3GPP TSG-RAN WG1 Meeting #101-e Tdoc R1-20xxxxx

e-Meeting, May 25th – June 5th, 2020

**Agenda Item: 8.3**

**Title: Email discussion for TR skeleton for Study on support of reduced capability NR devices**

**Source: Rapporteur (Ericsson)**

**Document for: Discussion, Decision**

# 1 Introduction

This document captures the RAN1#101e email discussion [101-e-NR-RedCap-Skeleton] for the TR skeleton for the study item “Study on support of reduced capability NR devices” with SID in [RP-193238](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_86/Docs/RP-193238.zip). Companies are invited to enter their comments on the TR skeleton below.

# 2 Draft TR skeleton

A draft TR skeleton has been provided by the rapporteur in [R1-2003288](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003288.zip) and presented in an online (GTW) session in RAN1#101e. The structure of the draft TR skeleton is inspired by TR 36.888. There are clauses for all SI objectives, including clauses 8.2, 8.3, 10 and 11 which concern RAN2-led objectives. The text that has been inserted in some clauses originates from the SID.

# 3 Discussion

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| **Company** | **Comments** |
| FUTUREWEI | 1. There should be a section for each technique in section 7.X on "Compatibility and coexistence with NR"

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. 1. Some text has been copied and pasted into the skeleton, which is fine. Under 7.3 two notes from the SID should be copied:
* The lowest capability considered should be no less than an LTE Category 1bis modem
* Rel-15 SSB bandwidth should be reused and L1 changes minimized

[Rapporteur] The gray text was only intended as an Editor’s Note in the initial version. I’ve removed all the gray text now. We can consider inserting corresponding text later.1. The techniques to be studied under section 7.6 have not yet been agreed. We are *only* OK with listing in the TR techniques that we all agree to include in the study. We are *not* OK with treating this as a ”blank check” for whatever proposal anybody wants to include that somehow requires less processing as we only have limited time and we should focus on the WID objectives that we were able to clearly define.

Specifically, we are not ok to include generic ”TBS reduction” or ”peak data rate reduction” or ”modulation restriction” or ”HARQ simplifications”. The only technique that we are ok to include now is ”restriction to a single MIMO layer”. We are also OK to state ”Section 7.2 reduced number of UE Rx/Tx antennas and Section 7.3 UE bandwidth reduction will reduce the UE processing.” Our recommendation is to progress those two objectives, and then decide later whether we will study anything beyond those techniques. This will also avoid us getting stuck now in arguments about what exact data rates and how many types of devices redcap supports. The SID has some requirements for different services, but can be satisfied with just one redcap device that meets all the requirements. There is nothing in the SID that says we must develop a custom devices that exactly match and do not exceed the data rates listed for the three use cases.[Rapporteur] This can be discussed in email discussion [101-e-NR-RedCap-01]. |
| vivo | 1. The contents in section 5 (requirements) should be put on hold until the outcome of the other email thread [101-e-NR-RedCap-01]

[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired.1. As discussed in email thread [101-e-NR-RedCap-01], the aspects related to form factor limitation should be studied at least for wearables, for example the reduced antenna gain. Not clear which part of section 7 is supposed to capture such study?

[Rapporteur] If the email discussion [101-e-NR-RedCap-01] agrees to evaluate it, we can consider inserting a section for it, unless it is considered enough to discuss that aspect in the existing sections.1. Many of the complexity reductions techniques captured in section 7 are expected to provide power consumption benefit as well, suggest to add a subsection ”power consumption” under each technique to capture the relavant quantative analysis, if any. This is similar to what was done in TR36.888.

[Rapporteur] What performance aspects to evaluate can be discussed in email discussion [101-e-NR-RedCap-01]. It is not clear from the SID that power saving aspects of the cost reduction techniques and cost reduction aspects of the power saving techniques should be evaluated, but in that case perhaps it can be captured in the subsections on other performance impacts.1. There are battery life requirements for industrial sensors and wearables, and we suppose some quantative study should be carried out in the SI to show the feasibility of reaching the relavent battery life requirments. However, it is not clear which section is supposed to capture such study?

