

3GPP TSG-RAN Meeting #97-e

Electronic Meeting, September 12 - 16, 2022

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Agenda Item: 9.1.1

Source: Ericsson

Title: Moderator's summary for discussion [97e-15-R18-RedCap]

Document for: Discussion

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## 1 Introduction

This document is the moderator's summary for RAN#97-e email discussion [97e-15-R18-RedCap]. The goal of the discussion is to discuss and provide the final scope of a new Rel-18 RedCap WI. The input documents to this discussion are listed as references [1] - [21] in the References section. The draft WID provided in [1] is based on the earlier draft WID in [22]. The status of the related study items is captured in [23] - [26]. The moderator's summary for the previous rounds in this discussion is available in [28].

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## 2 Initial round

### 2.1 Justification

The Justification part in the draft WID in [1] was copied from the Rel-18 RedCap SID in [27].

#### Feedback Form 1: Comments on the Justification in [1]

<b>1 – MediaTek Inc.</b>
A small correction is suggested: Revise "SI" in the last paragraph to "WI"
<b>2 – Spreadtrum Communications</b>
Fine.
<b>3 – Ericsson LM</b>
We are fine with the Justification part in the draft WID.

**4 – ZTE Corporation**

OK with MediaTek 's update.

Additionally, it is suggested to capture what has been studied in TR 38.865 similar as Rel-17, and an example is shown as follows

'Techniques for further UE complexity reduction and coverage recovery for these use cases have been studied in the further RedCap study item documented in TR 38.865.'

**5 – Guangdong OPPO Mobile Telecom.**

The justification can be reused for WID

**6 – Qualcomm Incorporated**

We are ok with the justification, also including the correction mentioned by MediaTek.

**7 – Panasonic Corporation**

Although we are ok with the justification part of the draft WID, the first sentence, "5G aims to accelerate industrial transformation and digitalization,..." may give the impression that "to accelerate industrial transformation and digitalization.." is the only aim of 5G. Probably, "One of 5G aim is to accelerate industrial transformation and digitalization,..." can avoid such misinterpretation.

**8 – China Mobile Com. Corporation**

OK to reuse Justification part

**9 – China Unicom**

We are fine with the Justification.

**10 – Xiaomi Communications**

We are ok to reuse the justification for WID.

**11 – THALES**

We are fine with the justification for the WID.

**12 – Samsung Electronics Polska**

Fine to reuse the justification.

**13 – Intel Belgium SA/NV**

The justification can be reused for WID

**14 – NEC Corporation**

We are fine with the Justification in [1] and correction by MediaTek.

<p><b>15 – Sony Europe B.V.</b></p> <p>We are fine with the justification.</p>
<p><b>16 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>OK</p>
<p><b>17 – Lenovo (Beijing) Ltd</b></p> <p>We are fine with the justification part.</p>

## 2.2 Enhanced eDRX

The draft WID in [1] has an objective on enhanced eDRX in RRC\_INACTIVE (>10.24s). The progress of the related SA2 study is captured in [23] and a corresponding SA2 WID has been approved in [24].

### **Feedback Form 2: Comments on the objective on enhanced eDRX in [1]**

<p><b>1 – Nokia Corporation</b></p> <p>We support inclusion of the objective on eDRX in the WI, as it will be beneficial for the battery life</p>
<p><b>2 – MediaTek Inc.</b></p> <p>We support enhanced eDRX scope included in Rel-18 RedCap WI</p>
<p><b>3 – Nordic Semiconductor ASA</b></p> <p>Support</p>
<p><b>4 – Spreadtrum Communications</b></p> <p>Support</p>
<p><b>5 – VODAFONE Group Plc</b></p> <p>Support</p>
<p><b>6 – Sierra Wireless</b></p> <p>Support</p>
<p><b>7 – Ericsson LM</b></p> <p>Support</p>

<p><b>8 – Classon Consulting</b></p> <p>[for FUTUREWEI] Prefer to decide the complexity reduction first as that has higher priority than this objective.</p>
<p><b>9 – ZTE Corporation</b></p> <p>Support</p>
<p><b>10 – vivo Mobile Communication Co.</b></p> <p>We support to include eDRX scope in Rel-18 RedCap WI.</p>
<p><b>11 – InterDigital</b></p> <p>support</p>
<p><b>12 – Panasonic Corporation</b></p> <p>We support the inclusion.</p>
<p><b>13 – CATT</b></p> <p>Support</p>
<p><b>14 – China Mobile Com. Corporation</b></p> <p>Support</p>
<p><b>15 – China Unicom</b></p> <p>Support</p>
<p><b>16 – Guangdong OPPO Mobile Telecom.</b></p> <p>Support</p>
<p><b>17 – QUALCOMM JAPAN LLC.</b></p> <p>Support</p>
<p><b>18 – THALES</b></p> <p>We support the inclusion of eDRX into the WID.</p>
<p><b>19 – Samsung Electronics Polska</b></p> <p>Support.</p>

<p><b>20 – Intel Belgium SA/NV</b></p> <p>support</p>
<p><b>21 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>Support</p>
<p><b>22 – Beijing Xiaomi Mobile Software</b></p> <p>support</p>
<p><b>23 – Lenovo (Beijing) Ltd</b></p> <p>We are fine to include the objective of enhanced eDRX.</p>

### 2.3 Further reduced UE complexity

The draft WID in [1] has an objective on further reduced UE complexity. The progress of the related RAN1 study is captured in [25] and TR 38.865 V1.0.0 has been submitted for approval in [26]. The recommendations in clause 9 in the TR contains some issues for down-selection by the RAN plenary. The following feedback forms address these issues.

According to clause 9 in the TR [26], most companies in RAN1 wanted to select one of option BW3 and PR3 as the main technique for further UE complexity reduction, whereas some companies wanted to consider option PR1 or BW1.

**Feedback Form 3: Which should be the main technique for further UE complexity reduction (BW3, PR3, PR1, or BW1)?**

<p><b>1 – Nokia Corporation</b></p> <p>From Nokia point of view we prefer to follow the RAN1 majority, and focus on selecting between options BW3 and PR3 in RAN#97e, rather than starting full discussion again. From these options our preference is BW3 as we see that would be relatively easy to introduce on top of Release 17 RedCap.</p>
<p><b>2 – MediaTek Inc.</b></p> <p>For the selection between BW3 and PR3, we see the the fundamental difference lies in that BW3 applies 5MHz FFT and post-FFT buffer while PR3 keeps 20 MHz FFT and post-FFT buffer. This difference then leads to the following characteristics:</p> <ul style="list-style-type: none"> <li>- <b>BW3 can cause SIB1 unavailability issue in TDD band/30kHz SCS:</b> <ul style="list-style-type: none"> <li>o BW3 loses SIB1 information at FFT processing stage, and UE can only recover SIB1 performance gap, 11 dB w.r.t. Rel-17 RedCap, by extensively combining 12 or more SIB1 repetitions.</li> </ul> </li> </ul> <p><b>At any location where Rel-17 RedCap UE cannot decode SIB1 with one-shot reception, the</b></p>

**Rel-18 UE with BW3 needs more than 12 SIB1 repetitions for successful decoding. Since UE cannot assume more than 8 repetitions from SIB1 in FR1 according to the following specification, this implies SIB1 unavailability in TDD band/30kHz SCS.**

- Clause 5.2.1 of TS 38.331: "the SIB1 is transmitted on the DL-SCH with a periodicity of **160 ms...** . For SSB and CORESET multiplexing pattern 1, SIB1 repetition transmission period is **20 ms.**"

**- PR3 can enlarge eco system of 20MHz RedCap:**

- The 20MHz FFT and post-FFT buffer allows the Rel-18 UE with PR3 to buffer 20MHz PDSCH (including SIB1). Given time for UE to finish reduced complexity processing, the UE can achieve the same performance as Rel-17 RedCap UE. This characteristics provides maximum network flexibility and enables 20MHz RedCap UE to realize complexity reduction or UE power saving gain. Therefore, **PR3enlarges the volume of 20MHz RedCap instead of causing market fragmentation.**

Given the complexity difference between BW3 and PR3 is up to ~1%, PR3 will be the sensible solution to move forward.

### **3 – Spreadtrum Communications**

Our preference is BW3.

Similar comments as Nokia, we don't need to discuss the pros and cons for all the solutions again, we should follow the majority in RAN1.

### **4 – NTT DOCOMO INC.**

Our preference is BW1 with a restriction on SCS as 15 kHz SCS while we are also fine with BW3 or PR3. Obviously, BW1 can provide the largest complexity reduction compared to other complexity reduction techniques while larger impacts are concerned for BW1 at the same time. However, we would like to note that such impacts can be minimized when 30 kHz SCS are not supported and only 15 kHz SCS is, and then BW1 also can provide a good balance between complexity reduction and impacts. It also should be noted that given that the target peak data rate for Rel-18 eRedCap is much smaller than that for Rel-17RedCap, the restriction on SCS as 15 kHz is reasonable. We still believe the additional 5~6% complexity reduction of BW1 over BW3/PR3 is worth it to address the corresponding impacts on BW1 with 15 kHz SCS.

### **5 – Nordic Semiconductor ASA**

From Nordic point of view, we prefer BW1 where UE may receive SSB (including PBCH) outside BWP. Again pointing out that potential complexity reduction for BW1 has been under-estimated.

Regarding BW3 and PR3, we do not see why PR3 should be significantly better in performance compared to BW3. In PR3, UE receives same amount of PRBs as in BW3 in one-shot.

However if BW3 is to be down-selected , we think that the following should be considered

- Separate SIB1 for R18 should be considered, to address MTK issue
- SSB/PBCH is reused
- Default scheduling tables should be reused
- CORESET#0 SSB multiplexing pattern 1 is reused

#### **6 – MediaTek Inc.**

##### **BW3 and BW1 require additional UE complexity, thus is not acceptable**

- We see Nordic also recognizes the SIB issue mentioned in our earlier post → there is additional UE complexity or network overhead (dedicated SIB1 as suggested by Nordic)
- We suggest to clarify the difference between BW3 and PR3. If BW3 can also buffer 20MHz PDSCH, there will be no complexity difference, and the down-selection looks not very meaningful.

#### **7 – VODAFONE Group Plc**

We are still wary of the possible fragmentation of economies of scale by introducing the R18 RedCap variant, and in turn benefitting the longevity of LTE devices. We expect there will be many multimode RedCap/LTE devices and hence opting for a solution that optimizes such devices would be useful. In addition, for a R18 RedCap to be meaningful, a reduction of around 10% is expected. With these considerations, option PR3 seems a reasonable option for the WID.

#### **8 – Nordic Semiconductor ASA**

@MTK: I am still waiting for answer on why PR3 would not have issues with SIB1, but BW3 would. ;)

#### **9 – Ericsson LM**

In our view, BW3 and/or PR3 are good candidate techniques for Rel-18 RedCap as they provide a good trade-off between complexity reduction and expected impacts. The down-selection or merge between BW3 and PR3 can potentially be done during the WI phase.

With regard to the comments on SIB1 link performance degradation by MediaTek, we agree that there is indeed a large degradation when a single transmission is used, but according to our results in R1-2207741 appendix A1.5, it seems that it can be largely compensated for by using 4 transmissions with soft combining. We are open to discuss optimizations for SIB1 transmission/reception for Rel-18 RedCap during the WI phase.

**10 – Sierra Wireless**

Like Vodafone, we are also still concerned with Redcap market fragmentation, so we are still not convinced that the ~10% cost saving is enough to justify the market fragmentation. However, if a work item is approved, we have a slight preference for PR3 vs BW3. We do not support BW1.

**11 – Classon Consulting**

[for FUTUREWEI] It should be enough for RAN to select BW3/PR3 and let the WG further decide, but we are also open to selecting now one of them with a preference for BW3.

**12 – Qualcomm Incorporated**

We prefer PR1 only option. PR1 is more desirable for dual-mode LTE-NR devices (combination of Cat-1bis and Rel-18 eRedCap) compared to other options. Given that eRedCap are commodity modems, for which global scale is important, it is highly likely that eRedCap modems will support LTE/NR dual mode. In these dual mode devices, the benefit of other options is unrealizable in practice as 20MHz RF/BB operation is anyway supported. PR1 also has benefits in terms of early implementation/deployment as network deployment and its coexistence impact is marginal.

**13 – ZTE Corporation**

BW3 is preferred since SIB1 performance can be implemented by soft combining and also potential enhancement in WI stage without large impacts on NW can also be considered. Additionally, if necessary, buffering 20M PDSCH can be considered as an optional capability.

**14 – vivo Mobile Communication Co.**

We support down selection between BW3 and PR3, and we slight prefer PR3, because PR3 can provide better scheduling flexibility for NW. while BW3 only supports continuous resource allocation. It should be noted that the additional 0.6% cost reduction from post-FFT data buffering component, by BW3 compared with PR3 is based on the condition that PDCCH processing is fast enough, however, we do not have PDCCH processing timeline requirement in the current specification which makes it difficult to obtain the additional cost reduction in reality.

**15 – InterDigital**

Although our preference is BW1, we will be ok to down-select between BW3 and PR3 for the progress.

**16 – Guangdong OPPO Mobile Telecom.**

We would like to select option with trade-off spec. impact and the cost saving. It seems the TR is concluded more by specification impact, thus, PR3 should be naturally selected as main solution. The BW3 can only bring slightly more cost saving, with introduction of Base Band bandwidth adjustment within slot. We see this narrow BB bandwidth concept can only be considered if higher cost saving can be achieved, which would mean BW1. Thus, additional options on top of PR3 can go to BW1.

### 17 – Panasonic Corporation

The different combination between DL and UL was not evaluated in the study. For DL, we agree Mediatek view on the preference to PR3. For UL, considering of the channel estimation loss and CM/PAPR aspect for distributed transmission, just to take BW3 would be sufficient. The discussion on the buffering is related to only DL. So our preference is DL is PR3 and UL is BW3. We are also ok to select between BW3/PR3 in work item phase.

### 18 – CATT

We support down-selection between BW3 and PR3, which achieve best trade-off. BW3 is preferred due to slightly larger complexity reduction. BW1 should not be considered due to significant impact on performance, co-existence, specifications etc.

PR1 can be considered as an add-on during WI phase.

### 19 – Facebook

We can follow RAN1 recommendation in SI phase. The down selection will be further discussed in WI phase. Currently, we prefer down selection with BW3 or PR3. But it is depend on operator deployment scenarios.

### 20 – China Unicom

We support BW3 and PR3 but slightly prefer BW3.

