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 Study on support of reduced capability NR devices
(Appendix 3: Updated proposals)**

**Source: Rapporteur (Ericsson)**

**Document for: Discussion, Decision**

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# 1 Introduction

An email discussion [101-e-NR-RedCap-01] was held during RAN1#101e for the study item “Study on support of reduced capability NR devices” [1]. The email discussion focusses on high-level topics and evaluation assumptions necessary to facilitate next step’s more concrete analysis and evaluations.

The contribution consists of the following documents:

1. ’Appendix 1: Questionnaire’ from the Rapporteur with received company comments
2. ’Appendix 2: Initial proposals’ from the Rapporteur with received company comments
3. ’Appendix 3: Updated proposals’ from the Rapporteur
4. A main document

This document is the ‘Appendix 3: Updated proposals’ document which contains updated proposals from the Rapporteur based on the comments received during the first and second steps in the email discussion which are documents in ’Appendix 1: Questionnaire’ and ’Appendix 2: Initial proposals’.

The section numbering in this document follows the proposed TR skeleton [2]. The TR skeleton itself was discussed separately in email discussion [101-e-NR-RedCap-Skeleton].

# 5 Requirements

Proposal 0: The peak bit rate requirements for industrial wireless sensors are assumed to correspond to LTE Cat-1bis (e.g. 10 Mbps peak bit rate in DL and UL).

Proposal 1: Reference bit rate is not assumed to correspond to cell-edge bit rate.

Proposal 3: The bit rates requirements indicated for smart wearable applications are assumed to correspond to high-end applications.

Proposal 4: For safety related sensors, latency requirements apply to traffic initiated from RRC\_CONNECTED.

# 6 Evaluation methodology

## 6.1 Evaluation methodology for UE complexity reduction

Proposal 5: Use the TR 36.888 methodology for UE cost/complexity evaluation as a starting point and determine what major updates are needed.

Proposal 6: Since there is no specific cost reduction target, cost/complexity estimation for the combinations of different complexity reduction techniques is down prioritized for this meeting.

Proposal 7: Cost/complexity breakdowns can be separate for FR1 and FR2.

Proposal 8: Include antenna parts at least in the cost/complexity breakdown for FR2.

Proposal 9: The reference NR device supports the following:

* All mandatory Rel-15 features (with or without capability signaling)
* Single RAT
* Band support:
	+ FR1: Single band
	+ FR1: Multiple bands (optional, details FFS)
	+ FR2: Single band
* Maximum bandwidth:
	+ For FR1: 100 MHz for DL and UL
	+ For FR2: 200 MHz for DL and UL
* Duplex mode:
	+ For FR1: FD-FDD
	+ For FR2: TDD
* Antennas:
	+ For FR1 bands {n7, n38, n41, n77, n78, n79}: 4Rx/1Tx
	+ For all other FR1/FR2 bands: 2Rx/1Tx
* Power class: PC3
* Processing time: Capability 1
* Modulation:
	+ For FR1: QPSK to 256QAM for DL, and QPSK to 64QAM for UL
	+ For FR2: QPSK to 64QAM for DL, and QPSK to 64QAM for UL
* Access: Direct DL/UL access between UE and gNB

Proposal 10: Potential benefits in terms of reduced device size can be mentioned where applicable in the TR (e.g. in the section on reduced number of antennas), but the SI will not aim to quantify such benefits.

## 6.2 Evaluation methodology for UE power saving

Proposal 11: Reuse the power consumption models and scaling factors for FR1 and FR2 provided in TR 38.840 (sections 8.1.1, 8.1.2, 8.1.3) as appropriate.

Proposal 12: The reference UE in the power saving evaluation is a RedCap UE. Potential configuration of legacy power saving features is FFS.

Proposal 13: The power saving evaluation in RAN1 focuses on the power saving from relaxed PDCCH monitoring (whereas the power saving for the SI objectives on Extended DRX and RRM relaxation is expected to be evaluated in RAN2, and the evaluation of the power saving from other features has lower priority).

Proposal 14: For wearables, use the traffic model from TR 38.840 with proper modification of at least packet size and mean inter-arrival time for RedCap use cases. Values are FFS.

Proposal 14a: For wearables, use FTP model 3 and VoIP to characterize the RedCap service types including IM, VoIP, heartbeat, etc.

Proposal 15: For industrial wireless sensor use cases, use a traffic model based on the service performance requirements for the process monitoring use case in TS 22.104 Table 5.2-2. At least [64 bytes] message size and [100 ms] transfer interval should be considered (other values are not precluded).