[Rapporteur] An introduction subclause has been added in clause 8, and if needed additional subclauses can be added in clause 8, probably by RAN2.1. Regarding section 12, our understanding is that co-existence with normal UEs is a design principle that we should keep in mind in the study and design for RedCap UEs, and this applies to all the techniques. Not sure if we need a dedicated section 12 for this.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence.  |
| Xiaomi | 1. The description of ”analysis of other performance impacts” should be more specific. We suggest it includes the coverage analysis, power consumption analysis at least.

[Rapporteur] This can be discussed in email discussion [101-e-NR-RedCap-01].1. The coexistense with normal NR UE should be analyzed for each candidate technique. Maybe we could add one sub-item for co-existence analysis for each technique instead of setting one dedicated section (section 12) for the overall analysis.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence.  |
| ZTE,Sanechips | 1. We think the requirement from the SID can be used as starting point for the requirement section, however, as we discussed in the other email thread, some requirement need to be clarified.

[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired.1. We agree with FUTUREWEI that under 7.3 two notes from the SID should be copied:
* The lowest capability considered should be no less than an LTE Category 1bis modem
* Rel-15 SSB bandwidth should be reused and L1 changes minimized

[Rapporteur] The gray text was only intended as an Editor’s Note in the initial version. I’ve removed all the gray text now. We can consider inserting corresponding text later.1. Regarding section 12, it seems the co-existence analysis should be inserted at each sub-section inside section 7.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. 1. Add one sub-section in section 7 (maybe 7.2.5) to discuss the impact from UE size. Also in section 7.7 we should also add similar subsection.

[Rapporteur] If the email discussion [101-e-NR-RedCap-01] agrees to evaluate it, we can consider inserting a section for it, unless it is considered enough to discuss that aspect in the existing sections.1. Power consumption analysis can be included in section ‘Analysis of other performance impacts’

[Rapporteur] This can be discussed in email discussion [101-e-NR-RedCap-01]. |
| Convida Wireless | The TR skeleton looks good. We have the following comments.* We think that co-existence with legacy NR UEs should be considered when we study all complexity reduction features. Therefore, it may be beneficial to have a subsection for co-existence under each subsection in Section 7.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. * RAN2 input on the subsections led by RAN2 may be needed, e.g. subsections 8.2 and 8.3.

[Rapporteur] The subclauses in 8.2, 8.3, 10 and 11 have been removed so that it is clearer that the structure in these parts are up to RAN2. |
| Qualcomm | 1. **General Comments**
* We think it is a good idea to re-use the structure of TR 36.888 in presenting the UE features for complexity reduction and power saving, as well as the candidate solutions for coverage recovery.
1. **Comments on Chapter 5**
* As a starting point, it is fine to reuse the texts of the SID to describe the generic requirements and use case specific requirements.
* Clarification about the deployment scenarios and associated use cases and reference/peak bit rates are preferred. For example:
	+ *Will the three use cases in SID be deployed in both FR1 and FR2 ?*
	+ *For a given use case, will the same reference/peak bit rates be supported in FR1 and FR2 ?*
	+ *Which use cases and deployment support low/higher mobility of RedCap UE ?*
* Considering the TU limit of this SI, we do not think new use cases should be introduced, if their performance requirements deviate significantly from those in the SID. Performance requiements identified for NR RedCap devices should justify the cost saving benefits and the standardization efforts of RAN1/2 for specifying a distinctive set of UE capabilities for NR Rel-17.

[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired.1. **Comments on Chapter 6**
* To begin with, we think the UE capabilities of a reference NR modem should be described, which is used as a benchmark in cost comparison for a given data rate capability.
* To evaluate the cost saving of UE features enabling complexity reduction, the cost break down for the reference NR modem should be modeled and captured in Section 6.1.