### 21 – MediaTek Inc.

Thanks for the discussion, below please kindly find MediaTek responses to earlier comments

#### - PR3 can support all 20MHz channels but BW3 cannot

- Comparing Clauses 7.2.2 (BW3) and 7.3.2 (PR3) of TR 38.865, it can be observed BW3 achieves additional complexity reduction by reduced Post-FFT data buffering, while **PR3 keeps the same post-FFT data buffering as Rel-17 RedCap.**
- **When PDSCH/SIB1 is buffered and there is sufficient time for reduced-complexity base-band processing, PR3 UE can finish PDSCH/SIB1 processing and achieve the same performance as Rel-17**
  - Note: If network delivers more RB amount than 5MHz, longer time for the Rel-18 UE should be accommodated as well
- **BW3 UE can only buffer 5MHz data in post-FFT data buffering**, and, according to Table 8.2.1-7 of TR 38.865, there is **11.24 dB performance gap w.r.t. Rel-17**
- @Nordic: We hope the above clarification can answer your question

#### - R18 further complexity solution should support flexible scheduling within 20MHz

- We share the same consideration as Qualcomm: 20MHz RF/BB operation is anyway supported from a whole receiver perspective. With this consideration, we see no need of additional restriction to network scheduling, while BW3 restricts contiguous RB allocation within 5MHz.

**- Avoid additional UE complexity and power consumption with BW3**

- Compared with Rel-17 UE, the 11 dB performance loss in SIB1 requires BW3 UE to perform a large amount of repetition combining (Ericsson: 4 soft combining; MTK: may need more than 8, depending on channel condition and combining implementation). This causes additional UE complexity and power consumption, and we do not think ~1% complexity reduction gain with BW3 is worthy.

**22 – Xiaomi Communications**

We are fine with BW3 and PR3.

For PR3, we share the same view as MTK that it can solve the SIB issue. Since the post-FFT buffer can store all the post-FFT symbols of SIB, once SIB reception with several channel estimation, signal detection and HARQ combining can achieve successful reception without performance degradation.

**23 – China Mobile Com. Corporation**

We think the down selection should be made between BW3 and PR3 based on RAN1 majority views, which is also concluded with observations of cost reduction, performance impact, network implementation and co-existence impact, and specification impact.

And for the SIB1 reception, both PR3 and BW3 has a limitation on the number of received PRBs, so maybe they have the same SIB1 coverage impact?

For the down selection, we prefer BW3 since it has slightly larger complexity reduction.

**24 – THALES**

We are fine with BW3 and PR3. A merge or down-selection during WI phase would be beneficial.

**25 – Samsung Electronics Polska**

We are fine to have BW3 in WI, which can provide a clean design, and a reasonable cost reduction at UE side.

We cannot accept BW1 due to the impact to the system.

Moreover, in our understanding, even with MTK's assumption for PR3, if there is coverage issue for SIB 1 with one transmission, buffering other post FFT data, that is not used for SIB 1 transmission cannot improve the coverage. Unless, in MTK's assumption, there is no PRB restriction for PR 3 for SIB 1. We don't think the assumption of buffer 20MHz after FFT is the common assumption for PR 3, and we don't think PR 3 can provide better performance than BW 3.

**26 – Nordic Semiconductor ASA**

@MTK

- **When PDSCH/SIB1 is buffered and there is sufficient time for reduced-complexity baseband processing, PR3 UE can finish PDSCH/SIB1 processing and achieve the same performance as Rel-17**

Thanks for clarification, Nordic brought this on RAN1 table, but it has been dismissed by RAN1 FL voting during SI. And it was agreed **”The same option is used for idle/inactive and connected mode”** Therefore, here Nordic is in violent agreement with MTK. :)

If down-selection between BW3 and PR3 is to be done, we could be fine with PR3 as well, since as argued in our contribution, post-data buffering savings between PR3 and BW3 are little. **Reduction of BD/CCE limits to half would bring much more saving than post-FFT data buffering.** :)

Here the ”rigorous numbers”.

PDCCH processing reduction: 5%→2.5%

Post-FFT buffering PR3 → BW3: 1%→0.67%

#### 27 – LG Electronics France

Between peak reduction and BW reduction, BW reduction is preferred to make Rel-18 RedCap UE identified in its complexity/cost reduction from previous releases. With the same reason, between BW1 and BW3, BW1 is preferred.

#### 28 – MediaTek Inc.

@Samsung:

- For PR3, we refer to **clause 7.3.2 (PR3) of TR 38.865**, which shows reducing post-FFT buffering is not the contributor to complexity reduction with PR3. Therefore, assumption of same post-FFT buffering as Rel-17 for PR3 is reasonable.
- **For SIB1, if there is no timing requirement (e.g. in initial access stage), UE can finish processing the RBs after several slots (e.g. 4 slots for finishing 48 RBs at a rate of processing 12 RB per slot).** Regarding how to achieve the same operation in connected mode, this can be part of the scope to support operations with 20MHz PDSCH.

@Nordic:

- Good to see we have the same understanding for how to resolve SIB1 issue with PR3. Given the small difference between PR3 and BW3, ”Post-FFT buffering PR3 → BW3: 1%→0.67%”, we hope PR3 makes more sense for you now.
- We also support investigation on Reduction of BD/CCE limits

**29 – Intel Belgium SA/NV**

We prefer to support BW3 and PR3. If further down-selection is needed, we prefer PR3 for the flexibility in resource allocation.

In our view, the FFT size is determined by 20MHz BW for both BW3 and PR3. The maximum number of allocated PRBs for PDSCH/PUSCH is 25 or 11 for SCS 15 or 30kHz. The only difference is BW3 enforces a resource allocation within 5MHz while PR3 allows resource allocation in 20MHz. Specifically, UE doesn't have a knowledge on a 5MHz subband before successful decoding of PDCCH, which results in similar impact to post-FFT data buffering of BW3/PR3.

BW1 should not be considered due to its high specification impact especially SSB and PDCCH in CSS.

**30 – Orange**

We would like to avoid fragmentation, hence a single option would be best. Our preferences would be for either BW3 or PR3, and are open to consider the technical / performance arguments on which one is best.

**31 – NEC Corporation**

We are fine to follow the recommendation of the study, i.e. we support BW3 or PR3. Down-selection between BW3 and PR3 could be done during WI phase. We do not support BW1.

**32 – Sony Europe B.V.**

BW3. This option provides a good balance between complexity reduction and specification impact. It has the benefit over PR1 of reducing physical channel processing complexity.

We would alternatively be OK with PR3 instead of BW3.

**33 – Huawei Tech.(UK) Co., Ltd**

BW3 or PR3 are each fine. In general, we seek a good cost saving in Rel-18 as there might not be further chances at enhancements of RedCap, thus a slight preference for BW3.

**34 – Lenovo (Beijing) Ltd**

Based on RAN1 evaluations, we prefer down selection between BW3 and PR3 given that they have moderate cost saving gain and small system impact. Further, BW3 is preferred since it has slightly larger cost reduction than PR3.

Clause 9 in the TR [26] recommends that PR1 is considered as a potential add-on during the WI phase.

**Feedback Form 4: Should PR1 be considered as a potential add-on, to be decided during WI phase?****1 – Nokia Corporation**

Here also we are fine to follow the RAN1 view (or recommendation), that Option PR1 is considered as a potential add-on. Whether to adopt this potential add-on can be decided during WI phase.

## 2 – MediaTek Inc.

Including PR1 to PR3 is not difficult, and whether/how to include PR1 can be handled in RAN1 work phase. For this RAN plenary meeting, it is suggested to focus on the selection/merge between PR3 and BW3.

## 3 – Nordic Semiconductor ASA

We suggest not only PR1 as add-on, but **as well reduction of BD/CCE limits, not to end up with the same design as CAT0, where PDCCH processing is more complex than PDSCH processing.**

## 4 – Spreadtrum Communications

Yes, and we think this should be captured in the WID scope for RAN1 guidance.

In addition, as there is a note in the SID: *“It is not precluded that some solutions for FR1 can be applied to FR2 in WI stage.”*, and our understanding is that PR1 is very suitable for FR2. Then PR1 is well worth considered not only for FR1, but also for FR2.

Furthermore, we think PR1 can be an add-on solution in FR1, and can be a standalone solution for FR2.

## 5 – NTT DOCOMO INC.

Yes, PR1 can be considered as a complementary technique on top of the main complexity reduction technique for further UE complexity reduction. We are also fine to discuss whether to support it in WI phase.

## 6 – VODAFONE Group Plc

We share Nokia’s view

## 7 – Ericsson LM

We share Spreadtrum’s view that PR1 can be considered for both FR1 and FR2. The exact value of the constraint in PR1 for FR2 can be decided during the WI phase depending on the target data rate for FR2 Rel-18 RedCap UEs. With the current constraint of  $\geq 4$ , the supported maximum data rate of an FR2 RedCap UE is more than 250 Mbps, and with a constraint of  $\geq 1$  (as in PR1), the maximum data rate is more than ~70 Mbps). A suitable target peak rate for FR2 with PR1 could be 70 Mbps (corresponding to 100 MHz, 66 PRBs, 120 kHz SCS,  $v \cdot Q \cdot f = 1$ ).

## 8 – Sierra Wireless

Agree with Nokia. PR1 can be considered as a **potential** add-on and whether to adopt this potential add-on can be decided during WI phase.

## 9 – Classon Consulting

[for FUTUREWEI] OK, but we feel this objective should focus on FR1. There was no study on FR2.

<p><b>10 – Qualcomm Incorporated</b></p> <p>PR1 should be considered as an add-on irrespective of which option is chosen as a main technique. In addition, it should be considered whether PR1 can be made early implementable.</p>
<p><b>11 – vivo Mobile Communication Co.</b></p> <p>We are fine to follow RAN1 recommendation that PR1 is considered as a potential add-on. Whether to adopt this potential add-on can be decided during WI phase.</p>
<p><b>12 – ZTE Corporation</b></p> <p>We support PR1 as potential add on and also OK to decide in WI phase. The corresponding description should be captured in the WID.</p>
<p><b>13 – Guangdong OPPO Mobile Telecom.</b></p> <p>The principle of PR1 is OK, but we can not agree to explicitly mention it, we see PR3 many need some update in UE capability but may not be what PR1 exactly defined.</p>
<p><b>14 – Panasonic Corporation</b></p> <p>We agree Nokia that to follow WG conclusion.</p>
<p><b>15 – CATT</b></p> <p>We agree to consider PR1 as a potential add-on during WI phase.</p>
<p><b>16 – China Unicom</b></p> <p>We are fine to add PR1 as potential add-on in the WI and decided in the WI phase.</p>
<p><b>17 – THALES</b></p> <p>We share Ericsson’s and Spreadtrum’s view that PR1 can be considered for both FR1 and FR2.</p>
<p><b>18 – Xiaomi Communications</b></p> <p>We support PR1 as an add-on solution for eRedCap and also OK to decide during WI phase.</p>
<p><b>19 – Samsung Electronics Polska</b></p> <p>Suggest to decide in RAN plenary. We don’t think this is necessary.</p>
<p><b>20 – LG Electronics France</b></p> <p>We are open to discuss PR1 as an addition to BW reduction</p>

<p><b>21 – Intel Belgium SA/NV</b></p> <p>We are fine to consider PR1 as add-on to basic option BW3/PR3. We prefer to limit the scope to FR1 only.</p>
<p><b>22 – NEC Corporation</b></p> <p>We are fine to decide it during WI phase.</p>
<p><b>23 – Sony Europe B.V.</b></p> <p>Yes. PR1 should be an add-on to BW3 (or PR3). PR1 allows us to achieve the objective of 10Mbps, which we think is important for eRedCap. PR1 is a low hanging fruit and specification impact will be minimal. Further discussion on "adding-on PR1" in the working groups is unlikely to add further insight, hence we think that RAN plenary can take the decision to include PR1 in the WID.</p>
<p><b>24 – China Mobile Com. Corporation</b></p> <p>Fine to decide it during WI phase as TR recommended.</p>
<p><b>25 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>Preferably, RAN can decide directly to include PR1 in the WID without taking up RAN1 time on the same discussions again.</p>
<p><b>26 – Lenovo (Beijing) Ltd</b></p> <p>We are open to have PR1 as a potential add-on.</p>

Clause 9 in the TR [26] indicates that there were different views regarding whether to include PT1 and/or PT2 in the WI scope.

**Feedback Form 5: Should PT1 and/or PT2 be included in the WI scope?**

<p><b>1 – Nokia Corporation</b></p> <p>We see that we should not introduce support for option PT1 or PT2 due to significant impact to scheduler complexity and flexibility, and potential coexistence issues with legacy UEs. This would also contribute to market fragmentation with some UEs support PT1, some PT2, some both and some not needing either of these</p>
<p><b>2 – MediaTek Inc.</b></p> <p><b>Yes for further investigation.</b></p> <p>Given PR3 and BW3 both support 20MHz control channel, the corresponding PDCCH processing can eat</p>

out most available processing time within a slot. In this regard, we support to investigate the conditions that can allow longer processing time, subject to minimum system impact.

### **3 – Nordic Semiconductor ASA**

**We support N1/N2 relaxations to be included.**

We may agree that scheduler complexity may be increased, but we do not agree that there are necessarily coexistence issues. SIBs have no HARQ-ACK. And early indication (if anyway supported) would handle initial access.

As mentioned already, R18 RedCap UE complexity with BW3 reduces cost by 60-70%, but in paradox PDCCH processing has not be reduced at all, it is the same as for R15 eMBB UE.

Relaxed N1/N2 allows PDCCH processing to be relaxed. Alternatively, if monitoring demands in terms of CCE/BD are relaxed, the same affect can be achieved.

Note that limiting BD/CCE limits to match those in initial access, would already reduce processing needs by half, while not causing coexistence issues, nor fragmenting RedCap market.

Therefore, if relaxed N1/N2 timeline is "no-go" for NW vendors, we suggest to considered BD/CCE relaxations instead, as a potential compromise.

### **4 – Spreadtrum Communications**

We are supportive for PT1 and/or PT2, as we see some benefits on complexity reduction and power saving.

### **5 – NTT DOCOMO INC.**

We think additional complexity reduction expected with PT1 and PT2 are meaningful gain to ensure the complexity reduction, and hence we are supportive to include PT1 and/or PT2 in the WI scope .

### **6 – VODAFONE Group Plc**

We share similar concerns as Nokia

### **7 – Qualcomm Incorporated**

We do not support the introduction of PT1 and/or PT2. Seems that that the trade off between UE complexity reduction benefit and network implementation burden is least favorable in this case.

### **8 – Ericsson LM**

No, PT1 and PT2 should be avoided from the WI scope. The additional cost savings with PT1 and PT2 are small, but they would incur significant network impacts, e.g., in terms of scheduling complexity and flexibility. Beside our concerns on network impacts, there would also be coexistence and specification

impacts that need to be dealt with during the WI phase, which could be difficult considering the limited TU budget.

**9 – Sierra Wireless**

PT1 and PT2 should NOT be included in the WI scope - same reasons as Nokia, Qualcomm and Ericsson have stated.

**10 – Classon Consulting**

[for FUTUREWEI] OK

**11 – vivo Mobile Communication Co.**

We support the relaxed processing time, i.e. PT1 and PT2, which is not only beneficial for complexity reduction, but also for power saving.

