.

**FL1 High Priority Question 3-2a: Companies are invited to provide comments on the *tab and row structure* in each spreadsheet, if any.**

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| **Company** | **Comments** |
| vivo | We are generally fine with the tabs. One suggestion is for each tab title, it is better to mention which channel is baseline and which channel is optional. For example, for “PBCH” tab, it can be renamed as “PBCH (M)”, or alternatively, for “PRACH Format 0”, it can be renamed as “PRACH Format 0 (O)” |
| LGE | The rows related to calculation of MCL and MPL on the “Msg2” tab in the eRedCapCoverageTemplate-0.7GHz-v000.xlsx, rows #54 to #65, are not removed yet. |
| Huawei, Hisilicon | OK |
| FL2 | Based on the received responses, the MCL/MPL related rows on the Msg2 tab in the 700-MHz spreadsheet have been removed in the updated version in Proposal 3-7a.One response proposed to indicate in each tab’s name whether it is optional or not. However, longer tab names will make fewer tabs visible at the same time and require more scrolling to make them visible. Therefore, the FL suggestion is to keep the tab names unchanged but follow the principle that the “more mandatory” channels (PBCH, PDCCH CSS, SIB1) are mapped to the three leftmost tabs and the “more optional” channels on the remaining (rightmost) tabs. |

Each company can provide coverage impact evaluation results in the orange cells in the columns corresponding to two reference cases (Rel-15 reference UE, and Rel-17 RedCap reference UE) and for the studied cases. At least evaluation results corresponding to UE complexity reduction option BW1 are needed. Potentially, coverage impact evaluation results for other UE complexity reduction options can be obtained as a subset of the results for BW1.

**FL1 High Priority Question 3-3a: Companies are invited to comment on the *column structure* on each tab. Consider whether coverage impact evaluation results for other UE complexity reduction options than BW1 can simply be obtained as a subset of the results for BW1, or whether (and what) additional results need to be provided.**

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| **Company** | **Comments** |
| Ericsson  | Our understanding is that it may be enough to provide coverage impact evaluation results for BW1 only and then the coverage impacts for other options can be obtained as a subset of the BW1 results.We can think of one possible exception: Assuming that BW2 supports fast frequent frequency retuning within 20 MHz, then it can support frequency hopping within 20 MHz, which may be a differentiator for BW2 compared to BW1/BW3, and if it is desired to study the coverage impact from this differentiator, then perhaps a BW2-specific frequency hopping case should be added for at least some channel(s), e.g., PUSCH and PUCCH. However, we do not expect the performance to differ much between frequency hopping within 20 MHz and frequency hopping within 5 MHz in most cases, so we are fine with the initial draft templates, i.e., fine without adding a BW2-specific case. |
| CATT | In our understanding, BW1 is the worst coverage case of potential Rel-18 eRedCap form. For other BW reduction options, the coverage should be similar to or better than BW1. We agree that only the coverage evaluation of BW1 should be treated as mandatory, others can be optional and up to company’s interest. |
| vivo | We have following questions for these orange cells:* We would like to ask what is the correct intention for the values in these orange cells, take “(2a) # of gNB TXRUs” cell as one example, now the values for Rel-15 Ref UE, Rel-17 and Rel-18 RedCap UEs are 2, and we noticed that in Rel-17 coverage evaluation, the value can be 2 or 4. So is it correct understanding that the values in the orange cells cannot be changed for evaluation alignment or the values can be changed by companies?
* If the values in theses orange cells cannot be changed, is it correct understanding that we need to do is only to fill in the cell “(19b) Required SNR for the data channel (dB)”?
* If the values in theses orange cells cannot be changed, for channel like SIB1 evaluation, the TBS is 1256bits, but the value in the cell of “(17b) Occupied channel bandwidth for data channel (Hz)” should be calculated based on the assumed MCS, transmission length etc, as long as the two option that the BW for SIB1 is larger than 5MHz and within 5MHz is met. So, for (17b) Occupied channel bandwidth for data channel (Hz), the value should be reported by companies along with the assumed MCS and transmission length?
 |
| LGE | Coverage evaluation result for other options can be obtained as a subset of the results for option BW1, thus we are okay with the column structure as it is.  |
| Qualcomm  | We assume that it is sufficient to provide coverage evaluation results for BW1 only. |
| DOCOMO | Agree with moderator that the coverage impacts for the other complexity reduction options than BW1 can be a subset of the BW1 evaluation results. |
| Samsung | For other options than BW1, we have a same view with CATT.  |
| Huawei, Hisilicon | The evaluation for BW1 is already enough, other additional results are not needed. |
| ZTE, Sanechips | Other options evaluation can be viewed as a subset of the BW1 evaluation results.  |
| Xiaomi | We have the same question as vivo that whether values in these orange cells such as “(2a) # of gNB TXRUs” can be changed by companies?  |
| Nokia, NSB | Evaluation results for UE complexity reduction options other than BW1, can be obtained as a subset of the results for BW1. |
| FL2 | The received responses generally express that it is enough to collect results for BW1 and that results for other options can be obtained as a subset of the BW1 results.Regarding Vivo’s questions about the orange cells, the intention is that companies can change the values in the orange cells but not in any other cells. The number of gNB transmit or receive chains can be 2 or 4, but according to the Rel-17 spreadsheet templates (see reference [6]), “companies are encouraged to use 4 for 2.6 GHz and 2 for 700 MHz for easily comparing the results”, and therefore these values have been indicated as preprinted default values in the draft spreadsheet templates, but companies are free to change them if they prefer to use the other value.Companies should consider every orange-colored cell when they provide evaluation results. For example, companies may want to consider updating the orange-colored cells related to antenna gains which are simply set to “0.00” in the template. |