[Rapporteur] These aspects are being discussed in email discussion [101-e-NR-RedCap-01].1. **Comments on Chapter 7**
* Since compact form factor is a generic requirement for most use cases of RedCap device, its impacts on the number of TX/RX antennas, antenna gains and other RF/BB components should be accounted for in the analysis of Section 7.2.
* UE complexity reduction techniques outlined in Sections 7.2 to 7.5 should be prioritized for this SI.
* For relaxed UE procesing capabilties in Section 7.6, candidate solutions proposed by comapnies should not be excluded, if they contribute significantly to the cost reduction and power saving.

[Rapporteur] These aspects are being discussed in email discussion [101-e-NR-RedCap-01].1. **Questions for Chapter 9**
* For the design target of “coverage recovery,” will it be discussed in Section 9.1.1?
* For the potential techniques/solutions applicable to “coverage recovery”, will it be discussed in Section 9.1.2 or other sections ?
* Is there a plan to study performance enhancement techniques other than coverage recovery ? If not, we think the title of this Chapter can be changed into “Coverage Recovery.”

[Rapporteur] Clause 9 has been renamed to “Coverage recovery” so that multiple subclauses can be included for different coverage recovery features if needed, and an introduction subclause has been inserted in the beginning of clause 9. |
| Huawei, HiSilicon | 1. For those sections led by RAN2, i.e. Section 8.2, 8.3,10 and 11, it is suggested to leave the structures for RAN2 decision. The skeleton should put these sections on hold without detailed subsections, until clear views are achieved by RAN2 with sufficient discussion.

[Rapporteur] The subclauses in 8.2, 8.3, 10 and 11 have been removed so that it is clearer that the structure in these parts are up to RAN2.1. A subsection 8.4 about other techniques for UE power saving such as specified in Rel-16 UE power saving can be added. It is beneficial if Rel-16 UE power saving techniques can be applied to REDCAP with potential/necessary adaptation.

[Rapporteur] It is not clear that other power saving techniques are in the SI scope, but if there turns out to be a need for an additional section, it can be added later.1. It is unclear what study or conclusion is expected for Section 12. Harmonious co-existence with Rel-15 and Rel-16 UE seems to be a guideline when designing certain properties of REDCAP UE, but no need to introduce such section.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. 1. Many subsections in Section 7 are named ’Analysis of other performance impacts’. We think ’other’ can be deleted from the title, since it is not clear what is the ’one performance impact’ coresponding to the ’other performance impact’.

[Rapporteur] In the headings, “other performance impacts” has been changed to “performance impacts”.1. A summary section for specification impacts seems better than discrete subsections in each section. One specification feature may be impacted by multiple REDCAP properties, e.g., RACH procedure may be impacted by coverage recovery and early type/capability identification. Thus an overview section can help understanding the specification impact more clearly.

[Rapporteur] Since relatively few companies commented that they want to remove the subclauses on specification impacts, I’ve kept them. If there turns out to be a need to summarize the specification impacts, perhaps we can do it in the Conclusions chapter. We can add subsections there later if needed.1. Since the contents of section 5 are under discussion in the other email thread in parallel and possibly with endorsement in the same meeting, it is recommanded to add a note there that the content from SID is a starting point and will be updated subjective to the output of the other email thread.

[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired.1. It is unclear for us why the first editor’s note in Sect. 9.1 is needed, i.e. why Sect. 7.7.3 may be particularly referred in Sect. 9.1. It seems not necessary.

[Rapporteur] All Editor’s Notes have been removed.1. Share the same view as FUTUREWEI and ZTE that under Sect. 7.3 two notes from the SID should be copied:
* The lowest capability considered should be no less than an LTE Category 1bis modem
* Rel-15 SSB bandwidth should be reused and L1 changes minimized

[Rapporteur] The gray text was only intended as an Editor’s Note in the initial version. I’ve removed all the gray text now. We can consider inserting corresponding text later. |
| Samsung | 1. “coexistence with NR” can be address together under (7.5.4) with a separate paragraph. We think some solutions to resolve coexistence issue (if any) should be addressed with spec impact. Otherwise, no need to mention it explicitly in TR since it is not an objective to study but a baseline requirement.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence, since it was requested by several companies.1. “9.1 Coverage recovery” can replace “9 Mitigation or limitation of performance degradation”. Based on SID, we will only need to study “Coverage recovery to compensate for potential coverage reduction due to the device complexity reduction.” There is no need to create multiple level of list.