**12 – ZTE Corporation**

PT1 and PT2 should not be included in the WID considering the scheduling impacts and coexistence impacts.

**13 – InterDigital**

We are supportive to include PT1 and PT2.

**14 – KDDI Corporation**

We share the view with Nokia and Ericsson. We are reluctant to include PT1/PT2 in the objectives, since it's not so attractive to operators considering its impact on network side.

**15 – Guangdong OPPO Mobile Telecom.**

We can consider them if time allowed. But, we should firstly decide the main solution.

**16 – CATT**

We do not agree to include PT1/PT2 in WID for the same reasons as commented by other companies.

**17 – THALES**

PT1 and PT2 should not be included, same view as Sierra Wireless.

**18 – Samsung Electronics Polska**

PT1/PT2 should not be included in WID. It has impact to the system and NW complexity while the gain is limited.

**19 – Xiaomi Communications**

We share the same view as Nokia, Qualcomm, Ericsson and other companies that PT1 and PT2 shouldn't be included. In addition, PT1 may have negative impact on the cost of post-FFT buffer when TBs in continuous slots are scheduled due to the long processing time.

**20 – LG Electronics France**

We don't think it should be included since it doesn't provide much benefits while making specifications diverge more

**21 – China Unicom**

We are not in favour of PT1/PT2, it has impact to the system and NW complexity.

**22 – Intel Belgium SA/NV**

We are supportive to introduce PT1 and PT2 for the additional complexity reduction

**23 – NEC Corporation**

Considering feedback from companies, we are fine not to include these options due to its impact on scheduling complexity and potential co-existence issue and marginal gain.

**24 – Sony Europe B.V.**

While we think that PT1 and PT2 provide a useful complexity reduction, they can be a lower priority than BW3 (with the PR1 add-on). The downside with PT1 / PT2 is the potential specification impact and coexistence issues (with some existing gNB implementations).

Our preference is that PT1 and PT2 would be supported in the WID.

**25 – China Mobile Com. Corporation**

We do not support the introduction of PT1 and/or PT2. Beside the scheduling complexity in connected mode, we worry the initial access impact if default scheduling timing can not be reused. If it has impact on scheduling of initial access phase, early identification will be required, further making gNB scheduling more complex, and PRACH resources will be more fragmented for early indication of both R17 and R18 RedCap UEs.

**26 – Huawei Tech.(UK) Co., Ltd**

There may not be further enhancement WIs for RedCap, so we think it is worth the effort to have PT1 and PT2 now. Of the 11-13% complexity gain for BW3+PT1+PT2, nearly half of the total cost saving comes from the PT relaxations – this is not something to set aside easily.

On scheduling, the gNB need only maintain one timeline for a UE, so the scheduling effort increase is not great, and with more RedCap UEs in the market thanks to a lower UE complexity, the gNB implementation effort is more motivated.

On coexistence, the early identification framework from Rel-17 can be essentially reused for Rel-18, and as indicated in some other papers, it may not always need to be used at all. Apart from that, BW3/PR3 may also need early identification, so it is clear to address the overall UE combination including PT1+2. Such an approach eliminates the market fragmentation concern, and RAN should generally assume such a good specification method in the expert WGs, rather than assuming the worst possible bad one described again by Nokia. But even that level of claimed solution can be avoided by adding a note that restricts RAN1,2 from creating such splits.

#### 27 – Lenovo (Beijing) Ltd

Not necessary since they have small cost saving gain.

If there are other comments on the objective on further reduced UE complexity, they can be provided below.

### Feedback Form 6: Other comments on the objective on further reduced UE complexity in [1]

#### 1 – MediaTek Inc.

We have concern on inclusion of low-power-class UE for the following two reasons:

- It has not been included in the complexity reduction study, and there is no quantitative result to support the benefit.
- Inclusion of additional UE type causes market fragmentation concern. **Without sufficient UE volume, the manufacturing cost will actually bring higher device cost for any RedCap UE type.**

#### 2 – MediaTek Inc.

Sorry for misplacing our comment on low-power-class UE in our previous post.

For further reduced UE complexity, we think it is very **important to enlarge the eco system of 20 MHz RedCap UEs instead of fragmenting RedCap UE market**. In this regard, allowing network and the Rel-18 UEs to operate with existing 20MHz channels is one practical way forward. Therefore, the following is suggested to be explicitly included:

- **Specify means to enable RedCap UE with further reduced UE complexity to process PDSCH of >5MHz RB span**
  - o **Existing SIB1 transmission is reused without enhancement**

#### 3 – Nordic Semiconductor ASA

Already mentioned PDCCH processing relaxation in terms of reduce BD/CCE should be added to WID, if N1/N2 processing timeline relaxation is not acceptable to NW vendors.

#### 4 – Ericsson LM

As mentioned in our response to Feedback form 4, at least PR1 can be considered for both FR1 and FR2, where the details can be worked out during WI phase, and a suitable target peak rate for FR2 with PR1 could be 70 Mbps (corresponding to 100 MHz, 66 PRBs, 120 kHz SCS,  $v \cdot Q \cdot f = 1$ ).

#### 5 – Classon Consulting

[for FUTUREWEI] The WID should include using the existing UE capability framework and by default supporting existing features, and we should try to decide in RAN whether or not a Rel-18 RedCap UE will support the Rel-17 RedCap UE features.

#### 6 – Facebook

In last RAN4 #104-e meeting, RAN4 discussed how to treat the leftover issues in Rel-17 RedCap WI. Finally, Moderator proposed as follow

- ***RAN4 can treat the leftover issues in Rel-18 RedCap enh WI based on updated objectives in the WID.***

Due to the lack of time in Rel-17 timeline, some RF/RRM requirements for SUL/NR-U/NR SL operating bands are not treated in detail. So, current TS38.101-1 specification had some uncertainties between RedCap operating bands and the detail RF requirements.

So, RAN4 need to fix the uncertainties in Rel-18 RedCap enh WI.

based on these, we propose that these leftover issues in Rel-17 need to be treated in the RedCap enh. WI in Rel-18. You can refer the our paper in RP-222213 in this meeting.

##### 4.1 Objective of Core part WI

...

##### **Leftover issues from Rel-17 RedCap WI**

- **Specify the additional UE RF/RRM core requirements not to contain any restriction to support all NR operating bands E.g.) NR-U/NR SL operating bands**

#### 7 – Samsung Electronics Polska

Considering the limited TU, we suggest to focus on the necessary specification change other than "optimization". For example, there is no need to support coverage enhancement of SIB1 and others. which should be clarified in the WID.

Moreover, If BW 3/PR 3 is supported, we would like to have some clarification on Post FFT buffer in WID, to provide clear guidance to Working group. In our view, the design should support post FFT buffer reduction (i.e. in both time and frequency domain).

#### 8 – Intel Belgium SA/NV

After reviewing the inputs from companies, we feel it is necessary to give a clear definition to BW3, especially what is the FFT size for BW3, or, whether the 5MHz is known before decoding a PDCCH.

In our views, BW3 and PR3 should be applicable without such assumption on the location of 5MHz.

#### 9 – Sony Europe B.V.

HD-FDD Type B provides a useful RF complexity reduction and we would hence like HD-FDD Type B to be included in the objectives.

## 2.4 Lower UE power class

The draft WID in [1] has an objective on lower UE power class.

### Feedback Form 7: Comments on the objective on lower UE power class in [1]

#### 1 – Nokia Corporation

We are supportive for inclusion of this objective, however RAN2 should be added to this objective as there are also impacts to RAN2 side due to this (similar to the cell reselection criteria for MTC)

#### 2 – MediaTek Inc.

We have concern on inclusion of low-power-class UE for the following two reasons:

- It has not been included in the complexity reduction study, and there is no quantitative result to support the benefit.
- Inclusion of additional UE type causes market fragmentation concern. **Without sufficient UE volume, the manufacturing cost will actually bring higher device cost for any RedCap UE type.**

#### 3 – Spreadtrum Communications

We are also supportive for this, and we prefer to keep the sub-bullet of it, e.g., Focus on non-coverage-limited scenarios, e.g., indoor industrial.

#### 4 – VODAFONE Group Plc

We share similar concerns presented on Mediatek's first bullet.

**5 – Nordic Semiconductor ASA**

OK, but if TUs are limited, this feature should not be high in priority.

**6 – Ericsson LM**

We would like to first point out that the objective on lower UE power class in the draft WID concerns only FR1. A lower UE power class (PC7) has already been introduced for FR2 RedCap UEs in Rel-17. Now, with regards to introduction of lower UE power class in FR1, we do not currently see a strong need for it. However, we are keen on hearing the views from other companies and would be open to reconsider our position if there are strong arguments to support such a feature.

**7 – Sierra Wireless**

We do not see a strong need for it right now (i.e. Rel18). Something that could be considered in later releases.

**8 – Classon Consulting**

[for FUTUREWEI] not a priority to include, prefer to decide the complexity reduction objective first

**9 – QUALCOMM JAPAN LLC.**

The objective formulation is general right now, what power would be the target for this? At least more details are needed before including such an objective.

**10 – vivo Mobile Communication Co.**

We support low UE power class, which was supposed to be included in the WI phase since last December. Some replies to companies who have concerns or question, from our understanding, the objective of lower UE power class for WI was stable as noted in RAN#94, that is why the Rel-18 RedCap SI did not list it as one objective and study it. We think discussion for this objective is whether/what more details need to be added. Regarding to the target value for lower UE power class, similar as NB-IoT and MTC, 14dBm and 20dBm can be good candidates. But the target value(s) may not be need to include in the WI objective now, it is better to be decided by RAN4 after their assessment.

**11 – ZTE Corporation**

It can be considered if TU permits. Additionally, if introduced, more details for lower UE power class should be clarified, e.g. 14dBm or 20dBm, FR1 or FR2.

**12 – Guangdong OPPO Mobile Telecom.**

We wonder how to evaluate the complexity in the WI phase. Thus, we need to discuss whether the low power class should be introduced.

**13 – CATT**

We are open to consider lower UE power class as long as no dedicated coverage compensation is needed.

**14 – Facebook**

We can discuss whether the necessity of lower power class according to the RedCap device deployment scenarios or not. So, currently, we are fine to add this scope in Rel-18 WI.

**15 – Xiaomi Communications**

We are open to consider lower UE power class, but we think some details need further clarify at the RAN plenary meeting:

1. What are the application scenarios for lower UE power class?
2. What power should be for the lower UE power class, 14dBm, 20dBm or others?
3. Whether the lower UE power class only for FR1, or both of FR1 and FR2?

**16 – Samsung Electronics Polska**

It's ok to include this into WID objective and leave the detailed values for RAN4 further assess.

**17 – Intel Belgium SA/NV**

We are OK to include an objective for low power class. It is also preferred to clearly capture a target power level.

**18 – Sony Europe B.V.**

We are OK to include lower power class in the WID objectives. The details can be ironed out in RAN4.

**19 – Huawei Tech.(UK) Co.. Ltd**

Low power class was specified only for NB-IoT and LTE-MTC. In the SID RP-213661 it is stated that Rel-18 RedCap should not overlap with existing LPWA solutions.

**20 – China Mobile Com. Corporation**

We are open for this objective, as long as it does not involve coverage enhancement for this.

**21 – MediaTek Inc.**

The complexity reduction scope of R18 RedCap WI should be based on the complexity reduction study outcome. Since low-power-class UE is not part of the study, we think inclusion of the low-power-class UE is up-scoping for the complexity reduction part of scope. According to RAN chair guidance we understand there should be no upscoping at this meeting, so would suggest not to discuss further

**22 – CHTTL**

We share similar concern as MTK in #2.

**23 – CHTTL**

We share similar concern as MTK in #2.

## 24 – Lenovo (Beijing) Ltd

We are fine to have only RAN4 for this objective for now, and are open to include more WGs in the future discussion, if necessary.

## 2.5 Other aspects

If there are comments on other aspects of the WI scope, they can be provided in Feedback Form 8 below. For comments specific to the objective on further reduced UE complexity, please consider using Feedback Form 6 in Section 2.3 instead.

### Feedback Form 8: Comments on other aspects of the WI scope

#### 1 – Spreadtrum Communications

Considering the possible RAN2 impacts, we have the following RAN2-led objective suggestions:

- Specify functionality that will enable eRedCap UEs to be explicitly identifiable to networks, including the ability for the early indication to be configurable by the network. [RAN2, RAN1]
- Specify necessary updates of UE capabilities (38.306) and RRC parameters (38.331). [RAN2]

For the notes part, we have the following suggestions:

- Coexistence with non-RedCap UEs and Rel-17 RedCap UEs is to be ensured.
- Both 15 kHz SCS and 30 kHz SCS are supported for Rel-18 eRedCap in FR1.
- This WI focuses on SA mode and single connectivity with operation in a single band at a time.
- It is not precluded that some solutions for FR1 can be applied to FR2 in WI stage.
- Aim to define a single Rel-18 eRedCap UE type for further UE complexity reduction.

#### 2 – Nordic Semiconductor ASA

Generally OK with SPRD additions. We agree that separate Early identification for R18 should be supported, whether it is used by gNB is up to implementation. Anyway, given that Early indication framework is in place already for R17 RedCap, spec effort should be negligible.

**Also we do not see combination of R18 RedCap with LTE Cat 1 bis as priority deployment.** This because,

- When R18 is deployed, NR SA is the main technology in the market, and DSS most likely used in low-bands to accommodate remaining LTE-only devices.
- 5/10Mbits radio (unlike R17 RedCap 60Mbit radio) combined with TYPE-A HD-FDD + [TDD] allows for small-factor, low power consumption, and low cost NR based devices for Massive IoT. For use-cases where LPWA bit-rate is insufficient.

### 3 – Classon Consulting

[for FUTUREWEI]

- \* We should be introducing at most one new UE type in Rel-18 (if UE type needs to be mentioned)
- \* Assuming BW3/PR3, the network can configure the same or a separate early indication as used for Rel-17 RedCap
- \* The complexity reduction should be for FR1

### 4 – ZTE Corporation

For bandwidth reduction techniques, BW1/2/3, they are actually studied and applied in FR1. Therefore, not all the frequency ranges are applicable and a minor update is suggested

- This WI considers all **applicable** frequency ranges and all applicable duplex modes.

### 5 – ZTE Corporation

For bandwidth reduction techniques, BW1/2/3, they are actually studied and applied in FR1. Therefore, not all the frequency ranges are applicable and a minor update is suggested

- This WI considers all **applicable** frequency ranges and all applicable duplex modes.