## 6.3 Evaluation methodology for coverage recovery

Proposal 16: Base the coverage analysis on the IMT-2020 self-evaluation methodology.

Proposal 17: For coverage analysis, down select between the following options:

1. Align with the CE SI and perform the coverage analysis on the set of signals, channels and messages agreed to be within the scope of the CE SI.
2. Use a link budget approach taking all relevant DL and UL channels into account; including PSS/SSS, PBCH, PDCCH, PDSCH, PRACH, PUCCH, PUSCH, SIB1, Paging, RAR, Message-3, Message-4, and Message-5.

Proposal 18: Await agreements in the CE SI regarding simulation assumptions, quality targets and performance metrics before proceeding with proposals in the RedCap SI.

Proposal 19: The RedCap SI determines the “Hardware link budget” following the IMT-2020 self-evaluation methodology according to the below template, where items related to the “Maximum range” have been deleted (using track changes for traceability) and the table has been adapted to support any studied signal, channel or message (not necessarily only data and control channels).

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Scenario |  |
| Frame structure |  |
| Carrier frequency (Hz) |  |
|  |  |
|  |  |
|  |  |  |  |
|  |  |  |  |
| Transmission bit rate (bit/s) |  |  |  |
|  |  |  |  |
| Target packet error rate for the required SNR in item (19a)  |  |  |  |
|  |  |  |  |
| Spectral efficiency (bit/s/Hz) |  |  |  |
|  |  |  |  |
| UE speed (km/h) |  |  |  |
| Feeder loss (dB) |  |  |  |
| **Transmitter** |  |  |
| (1) Number of transmit antennas. (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) |  |  |  |
| (1bis) Number of transmit antenna ports |  |
| (2) Maximal transmit power per antenna (dBm) |  |
| (3) Total transmit power = function of (1) and (2) (dBm) (The value shall not exceed the indicated value in § 8.4 of Report ITU-R M.2412-0) |  |
| (4) Transmitter antenna gain (dBi) |  |  |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB) |  |  |
| (6) Channel power boosting gain or loss (dB) |  |  |
|  |  |  |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink) |  |  |
| (9a) EIRP = (3) + (4) + (5) + (6) – (8) dBm |  |  |
|  |  |  |
| **Receiver** |  |
| (10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) |  |  |
| (10bis) Number of receive antenna ports |  |  |
| (11) Receiver antenna gain (dBi) |  |  |
| (11bis) Receiver array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, etc.) (dB) |  |  |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink) |  |  |
| (13) Receiver noise figure (dB) |  |  |
| (14) Thermal noise density (dBm/Hz) |  |  |
| (15a) Receiver interference density (dBm/Hz)  |  |  |
|  |  |  |  |  |
| (16a) Total noise plus interference density = 10 log (10^(((13) + (14))/10) + 10^((15a)/10)) dBm/Hz  |  |  |  |  |
|  |  |  |  |  |
| (17a) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz) |  |  |  |  |
|  |  |  |  |
| (18a) Effective noise power = (16a) + 10 log((17a)) dBm |  |  |  |
|  |  |  |  |
| (19a) Required SNR (dB)  |  |  |  |
|  |  |  |  |
| (20) Receiver implementation margin (dB) |  |  |  |
| (21a) H-ARQ gain (dB) |  |  |  |
|  |  |  |  |
| (22a) Receiver sensitivity = (18a) + (19a) + (20) – (21a) dBm |  |  |  |
|  |  |  |  |
| (23a) Hardware link budget = (9a) + (11) + (11bis) – (22a) dB |  |  |  |  |
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Proposal 20: Add one final row supporting the calculation of the maximum coupling loss (MCL), which is defined as the total transmitted power minus receiver sensitivity, as measured at the antenna connectors, i.e. = (3) + (6) - (22a).

## 6.4 Evaluation methodology for other performance impacts

Proposal 21: The evaluation of performance impacts includes at least peak data rate and latency. Other performance metrics such as power consumption and spectral efficiency are not precluded.

# 7 UE complexity reduction features

## 7.2 Reduced number of UE Rx/Tx antennas

Proposal 22: For FR1, study two antenna configurations for RedCap UEs, namely 1Rx/1Tx and 2Rx/1Tx.

Proposal 22a: For FR1, potential reduced antenna radiation efficiency due to device size limitations for wearables can be reported as part of the antenna gains in the coverage analysis.

Proposal 23: For FR2, study two antenna configurations for RedCap UEs, namely 1Rx/1Tx and 2Rx/1Tx, where study of 2Rx/1Tx is prioritized.