It has been agreed that a 3-dB UE antenna efficiency loss can be optionally assumed. The FL suggestion is that the templates do not include this optional loss, to minimize the total number of spreadsheets/tabs/columns in the templates. Observations regarding what impact the optional loss would have can be made separately (e.g., by post-processing by the FL for the collection of evaluation results).

**FL1 High Priority Question 3-4a: Companies are invited to comment on the FL suggestion to not include the optional 3-dB loss in the template (but to rely on post-processing of the results in the template).**

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| **Company** | **Comments** |
| Ericsson | This is a reasonable approach as it prevents having unnecessary large number of templates. |
| Spreadtrum | Fine with the FL suggestion.  |
| FUTUREWEI | The 3dB optional should not be included in the template |
| CATT | OK. The result of 3 dB loss can be easily obtained by a 3 dB bias from the result of non-3 dB case. Conclusions related to 3 dB loss can be drawn after this post-processing handling.  |
| vivo | We are fine with FL suggestions. |
| LGE | We are okay to not include the optional 3 dB antenna efficiency loss to minimize the number of evaluation results and to avoid the templates being too crowded. If companies want to include 3 dB loss, they can input comments in spreadsheets and the results with 3 dB loss should be post-processed.  |
| Qualcomm | We are fine with FL suggestion. No separate spreadsheets/tabs/columns are needed for optional 3-dB loss. |
| DOCOMO | Support FL suggestion. |
| Samsung | Fine.  |
| Huawei, Hisilicon | Fine. |
| ZTE, Sanechips | OK with FL suggestion. |
| Xiaomi | Fine. |
| Nokia, NSB | Agree with FL suggestion. |
| FL2 | All received responses agree that it is not necessary to include the optional 3-dB loss in the templates. |

For evaluation of PRACH with 11-PRB UE bandwidth, where the UE bandwidth is slightly smaller than the nominal PRACH bandwidth, the assumed receiver noise power may depend on whether the PRACH receiver is assumed to be aware that the PRACH transmission is restricted to 11 PRBs or not, which may depend on whether the 5-MHz RedCap UE is assumed to use separate PRACH resources or not.