### 6 – vivo Mobile Communication Co.

In addition to above scope, we could consider to include the scope for NCD-SSB in idle and inactive mode. This has been discussed in Rel-17, which was agreed in RAN1 but finally downs coped by RAN plenary due to limited TU in RAN WG. We think the current reserved TU for Rel-18 RedCap in RAN2 and RAN4 is enough to include the scope for NCD-SSB in idle/inactive mode. From specification perspective, given that NCD-SSB has the same properties/values (e.g., ssb-PositionsInBurst, PCI, ssb-PBCH-BlockPower) as the corresponding CD-SSB, existing procedure and requirements for paging monitoring, measurements, cell (re-)selection based on CD-SSB can be applicable for NCD-SSB directly. In RAN1, this has been discussed and agreed before, so little TU will be required. In RAN2 and RAN4, we only to discuss the applicable for NCD-SSB based on the existing mechanism or requirements for CD-SSB adaptively. Thus, limited TU is needed with this scope.

Besides, Rel-17 RedCap UEs mandatorily support NCD-SSB in connected mode. From UE perspective, there is no additional effort for UE to support NCD-SSB in idle/inactive mode. While from network perspective, network anyway needs to provide NCD-SSB as long as it is configured for one connected RedCap UE in this cell. There is no additional overhead for RedCap UEs in idle/inactive to use NCD-SSB.

Thus, we think it is reasonable to include the scope for NCD-SSB in idle and inactive mode in Rel-18 Scope.

## 7 – Facebook

We prefer to consider RAN4 RF/RRM scopes for leftover issues in Rel-17 RedCap. As we mentioned in section 2.3, RAN need to decide how to treat the leftover issues based on the previous RAN/RAN4 agreements.

So, we would like to add the additional objectives in the Rel-18 RedCap enh. WI as follow

### 4.1 Objective of Core part WI

...

### Leftover issues from Rel-17 RedCap WI

- **Specify the additional UE RF/RRM core requirements not to contain any restriction to support all NR operating bands E.g.) NR-U/NR SL operating bands [RAN4]**

## 8 – Qualcomm Incorporated

One additional aspect of the Rel-18 RedCap WI should be to define 2Rx operation for up to 100MHz in high FR1 bands (where the eMBB requirement is 4Rx). A similar proposal has been made by Apple and Samsung as part of the Rel-18 XR WI. The primary reason to do this in the eRedCap WI instead of the XR WI is that by inheriting the RedCap limitations, such as no CA/DC/SUL, the concerns on applicability to eMBB smartphones can be better addressed.

## 9 – QUALCOMM JAPAN LLC.

While the release-18 study focused mainly on relaxations from the RF and baseband perspectives, we think some upper layer aspect, i.e. relaxation for upper layer processing, should be addressed in the WI. In RP-222063, we proposed introducing a compact ASN.1. But even something much simpler than that, but still related to ASN.1 processing, can contribute to low cost / low complexity UE implementation. One specific item we proposed to consider is removing the need (or making it UE optional) of dynamic construction of UE capability report upon UE capability enquiry. Today, the UE must do it on the fly based on the network UE capability filter (e.g. which bands are relevant for UE capability reporting). We learned during the past years with LTE and NR implementations that it is very demanding procedure in terms of upper layer processing. It should be noted that the UE capability filter was meant to reduce the UE capability size, but the UE capability size is anyway small for eRedCap since for instance there is no band combination UE capability signalling.

## 10 – NEC Corporation

No additional scope should be considered.

## 11 – MediaTek Inc.

We agree with NEC. These issues seem to be beyond the scope of the existing WI, and, **according to RAN chair guidance, we understand there should be no upscoping at this meeting**, so would suggest not to discuss further.

## 12 – Facebook

[To NEC, MTK] If RAN do not have any action for the leftover issue, then how can we resolve the specification misalignments in TS38.101-1? It shall be discussed and decided on leftover issues from Rel-17. Also our proposal is aligned with the agreed WF(RP-212634) and Moderator summary at last RAN4 meeting.

***In Rel-17, there will be no work on any RedCap specific specification update for any of the following:***

- 1.RedCap UEs also supporting V2X/PC5 on n47
- 2.RedCap UEs operating in unlicensed bands
- 3.RedCap UEs supporting SUL

***The specification will not contain any explicit restriction to prevent implementation of RedCap UEs with these features.***

I would like to hear for the reason that the leftover issues are not considered in Rel-18 RedCap enh. WI.

## 13 – Huawei Tech.(UK) Co.. Ltd

Regarding the notes below in the draft WID, we have the following comments,

- The SI did not consider FR2 in general, so we think the applicable frequency ranges need some consideration by RAN.
- Specifically, there is a problem for BW3/PR3 vs. the statement that the WI considers all frequency ranges, since they are defined on a 5 MHz basis. However, other complexity reductions such as PR1, PT1, PT2 do not present a basic technical problem in the same way (PR1 seems to need thinking about the needed data rates, however).
- We agree to have a note about coexistence and about not overlapping with LPWA use cases.
- We suggest to include a note restricting to at most one new UE type.

The notes can be written in the WID as follows:

***Notes:***

- ***The work defined as part of this WI is not to overlap with LPWA use cases.***
- ***Coexistence with non-RedCap UEs and Rel-17 RedCap UEs should be ensured.***
- ***Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction.***
- ***This WI considers [all frequency ranges and] all applicable duplex modes unless otherwise specified.***

...and we assume that some resolution is needed on frequency ranges in the last of the proposed notes.

## 14 – Nokia Corporation

In our view no further upscoping of the objectives should be done, especially as the proposed upscopings are not essential for RedCap operations or UEs.

## 2.6 Summary of initial round

### **Justification**

The Justification in [1] seems to be acceptable to the responding companies with a few small modifications:

- Change "5G aims to accelerate..." to "One 5G aim is to accelerate..."
- Change "The SI" to "The WI".
- Add the sentence "Techniques for further UE complexity reduction have been studied in the study item documented in TR 38.865".

### **Enhanced eDRX**

The objective on enhanced eDRX in [1] seems to be acceptable to all responding companies.

### **Further reduced UE complexity**

Regarding the main UE complexity reduction technique (BW3, PR3, PR1, or BW1), a large majority of the responding companies prefers BW3 or PR3. Most of these companies indicate that they would be fine with either one of BW3 and PR3. Several companies propose that the down-selection or merge of BW3 and PR3 can be done in WI phase. This could help avoid further discussion in RAN#97e on the detailed differences between the two rather similar options BW3 and PR3.

Regarding PR1 as an add-on, a large majority of the responding companies agree with following the RAN1 recommendation that PR1 is considered as a potential add-on and that whether to adopt this potential add-on can be decided during WI phase. Some companies express that PR1 can be considered for both FR1 and FR2.

Regarding PT1 and PT2, the responding companies have split views, with a majority not in favor and a minority in favor of including them in the WI scope. Based on the responses, it seems unlikely that there will be consensus for including them in scope.

Some companies propose to add additional techniques:

- Means to process SIB1 PDSCH with >5 MHz PRB span
- Relaxed PDCCH (BD/CCE) processing
- HD-FDD operation type B

Finally, it seems to the moderator that RAN2 and RAN4 ought to be added to the objective for further reduced UE complexity.

### **Lower UE power class**

There are split views among the responding companies on whether to include an objective on lower UE power class. Many of the companies seem to be open to include it, but include that it should be with lower priority

than the other objectives and/or that more details need to be included, in particular the maximum transmission power of the lower UE power class.

Some companies suggest that including the lower UE power class would mean an up-scoping. However, this objective was included already in the draft WID [1], which was an outcome from the RAN#94e Rel-18 scoping discussion, so it is not a new proposal.

Considering that the work with this objective (if included) would not start until 2023, and in order to use the remaining time of RAN#97e efficiently, one possibility could be to postpone the discussion for this particular objective till RAN#98.

### **Other aspects**

Several companies comment on the need for an objective about early indication and on the additional notes below the main objectives. The following update can be considered:

- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".
- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".
- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction".
- Discuss what frequency ranges to support.

Some companies propose to add additional objectives:

- NCD-SSB in idle/inactive mode
- RAN4 requirements for all bands, e.g., NR-U and NR SL bands
- 2-Rx operation for up to 100 MHz in high FR1 bands
- Relaxation for upper layer processing, e.g., compact ASN.1

However, other companies argue that no additional scope should be considered.

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## **3 Intermediate round**

### **3.1 Enhanced eDRX**

Based on the summary of the initial round in Section 2.6, the objective on enhanced eDRX from [1] can be kept as is in the next draft WID.

## 3.2 Further reduced UE complexity

Based on the initial round summarized in Section 2.6, it seems that BW3 and/or PR3 can be selected as the main technique for further UE complexity reduction, and that it can be left to the WI phase to do further down-selection between BW3 and PR3, possibly e.g. selecting one option in one direction and the other option in the other direction.

**Feedback Form 9: Proposal: The main technique for further UE complexity reduction is based on BW3 and/or PR3, to be down-selected or merged in WI phase.**

### 1 – Nordic Semiconductor ASA

We believe RAN should down-select one technique, this was the recommendation from majority of companies in RAN1. Given that there will be limited TUs also for WI, I can imagine RAN1 easily spends whole meeting on down-selection and merge.

One way to proceed is, RAN to make guidance on whether "Design should enable (or NOT) a UE to buffer only subset of PRBs ,corresponding to scheduled PDSCH, within 20MHz DL BWP.

### 2 – Classon Consulting

[for FUTUREWEI] Support

### 3 – InterDigital

Ok with the proposal for the progress.

### 4 – Apple Poland Sp. z.o.o.

Our preference is still down selecting in this RAN plenary as the differences between PR3/BW3 have been studied extensively in the past work group meeting. Plenary is definitely a right place to make this sort of tough decision than RAN1. If RAN1 can down selection, it already happened in last RAN1 meeting. In addition, from cost reduction perspective, a combination of BW3 and PR3 (one for DL and the other for UL) is not preferred as it even makes design more complicated. The justification is less clear as it is not beneficial for SIB1 reception problem observed.

### 5 – Facebook

We support the Moderator proposal.

### 6 – CATT

We also prefer to down-select between BW3 and PR3 in this RAN plenary meeting considering that they have been thoroughly studied in RAN1. But if not possible, we are fine to make the decision in WI phase but would like to consider either BW3 or PR3 for both DL and UL only.

### 7 – Qualcomm Incorporated

Our preference is PR1 only and neither PR3 or BW3. However, if one of BW3 or PR3 is to be introduced then making the selection between them at the Plenary is highly preferred by us. The difference between

the two options is relatively minor; therefore we could accept either, although our first preference remain PR1 only.

#### **8 – Spreadtrum Communications**

Fine with the moderator’s proposal.

Additionally we also share the similar observation with Nordic, Apple and CATT. If possibly down selecting can be done at this RAN plenary, it would be helpful for TU usage and arrangement in WI phase.

#### **9 – Panasonic Corporation**

Support

#### **10 – NEC Corporation**

Support

#### **11 – Xiaomi Communications**

We slightly prefer to do down-selection between PR3 and BW3 at this RAN plenary meeting due to the heavy workload and the limited TU in the WI phase.

#### **12 – vivo Mobile Communication Co.**

The main difference between BW3 and PR3 is whether UE need to buffer the subset of PRBs based on the scheduling information or 20MHz bandwidth. We are not convinced the value to select both or merge them (unclear what would be the case to merge). So, we prefer to down-select between BW3 and PR3 in this RAN plenary meeting. If majority want to down-select during the WI phase, we are fine with it. In addition, we share Nordic’s views to save RAN1 time, it is better for RAN to make guidance on whether ”Design should enable (or NOT) a UE to buffer only subset of PRBs, corresponding to scheduled PDSCH, within 20MHz DL BWP.

#### **13 – Sierra Wireless**

Support

#### **14 – Sierra Wireless**

Support

#### **15 – MediaTek Inc.**

Thanks moderator for the summary and further proposal. For further complexity reduction, our views are as follows

- **1st preference: RAN plenary to decide the solution allowing network to reuse all 20MHz channels (including PDSCH)**
  - o If distributed RB allocation is a concern for UL, **DL PR3 and UL BW3 looks a possible way forward**

- **If down-selection is not achieved, RAN plenary to provide guidance for RAN1 down selection.**  
To enable network to reuse settings for 20MHz RedCap UEs (minimum additional deployment effort), it would be sensible to require ”**aiming for support of 20MHz PDSCH without restriction in RB number and allocation**”

**16 – NTT DOCOMO INC.**

We can accept this proposal while our 1st preference is BW1.

For down-selection between BW3 and PR3, it is preferable to be done in RAN plenary, however, we are not sure we have a common understanding on the difference between BW3 and PR3. For example, given that a UE can receive the channels which exceed 5MHz BW without any performance loss for PR3 as commented by some companies, it is not sure whether the peak data rate would be reduced to 10Mbps or not reduced compared to Rel-17 RedCap UE which has 20 MHz UE BW. So we slightly prefer BW3 at this point.

**17 – NTT DOCOMO INC.**

We can accept this proposal while our 1st preference is BW1.

For down-selection between BW3 and PR3, it is preferable to be done in RAN plenary, however, we are not sure we have a common understanding on the difference between BW3 and PR3. For example, given that a UE can receive the channels which exceed 5MHz BW without any performance loss for PR3 as commented by some companies, it is not sure whether the peak data rate would be reduced to 10Mbps or not reduced compared to Rel-17 RedCap UE which has 20 MHz UE BW. So we slightly prefer BW3 at this point.

**18 – ZTE Corporation**

The difference between BW3 and PR3, and the merged solution may need further RAN1 clarification. Therefore, we are OK to further down select in WI phase **before the RAN-P #98 meeting**.

**19 – Nokia Corporation**

We are fine with the proposal. Ideally down-selection would be done in RAN#97e plenary, or alternatively give RAN1 until December and if no decisions then RAN#98e to down-select.

**20 – KDDI Corporation**

We support the moderators’ proposal.

**21 – China Mobile Com. Corporation**

We also prefer to make down selection in RAN plenary, for the reason of limited TU as mentioned by other companies. And our preference is BW3.

For BW3, buffering subset of PRBs can be realized by cross slot scheduling or predefining a frequency region for FDRA indication, the detail design can be studied during WI.

For PR3, cross slot scheduling can also enable UE to know which subset of PRBs are to be used, then UE can only buffer part of PRBs. But predefining a frequency region for FDRA indication is not feasible for PR3 since we have agreements for PR3 that ”The resource allocation spans a bandwidth of maximum 20 MHz (maximum UE channel bandwidth)”

**22 – Panasonic Corporation**

I think the discussion on the difference between BW3 and PR3 is for DL. To conclude UL BW3 in this plenary. To discuss BW3 and PR3 in working group can be also one way.

**23 – Panasonic Corporation**

I think the discussion on the difference between BW3 and PR3 is for DL. To conclude UL BW3 in this plenary. To discuss BW3 and PR3 in working group can be also one way.

**24 – LG Electronics Inc.**

We are okay to down-select b/w BW3 and PR3, but NOT okay to merge the BW3 and PR3.  
Between BW3 and PR3, we have a preference for BW3 over PR3, because either way the spec impact is not significant as captured in the TR, but we can expect more complexity reduction by > 10% from BW3 compared to PR3.  
Lastly, as recommended in the TR conclusion, we prefer the down-selection to be done at this RAN plenary if time allows.