[Rapporteur] Clause 9 has been renamed to “Coverage recovery” so that multiple subclauses can be included for different coverage recovery features if needed, and an introduction subclause has been inserted in the beginning of clause 9. |
| LG | We agree that the coexistence with Rel-15 and Rel-16 NR UEs is important and should be ensured, but don’t think we need to put “coexistence with NR” sub-sections in each of the sections for complexity reduction features. If it only relates to the complexity reductions features, then creating a section under 7 UE complexity reduction features (e.g., 7.X coexistence with NR) and summarizing the issues related to the NR coexistence under 7.X is suggested as an alternative approach.[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence, since it was requested by several companies.How we can achieve the required battery lifetime (e.g., years of battery lifetime for industrial wireless sensors) is not clear. So, evaluation on the battery lifetime including how and where in the TR quantifying the battery lifetime is to captured needs to be discussed.[Rapporteur] An introduction subclause has been added in clause 8, and if needed additional subclauses can be added in clause 8, probably by RAN2. |
| SONY | Taking inspiration from TR36.888 is good. Views related some of the sections are included below.**5 Requirements**We note that the requirements in the SID are a “baseline”. While we are OK working in the general direction of these baseline requirements, we should treat these requirements as informative, rather than normative. More specific comments are included in the [01] email thread.[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired.**7 UE Complexity reduction features**The 7.x.3 subsections are about “analysis of other performance impacts”, but previous sections (7.x.1 / 7.x.2) do not consider first-stage performance impacts. Hence 7.x.3 sections should be titled “analysis of performance impacts” with an editor’s note that performance impacts include power consumption, coverage and data rate.[Rapporteur] In the headings, “other performance impacts” has been changed to “performance impacts”.There should be a section 7.x for “other complexity reduction features”. The SID states that the complexity reduction features include reduced RX/TX antennas, bandwidth reduction etc., but this does not mean that the complexity reduction features to be studied are limited to / restricted to those outlined in the SID.[Rapporteur] If other techniques are agreed to be included in the study, additional sections can be added then.**8.1 Reduced PDCCH monitoring**Similar to our comments for section 7, section 8.1.3 should be titled “analysis of performance impacts”. In this case an editor’s note on performance impacts can include system impacts (blocking), power consumption, data rates and latency.[Rapporteur] In the headings, “other performance impacts” has been changed to “performance impacts”. What performance impacts to include can discussed in email discussion [101-e-NR-RedCap-01].It is unclear to us that “reduced PDCCH monitoring” is a single feature or whether several schemes will be considered under this heading.[Rapporteur] If necessary, additional headings can be added later.**9.1 Coverage recovery**This isn’t a single feature. There should separate (sub-)sections for different coverage recovery techniques. So, we could have separate sections for different coverage recovery techniques (which might include repetition, frequency hopping, beamforming, or whatever else is reasonably proposed).[Rapporteur] Clause 9 has been renamed to “Coverage recovery” so that multiple subclauses can be included for different coverage recovery features if needed, and an introduction subclause has been inserted in the beginning of clause 9.**12 Coexistence**Each “feature” section in section 7/8/9 should have a separate “coexistence” sub-section rather than there being a single global “12 coexistence” section.[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. |
| Intel | Some comments on the TR skeleton from our side: * **Subclause 6.4** seems not necessary at this stage. For any additional performance metrics, they can be reported as part of the analyses of the corresponding feature.

[Rapporteur] Subclause 6.4 is intended to concern other potential performance impacts if needed (e.g. peak rate and latency) as discussed in email discussion [101-e-NR-RedCap-01].* The exact scope for **Section 7.7** seems not so clear. For instance, in Subclause 9.1, the Editor’s note suggests referring to the coverage recovery analyses presented in Subclause 7.7.3 (“Analysis of other performance impacts”). The impact on coverage could even be referred to from the corresponding Subclauses on “Analysis of other performance impacts” for the individual complexity reduction features. Further, whether the impact on coverage loss may be additive across different complexity reduction features can be captured in Subclause 9.1.2 itself, without the dedicated Subclause 7.7. Such an approach may be preferable as against aiming to converge on a subset of features/configurations to derive conclusions for certain combinations. In any case, further motivation for Section 7.7 is appreciated.