**FL1 High Priority Question 3-5a: Companies are invited to comment on whether the receiver noise should be assumed to be restricted to 11 PRBs (e.g., by assuming separate PRACH resources) when the PRACH transmission is assumed to be restricted to 11 PRBs.**

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| **Company** | **Comments** |
| Ericsson | For simplicity, the receiver noise can be assumed to be restricted to 11 PRBs. Also, even if the receiver bandwidth can be slightly larger than 11 PRBs, the impact on the receiver noise is very small. |
| Spreadtrum | The receiver noise can be assumed to be restricted to 11 PRBs. |
| vivo | The receiver noise can be assumed to be restricted to 11 PRBs. |
| LGE | We are okay that the receiver noise is assumed to be restricted to 11 PRBs (e.g., by assuming separate PRACH resources) when the PRACH transmission is assumed to be restricted to 11 PRBs. |
| DOCOMO | For the coverage impact evaluation, the receiver noise can be assumed to be restricted to 11 PRB. Whether PRACH resource is configured separately or not can be discussed further in the later phase. |
| Samsung | OK with assuming to be restricting to 11 PRBs for the receiver noise. |
| Huawei, Hisilicon | Yes, when separate PRACH resources are configured for 5-MHz RedCap UEs and the PRACH transmission is assumed to be restricted to 11 PRBs, the receiver noise restricted to 11 PRBs can be assumed  |
| ZTE, Sanechips | We want to clarify, is this question 3-5a only for SCS=30KHz scenario? What about SCS=15KHz scenario, should we assume the receiver noise should be assumed to be restricted to 25 PRBs? |
| Nokia, NSB | As noted by the FL, the noise bandwidth depends on whether separate PRACH resources are configured for the 5-MHz RedCap UE. For the purpose of this study, it can be assumed that noise bandwidth is the same as for other UEs, i.e., not restricted to 11 PRBs, as a worst-case scenario. |
| FL2 | The received responses generally agree that (for the purpose of this study) the receiver noise can be assumed to be restricted to 11 PRBs for PRACH in the 30-kHz SCS case. The draft templates have been updated accordingly in the versions in Proposal 3-7a.Regarding ZTE’s question about the 700-MHz case, it is assumed that the receiver noise has the same bandwidth as the PRACH transmission, which fits without problem within the UE bandwidth in this case. |

**FL1 High Priority Question 3-6a: Companies are invited to provide any other comments they might have on the initial draft templates for collection of coverage impact evaluation results (see links in the beginning of this section).**

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| **Company** | **Comments** |
| Huawei, Hisilicon | We would like to suggest that companies could report clearly its simulation assumptions of PBCH, PDCCH CSS, SIB1, etc., whether their bandwidth exceed 5 MHz, whether these channels are received by simply punctured or soft-combination & RF retuning is assumed within multiple repetition transmissions. It could help companies to align assumptions and provide better link-level results. |
| Xiaomi | Share the same view as Huawei that whether RF retuning & soft-combination for the reception of PBCH and SIB1 could be reported by each company.  |
| FL2 | The received responses express that it would be beneficial if the method used to receive a channel with larger bandwidth than the UE bandwidth (e.g., puncturing, or RF retuning with soft combination) is reported by each company. The FL suggestion is to use the Comments field at the last row of each column on each tab to provide this information (beside describing it in the contributions). |

Based on the received responses to Questions 3-1a through 3-6a, the following proposal can be considered.

**FL2 High Priority Proposal 3-7a: Adopt these templates for collection of coverage impact evaluation results:**

1. [**eRedCapCoverageTemplate-0.7GHz-v001.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-0.7GHz-v001.xlsx)
2. [**eRedCapCoverageTemplate-2.6GHz-11PRBs-v001.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-11PRBs-v001.xlsx)
3. [**eRedCapCoverageTemplate-2.6GHz-12PRBs-Opt-v001.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-2.6GHz-12PRBs-Opt-v001.xlsx)
4. [**eRedCapCoverageTemplate-4GHz-11PRBs-24dBmPSD-Opt-v001.xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-24dBmPSD-Opt-v001.xlsx)
5. [**eRedCapCoverageTemplate-4GHz-11PRBs-33dBmPSD-Opt-v001xlsx**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Inbox/drafts/9.6/Post/Templates/Drafts/eRedCapCoverageTemplate-4GHz-11PRBs-33dBmPSD-Opt-v001.xlsx)

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| **Company** | **Y/N** | **Comments** |
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# 4 Early collection of evaluation results

In the rapporteur’s work plan [2], it is suggested to arrange an email discussion before RAN1#110 to collect evaluation results. The email discussion for collection of evaluation results could potentially start right after the silent period (4th July – 7th August), i.e., on Monday 8th August and end a few days before the meeting to allow a few days for summary and analysis by feature leads and companies.