**25 – VODAFONE Group Plc**

We prefer to have the downselection in RAN as recommended in the TR

**26 – China Unicom**

We support to down-selection between BW3 and/or PR3 in WI phase, we prefer BW3.

**27 – China Unicom**

We support to down-selection between BW3 and/or PR3 in WI phase, we prefer BW3.

**28 – Intel Belgium SA/NV**

We also prefer to down select between BW3 and PR3. However, it may be hard to converge. Therefore, we also prefer that RAN can provide some guideline on the direction of BW3/PR3. One example is that proposed by Nordic, i.e. ‘RAN to make guidance on whether ”Design should enable (or NOT) a UE to buffer only subset of PRBs, corresponding to scheduled PDSCH, within 20MHz DL BWP’. Other variance can be considered too, e.g., whether the location of 5MHz can be known to UE before successful PDCCH decoding in BW3.  
Above all, we don’t know what is exact BW3/PR3 at the moment since the exact behavior can only be known after it is agreed and specified in RAN WGs. Therefore, some high level RAN guidelines on BW3/PR3 seems a good way forward

**29 – MediaTek Inc.**

As one proponent for down-selection in this RAN plenary meeting, the following information can be useful for companies’ consideration:

- **BW3 requires additional UE complexity to tackle SIB1 performance issue, which conflicts with the objective of complexity reduction**

- @CMCC: SIB1 cannot apply cross-slot scheduling, and the predefined RB range is optimized for legacy UEs (thus >5MHz for the Rel-18 UE)

**- PR3 provides maximum network flexibility**

- PR3 UE can support contiguous RB allocation within 5MHz, but BW3 UE cannot support distributive RB allocation or >5MHz RB span in PDSCH
- PR3 UE keeps the same post-FFT data buffer as Rel-17 UE, which can enable network to reuse all 20MHz channels.

**- The complexity difference between BW3 and PR3 is up to 1% w.r.t. Rel-17 RedCap**

- Ease of network deployment benefits UE volume, which in turn helps reduced manufacturing cost (much large cost benefit than 1% complexity difference)

**30 – Samsung Electronics Polska**

We support down selected to BW 3 in RAN other than leave this to WG.

@Mediatek, for PR3, we don't think it is common understanding on post-FFT buffer as Rel-17 UE. if SIB1 cannot span more than 5MHz, the coverage of SIB 1 is similar as BW 3. Not much frequency diversity gain from 5MHz to 20MHz.

Moreover, we think BW 3 can have much cleaner design than PR 3.

Moreover, we think some clarification that this is only for FR 1.

**31 – Ericsson LM**

We support the proposal. We think that more discussion is needed in RAN1 before down-selection between or merge of BW3 and/or PR3 is done. For instance, as also pointed out by MediaTek, it could be that PR3 is supported in DL while BW3 is supported in UL. To alleviate some of the concerns from companies above, we suggest updating the proposal as follows:

**The main technique for further UE complexity reduction is based on BW3 and/or PR3, to be down-selected or merged by RAN1#111 in WI phase.**

**32 – Sony Europe B.V.**

OK to downselect between BW3 and PR3 in the WI phase. Our preference is BW3.

RAN plenary should not get into details about "Design should enable (or NOT) a UE to buffer only subset of PRBs, corresponding to scheduled PDSCH, within 20MHz DL BWP". While some companies might think that this provides a differentiation between BW3 and PR3, others don't, as discussed in RAN1#110.

**33 – Huawei Tech.(UK) Co.. Ltd**

It should still be better for RAN to decide which of BW3 and PR3, to avoid WG-level discussions on other schemes branching out from, or linking between, the two candidate schemes. Is there not a high-enough level of interest in either BW3 nor PR3 for RAN to be able to choose which is valuable enough to specify?

Based on the initial round summarized in Section 2.6, it seems that PR1 can be considered as a potential add-on, to be decided during WI phase, at least for FR1.

**Feedback Form 10: Proposal: Whether to adopt PR1 as a potential add-on for FR1 and/or FR2 is decided during WI phase.**

<p><b>1 – Nordic Semiconductor ASA</b></p> <p>That is OK, as soon as it is clear that BW3/PR3 targets FR1 only.</p>
<p><b>2 – Classon Consulting</b></p> <p>[for FUTUREWEI] Can accept but for FR1 only</p>
<p><b>3 – Apple Poland Sp. z.o.o.</b></p> <p>Support.</p>
<p><b>4 – Facebook</b></p> <p>We can accept the Moderator proposal</p>
<p><b>5 – CATT</b></p> <p>Support</p>
<p><b>6 – Spreadtrum Communications</b></p> <p>Support</p>
<p><b>7 – Panasonic Corporation</b></p> <p>Support</p>
<p><b>8 – Qualcomm Incorporated</b></p> <p>This decision should be made at the Plenary. Actually we are unsure why further deliberation in RAN1 would be necessary.</p> <p>We support introducing PR1. Also, it should be with the clarification that UEs implementing PR1 but without PR3/BW3 limitation are supported.</p>
<p><b>9 – NEC Corporation</b></p> <p>Support</p>
<p><b>10 – Xiaomi Communications</b></p> <p>1. We support PR1 as an add-on solution on top of BW3 or PR3 to further reduce complexity. Also, we slightly prefer the QC’s view that the decision is made at this RAN plenary.</p> <p>2. Since BW3 or PR3 targets to FR1 only, PR1 as an add-on solution on top of BW3 or PR3 should also target to FR1 only.</p>

<p><b>11 – vivo Mobile Communication Co.</b></p> <p>support.</p>
<p><b>12 – Sierra Wireless</b></p> <p>support</p>
<p><b>13 – NTT DOCOMO INC.</b></p> <p>Support this proposal while we support introducing PR1 and prefer to decide in this RAN plenary.</p>
<p><b>14 – MediaTek Inc.</b></p> <p>Support with the condition ”<b>after the decision on main complexity reduction scheme based on PR3 and/or BW3</b>”.</p>
<p><b>15 – Nordic Semiconductor ASA</b></p> <p>Support of standalone PR1 is not expectable to us, as it would further fragment RedCap Ecosystem. Moreover, complexity reduction potential of standalone PR1 has been marginal.</p>
<p><b>16 – ZTE Corporation</b></p> <p>Support</p>
<p><b>17 – Nokia Corporation</b></p> <p>We are fine to consider PR1 as additional complexity reduction solution during the WI phase</p>
<p><b>18 – KDDI Corporation</b></p> <p>We are fine with the proposal.</p>
<p><b>19 – KDDI Corporation</b></p> <p>We are fine with the proposal.</p>
<p><b>20 – China Mobile Com. Corporation</b></p> <p>Support</p>
<p><b>21 – LG Electronics Inc.</b></p> <p>Okay with the FR1 only. Or, removing the “for FR1 and/or FR2” would also be acceptable to us.</p> <p>Whether any of the techniques can also be applied to FR2 can be discussed during the WI phase perhaps after completing the design for FR1.</p>

<p><b>22 – VODAFONE Group Plc</b></p> <p>We share the same view as LG, focus on FR2 can be done after FR1 design is complete</p>
<p><b>23 – China Unicom</b></p> <p>Support</p>
<p><b>24 – Intel Belgium SA/NV</b></p> <p>Support</p>
<p><b>25 – Samsung Electronics Polska</b></p> <p>We don't think this provide the most cost reduction. But we can live with PR1 if this is majority view. One more thing we'd like to clarify, if this is agreed as "add-on" technique, does this mean a potential new UE capability/type? Or eRedcap needs to support both [BW3/PR3] and PR 1? Some clarification is needed in RAN.</p> <p>Moreover, we don't see strong needs to support PR1 in FR 2, which may potentially fragment the market (assuming BW3/PR3 only applies to FR 1)</p>
<p><b>26 – Samsung Electronics Polska</b></p> <p>We don't think this provide the most cost reduction. But we can live with PR1 if this is majority view. One more thing we'd like to clarify, if this is agreed as "add-on" technique, does this mean a potential new UE capability/type? Or eRedcap needs to support both [BW3/PR3] and PR 1? Some clarification is needed in RAN.</p> <p>Moreover, we don't see strong needs to support PR1 in FR 2, which may potentially fragment the market (assuming BW3/PR3 only applies to FR 1)</p>
<p><b>27 – Ericsson LM</b></p> <p>We support the proposal. For PR1 for FR2, a target peak rate higher than 10 Mbps could be considered.</p>
<p><b>28 – Sony Europe B.V.</b></p> <p>Agree that PR1 should be an add-on. PR1 is a key enabler for achieving a 10Mbps peak data rate. We don't see what value the working groups can add to the decision as to whether include this "potential" add-on. We think that RAN plenary can just decide to include the PR1 add-on.</p>
<p><b>29 – Huawei Tech.(UK) Co.. Ltd</b></p> <p>Once again, RAN should be able to decide whether there is a high-enough level of interest to specify PR1 (together with either BW/PR3), and save WG time as a result. In any case, FR1 only, as per other comments.</p>

Based on the initial round summarized in Section 2.6, it does not seem that there will be consensus for including PT1 and/or PT2 in the WI scope.

### 3.3 Lower UE power class

Based on the initial round summarized in Section 2.6, the following can be considered.

**Feedback Form 11: Proposal: Postpone the discussion on whether to include lower UE power class in the WI scope until RAN#98.**

<p><b>1 – Nordic Semiconductor ASA</b></p> <p>OK</p>
<p><b>2 – Classon Consulting</b></p> <p>[for FUTUREWEI] can accept</p>
<p><b>3 – InterDigital</b></p> <p>Ok</p>
<p><b>4 – Apple Poland Sp. z.o.o.</b></p> <p>Ok.</p>
<p><b>5 – Facebook</b></p> <p>OK.</p>
<p><b>6 – CATT</b></p> <p>Fine</p>
<p><b>7 – Spreadtrum Communications</b></p> <p>OK</p>
<p><b>8 – Panasonic Corporation</b></p> <p>Support</p>
<p><b>9 – vivo Mobile Communication Co.</b></p> <p>We do not agree with this proposal. The objective of low UE power class was the outcome of Rel-18 discussion “RAN#94e-R18Prep-05 - RedCap Evolution” (as in RP-212665), it was assumed to be in the follow-up WI for Rel-18 eRedCap after the completion of SI. RAN4 RF TU has been allocated to this objective (RP-213697). Therefore, unless there is consensus to remove or postpone this objective, it should be included.</p> <p>The main questions we see in the initial round was:</p> <p>1) Clarify the exact power class level to be specified. From our perspective we can leave it to RAN4 to decide, if some starting point is needed, 14dBm/20dBm as specified in LTE can be considered.</p>

2) Clarify that in this WI there will be no coverage compensation techniques to be specified for the UE with low power class. We are fine with this.

**10 – Sierra Wireless**

Support

**11 – Qualcomm Incorporated**

We agree with the proposal. Whenever the decision is made to add this objective, the decision should include the target power level(s).

**12 – Xiaomi Communications**

Support

**13 – MediaTek Inc.**

**Not support . We should exclude low-power-class UE since no WG evaluation and recommendation for the benefit of complexity reduction.**

- **If we include low-power-class UE, it is no reason we exclude any complexity reduction scheme in the SI.** We should keep the same principle and include scheme(s) with justified benefit(s) and WG recommendation(s).
- Our understanding on RP-212665 is that we will decide at plenary to keep/remove the (low-priority) objectives. It doesn't mean low-power-class UE is already in the scope.

**14 – ZTE Corporation**

Support.

**15 – QUALCOMM JAPAN LLC.**

We agree that this can be postponed but it would still be useful to have more details on what is the exact target to know what we are talking about. We risk wasting a lot of time in RAN#98 to discuss this.

**16 – QUALCOMM JAPAN LLC.**

We agree that this can be postponed but it would still be useful to have more details on what is the exact target to know what we are talking about. We risk wasting a lot of time in RAN#98 to discuss this.

**17 – Nokia Corporation**

Support

**18 – KDDI Corporation**

Support

**19 – vivo Mobile Communication Co.**

To response MediaTek’s comments, we would like to provide more comments for lower UE power class.

About the complexity reduction for this lower UE power class, it was evaluated for MTC in TR36.888. The observation was “The power amplifier accounts for 25-30% of the cost of the RF module of the reference LTE modem with the RF functional block accounting for 40% of the total cost of the modem. Removal of the power amplifier will result in a 10-12% overall relative cost saving and an output power in the order of 0dBm. A lower saving is seen when the power amplifier is retained but there is a reduction in output power and relaxation in linearity: in this case the saving amounts to 2-7%.”

For NR, assuming the lower power class is 14dBm, if we adopt the same methodology that the cost saving is linearity, even without combining any 5MHz BW reduction options, PR options and PT1/PT2, the cost saving can be 17.6% compared to the Rel-17 RedCap with HD-FDD, 1Rx. This cost saving is much more compared to any BW3/PR3, PR1, PT1/PT2 and any combination of them. Supporting lower UE power class has almost no specification impacts in RAN1, and small specification impacts in RAN4 as the focus is non-coverage-limited scenarios, e.g., indoor industrial. It does not make sense to drop the feature that can bring significate cost saving and power efficiency improvements.

**20 – LG Electronics Inc.**

Okay.

**21 – VODAFONE Group Plc**

If coverage enhancements are granted to not be needed for this definition we are fine to postpone it

**22 – Intel Belgium SA/NV**

**OK**

**23 – Samsung Electronics Polska**

Fine

**24 – Ericsson LM**

Support the proposal

**25 – China Mobile Com. Corporation**

OK

**26 – Sony Europe B.V.**

OK to postpone discussion until RAN#98.

**27 – Huawei Tech.(UK) Co.. Ltd**

It does not seem necessary to delay the decision, since a no consensus status simply means the work is not going ahead. RAN does not have to commit to revisit the point in December in this case.

## 28 – Huawei Tech.(UK) Co.. Ltd

It does not seem necessary to delay the decision, since a no consensus status simply means the work is not going ahead. RAN does not have to commit to revisit the point in December in this case.

### 3.4 Other aspects

Based on the initial round summarized in Section 2.6, the following can be considered. Note that Section 2.6 lists potential additional techniques both under the heading 'Further reduced UE complexity' and under 'Other aspects'.

#### Feedback Form 12: Should any additional techniques (see Section 2.6) be including in the WI scope?

##### 1 – Nordic Semiconductor ASA

- Means to process SIB1 PDSCH with >5 MHz PRB span

Selecting PR3 solves the issue here as discussed in previous round

- Relaxed PDCCH (BD/CCE) processing

Support. This is similar type of add ON as PR1. As argued before, with BW3/PR3, the PDCCH processing is more complex than PDSCH processing. On the other hand, the limits should not be reduced too much, such that the full coexistence with R17 RedCap is achieved in initial access. Also spec effort for this would be at the same level as PR1.