## 7.3 UE bandwidth reduction

The following agreement was made in a RAN1#101e GTW online session:

|  |
| --- |
| Agreements: * For FR1, study at least 20MHz maximum UE bandwidth at least for initial access
	+ Other bandwidths FFS
* For FR2, study 50MHz and 100 MHz maximum UE bandwidth at least for initial access
	+ Other bandwidths FFS
 |

Proposal 24a: For FR1, study potential issues with supporting FDMed ROs spanning a larger bandwidth than the UE bandwidth.

Proposal 25a: For FR2, study potential issues with supporting SSB/CORESET#0 multiplexing patterns spanning a larger bandwidth than the UE bandwidth.

## 7.4 Half-duplex FDD operation

Proposal 26: Study HD-FDD operation Type A and Type B, where study of Type A is prioritized.

Proposal 27: Let RAN4 determine the values of DL-to-UL and UL-to-DL guard periods, if needed.

## 7.5 Relaxed UE processing time

Proposal 28: Study a more relaxed UE processing time in terms of N1/N2 compared to capability #1, including the impacts on cost/complexity, power saving, latency and scheduling flexibility (at least qualitatively).

Proposal 29: Study relaxed CSI computation time as a complexity reduction technique through relaxed UE processing time with low priority.

## 7.6 Relaxed UE processing capability

Proposal 30: Study peak data rate relaxation and focus at least on:

* Maximum modulation order restriction
* Reducing the maximum number of MIMO layers

## 7.7 Combinations of UE complexity reduction features

Proposal 32: Discussion on combinations of UE complexity reduction features is down prioritized till the next meeting.

# 8 UE power saving and battery lifetime enhancement

## 8.1 Reduced PDCCH monitoring

Proposal 33: Study the impact of BD and CCE limits reduction on power saving and PDCCH blocking probability (quantitatively) and impacts on latency and scheduling flexibility (at least qualitatively).

# 9 Comments

|  |  |  |
| --- | --- | --- |
| **Company** | **Proposal** | **Comments (major concerns)** |
| Qualcomm | 3 | We think the low-end wearables can be further studied for RedCap UE, and would suggest to keep it in the scope of this SI. If there is no consensus yet for the bit rates requirements of low-end wearables, it can be further discussed at RAN-P and clarified in the SID. |
| 9 5 | * Band Support
	+ we have concerns to include “multiple bands” for reference device deployed in FR1, since it potentially increases the load of evaluation and is not a mandatory UE capability for NR Rel-15/16.
* Modulation
	+ In addition to the max modulation order, we think the MCS tables supported by the reference UE on DL/UL need to be clarified for the analysis of peak data rates and reference bit rates.
 |
| 16 and 18 | * We think the link budget template used for coverage evaluation of RedCap UE should be clarified in these proposals (e.g. new entries associated with compact form factor should be modeled for RedCap UE, which may not be included in IMT-2020 template or the template used by CE SI)
* In addition, could you please clarify if “coverage analysis” has the same meaning as “coverage evaluation” in Proposal 16 ?
 |
| OPPO | 0 and 3 | Referring the 36.306, the LTE cat 1bis is around 10 Mbps in DL and 5Mbps in UL. Thus the proposal 0 would be higher than 1bs for UL. With the “(e.g. 10 Mbps peak bit rate in DL and UL)”. We also think the low-end wearable should be not excluded in the study. Not sure if removing it is due to the SID, e.g. it may be lower than cat 1bis. If we 10 Mbps in DL and 5Mbps in UL for low-send wearable, it would be ok. |
| 19 and 22a | In 19, we should also include the link budget entries in the table for compact form factors into the template as the proposal 22a The wording of 22a should be changed back to “reflected as part of the antenna gains in the coverage analysis”. We should remove “potential”.Since it is clear that the form factor will impact the antenna gain. The only matter is exactly number. At least 3 dB should be considered. |
| vivo | 3 | Low-end wearables are important use cases for RedCap thus no reason for exclude it. The use cases and requirements in SID justification parts are only examples and the objective section does not say we cannot consider any other use cases beyond these examples. From the collected views, 17 companies supported to include low-end wearables into the study. Some companies would like to have more time to check the data rate requirements for low-end wearables, this is fine but we should first confirm the use case and can leave the detailed data rate values in bracket for further check. Suggest to revise proposal 3 as Proposal 3: The bit rates requirements indicated for smart wearable applications are assumed to correspond to high-end applications. For low-end wearables, lower bitrates can be assumed, e.g. [2-5 Mbps] reference bit rate in DL and UL and [10 Mbps] peak bit rate in DL and UL. |
|  9 | Two concerns with proposal 91. As commented before, several mandatory with capability signaling features has not been implemented yet even for normal UEs, it is not reasonable to assume a reduced complexity UEs will support these features for sure. Therefore these feature has to be discussed case by case, if necessary.
2. In the duplex mode for FR1, both FD-FDD and TDD should be included.

