

3GPP TSG-RAN Meeting #93e

RP-21xxxx

Electronic, 13 – 17 September 2021

Agenda Item: 9.3.1.7

Source: Email discussion moderator (Intel)

Title: Email discussion summary for [93e-16-RedCap-WI]

Document for: Discussion and decision

1 Introduction

This document reports on the following email discussion during RAN#93-e:

[93e-16-RedCap-WI]

Input contributions covered: RP-212127, RP-212138

2 RP-212127

RP-212127 discusses the Initial DL BWP for RedCap UEs and makes the following proposals:

Proposal-1: *If RedCap UE offloading within carrier is supported in R17, remove restriction on mandatory presence of CORESET#0 by MIB in active BWP on a PCell, UE monitors for CSS (if configured) in commonCORESET(s) configured by pdccch-ConfigCommon with the following R15/R16 principles*

- *RedCap UE does not monitor for SIB1 in an active BWP if not provided with searchSpaceSIB1 in that BWP*
- *RedCap UE does not monitor for OSI in an active BWP if not provided with searchSpaceOtherSystemInformation in that BWP*
- *RedCap UE does not monitor for paging in active BWP if not provided with pagingSearchSpace in that BWP*
- *RedCap UE does not monitor for RAR in an active BWP if not provided with ra-SearchSpace in that BWP*

Proposal-2: *If RedCap UE offloading within carrier is supported in R17, at least in RRC connected mode and in RedCap UE's active BWP, a RedCap UE with baseline capability expects gNB to transmit an SSB within the active BWP.*

- *Note: This is the same as for R15/R16 UE*

2.1 Initial Round

In the following feedback forms companies are invited to provide general comments to the contribution and also specific comments to the proposals.

Feedback Form 1: General comments to RP-212127

1 – Nordic Semiconductor ASA

As mentioned in the online. RAN should give guidance at least on whether offloading should be supported in R17 in the first place. If supported, we believe that reusing R15/R16 mechanisms of initial DL BWP for "separate" initial DL BWP for RedCap UE as much as possible should be the guidance from plenary to both RAN1 and RAN2. This to ensure finalization of the WID on time.

2 – Ericsson LM

Regarding the two observations related to initial BWP in Section 2 of the contribution, we do not agree that it is always possible to configure the legacy initial DL BWP near the carrier edge in TDD, e.g., in cases where the legacy initial DL/UL BWPs have been configured with different bandwidths.

This solution discussed in the contribution can be considered when the initial DL BWP for non-RedCap have the same/similar size as the non-RedCap initial UL BWP. For example, both initial UL and DL BWPs has size 100 MHz, 60 MHz, or 40 MHz. However, such a solution cannot be used for cases where initial UL BWP considerably larger than the initial DL BWP for non-RedCap, e.g.:

- initial UL BWP= 100 MHz, initial DL BWP=40 MHz
- initial UL BWP= 40 MHz, initial DL BWP=20 MHz

Hence, we can have configurations for initial DL/UL BWPs (e.g., 100 MHz UL BWP, 40 MHz DL BWP for non-RedCap) in which the RedCap initial DL BWP does not cover CORESET#0, thus the observations in this contribution may not be always applicable. In general, it may not be desired to put constraints on the size of the initial DL BWP for non-RedCap (e.g., to be the same as initial UL BWP) as it limits the flexibility of initial DL BWP configuration and can impact the non-RedCap UEs (e.g., in terms of power consumption in a large DL BWP).

Therefore, we think that the SSB/CORESET#0/SIB1 presence needs to be discussed not only in the context of the offloading case addressed by the two proposals, but also in the context of the other purposes listed in the contribution (i.e., to enable the case when SIB1-configured initial DL BWP for non-RedCap UEs is greater than 20 MHz in FR1, to enable the same centre frequency between (separate) initial DL and UL BWPs in TDD operation, and to enable placing an initial UL BWP to the edge of carrier to mitigate resource fragmentation of non-RedCap UEs).

Since this quickly becomes a very technical discussion, we prefer to let RAN1 continue to discuss these topics and try to reach a viable compromise, rather than trying to resolve these details on RAN plenary level.