- HD-FDD operation type B

We are supportive here. This would have had significant reduction on BB complexity, this because UL and DL chain concurrent processing can be avoided and same hardware used for both. **However majority of companies in RAN1 voted this to be out of SI scope.**

- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".

Support

- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".

Support

- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction".

Support

- Discuss what frequency ranges to support.

BW3/PR3 should be limited to FR1

- NCD-SSB in idle/inactive mode

Support if fits to TUs, this has been left-over from R17

- RAN4 requirements for all bands, e.g., NR-U and NR SL bands

Support if fits to TUs, this has been left-over from R17

- 2-Rx operation for up to 100 MHz in high FR1 bands

Do not support, this sounds like increased capability, rather than reduced capability feature :)

- Relaxation for upper layer processing, e.g., compact ASN.1

Support, makes sense

## 2 – Classon Consulting

[for FUTUREWEI] It would have been better for the moderator to summarize again the proposals, thanks to Nordic for doing so.

We support including the bullets on early indication and at most one new UE type. We also support adding the statement: ***The existing UE capability framework is used; changes to capability signaling are specified only if necessary. By default, all non-RedCap UE capabilities are applicable for RedCap UEs.***

We do not support HDD, FR2, or 2RX 100MHz devices.

We understand the point on SIB1 processing, we feel there may be ways to do this for BW3 as well as PR3. But it may be best to discuss in the WG.

It would be good to resolve here also which rel-17 RedCap features are supported.

## 3 – Ericsson LM

[As moderator]

This Feedback Form asks whether any additional techniques should be included in the WI scope and refers to the summary in Section 2.6. My intention was to refer to the following techniques listed in Section 2.6, but it is of course possible to bring up other potential additional techniques as well in Feedback Form 12.

- Means to process SIB1 PDSCH with >5 MHz PRB span
- Relaxed PDCCH (BD/CCE) processing
- HD-FDD operation type B
- NCD-SSB in idle/inactive mode
- RAN4 requirements for all bands, e.g., NR-U and NR SL bands

- 2-Rx operation for up to 100 MHz in high FR1 bands
- Relaxation for upper layer processing, e.g., compact ASN.1

For the following bullets listed in Section 2.6, my intention was to simply implement them in the updated draft WID that I will provide at the end of the intermediate round, and then we can take it from there.

- Change "5G aims to accelerate..." to "One 5G aim is to accelerate...".
- Change "The SI" to "The WI".
- Add the sentence "Techniques for further UE complexity reduction have been studied in the study item documented in TR 38.865".
- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".
- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".
- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction".

Sorry that this was not more clear in the discussion document, but hopefully it is clear enough now. Let me know if there are any comments or questions.

#### **4 – Apple Poland Sp. z.o.o.**

On '2-Rx operation for up to 100 MHz in high FR1 bands', 100 MHz for RedCap can provide an interesting combination of UE features for some applications/use cases, in general we are quite supportive if that can be adopted in Rel-18 eRedCap. We encourage companies to be open to that discussion.

In addition, we support to add 'SIB1', 'Relaxed PDCCH' and NCD-SSB in idle/inactive mode.

#### **5 – Facebook**

We can support to include these scope in Rel-18 WI. Also the proposed updating bullets are fine.

- Relaxed PDCCH (BD/CCE) processing
- HD-FDD operation type B
- NCD-SSB in idle/inactive mode
- RAN4 RF/RRM requirements for all bands, e.g., NR-U and NR SL bands
- 2-Rx operation for up to 100 MHz in high FR1 bands
- Relaxation for upper layer processing, e.g., compact ASN.1

## **6 – Spreadtrum Communications**

We think “NCD-SSB in idle/inactive mode” can be considered, since it brings benefits without negative impacts.

For “SIB1 PDSCH with >5 MHz PRB span” and “relaxed PDCCH (BD/CCE) processing”, we think these are the details of the main solution, and can be discussed in WI phase.

We are open to other potential techniques or enhancements, while the total available or required TU shall be carefully estimated before make decision.

## **7 – Spreadtrum Communications**

Additionally, we are fine with all the changes listed by moderator, e.g., the changes for justification part and the added subbulet and notes for objective part.

## **8 – vivo Mobile Communication Co.**

- For means to process SIB1 PDSCH with >5 MHz PRB span, since SIB1 does not require HARQ-ACK feedback, we do not see additional time or other means are needed.
- We are open for Relaxed PDCCH (BD/CCE) processing
- We are supportive for NCD-SSB in idle/inactive mode. This is down-scoped in RAN due to limited time although RAN1 already made WA. It should be included in R18.
- For RAN4 requirements for all bands, e.g., NR-U and NR SL bands, we are a little bit worried about RAN4 TU.
- For 2-Rx operation for up to 100 MHz in high FR1 bands, it has some dependency with the XR WI. We would like to see how the progress is made in XR WI first.
- For relaxation for upper layer processing, e.g., compact ASN.1, we are open for it.

## **9 – Sierra Wireless**

We support the following additions:

Add a sub-bullet stating that ”An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate”.

- Add a note that ”Both 15 kHz SCS and 30 kHz SCS are supported in FR1”.
- Add a note ”Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction”.

BW3/PR3 should be limited to FR1

- RAN4 requirements for all bands, e.g., NR-U and NR SL bands

## **10 – Qualcomm Incorporated**

Qualcomm will submit two separate comments in this section, apologies for that. This current comment is on "2-Rx operation for up to 100 MHz in high FR1 bands".

Just want to emphasize that this item should not be viewed as up-scoping. As a matter of fact, no RAN1 work is involved in this beyond making the 20MHz limitation optional. The proposal here is to make it a Plenary decision whether 2Rx operation for the target devices (e.g. VR glasses) should be supported or not. And if it is decided that it should be supported, then the target devices should be called RedCap devices. No work in the RedCap WI would be necessary.

## **11 – QUALCOMM JAPAN LLC.**

We would like to ask companies to understand our proposal for ASN.1 processing relaxation is meant to avoid changing the existing RRC processing time requirements, which, if changed, will impact network implementation, e.g. when to give UL grant for L3 response (you can think of it as a L3 processing time relaxation).

As we mentioned earlier, we are fine to have a smaller objective than a "compact ASN.1", as we observe companies consider it is too much work. And repeating our comment, we think relaxing the RRC processing for UE capability enquiry procedure will largely help achieving the goal of not changing the RRC processing time.

## **12 – QUALCOMM JAPAN LLC.**

We would like to ask companies to understand our proposal for ASN.1 processing relaxation is meant to avoid changing the existing RRC processing time requirements, which, if changed, will impact network implementation, e.g. when to give UL grant for L3 response (you can think of it as a L3 processing time relaxation).

As we mentioned earlier, we are fine to have a smaller objective than a "compact ASN.1", as we observe companies consider it is too much work. And repeating our comment, we think relaxing the RRC processing for UE capability enquiry procedure will largely help achieving the goal of not changing the RRC processing time.

## **13 – Nordic Semiconductor ASA**

@QC, it is hard to understand that device which supports 100MHz in C-band could be labeled a RedCap device. Number of layers 1 or 2 can be already signaled per band. This would result in eRedCap being more complex than RedCap, and this is not acceptable.

## **14 – ZTE Corporation**

Those additional techniques should be deprioritized, since the main techniques, e.g., BW3,PR3,PR1 are still not decided yet. We should firstly focus on the main techniques.

Additionally, for the text modification bullets, we are generally fine except for the following one

- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".

Since PR3 or BW3 is still not down-selected yet, it is uncertain that whether the separate early indication is needed. Therefore, it is suggested to remove following bullet and discuss this issue in WI phase.

## 15 – Nokia Corporation

We don't see it's sensible to increase the scope with additional items.

The following list show how many different items there are, items which are likely to fragment RedCap market, increase significantly workload and make Release 17 and 18 RedCaps incompatible between each other (like with compact ASN.1 proposal)

- Means to process SIB1 PDSCH with >5 MHz PRB span
- Relaxed PDCCH (BD/CCE) processing
- HD-FDD operation type B
- NCD-SSB in idle/inactive mode
- RAN4 requirements for all bands, e.g., NR-U and NR SL bands
- 2-Rx operation for up to 100 MHz in high FR1 bands
- Relaxation for upper layer processing, e.g., compact ASN.1

If any additional items are included, then proper study on the implications and benefits has to conducted first.

## 16 – Xiaomi Communications

We support to add the following items into the R18 eRedCap WID:

- NCD-SSB in idle/inactive mode
- Add the sentence "Techniques for further UE complexity reduction have been studied in the study item documented in TR 38.865".
- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".
- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".
- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction".
- Discuss what frequency ranges to support.

The following items are out of scope of R18 eRedCap SI and is not preferred by us:

- Relaxed PDCCH (BD/CCE) processing
- HD-FDD operation type B

In addition, for means to process SIB1 PDSCH with >5MHz PRB span, we think it mainly depends on UE implementation and has no impact on the specification. For 2-Rx operation for up to 100MHz in high FR1 bands, it makes the device more complex than R17 RedCap, which can't be accepted by us. It is more properly to be discussed in the XR WI.

**17 – LG Electronics Inc.**

For those changes to be applied for the justification part, we support them.

For the (additional) techniques summarized by the Moderator, none of them needs to be included at this RAN plenary meeting.

Some of them may need to be added later on depending on the discussion in the WG, but only if it is considered necessary to support the main or already agreed techniques.

**18 – LG Electronics Inc.**

For those changes to be applied for the justification part, we support them.

For the (additional) techniques summarized by the Moderator, none of them needs to be included at this RAN plenary meeting.

Some of them may need to be added later on depending on the discussion in the WG, but only if it is considered necessary to support the main or already agreed techniques.

**19 – LG Electronics Inc.**

For those changes to be applied for the justification part, we support them.

For the (additional) techniques summarized by the Moderator, none of them needs to be included at this RAN plenary meeting.

Some of them may need to be added later on depending on the discussion in the WG, but only if it is considered necessary to support the main or already agreed techniques.

**20 – MediaTek Inc.**

- **We shall not discuss any proposal from t-docs marked as “not handled”, e.g. 100MHz RedCap**
- **We shall not discuss any proposal not studied in the SI**

**21 – VODAFONE Group Plc**

We support at least NCD-SSB in idle/inactive mode as it is leftovers work from R17. Some techniques may depend on the decision on BW3/PR3 while others can be discussed at the WG depending on the progress of the WI. The Justification notes seem OK to us

**22 – Intel Belgium SA/NV**

- Means to process SIB1 PDSCH with >5 MHz PRB span

We prefer to stick to the definition on BW3/PR3 in RAN1. For BW3 and PR3, the maximum number of PRBs is limited to 25 or 11 for SCS 15 or 30kHz, which applies to both UE-specific (unicast) and common (broadcast) channels

We are OK for the following bullets

- Add a sub-bullet stating that ”An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate”.

- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".
- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction" NCD-SSB in idle/inactive mode

### 23 – CATT

We do not think any additional technique listed in section 2.6 should be included in WID.

### 24 – Ericsson LM

Means to process SIB1 PDSCH with >5 MHz PRB span: This can be discussed during the WI phase in connection to the down-selection or merge of BW3 and PR3.

Relaxed PDCCH (BD/CCE) processing: No, this should be avoided as it would lead to significant network impacts (e.g., scheduler complexity) and coexistence impacts (e.g., during initial access). Also, the complexity reduction benefits of relaxed PDCCH processing have not been properly studied.

HD-FDD operation type B: No, this should be avoided due to unclear complexity reduction benefits and limited TU budget.

NCD-SSB in idle/inactive mode: No

RAN4 requirements for all bands, e.g., NR-U and NR SL bands: No

2-Rx operation for up to 100 MHz in high FR1 bands: No

Relaxation for upper layer processing, e.g., compact ASN.1: No

### 25 – Samsung Electronics Polska

· Means to process SIB1 PDSCH with >5 MHz PRB span =>**No**. It only targets at PR3 but not BW3. In our view, the coverage of SIB1 with multiple combination has no issue even with BW3.

· Relaxed PDCCH (BD/CCE) processing=> **No**. This has not been studied in SI, and this has duplication with R16 UE power saving.

· HD-FDD operation type B=>**No**. This has not been studied in SI.

· NCD-SSB in idle/inactive mode => **No**. We don't see strong needs for NCD-SSB in idle/inactive mode. This would require significant standardization efforts in WGs while it would not "reduce" the complexity but just add additional option.

· RAN4 requirements for all bands, e.g., NR-U and NR SL bands =>**No**. In our understanding, this may lead to RAN 1 impact as well. and it has not been well studied.

· 2-Rx operation for up to 100 MHz in high FR1 bands =>We are also interested in 2-Rx with 100Mhz for FR 1 bands for XR. However, we think it is more suitable to be discussed in XR (maybe in RAN 4 only) other than eRedcap, since this eRedcap WI focuses on design of a device with 10Mbps peak data rate.

· Relaxation for upper layer processing, e.g., compact ASN.1 =>**No**. This type of enhancement hasn't been studied in SI phase, but it requires thorough review on the existing ASN.1 in RAN 2. As we do not

see a critical issue to reuse the existing ASN.1 for the RedCap enhancement, this enhancement may be considered in later release e.g. when RAN2 starts to discuss the support of less than 5 MHz BW.

#### **26 – Sony Europe B.V.**

We think that HD-FDD Type B is an important technique for reducing RF complexity. It also facilitates dual-mode LTE/NR devices in our opinion.

We are OK with considering means to process SIB1 PDSCH with >5MHz span. Maybe this could be a sub-objective of BW3 / PR3.

Relaxation of upper layer processing, e.g. compact ASN.1 is of interest. Maybe RAN2 could perform an initial feasibility study of this.

Hence, our preferences are:

- HD-FDD operation type B
- Means to process SIB1 PDSCH with >5 MHz PRB span
- Relaxation for upper layer processing, e.g., compact ASN.1

#### **27 – Huawei Tech.(UK) Co.. Ltd**

Similar view as others, per RAN chair guidance, no upscoping is allowed at this meeting. Therefore, it is inappropriate to discuss the following items

- “HD-FDD operation type B”
- “2-Rx operation for up to 100 MHz in high FR1 bands”
- RAN4 requirements for all bands, e.g., NR-U and NR SL bands
- NCD-SSB in idle/inactive mode
- Relaxed PDCCH (BD/CCE) processing

Regarding the second part on clarifications and the notes, the six items in the list are OK for us. However, the following bullet is missing from the list. It is unclear how to address it and whether it is kept in the next version of draft WI. More clarification from moderator seems needed, and some further effort in RAN on the frequency ranges (hence we use [...] for now, temporarily).

***- This WI considers [all frequency ranges and] all applicable duplex modes unless otherwise specified.***

#### **28 – China Mobile Com. Corporation**

- Means to process SIB1 PDSCH with >5 MHz PRB span: this is related to the down selection of BW3 or PR3. As Xiaomi comments, it can be UE implementation.