Suggest the following revisions to Proposal 9: Proposal 9: The reference NR device supports the following:* All mandatory Rel-15 features ~~(with or without capability signaling)~~
* Single RAT
* Band support:
	+ FR1: Single band
	+ FR1: Multiple bands (optional, details FFS)
	+ FR2: Single band
* Maximum bandwidth:
	+ For FR1: 100 MHz for DL and UL
	+ For FR2: 200 MHz for DL and UL
* Duplex mode:
	+ For FR1: FD-FDD, TDD
	+ For FR2: TDD
* Antennas:
	+ For FR1 bands {n7, n38, n41, n77, n78, n79}: 4Rx/1Tx
	+ For all other FR1/FR2 bands: 2Rx/1Tx
* Power class: PC3
* Processing time: Capability 1
* Modulation:
	+ For FR1: QPSK to 256QAM for DL, and QPSK to 64QAM for UL
	+ For FR2: QPSK to 64QAM for DL, and QPSK to 64QAM for UL
* Access: Direct DL/UL access between UE and gNB
 |
| 12 | Based on the current formulation, the proposal 12 seems not quite meaningful.  |
| 13 | Power saving benefit will be an important metric for many of other features, for example the reduced Rx antenna, reduced bandwidth, relaxed UE processing time, etc. For a particular feature, if power saving benefit is significant, it should be considered even if the cost/complexity reduction may not be large. Note that we have power consumption analysis in each of the techniques captured in TR36.888, we expect similar study should be carried out in RedCap. Suggest the following revisions to proposal 13Proposal 13: The power saving evaluation in RAN1 focuses on the power saving from relaxed PDCCH monitoring (whereas the power saving for the SI objectives on Extended DRX and RRM relaxation is expected to be evaluated in RAN2, and the evaluation of the power saving from other features ~~has lower priority~~ is not precluded). |
| 17 | We think it should be able to select option 2 already as it is clearly favoured by most of companies based on the feedback.  |
| 21 | As said before, power consumption is an important metric for all most of the features discussed in RedCap SI, however, such metric seems to be deprioritized by the current wording which is unacceptable. Suggest the following revisionProposal 21: The evaluation of performance impacts includes at least power consumption, peak data rate and latency. Other performance metrics such as spectral efficiency are not precluded. |
| 22 | Generally fine, but we think we should try to align the assumptions for antenna efficiency loss as much as possible, in order to have comparable evaluation results. Therefore it should be defined as part of evaluation assumption discussion in the next step, rather than reported by each company. Suggest the following small update. Proposal 22a: For FR1, potential reduced antenna radiation efficiency due to device size limitations for wearables can be defined as part of the antenna gains in the coverage evaluation assumptions. |
| 30 | It is still not clear to us why reduced HARQ process number is not considered. In general less buffer is required if reduced capability UE is allowed to support much less number of HARQ processes.  |
| Samsung | 3 | We also think low-end wearable use case can be considered in this SI.  |
| 6, 18, 32, 29 | There is no need to agree on a proposal to say we downprioritized something for this meeting in the last day. (Proposal 6, 18, 32)No need to agree on something with low priority. That is, unless we study and agree to capture a feature, there is no need to mention it in TR. (Proposal 29) |
| 9 | In general, for the reference NR device, it should be one simple reference device other than create multiple references. It would increase the effort of the study and evaluation. Therefore, we suggest to remove the following parts1. Delete “FR1: Multiple bands (optional, details FFS)”—> not essential and had to converge
2. Delete “For FR1 bands {n7, n38, n41, n77, n78, n79}: 4Rx/1Tx ”🡪 This is not necessary to create multiple options for each assumption. We can make some observation on % of cost increase with 4Rx, if needed.
 |
| 12 | No need to consider legacy power saving features. No benefit and it increases evaluation overhead. Reduction on PDCCH monitoring can be applied independently to any legacy power saving features. Proposal 12: The reference UE in the power saving evaluation is a RedCap UE. ~~Potential configuration of legacy power saving features is FFS.~~ |
| 14 | Proposal 14a is enough, proposal 14 can be removed.  |
| 17 | We don’t agree to down scope between these two options. We are not clear on what’s CE SI will agree in option 1. And we don’t think all the UL/DL channels in option 2 needs to be evaluated.  |
| 19, 20 | OK in principle, but we need more time to check and also try to align with output of CE SI.  |
| 24a, 25a | Further clarification is needed for the proposal. In addition, we think this belongs to one of potential impacts on BW reduction. We don’t think need to list this one specially.  |
| Xiaomi | 3 | Low-end wearables can be further studied and it may be discussed in the coming RAN plenary on the SID. |
| 23 | Since the two configurations are both studied, we do not think priority should be defined. |