3 – Classon Consulting

for FUTUREWEI We are open to discussions on breaking the deadlock in RAN1, but feel this is a very detailed proposal for plenary. Likely we will need to resolve SSB presence first.

4 – Apple Poland Sp. z.o.o.

Apple

We support the proposals as one of co-sourcing companies.

One thing to highlight is that the initial DL BWP without covering CD-SSB occurs when addressing PUSCH resource fragmentation concern raised by one infra-vendor. It should be noted that it is always possible and fully under gNB control to share the CD-SSB between non-Redcap and Redcap UEs, if SSB overhead is really concerned, i.e., by configuring the separate Redcap-specific initial DL BWP covering CD-SSB. Of course, it may impact non-Redcap UE throughput performance but it addresses the SSB overhead concern. The point is that transmitting an additional SSB for separate initial BWP is only applied in case gNB wants to get the benefit of initial UL BWP configuration flexibility to solve the PUSCH fragmentation problem.

5 – Qualcomm Incorporated

We support agreeing on Proposal 1, although it is much more meaningful to agree on it together with a solution, i.e. with Proposal 2. Just agreeing supporting off-loading but keep disagreeing on how to do it is not going to take us forward. The DL-UL frequency offset brought up by Ericsson is not part of the current proposals per our understanding, but of course it can be discussed. From our perspective, we are not supportive of it though. We don't think the RedCap UE complexity should be increased compared to what an eMBB UE is expected to be capable of.

6 – Guangdong OPPO Mobile Telecom.

OPPO We are fine to have removing the restriction of CORESET #0 by MIB in proposal 1. The question has been discussed for some time and this is to make it move forward. We understand there is not optimal solution for it and the network still can configure the initial BWP or not.

7 – CATT

From technical point of view, we still have concerns in mandating SSB in any separate initial DL BWP, no matter it can be used for random access or not.

We appreciate the analysis on DL resource cost of additional SSB, however it is not fully convincing to us, since: (1) It assumes the largest carrier bandwidth of 100 MHz in FR1 and a periodicity of 20ms for the SSB, but the carrier bandwidth may be narrower and a smaller periodicity of SSB (down to 5ms) may be applied in real deployment. (2) The analysis only consider the ratio of additional SSB to 'total DL resource', but it is more important to consider the ratio of additional SSB to 'remaining DL resource in the current network'. The remaining DL resource is not ample as the network has to transmit legacy SSB/CORESET#0/CSS/SIB1/OSI/CSI-RS/TRS ..., making the cost of additional SSB non-negligible. (3) It does not talk about the inter-cell interference caused by additional SSB, which affects the network planning in return.

But given the fact that RANP is not the proper place to bear such detailed technical debate, our suggestion is to leave it to RAN1 discussion. There are still two RAN1 meetings left, and we can see if the group can reach consensus/compromise first.

8 – vivo Communication Technology

We think some RAN conclusion/guidance would be preferable to facilitate the RAN1 discussion in the remaining two meetings until Dec. In this regard, we think the SSB presence in at least RRC configured BWP is very critical to keep the reasonable complexity/power consumption for RedCap devices, compared to the normal devices.

9 – Spreadtrum Communications

As UE vendor, we do support SSB in the initial DL BWP. Ignoring the SSB issue to discuss CSS may not lead to the compromised solution.

- For SSB/CORESET#0 multiplexing pattern 1, there is always SSB in the initial DL BWP in legacy. For RedCap, there should be SSB in the separate initial DL BWP. To reduce network overhead, some CSS (e.g. SIB/paging) may not be configured in the separate initial DL BWP, it can be further discussed in RAN1 for technical details. In connected mode, FG 6-1a is still optional, so gNB can configure the initial DL BWP in UE-specific ways. It is up to support of FG 6-1a for RedCap UE.
- For SSB/CORESET#0 multiplexing pattern 2/3 (FR2 only), SSB is not in the initial DL BWP, but as non-RedCap UE is full BW, so it can open the wide BW to cover the SSB and the initial DL BWP. As mentioned in RAN1 by some companies, it can still be solved by RedCap UE with sacrifice of power consumption (RF retuning), if we do not address the power consumption issue in FR2. Issue for multiplexing pattern 2/3 can be further studied in RAN1 for technical details.