**FL1 High Priority Question 4-1a: The rapporteur suggestion is to have an email discussion for early collection of evaluation results from Monday 8th August until Tuesday 16th August. Companies are invited to comment on the suggestion.**

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| **Company** | **Comments** |
| Ericsson | It is beneficial to collect evaluation results as early as possible (preferably before the RAN1#110 submission deadline) to ensure high quality and timely completion of the study item. |
| Spreadtrum | OK with the rapporteur suggestion. |
| FUTUREWEI | No. Any formal email discussion should have been requested and approved in the last RAN meeting. The moderators can collect the results submitted in tdocs and provide for discussion when the meeting starts. |
| CATT | We are fine with the arrangement. |
| vivo | We are fine with the time with the understanding that companies are still allowed to update their results after the deadline. |
| LGE | We are okay with the suggestion. |
| Qualcomm | We are fine with the early email discussion with the understanding that there is no change in the contribution deadline which is potentially Fri. Aug. 12. |
| DOCOMO | Fine with the FL suggestion. |
| Samsung | We don’t support data collection before Tdoc deadline. We can accept to collect results after Tdoc deadline with the agreed format.  |
| Huawei, Hisilicon | It would have been better if this new proposed email thread could have been approved together during the RAN1 meeting. But we are fine with the FL suggestion. |
| ZTE, Sanechips | OK with the FL suggestion. |
| Xiaomi  | Agree with Samsung that we can also accept to collect results after Tdoc deadline. |
| Nokia, NSB | We are OK with FL suggestion. |
| FL2 | Most of the received responses are fine with the suggestion to have an email discussion for early collection of evaluation results from Monday 8th August until Tuesday 16th August. A few responses do not support collection of evaluation results before the RAN1#110 submission deadline.Some responses express that it would have been better to discuss and approve an email discussion during the last meeting. It should be noted that the prospect to have such an email discussion was discussed when the work plan [2] was presented in the last meeting, and the main feedback received then was that email discussions should not be carried out during the silent period (4th July – 7th August). The email discussion is now proposed to start on 8th August, i.e., right after the quiet period.The study item has a tight timeline. Early collection of evaluation results can enable companies to take evaluation results from multiple sources into account both when reviewing their own results and when finetuning their proposed observations and conclusions in their contributions, helping to improve the quality of both evaluation results and proposed observations and conclusions. Without the early collection, all results will be provided at the submission deadline and that all contributions will be based on results from a single source only. A potential alternative is to arrange an informal email discussion on the RAN1 drafts reflector for early collection of evaluation results, but a formal email discussion will probably attract more attention and interest.Based on the responses and above considerations, the FL would like to make the following proposal.**High Priority Proposal 4-1b: Arrange an email discussion for early collection of evaluation results from Monday 8th August until Tuesday 16th August.** |
| **Company** | **Y/N** | **Comments** |
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# References

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| [1] | [RP-221161](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_96/Docs/RP-221161.zip) | Revised SID on Study on further NR RedCap (reduced capability) UE complexity reduction | Ericsson |
| [2] | [R1-2204058](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204058.zip) | Work plan for Study on further NR RedCap UE complexity reduction | Rapporteur (Ericsson) |
| [3] | [RP-221160](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_96/Docs/RP-221160.zip) | Status report for Study on further NR RedCap (reduced capability) UE complexity reduction | RAN1 |
| [4] | [TR 38.865 V0.0.1](https://ftp.3gpp.org/Specs/archive/38_series/38.865/38865-001.zip) | Study on further NR RedCap UE complexity reduction (Release 18) | RAN1 |
| [5] | [R1-2007481](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Docs/R1-2007481.zip) | FL summary #4 for RedCap evaluation templates | Moderator (Ericsson, Apple, Qualcomm) |
| [6] | [R1-2009293](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_103-e/Docs/R1-2009293.zip) | FL summary on RedCap evaluation results | Moderator (Ericsson, Apple, Qualcomm) |
| [7] | [TR 38.875 V17.0.0](https://www.3gpp.org/ftp/Specs/archive/38_series/38.875/38875-h00.zip) | Study on support of reduced capability NR devices (Release 17) | 3GPP |