| 27 | We have concerns on the exact meaning of “guard period”. Could the rapporteur clarify whether this “guard period” considers the impact of timing advance? In addition, there may be different definition of “guard period”. For example, in LTE HD-FDD UE, the guard period is defined as period(s) before and after (only for Type B) UL transmission. However, for NR UE not capable of full-duplex, guard period is defined as periods after UL transmission and after DL reception. Could the rapporteur clarify what is the definition of “guard period” in the proposal? |
| MediaTek | 3 | We don’t see a need for Proposal 3.From RAN1 perspective, there is no difference in calling the use-case as “wearables” or “high-end wearables”.If there is a need to change the use-cases, this is something can be done in RAN plenary. |
| 16 | We don’t see that the coverage analysis need be solely based on the IMT-2020 self-evaluation methodology. As the SID scope is to recover coverage loss due to complexity-reduction features, the methodology should focus on the relative metrics with respect to the reference NR. For this purpose, a simplified link-level simulation can be used. |
| 17 & 18 | No need to evaluate the channels that are not impacted by the complexity reduction features.No need to wait for CE SI, we can evaluate PDCCH based on simplified link-level simulation first. |
| 21 | Other system performance impact shouldn’t be excluded, such as PDCCH blockage probability. |
| 22a | We can’t accept this proposal.The SID scope is to recover coverage loss due to complexity-reduction features:“*Coverage recovery to compensate for potential coverage reduction due to the device complexity reduction*”.The impact of antenna’s radiation efficiency due to device size limitations is not part of the SID scope. |
| FUTUREWEI | 0,1,3,4 | Can accept, but are **not essential** and should not be part of email discussion if not agreed. Adding a 4th use case for low end wearables is for RAN, not here. |
|  | 5,6,7,8,910 | 5-9 are **essential** for next meeting, should have email discussion if not agreed today. Should add to proposal 9 preamble that this reference UE is for “evaluation of complexity reduction”. We should avail ourselves of all mandatory and optional power savings and coverage recovery features in rel-15 and -16 before developing new ones. This can be part of the final recommendation. For 9, multiple bands should remain as ‘optional’…it is important to be able to make statements before final recommendations if some techniques have gains that accumulate across multiple bands (or not).10 is **nice to have** but can wait if controversial |
|  | 11,12,13,14,14a,1533 | These would be **good to have** for next meeting, so OK to be part of email discussion if cannot converge today. Also OK to wait as scope of power savings may be discussed in RAN. |
|  | 16,17,18,**19**,20, 21 | These are **not essential**, as (a) compensating for techniques can wait until we progress the techniques, (b) we should not duplicate or deviate from the cov enh SI. So if not agreed today should not be part of email discussion.16-18,20, 21 can accept. **19 is too soon** as it assumes one option for 17. |
|  | 22,2324a 25a26, 27, 28, 29, 30, 32 | It is **essential** to have some agreements on reduced antenna, if 22 and 23 are not agreed should be part of email discussion. 22a is nice to have but can wait if not agreed today.Already made progress on BW reduction, 24a 25a are nice to have but should not be part of email discussion if not agreed.26-32 are nice to have but not be part of email discussion if not agreed. Nothing further is acceptable in 30, can discuss in RAN as needed. |
| Sierra Wireless | 3 | We are aggregable to this proposal, but we also feel that we do not need this proposal.Also, we see no need to explicitly add the low-end wearable use case as suggested by some companies. P0 already has the lowest peak bit rates possible according the SID and thus includes the low-end wearable use case so we do not need anything more. Even lower-end wearables (i.e. <10mbps) and low-end IWSN were discussed in plenary and it was not agreeable to include this into the SID as it was felt by many companies that these use cases are already supported by LPWA UEs (LTE-M/NB-IOT). |
| 9 | Although we feel strongly that a multi-band UE should be considered as the only baseline UE, we are willing to compromise and agree to the proposal as written. We would not be agreeable or have strong concerns if the multi-band option is removed as suggested by some companies above. There are ZERO single band NR UEs commercially deployed today, so suggesting to use only a single band UE is invalid and unfairly biases towards some cost reduction techniques. Sierra is genuinely looking to create a commercially viable cost reduced device and want to avoid complex specification changes which do not material impact cost. |
| 22a | We have strong concerns with this proposal as it may create a large coverage issue (e.g. we need to add +10 dB of coverage) a.k.a. “a blank cheque”. Any significant coverage enhancements should be handled in the CovEnh SI, not here.  |