10 – Intel Corporation (UK) Ltd

[Intel]

As observed by Ericsson, even without support of “offloading use-case” for offloading of RedCap common control information for idle/inactive states, there can be cases wherein separate initial DL BWP may need to be configured to RedCap UEs. Alternatively, it would impact the configurations possible for non-RedCap UEs via restrictions to scheduling/configurations.

Next, for the “offloading use-case”, the overall benefit from such “offloading” from CORESET #0 would be obviated for the most part if all common control, especially SI messages are to be mandatorily duplicated by the gNB in the separate initial DL BWP. The R15/16 mechanisms do not quite apply since there never was such a scenario wherein the UE operates outside of CORESET #0 during idle/inactive states.

Considering these and the other technical details related to behavior in connected mode as well (which required a “package proposal” to be discussed in the first place), we agree with Ericsson that it would be more prudent to continue discussing the options in RAN1 using the latest compromise proposal from the FL from RAN1 #106-e as a starting point.

11 – Samsung Electronics Polska

We suggest to discuss this issue in RAN 1 other than RAN plenary.

12 – Deutsche Telekom AG

We agree with Samsung that this is a detailed RAN1 discussion, not a RAN plenary one !

13 – TELECOM ITALIA S.p.A.

The analysis made by CATT is clearly showing a major impact on the network side. Since we are at the end of the Release, this is a good candidate for Rel 18.

Moreover, this is also a good example that overall energy efficiency and impact on environment should be taken into account: the impact on network consumption is not negligible.

14 – Huawei Tech.(UK) Co.. Ltd

At a high level, offloading can be useful when it is introduced without increasing overhead. Proposal 1 is one step in reducing overhead, but Proposal 2 is a backward step of adding overhead as the RedCap population grows.

15 – VODAFONE Group Plc

We tend to agree that the discussion should be held at RAN1 in order to have a better understanding between the balance of UE implementation added complexity (by having or not mandatory CORESET#0 and SSB) and network efficiency impact of facilitating offloading.

16 – ZTE Corporation

Generally speaking, these 2 proposals are related to amount of details, which actually should be discussed in RAN1.

For proposal 1, from our understanding, these principles are applied for UE-specific RRC configured BWP, instead of active BWP.

If the active BWP can refer to the separate initial BWP, and the CSS is not configured for separate initial BWP, how the UE operate/Whether to retune to legacy CORESET0 to monitor should be clarified.

Additionally, the specification would not reflect whether the offloading is supported or not. Therefore, the ‘if’ condition seems to be inappropriate.

For proposal 2,

We think this proposal is trying to say we should keep the FG 6-1 as the legacy. Based on this, the targets BWPs are the UE-specific RRC configured BWP instead of the active BWP.

Additionally, if the active BWP can refer to the separate initial BWP, the overhead for additional SSB should be carefully taken, since it would cause large NW resource occupation and resource fragmentation.

Similarly, the specification would not reflect whether the offloading is supported or not. Therefore, the ‘if’ condition seems to be inappropriate. Also, the ‘*baseline capability*’ needs clarification here.

17 – Nokia France

In general, it is better to start with the Feature Lead’s compromise proposal discussed at the last RAN1 meeting (proposal 2.2-60 in R1-2108632), as that one had been discussed extensively and a large number of companies were willing to accept the proposal. It also provides more details and context.

In addition, we disagree to frame proposals 1 & 2 only in the context of offloading. It should be up to the network to decide under what conditions and for what reasons it wants to configure a separate initial DL BWP for RedCap UEs. This is more clearly expressed in the FL’s compromise proposal, which simply states “if a separate initial DL BWP for RedCap UEs is configured...”.

Regarding proposal-2, bullet 4 of the FL’s proposal in R1-2108632 is better constructed, as it includes an important compromise whereby a UE that can support FG 6-1a shall not expect SSB in the DL BWP.