- Relaxed PDCCH (BD/CCE) processing: this has been discussed before we made the SI scope, and it has been excluded.
- HD-FDD operation type B: Not support.
- NCD-SSB in idle/inactive mode: Currently, paging can only be configured on BWP if it contains CD-SSB, if it is to extend paging to BWP with NCD-SSB, R18 Ues may have higher capability than R17.
- 2-Rx operation for up to 100 MHz in high FR1 bands: This is not a reduced capability UE, since the basic feature group 28-1 of RedCap has a definition for the BW of both FR1 and FR2
- For others, we think the limited TU should be considered.

Generally OK with the following except the early indication one. And share similar view as ZTE, whether early indication is needed can be discussed during WI.

- Change "5G aims to accelerate..." to "One 5G aim is to accelerate..."
- Change "The SI" to "The WI".
- Add the sentence "Techniques for further UE complexity reduction have been studied in the study item documented in TR 38.865".
- Add a sub-bullet stating that "An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate".
- Add a note that "Both 15 kHz SCS and 30 kHz SCS are supported in FR1".
- Add a note "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction".

If there are any other comments, they can be provided below.

### Feedback Form 13: Other comments on the WI scope

#### 1 – ZTE Corporation

'all frequency ranges' is not clear in the Note, which may cause the different understanding, e.g., frequency ranges is referring to the frequency bands supported by Rel-17 RedCap UE, or all the FR1 frequency ranges or all the FR1 and FR2 frequency ranges. Moreover, the applicable frequency ranges should be discussed by RAN4 based on the WI scope. Therefore, it is suggested to remove it in current stage as follows.

- This WI considers ~~all frequency ranges and~~ all applicable duplex modes unless otherwise specified.

#### 2 – MediaTek Inc.

- The first sentence of the "Objective" should be aligned with the justification ("To further expand the market for RedCap **use cases with relatively low cost, low energy consumption, and low data rate requirements**"), and therefore the following revision is suggested:

- o To ~~further expand the RedCap~~ support use cases **with relatively low cost, low energy consumption, and low data rate requirements w.r.t Rel-17 RedCap UEs**, the following enhancements ~~can be considered shall be specified~~:

- With the use case characteristics already clarified, we also suggest to remove following paragraph in "Justification" since it looks dummy in providing any useful information:

- o ~~Now when the foundation has been laid in Rel-17, enhancements can be considered to improve the support for the mentioned use cases and also to expand RedCap into a new range of use cases such as smart grid.~~

### 3 – Samsung Electronics Polska

We support the points raised by ZTE on bands supported by eRedcap. It should be clarified in WID.

## 3.5 Summary of intermediate round

### Further reduced UE complexity

**Proposal: The main technique for further UE complexity reduction is based on BW3 and/or PR3, to be down-selected or merged in WI phase.**

About half of the responding companies support the proposal, and the other half want to do the down-selection now. Some companies propose to agree that the down-selection should be done in WI phase before RAN#98.

**Proposal: Whether to adopt PR1 as a potential add-on for FR1 and/or FR2 is decided during WI phase.**

The above proposal was supported by a large majority of the responding companies. However, some companies prefer to make the decision already now, and some companies only want to prioritize FR1 or only support FR1. Some companies want to clarify whether PR1 should always be an add-on or can be used standalone.

### Lower UE power class

A large majority of the responding companies are fine with postponing the discussion on whether to include lower UE power class in the WI scope until RAN#98, at least assuming that the potential objective does not include any coverage compensation work. A few companies want to make the decision now.

### Other aspects

The following potential additional techniques were discussed:

1. Means to process SIB1 PDSCH with >5 MHz PRB span
2. Relaxed PDCCH (BD/CCE) processing
3. HD-FDD operation type B

4. NCD-SSB in idle/inactive mode
5. RAN4 requirements for all bands, e.g., NR-U and NR SL bands
6. 2-Rx operation for up to 100 MHz in high FR1 bands
7. Relaxation for upper layer processing, e.g., compact ASN.1

None of the potential additional techniques listed above achieved large support for listing them as explicit objectives in the WI scope.

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## 4 Final round

### 4.1 Draft WID

Based on the guidance from the Wednesday GTW session, the updated draft WID in WID-v000.docx can be considered.

#### **Feedback Form 14: Proposal: Approve the updated draft WID (WID-v000.docx)**

##### **1 – Nordic Semiconductor ASA**

Comment#1: Based on discussion we had in online, it is open or there has been concerns on how to handle SIB1 in BW3

o UE bandwidth reduction in FR1

§ 5 MHz BB bandwidth only for PDSCH (~~for both unicast and broadcast~~ FFS: SIB1 reception) 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.

Comment#2: It should be clarified that PR1 is an add-on to BW3, this can be captured as follows

o UE bandwidth reduction in FR1

§ 5 MHz BB bandwidth only for PDSCH (~~for both unicast and broadcast~~ FFS: SIB1 reception) 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.

o For a UE with reduced bandwidth, further specify

§ Relaxation of the constraint ( $vLayers \cdot Qm \cdot f \geq 4$ ) for peak data rate reduction

§ The relaxed constraint is, e.g., 1 (instead of 4).

§ The parameters ( $vLayers, Q_m, f$ ) can be as in Rel-17 RedCap.

## 2 – Classon Consulting

[for FUTUREWEI] Though our preference is just to Note as proposed in our paper RP-222061 that the existing SIB1 transmission is reused without enhancement, we are OK with the Nordic updates. In any case, per the TR we know that: "For broadcast channels ... Rel-18 UE may utilize additional processing/-combining to compensate the coverage difference when considering coexistence and minimizing impact on legacy UEs." This means that even for BW3, while we may have restricted contiguous resource allocations for the HARQ channels, SIB1 can be reused.

## 3 – Panasonic Corporation

TR 38.865 captures following in section 7.2.2.

*Note 1: BW3 may have different degrees of impacts on the post-FFT data buffering depending on the scheduling aspects (cross-slot scheduling, RF retuning, etc.).*

Based on this, RAN1 is going to discuss whether some scheduling restriction is applied to limit the post-FFT buffering as the total of 5MHz. If there is no consensus on the scheduling restriction, our understanding is no complexity difference between

contiguous resource allocation only (BW3) and to support non-contiguous resource allocation (PR3). It is surely related to Nordic's comment on SIB reception (Not only SIB1 but also other common PDSCH channels when these are shared). Therefore, our proposal is to add following bullet,

FFS: non-contiguous resource allocation of the total of 5MHz PRBs depending on the scheduling restriction discussion.

## 4 – Panasonic Corporation

One may argue that, if PDCCH decoding is very fast, BW3 can save post-FFT data buffering. But my understanding is, if PDCCH decoding is very fast, post FFT data buffering be save regardless of contiguous or non-contiguous.

## 5 – Intel Belgium SA/NV

Regarding the description on BW3, we support the current draft WID, i.e., to stick to what agreed in SI and TR. That is the reception unicast PDSCH and broadcast PDSCH are both limited in 5MHz (25 or 11 PRBs for SCS 15 or 30kHz). We don't it is helpful to reopen a discussion to allow >25 or >11 PRB reception for broadcast PDSCH.

Considering a UE anyway should support reception in 20MHz for PDCCH, CSI-RS, etc., it would be reasonable to assume UE can do FFT of (up to) 20MHz in all OFDM symbols. Consequently, the difference between BW3 and PR3 is only about resource allocation in 5MHz bandwidth or 20MHz bandwidth. The total number of allocated PRBs is 25 or 11 for SCS 15 or 30kHz. We share same view as Panasonic and prefer to allow the use of non-consecutive resource allocation in up to 20MHz. However, if majority companies want to limit to 5MHz bandwidth, we are also fine for compromise

Regarding PR1, we share same view as Nordic. PR1, if applicable, should be an add-on to the basic BW reduction option BW3. This is to align with what agreed in TR. It doesn't help RAN1 discussion if both BW3 and PR1 are allowed as the basic option.

Regarding the bullet on early identification. it is appreciated the supporter can clarify why 'the network can configure it to be the same as used for Rel-17 RedCap UEs'. In such case, can network differentiate R17 RedCap UE and R18 RedCap UE? If not, why early identification of Rel-18 RedCap UE is configured in such way.

## 6 – Spreadtrum Communications

Thanks for the draft WID, our further comments as follows:

1. For PR1, we share the similar views as Nordic that the PR1 should be a “add-on” solution, this also reflects the SI's recommendation and the majority views from last two NWM round. We should make it clear in the WID to avoid unnecessary duplicated discussion in WI phase.

2. Other minor editorial suggestions

- we suggest to adjust the order of the objectives, e.g., First objective: Complexity/cost reduction, second objective: Power saving/energy efficiency enhancements, as complexity/cost reduction is the most important objective for this item.
- we suggest to change the wording “Rel-18 RedCap” to “Rel-18 eRedCap” in justification and objective part since the WID title is “New WID on **enhanced** support of reduced capability NR devices”.

## 7 – ZTE Corporation

Comment 1: for PR1, we also think what we agreed is PR1 is supported as add-on technique, which should be reflected in the WID. Additionally, the explanation for relaxation of the constraint could be the sub-bullets. Therefore, following text based on Nordic's update is proposed.

**o For a UE with reduced bandwidth, further specify, UE peak data rate reduction in FR1**

- Relaxation of the constraint ( $vLayers \cdot Q_m \cdot f \geq 4$ ) for peak data rate reduction
  - The relaxed constraint is, e.g., 1 (instead of 4).
  - The parameters ( $vLayers, Q_m, f$ ) can be as in Rel-17 RedCap.

Comment 2: Early indication configured by NW precludes the mandated msg3 indication similar as Rel-17. We do not think it is appropriate to specify the detailed methods for the early indication in current stage. Further discussion in RAN1 and RAN2 is needed. Therefore, it is suggested to modify it as follows

~~o An early indication can be configured by the network, and if an early indication is **supported** configured, the network can configure it **can** to be the same as used for Rel-17 RedCap UEs, or separate.~~

## 8 – ZTE Corporation

Comment 1: for PR1, we also think what we agreed is PR1 is supported as add-on technique, which should be reflected in the WID. Additionally, the explanation for relaxation of the constraint could be the sub-bullets. Therefore, following text based on Nordic's update is proposed.

**o For a UE with reduced bandwidth, further specify, UE peak data rate reduction in FR1**

- Relaxation of the constraint ( $vLayers \cdot Qm \cdot f \geq 4$ ) for peak data rate reduction
- The relaxed constraint is, e.g., 1 (instead of 4).
- The parameters ( $vLayers, Qm, f$ ) can be as in Rel-17 RedCap.

Comment 2: Early indication configured by NW precludes the mandated msg3 indication similar as Rel-17. We do not think it is appropriate to specify the detailed methods for the early indication in current stage. Further discussion in RAN1 and RAN2 is needed. Therefore, it is suggested to modify it as follows

~~o An early indication can be configured by the network, and if an early indication is **supported** configured, the network can configure it **can** to be the same as used for Rel-17 RedCap UEs, or separate.~~

## 9 – Facebook

We are same view with Intel for BW3 and PR1.

For the early identification, RAN first have clear understanding for the usage and benefits and further discuss the reason to distinguish Rel-17 RedCap UE and Rel-18 RedCap UE. Also, what is expected benefits in gNB scheduling perspectives?

**Also, we just want to clarify when RAN will discuss the other aspect WI objectives?**

As you know that RAN had make clear principle for the RedCap device not to contain any restriction for the all NR operating bands in Rel-17.

But, RAN4 specification had some misalignments and uncertainties from the principle.

So, we request to add the leftover issues (not support any specific NR operating bands e.g. NR-U and NR-SL for RedCap device) shall be included in Rel-18 RedCap enh. WI to resolve this specification hole and align with the RAN principle. Also we think that these leftover issues are only impacted in RAN4 WG TU. If I missed some other WG impact, then please give your comments which issues will be addressed in other RAN WG.

So, we would like to add this leftover issues in the objectives of the Rel-18 WID.

## Leftover issues from Rel-17 RedCap WI

- Specify the additional UE RF/RRM core requirements not to contain any restriction to support all NR operating bands E.g.) NR-U/NR SL operating bands [RAN4]

### 10 – vivo Mobile Communication Co.

**Comment#1:** For BW3, it is better to clarify that the 5MHz BB bandwidth for data and broadcast channels within the 20MHz is fixed or it can be determined based on the scheduling DCI. The reason why BW3 can have additional cost saving compared to PR3 is the Post-FFT data buffering for BW3 does not need to buffer 20MHz for the whole slot. We are also fine if everyone is fine to further clarify it within the WG. But better to have common understanding about what is BW3.

#### **Comment#2:**

We disagree the bullet “An early indication can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate.” in the draft WID, because:

1. This has not been discussed and recommended in study item. Therefore this should not be added in the WID.
2. Low power class has been assumed in the WID since last December with RAN4 RF TU allocated, however, it is now postponed to next meeting. We are very surprised this new proposal (additional early indication) coming from nowhere is now included, considering the RAN Chair’s guidance of no upscoping of Rel-18 items in this meeting.
3. Even though it might be considered as a new proposal, there are only several (5?) companies commented on the need for this early indication during the previous discussion. We don’t think there is enough support for it. While some other aspects got more supporters are not considered. We think all the other aspects should be treated fairly.
4. We understand that the early identification for Rel-18 eRedCap UE can be the same as used for Rel-17 RedCap UEs which is already covered by the last bullet that “The existing UE capability framework is used, and changes to capability signalling are specified only if necessary. By default, all non-RedCap UE capabilities are applicable for RedCap UEs.” About the network can configure **separate early identification** for Rel-18 eRedCap UE, it is motivated by the SIB1/OSIs/MSG2 etc. But they are not coverage bottle neck channels and even if separate early identification is supported, SIB1 still can be scheduled exceeding 5MHz. Separate early identification cannot be the solution for SIB1 scheduling. If companies really have concern on SIB1, then we should select PR3, not BW3. Thus, we are not convinced the need for this **separate** early indication.

### 11 – Guangdong OPPO Mobile Telecom.

We think the WID should reflect what we had discussed in the last GTW, E.g. BW3 agreed, PR1 should be combined.

1. For the BW3, 2nd sub-bullet of the 1st main bullet should make it more clear. The BWP up to 20MHz should be not only “allowed”. It have to support. ”§ The other physical channels and signals are still able to use a BWP up to the 20 MHz maximum UE RF+BB bandwidth.”

2. We see PR1 only be meaningful if it is with BW3 UE type. Thus, the "one Rel-18 RedCap UE type for further UE complexity reduction" is reflecting the principle. A Rel-18 RedCap UE should be only support 5MHz data AND  $vLayers \cdot Qm \cdot f \geq 1$ . If they are detached, that will mean 2 UE types.

"Aim to dDefine at most one Rel-18 RedCap UE type for further UE complexity reduction."

3. We doubt the earlier identification is needed separately. We can say ", or, separate if found necessary by further discussion."