| Huawei, HiSilicon | 7 | Add in the end of P7: *only if obvious benefits observed* |
| 9 | Multi-band phone is typical, so at least TDD and FDD duplexing modes should be considered.We propose* *Band support:*
	+ *FR1: Single band or Multiple bands (details FFS)*
	+ *FR2: Single band*
* *Duplex mode:*
	+ *For FR1: FD-FDD, TDD*
 |
| 12，13 | Our main concern of these two proposals is the need of extra work on power saving objective in addition to those that already can be gained from Rel-16 power saving features with small adjustment. |
| 16, 17, 19, 20 | We strongly recommend a simplified approach as proposed below. It should be obvious that for RedCap we are not aiming for a large evaluation campaign which can be more properly done in CovEnh SI, since the objective here is limited to the loss from complexity reduction aspect as stated in SID. Therefore, the following could be proposed as revision of P16+P17+P19+P20:* *The coverage analysis on the IMT-2020 self-evaluation methodology can be starting point with further simplifications as e.g.*
* *Step 1: Obtain the required SINR for the given target data rate for NR legacy UEs.*
* *Step 2: Obtain the required SINR for the given target data rate for NR RedCap UEs.*
* *Step 3: Obtain the performance loss on the basis of required SINR.*
* *Further evaluations e.g. link budget can be performed on channels/signals that are considered necessary after looking into the outcome of CE SI.*
 |
| 21 | We have concern that so far all aspects to be investigated focus on UE side while the system performance e.g. spectral efficiency as one of the key network KPI would significantly degrade, especially when there are larger number of RedCap UEs.Suggested proposal:*The evaluation of performance impacts includes at least peak data rate, latency and coexistence with eMBB UEs in terms of e.g. spectral efficiency. Other performance metrics such as power consumption are not precluded.* |
| 25a | Revised as :*For FR2, study potential issues with supporting SSB/CORESET#0 multiplexing patterns spanning a larger bandwidth than the UE bandwidth and the benefits, specification impact compared to supporting legacy SSB/CORESET#0 by a UE with BW larger than SSB/CORESET#0.* |
| 28 | We don’t prefer to spend much time on this but as we are in SI stage, study is fine; on the other hand, considering the possible contribution from this aspect is naturally small compared to other features like BW reduction, antenna number reduction etc, it seems fair to say that the study of this can be *low priority*. |
| 30 | Study peak data rate relaxation and focus at least on:* *Maximum modulation order restriction*
* *Reducing the maximum number of MIMO layers*
* *Maximum Bandwidth for data transmission*
 |
| ZTE,Sanechips | 1,3  | Not sure what is the purpose of these two proposals, suggest to delete them. |
| 9 | Not sure the reason to add ‘multiple bands’ for reference device in FR1 here. This will complicate the evaluation therefore we propose to remove it. |
| 12 | We suggest to change the reference UE to “ a RedCap UE with potential configuration of legacy NR power saving features ( details FFS)” |
| 14,14a,15 | These address the traffic model for wearables, industrial sensor, what about the other use case , video surveillance , which is also mentioned in the SID? We prefer to treat them in the same priority. What we can do is to also include this in the email discussion. |
| 16~19 | We think the most important issue for coverage recovery is we need to first decide if the recovery is meant for each channel/signal/msg , or only for the limiting channel/signal/message. 16~19 will be depend on the decision of this question. |
| 22a | It’s better to use ‘reflected as part of the antenna gains in the coverage analysis’ than ‘reported as part of the antenna gains in the coverage analysis’. We prefer to change back to the original wording. |
| SONY | 22a | While we are very supportive of considering the impact of size on antenna efficiency (given that the SI is partly motivated by support of small form factor devices), we do not agree with the current wording of proposal 22a and much prefer the rapporteur’s original proposal:Proposal 22a: For FR1, potential reduced antenna efficiency due to device size limitations for wearables can be reflected as part of the antenna gains in the coverage analysis.The issues we have with the updated proposal (talking about “antenna radiation efficiency”) are:* “antenna radiation efficiency” refers to transmission and not to reception. While the receiver antenna efficiency might be equal to the antenna radiation efficiency, proposal 22a should not be talking specifically about a transmitter attribute.
* According to references, the antenna radiation efficiency is just part of the antenna efficiency and excludes efficiency losses due to, for example, dielectric losses. Why do we want to specifically exclude such losses, especially when they have specifically been observed to be an issue (for example in Apple’s contribution R1-2004251:

*For NR system with frequencies ranging from 2.5GHz (e.g. n38) to around 5GHz (e.g. n79) in FR1, the requested antenna size varies from 12 cm to 5 cm. For these wearable and low-cost devices with smaller sizes, patch antenna is typically printed on the circuit board with a higher dielectric constant, thus reducing antenna sizes at the cost of additional gain loss. This should be also taken into account as another factor to develop coverage recovery solutions in general.*Let’s just agree with the rapporteur’s original proposal 22a (above). |
| 24a | It is not immediately evident what “RO” refers to in the text “For FR1, study potential issues with supporting FDMed ROs spanning a larger bandwidth than the UE bandwidth”. Can we just use the non-TLA form / long form of “RO” in this proposal? |
| OTHER | We list here some issues that we think should be addressed, but do not classify them in the “showstopper” category. 3: there are no bit rate requirements. Section 5 of the skeleton TR is empty.6: “Since there is no specific cost reduction target, cost/complexity estimation for the combinations of different complexity reduction techniques is down prioritized for this meeting.”. It is quite clear that there will be no discussion on combinations of complexity reduction techniques before COB 5June in RAN1#101e, so proposal 6 is stating the obvious. 14a: “Proposal 14a: For wearables, use FTP model 3 and VoIP to characterize the RedCap service types including IM, VoIP, heartbeat, etc.”. From the email discussion, “heartbeat” refers to “background applications / keep-alives”, but given that this proposal is talking about wearables, we hope that there is no confusion about this referring to heart rate monitors…18: The proposal literally says that we need to wait for the CE SI to agree on some evaluation methodology aspects before any proposals can be accepted in Redcap. Presumably this gating function only applied to proposals on the redcap evaluation methodology. Hence we would propose to have “Await agreements in the CE SI regarding simulation assumptions, quality targets and performance metrics before proceeding with evaluation methodology proposals in the RedCap SI”.32: “Discussion on combinations of UE complexity reduction features is down prioritized till the next meeting.” As per the comment on proposal 6, it is stating the obvious that these combinations will not be discussed in RAN1#101e. In fact, how is proposal 33 different from proposal 6? |
| Qualcomm | 3 | Regarding the peak bit rates for smart wearables, the SID mentions DL peak bit rate of 150 Mbps and UL peak bit rate of 50 Mbps. However, for wearable devices requiring small form factor and supporting 1T1R only, it needs to be clarified if the 150/50 Mbps peak bit rates are achievable. Therefore, we suggest the following change to **Proposal 3**:**Proposal 3**: **Clarify the The peak and reference** bit rates requirements indicated **in the SID** for smart wearable applications, especially for devices requiring small factor and supporting 1Tx and 1Rx antenna configuration only. are assumed to correspond to high-end applications..  |
| 26, 27 | We think the HD-FDD operation for RedCap UE can be studied in RAN1, and RAN1 can assume specific DL-to-UL switching time and UL-to-DL switching time based on previous 3GPP studies for LTE HD-FDD and NR TDD. Moreover, the switching time assumed by RAN1 study will be confirmed by RAN4. Therefore, we suggest the following changes to Proposals 26 and 27:**Proposal 26**: Study HD-FDD operation Type A and Type B **in RAN1**, where study of Type A is prioritized.**Proposal 27**: : Let RAN4 **confirm** determine the values of DL-to-UL and UL-to-DL **switching time** guard periods **assumed by RAN1 for HD-FDD operation of RedCap UE,** if needed. |
| 30 | We think the peak data rate relaxation should include the max UE BW for data transmission/reception.Therefore, we suggest the following changes to Proposal 30:**Proposal 30**: Study peak data rate relaxation and focus at least on:* Maximum modulation order restriction
* Reducing the maximum number of MIMO layers
* **Reduced Max UE BW for data transmission and reception**
 |
| Sequans | 9 | We are still a bit puzzled with the planned use of the reference NR device in the proposal. To our understanding it should be the reference point for cost and complexity, as defined (and deployed) today, and the RedCap UE should be compared to this reference. As of today, all NR devices support complex aggregation scenarios and from ecosystem standpoint, this leads to the perception that 5G devices are expensive. So, though we understand that CA is not per say a capability, it has definitely a cost impact that should be assessed in the study. Shouldn’t that be reflected at the reference NR device? Same argument could be made for MIMO capability – 4x4 MIMO for bands with 4Rx and 2x2 MIMO for the other may be of interest if reducing the number of MIMO layer is considered as cost/complexity reduction axis (which it is indeed, considering proposal 30).Unless, the target here is to only consider the simplest NR device defined in Rel-15/16 that is able to support the targeted use cases. And then define different reference device(s) to evaluate reduction in some specific axes (e.g. CA, MIMO). If this is clarified to be the case, then we are fine with the proposal. |