Overall, the discussion should take place in RAN1 based on the FL’s proposal 2.2-60 in R1-2108632.

18 – NTT DOCOMO INC.

We share the view with Ericsson that the observation in the contribution is not always applicable. Since this aspect was discussed in the last RAN1 meeting with the package proposal 2.2-60 in R1-2108632, we think this should be discussed in the next RAN1 meeting with the proposal 2.2-60 as the starting point.

19 – MediaTek Inc.

We would agree that Proposals 1 and 2 seem justified to optimise if RedCap UE offloading within carrier is supported in R17.

One question to the proponents regarding the RedCap UE RRM measurements in such a scenario: Is it also understood that for RRM measurements of serving and neighbour cells the RedCap UE would tune back to the cell-defining SSB?

20 – Sony Europe B.V.

This technical discussion should be happening in RAN1, not RAN plenary.

21 – LG Electronics Inc.

We think the discussion on whether to support the offloading for Rel-17 RedCap is relevant for RAN discussion and the offloading should be supported in Rel-17 RedCap if time allows and we think it does.

We are in principle okay with the proposals in that the existing Rel-15/16 behavior should be reused unless it is against the main objectives of RedCap which is low complexity/cost and lower power.

Solution-wise, we tend to agree that details can be discussed in the working group.

22 – China Mobile Com. Corporation

We support the motivation of offloading. From the operator's point of view, easy capacity expansion and providing a good user experience is a very important consideration.

The current proposal is taken from the FL Proposal 2.2-60 in R1-2108632 during RAN1#106e, and we think it is best to discuss it through RAN1.

For current compromise solution, we want to understand the procedure for the following scenario.

- For a device that only supports UE Feature 6-1, if it wants to access a network where the initial UL BWP bandwidth for the non-RedCap exceeds 20M, a separate UL/DL BWP needs to be configured. According to current proposal, for idle/inactive UEs, they don't expect SSB to be configured in the initial DL BWP. When the terminal enters the connected state, due to the UE capability, it can only work near CORESET#0.

There are two problems with this:

1. The RedCap UEs with UE feature 6-1 only will be gathered around CORESET#0. Since SIB-related information needs to be transmitted in CORESET#0, and the BWP bandwidth of RedCap is limited with 20MHz, it will cause resource congestion and reduced user experience. As a result, the network has to provide additional SSB to offloading UE to other frequency resource for user experience, which leads to increased network overhead and affects user performance.
2. If the initial DL BWP used for idle/inactive state does not overlap with CORESET#0 and no SSB is configured, it cannot be converted to a RRC configured BWP after the user enters the connected state. So the benefit of the Initial DL BWP is limited.

However, for RedCap UEs with feature 6-1a capabilities, there is no such limitation, and flexible offloading or other motivations can be easily realized.

From this perspective, only supporting UE feature 6-1 means that the network will sacrifice network resources and reduce network performance in order to satisfy user experience. To realize efficient offloading

without additional SSB overhead without feature 6-1a, we propose to support misalignment of uplink and downlink center frequencies, so that for UL heavy services, the uplink BWP can be placed flexible without causing resource congestion while DL BWP can be placed together.

Feedback Form 2: Comments to Proposal 1 in RP-212127

1 – Nordic Semiconductor ASA

We are fine with Intel proposal to restrict proposal for RRC connected and let RAN1 and RAN2 to discuss IDLE and INACTIVE state. This could be formulated as "Reuse Paging, RAR, OSI, SIB1 delivery of R15/R16 in separate initial DL BWP for RedCap UE during RRC connected"

2 – Ericsson LM

Similar proposals are already under discussion in RAN1 as part of an FL compromise proposal that was discussed in the August RAN1 meeting (see Proposal 2.2-60 in R1-2108632). We prefer to continue the discussion on possible compromises that was started in the August RAN1 meeting rather than to make agreements regarding parts of a detailed solution on RAN plenary level.

3 – Classon Consulting

for FUTUREWEI It should be up to the network whether to transmit an SSB. There are some devices / traffic types that do not have battery issues or processing considerations.