## 12 – Qualcomm Incorporated

We cannot agree with limiting PR1 to be an add-on only. As it was mentioned before, an LTE Cat1bis + NR RedCap dual mode UE needs to have ~10Mbps peak data rate, which necessitates PR1, while for this UE, BW3 is a waste because the UE is forced to be able to handle full RB allocation anyway for LTE. It makes no difference whether any percentage gain there would be with BW3, this UE is not allowed to use it due to its support of LTE.

Many, if not most redCap/eRedCap UEs will be such dual mode for obvious reasons.

For the same reason, we do not agree with the following addition in the WID:

"Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction."

It could be replaced, for example, with the following:

"Aim to define at most one additional Rel-18 RedCap UE type for further UE complexity reduction beside PR1."

## 13 – Xiaomi Communications

We are fine with the draft WID

## 14 – Nordic Semiconductor ASA

"It makes no difference whether any percentage gain there would be with BW3" strongly disagree with this statement, since NR is clearly more demanding in terms of processing timelines and thus chipset requirements. In fact, BW3 + Cat1bis is much better match here.

What is clear from R18 SID, however, is that introducing PR1 on top of R17RedCap makes no difference.

Therefore, to avoid fragmentation of market, there should not be more than two RedCap types.

R17 RedCap + CAT4 or lower (50% reduction)

R18 RedCap + CAT1 or lower (including LTE-M) (additional 10% reduction)

There is no need to further fragment market by introducing

- **R17 RedCap with PR1 (in fact this was discussed during R17 RedCap WID but consensus in RAN1 could not have been achieved, why situation should be different now), or**

- R17 RedCap with 100MHz support in C-band

If QC insists on introducing yet another RedCap UE (R17+PR1) then as per guidance from chairman, lets work on BW3 only for now, and return to PR1 in Dec Plenary, i.e. remove PR1 completely from WID for now. Thanks.

#### 15 – NTT DOCOMO INC.

##### Comment#1

For PR1, we have a same view as Nordic that it should be considered as add-on feature on top of BW3 and should not be allowed to support as standalone. PR1 would be helpful for further peak data rate reduction, however, the complexity reduction gain captured in TR is quite small. Therefore, we are fine with the update by Nordic to make it clear, i.e., **”For a UE with reduced bandwidth, further specify,”** , not to result in two types of Rel-18 eRedCap UE.

##### Comment#2

For the very last sub-bullet for Complexity/cost reduction, some UE capability for non-RedCap UE may not be applicable for Rel-18 eRedCap UE as discussed for Rel-17 RedCap, and hence we propose to update as follows;

By default, all non-RedCap UE capabilities are applicable for **Rel-18 eRedCap UEs unless otherwise specified.**

#### 16 – LG Electronics Inc.

[Comment#1]

For the UE bandwidth reduction option BW3, even if there may be different views on details, there has been a clear definition in the TR on the BW3 which is as described by the moderator in the draft WID. We think **it is NOT desirable to modify definition on BW3 at this stage.** Combining the definition on BW3 from the TR and the Note in the draft WID (“Coexistence with non-RedCap UEs and Rel-17 RedCap UEs should be ensured.”), anyway we need to discuss in RAN1 e.g., how to provide Rel-18 RedCap UEs with the broadcast or common PDSCH while considering the legacy PDSCHs for non-RedCap and Rel-17 RedCap UEs. So, rather than entailing details on BW3 in WI objectives, we prefer to **leave the details open for further WG discussion.**

[Comment#2]

For PR1, we also think it should be considered as potential add-on and whether to specify the PR1 should be decided during the WI phase as recommended in TR conclusion. But, the draft WID seems to promote the PR1 as if it was already agreed to specify it in Rel-18.

If we are not mistaken, for PR1, it should be formulated e.g., as follows:

**“RAN1 starts discussion on whether to specify PR1 as an add-on to the UE bandwidth reduction technique.”**

## 17 – CATT

We share the similar view as Intel and LG that it is desirable to stick to the definition of BW3 as in the TR and details can be further discussed in RAN1. So we are fine with the UE BW reduction part in the current WID.

Regarding early indication, we share the comments from some other companies that whether separate indication is supported/configured or not should be further discussed and should be removed from the WID for now.

## 18 – Samsung Electronics Polska

### For BW 3:

We are fine with current WID description, which follows the description in TR. We don't agree to make SIB as FFS.

Regarding on the "contiguous resource allocation" vs "non-contiguous resource allocation", we think it should be better clarified in RAN plenary. In our understanding, the analysis/evaluation in RAN 1 assumed contiguous RA for BW 3.

Moreover, we also want to clarify that for BW 3, we assume "Post-FFT buffer" reduction, that is, UE only needs to buffer couple of symbols of 5MHz before PDCCH is decoded, although how much to buffer is up to UE implementation. UE is not required to buffer more than 5MHz in frequency domain.

### For PR1:

In our understanding, we will introduce one new eRedcap, with BW 3 + PR1. we are not aiming to create BW3, BW 3+ PR1, PR1+Rel-17 Redcap, considering fragmentation. We think this needs to be clarified either in WID or noted in RAN chairman note.

### For early identification:

For early identification, we also want to keep it open, since there was no sufficient discussion on how to support early identification, we think WG can have some further discussion. The following changes is proposed:

o An early indication can be configured by the network, ~~and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate.~~

### Others:

In our understanding, this cost reduction only applies for FR 1, therefore, it will not have impact on 38.101-2, which is related to FR2.

## 19 – Nokia Corporation

We support the current WID. For the early indication we expect that Release 17 framework would be used unless something fundamental is identified why this should not be the case.

The current text "Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction." seems to capture the majority view based on the comments received, thus perhaps best to stick with this wording for now and possible see later the situation once work has progressed more.

## 20 – Huawei Tech.(UK) Co.. Ltd

We support the principles in the WID, though some final clarifications are needed before approval:

- It should be clear that PR1 is only on top of BW3, as this is what the SI looked at and TR reported on. Some kind of change is required, e.g.: “**For a UE with UE bandwidth reduction defined above**, UE peak data rate reduction in FR1”.
- The text “all frequency ranges and” should be removed from the note “This WI considers ~~all applicable frequency ranges and~~ all applicable duplex modes unless otherwise specified” at this stage because BW3 is adopted and its 5MHz BB bandwidth is not applicable to FR2, nor is PR1 applied to FR2.
- In section 5, TS 36.133 should be removed as Rel-17 WID because of no EN-DC involvement (also not present in Rel-17 WID).
- In section 5, TS 38.101-2 should be removed because of no FR2 involvement.
- In section 7, RAN WG3 should be removed similar to Rel-17 WID, and since there are no RAN3 specs impacted.
- In section 8, CT4 may be needed according to the section 8 of the running SA WID SP-220803. Similarly, should mention “**possibly CT4**” in the note under the corresponding objective for eDRX.

## 21 – VODAFONE Group Plc

A clarification on the “contiguous resource allocation” vs “non-contiguous resource allocation” should be done in RAN plenary to have a common understanding on how BW3 differs from PR3.

PR1 should be clarified as an add-on technique to BW3 in order to align with what is stated on the bullet below “Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction.”

## 22 – MediaTek Inc.

Thanks for moderator proposal, and below please find our suggested revisions:

- **Clarification on BW3 definition is needed** and the following revision for bandwidth reduction is suggested:
  - o “UE **BB** bandwidth reduction in FR1
    - 5 MHz BB bandwidth only for PDSCH (for both unicast and broadcast) and PUSCH, with 20 MHz RF bandwidth for UL and DL
    - **Clarify the BB bandwidth is transmission bandwidth or processing bandwidth**
    - **Clarify assumptions on whether UE can buffer 20 MHz post-FFT data for PDSCH reception in a slot**

- The other physical channels and signals are still allowed to use a BWP up to the 20 MHz maximum UE RF+BB bandwidth.”
  
- **Main sentence is too open-ended**, and we suggest to the following revision for consistency with ”Justification”:

  - **”To support use cases requiring relatively lower cost, lower energy consumption, and lower data rate requirements than Rel-17 RedCap UE, the objective is to specify support for the following enhancements:”**

  
- **Applicability is only in FR1** since both complexity reduction schemes are only studied for FR1:
  - ”Further reduced UE complexity **in FR1** [RAN1, RAN2, RAN4] ”
  
- Further discussion and decision are needed for whether to introduce additional UE type (can be a R18 feature instead), whether to introduce additional early indication, and inheritability of the capability
  - **”If needed, Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction.”**
  - **”If needed, specify an early indication **that** can be configured by the network, and if an early indication is configured, the network can configure it to be the same as used for Rel-17 RedCap UEs, or separate.”**
  - ”The existing UE capability framework is used, and changes to capability signalling are specified only if necessary. ~~By default, all non-RedCap UE capabilities are applicable for RedCap UEs.~~”
  
- Revision to the note for the consistency with ”Justification”:

  - **”The work defined as part of this WI is to provide NR support for low-tier devices between existing LPWA UEs and the capabilities of Rel-17 RedCap UE and not to overlap with LPWA use cases.”**

## 23 – Ericsson LM

We support the WID as is.

## 24 – Sony Europe B.V.

We are basically OK with the WID.

### Comment#1

Our understanding is that PR1 would be an add-on to BW3, hence we support text of the form “**For a UE with UE bandwidth reduction defined above**, UE peak data rate reduction in FR1”.

### Comment#2

BW3 does not need further clarification. Details of BW3 should be discussed in RAN1 and do not need to be discussed in RANP (in particular, details referring to post-FFT buffering can be discussed, if even necessary, in RAN1: this is not the sort of discussion for RANP).

### Comment#3

[this doesn't affect the draft WID text] Both BW3 and PR3 support non-contiguous allocation. The non-contiguous allocation in BW3 would have to be contained within 5MHz, whereas the non-contiguous allocation can be contained within 20MHz in PR3. The "contiguous-ness" of allocations is not what differentiates BW3 from PR3, as discussed in RAN1#110. The

### Comment#4

In section 8, shouldn't we be referring to "eDRX" and not "DRX":

"The WI objective on enhanced eDRX in RRC\_INACTIVE requires SA2 and CT1 involvement."

[we are also OK to add other groups, such as CT4, as suggested by HW]

### Comment#5

[this doesn't affect the draft WID]. It has been discussed that R18-eRedCap provides an approximately 10% complexity benefit compared to R17-RedCap. We think that this statement is correct based on the agreed evaluation methodology. However, we think that the actual benefits of R18-eRedCap are much more significant than this nominal 10% benefit. We very much support R18-eRedCap.

## 25 – NEC Corporation

We are fine with the draft WID. On early indication, we are also fine with update by Samsung.

## 26 – Classon Consulting

[for FUTUREWEI] The chair modified the input proposals by deleting text, which were then agreed in GTW. It is not good practice to "undo" GTW decisions.

**Proposal: The main technique for further UE complexity reduction is based on BW3 and/or PR3, to be down-selected or merged in WI phase.**

**Proposal: Whether to adopt PR1 as a potential add-on for FR1 and/or FR2 is decided during WI phase.**

## 4.2 Summary of final round

A slight majority of the responding companies commented that they would like to clarify that PR1 is an add-on to BW3. One company opposed this change, and another company expects RAN1 to discuss it. The moderator's understanding was that the sentence about aiming to define at most one UE type would serve as an indication of the intended direction, but as a further clarification it can be explicitly stated in the WID that

the "UE peak data rate reduction" is "for UE with UE BB bandwidth reduction".

Almost half of the responding companies indicated that they think the bullet about early indication is too restrictive and would need further discussion. The bullet can be changed to "An early indication can be configured by the network", and then the details can be worked out in the working groups. Some of the other bullets (about the UE capability framework, and about coexistence with non-RedCap and RedCap UEs) can perhaps be seen as suggesting that no major changes are desired for the early indication mechanisms either unless necessary.

About a third of the responding companies want to make clarifications of the BW3 objective, but about the same number of companies indicate that they want to stick to the current BW3 description. There is already a conclusion from the Wednesday GTW session that the exact definition of BW3 will be revisited in RAN1.

The above considerations and some hopefully uncontroversial comments have been taken into account in the updated draft WID with change tracking in WID-v001.docx and the cleaned-up WID in RP-222612 (Inbox, Docs).

**Proposal:**

**Approve the WID in RP-222612 (Inbox, Docs), with the understanding that the exact definition of the UE BB bandwidth reduction will be revisited in RAN1.**

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## 5 References

1. RP-222208, "New WI: Enhanced support of reduced capability NR devices", Ericsson
2. RP-222061, "On the scoping of RedCap for Rel-18", Futurewei Technologies
3. RP-222063, "Views on conclusions of the eRedCap study", Qualcomm Incorporated
4. RP-222077, "On Rel-18 RedCap Enhancement", OPPO
5. RP-222129, "Views on the WI scope of further NR RedCap UE complexity reduction", CMCC
6. RP-222139, "On down-selection of complexity reduction schemes", Nordic Semiconductor ASA
7. RP-222146, "Rel-18 eRedCap SI conclusion", Vivo
8. RP-222147, "On Rel-18 eRedCap WID scope", Vivo
9. RP-222167, "On further RedCap UE complexity reduction", Nokia, Nokia Shanghai Bell
10. RP-222209, "Views on New Rel-18 WI: Enhanced support of reduced capability NR devices", Ericsson
11. RP-222213, "Discussion on the leftover issues in RedCap WI in Rel-17", Facebook Japan K.K.
12. RP-222231, "On the work scope of Rel-18 further NR RedCap UE complexity reduction", Samsung
13. RP-222248, "Discussion on WID for further NR RedCap UE complexity reduction", NTT DOCOMO, INC.
14. RP-222256, "Views on Rel-18 RedCap WI scope", Xiaomi Communications
15. RP-222262, "Views on Further UE Complexity Reduction (RedCap) WI", Intel Corporation

16. RP-222282, "Views on Rel-18 eRedCap WID scope", Spreadtrum communications
17. RP-222339, "Discussion on potential WID scope for Rel-18 RedCap evolution", MediaTek Inc.
18. RP-222391, "Views on WID of Rel-18 eRedCap", CATT
19. RP-222441, "Discussion on Rel-18 eRedcap scope", ZTE, Sanechips
20. RP-222456, "On Rel-18 WI scope: NR further NR RedCap UE complexity reduction", Huawei, HiSilicon
21. RP-222482, "On the WI scope for Rel-18 further Redcap complexity reduction", Apple Inc.
22. RP-212705, "New WI: Enhanced support of reduced capability NR devices", Ericsson
23. S2-2206981, "FS\_REDCAP\_Ph2 Status Report"
24. S2-2207867, "New WID on 5GS support of NR RedCap UE with long eDRX for RRC\_INACTIVE State"
25. RP-222205, "Status report for Study on further NR RedCap UE complexity reduction"
26. RP-222207, TR 38.865 V1.0.0 "Study on further NR RedCap UE complexity reduction"
27. RP-221161, "Revised SID for Study on further NR RedCap UE complexity reduction"
28. RP-222575, "Moderator's summary for discussion [97e-15-R18-RedCap]"