| 22 | As commented before, we strongly believe that 2 RX antenna should be considered as minimum for NR RedCap devices as with 20MHz BW it can give good balance between the device cost and the high data rate requirements of SID targeted use cases. It will also ensure minimum coverage in a less troublesome way and good (at least as good as LTE) perceived quality of experience for users. We can agree to an aligned proposal with FR2 case:*For FR1, study two antenna configurations for RedCap UEs, namely 1Rx/1Tx and 2Rx/1Tx****, where study of 2Rx/1Tx is prioritized*** |
| 26 | We are not convinced if the HD-FDD cost/complexity benefit is justifiable as this technique will introduce mainly latency increase but also data rate and coverage reduction. However, we are willing to compromise and accept this proposal as is, assuming that the study will start with investigating these justification issues first, and not invest too much time on feature details unnecessarily. |
| Intel | 6 | Suggest deleting the phrase “for this meeting”. |
| 14, 14a | The need for both Proposals 14 and 14a is not clear. 14a should suffice for now. |
| 22a | While we think the consideration of small form factor is within scope of the SI, we would like to avoid a “blank check” as mentioned by Sierra. In this regard, we suggest adding a sub-bullet: “FFS: Maximum reduction in antenna gain efficiency” to indicate that this aspect will be gated appropriately. For the main bullet itself, we also have a slight preference to keep it more generic at this point (i.e., similar to original version of the proposal). |
| 24a, 25a | We do not see the need to agree to 24a and 25a at this point. The recommendations in these proposals can already follow from relevant studies on BW reduction. |
| Apple  | 16 | We shared Qualcomm’s view that it should be obvious to model the compact form factor of wearable device in the IMT-2020 template for RedCap UEs since wearable is one of the three targeted devices as captured in SID. Hence, we propose the following modification for P16: Proposal 16: Base the coverage analysis on the IMT-2020 self-evaluation methodology with additional consideration of RedCap devices specific factors including compact form factor for wearable devices.  |
| 17 | Share same view as Vivo and majority companies, Option 2 is clear majority view and should be taken.  |
| 22a | We support this proposal and as we see it as a key design challenge for the wearable device category. It was also specifically emphasized in the SID “One characteristic for the use case is that the device is small in size.”Regarding the differentiation between coverage recovery in Red-Cap devices and the other CE SI, we agree that there might be different understandings among companies. Our view is that CE SI mostly will focus on regular eMBB devices and identify the bottleneck from cell deployment perspective. While coverage recovery in Red-Cap devices will focus on limitation/losses that are specific/unique for this category of devices, which includes per-Antenna efficiency loss due to form factor and reduced #Rx antenna.. On the exact wording, vivo’s proposal is fine for us as copied below: Proposal 22a: For FR1, potential reduced antenna radiation efficiency due to device size limitations for wearables can be defined as part of the antenna gains in the coverage evaluation assumptions. |
| 30 | Although we agreed in 2nd round reply that HARQ process number is not related to peak data rate reduction, we also understand the concern raised by vivo on current proposals. More specifically, reducing HARQ processes number is clearly one attractive and important feature to reduce cost and has been adopted for LTE features. However, current formation maybe mis-understood as reducing HARQ process is excluded from this study. To avoid this, we propose to revise the proposal 30 as follows: Proposal 30: For relaxed UE processing capability, at least study peak data rate relaxation with focus at least on:* Maximum modulation order restriction

Reducing the maximum number of MIMO layers |

# References

[1] [RP-193238](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_86/Docs/RP-193238.zip), ”New SID on support of reduced capability NR devices”

[2] [R1-2003288](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003288.zip), “TR skeleton for Redcap”, Rapporteur (Ericsson)