[Rapporteur] All Editor’s Notes have been removed. The purpose of subclause 7.7 is to provide a place where the total impact of combinations of complexity reduction techniques can be described/evaluated. It would correspond to clause 7 in TR 36.888.* It is not clear whether **Subclause 9.1.3** is necessary. Is this aiming to capture impact from support of coverage recovery features? If so, then such impact would be dependent on particular coverage recovery features considered, and thus, better captured as part of Subclause 9.1.2.

[Rapporteur] Subclause 9.x.2 is intended to concern the coverage analysis and subclause 9.x.3 and other potential performance impacts if needed (e.g. peak rate and latency) as discussed in email discussion [101-e-NR-RedCap-01].* As commented by others above, we also suggest removal of **Section 12**. At this point, we do not see a need to have a dedicated section for this. Any assessment on coexistence with Rel-15 and Rel-16 UEs can be captured as part of the “Analysis” subclauses for the respective features.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. |
| Apple | * It should be noted that wearable device is clearly listed as one of three device types for RedCap study and lower antenna efficiency due to smaller form factor is one critical issue observed for this type of devices. This should be taken into account in the study to fulfil the objective of this SID. We are open to discuss which section to capture it. It seems that Section 6.3, Section 7.7.3 and Section 9 are relevant and should capture different aspects of this issue.

[Rapporteur] If the email discussion [101-e-NR-RedCap-01] agrees to evaluate it, we can consider inserting a section for it, unless it is considered enough to discuss that aspect in the existing sections.* We also shared the view that “co-existence with NR” is a design principle for RedCap SI and applied for all of solutions. If we want to capture the impact on this regard, it is preferable to put it under each feature.

[Rapporteur] Clause 12 on coexistence has been replaced with several subclauses on coexistence. * On Section 5, we also prefer to keep it empty at this moment and wait for the outcome of corresponding email thread discussions.

[Rapporteur] The text in the Requirements clause has been deleted for now in the TR skeleton. It can be inserted again later if desired. |
| OPPO | Ever Redcap technique and topics have a standard impact analysis in 3288. Similar as Huawei’s comment, we would like to not put specification impact into special study. Those is too restrictive to a study Item. We suggest remove the standard impact sections and it can be briefly mentioned in the conclusion part or overall summary part. For the role of standard impact, it would be more related to compatibility of the technique to be introduced. But it may not be the most important criteria for selecting them.[Rapporteur] Since relatively few companies commented that they want to remove the subclauses on specification impacts, I’ve kept them. If there turns out to be a need to summarize the specification impacts, perhaps we can do it in the Conclusions chapter. We can add subsections there later if needed.For the numbers of “Analysis of other performance impacts” sections, they could be analysis of performance impacts, to be general.[Rapporteur] In the headings, “other performance impacts” has been changed to “performance impacts”.The “7.7.2 Analysis of UE complexity reduction” seems not match with the 7.7, which is combination of UE complexity reduction features. We are not sure further complexity reduction is expected. [Rapporteur] The purpose of subclause 7.7 and specifically subclause 7.7.2 is to provide a place where the total impact of combinations of complexity reduction techniques can be described/evaluated. It would correspond to clause 7 in TR 36.888.We also suggestion to have a section like in 36.888 to indicate each technique with its estimated reduction in cost.[Rapporteur] The cost/complexity reduction of each individual complexity reduction technique is analyzed in subclauses 7.2.2, 7.3.2, 7.4.2, 7.5.2 and 7.6.2.For the 7.2. we suggest considering RX/TX performance loss due to form factor, e.g. compact size of wearable.[Rapporteur] If the email discussion [101-e-NR-RedCap-01] agrees to evaluate it, we can consider inserting a section for it, unless it is considered enough to discuss that aspect in the existing sections. |