4 – Classon Consulting

for FUTUREWEI We are open to discussions on breaking the deadlock in RAN1, but feel this is a very detailed proposal for plenary. Likely we will need to resolve SSB presence first.

5 – Apple Poland Sp. z.o.o.

Apple

Similar as Nordic, we can compromise to limit the proposal 1 to RRC_CONNECTED mode only.

It should be noted that this is legacy behavior and already in specification. Unless different agreement was made compared to legacy, this should be treated as default behavior for Redcap as usual.

6 – Qualcomm Incorporated

Repeating our previous comment: We support agreeing on Proposal 1, although it is much more meaningful to agree on it together with a solution, i.e. with Proposal 2. Just agreeing supporting off-loading but not agreeing on how to do it is not going to take us forward.

7 – Guangdong OPPO Mobile Telecom.

OPPO We are OK with the proposal, maybe it should be more specific to "DL" BWP.

8 – CATT

While Proposal 1 reasonably explains what RedCap UE should behave due to different possible configuration of separate initial DL BWP, it does not completely tackle essential issues from network view, e.g. whether SSB/CORESET#0/SIB1/OSI 'must' be included in separate initial DL BWP, whether random access can be performed without SSB in the separate initial DL BWP...

Hence, we prefer to leave it to RAN1 discussion rather than reach an agreement from RANP level.

9 – vivo Communication Technology

We support proposal 1, although we also agree with the other comments that proposal 2 is more critical from RAN1 progress perspective.

10 – Facebook

We support proposal 1.

11 – Panasonic Corporation

We are ok to agree this, especially to limit it to RRC_CONNECTED. In RRC_IDLE, we are not sure how deliver SI (or SI update) and paging in user-specific way using dedicated RRC. The principle used in Rel.15/16 cannot be used in the current discussion.

12 – Spreadtrum Communications

We are not sure whether there is the restriction for CORESET#0, when NCD-SSB is used in the separate initial DL BWP. Since CD-SSB is still in the legacy initial DL BWP, UE has to acquire SIB1 in the legacy initial DL BWP and then switch to the separate initial DL BWP after SIB1 acquisition. SIB1 may not configure CORESET#0/SIB1 CSS in the separate initial DL BWP.

13 – Intel Corporation (UK) Ltd

[Intel]

Agree with Ericsson that Proposal 1 has high correlation with the FL compromise proposal from RAN1 #106-e but with several other associated details that are absent from Proposal 1 in RP-212127. Instead of bringing those technical details to RAN discussions, it would be more effective to continue discussion in RAN1.

On technical details, as mentioned in our overall response above, we do not think R15/16 bears on Idle mode UE behavior w.r.t. SI reception outside of CORESET #0, and thus, the reasoning of applying R15/16 behavior does not apply automatically.

As discussed during the GTW session, we could possibly compromise to the idea of following R15/16 behavior for connected mode, but again, it may make more sense to sort out all details together as there are various related details that need to be addressed as well. For instance, the connected mode UE behavior related to SI reception was addressed with the following proposal from the “FL compromise proposal” referred to by Ericsson:

- c. In connected mode, the UE is not required to monitor CORESET#0 periodically for SI updates.**
FFS: How SI update notifications are indicated to RedCap UEs

14 – Samsung Electronics Polska

First of all, we think this proposal can be discussed in RAN 1.

Technically, we don't fully agree with the analysis in the paper. As discussed in RAN 1, the motivation of removing the restriction on mandatory presence of CORESET #0 is not only for “offloading purpose”. In addition, some clarifications on “*with the following R15/R16 principles*” is needed. To avoid discussions on wording, FL's proposals in RAN 1 can be a better starting point.

15 – Deutsche Telekom AG

We agree with Samsung that this a detailed RAN1 discussion, not a RAN plenary one !

16 – TELECOM ITALIA S.p.A.

As stated before, the impact on the network is not negligible. Due to the fact that we are at the end of the Release, we do not support proposal 1 and 2

17 – Huawei Tech.(UK) Co.. Ltd

Since this is subject to configuration by the network, meaning the UE has to be able to support both having CORESET#0 by MIB present or absent, this represents a reasonable compromise. In general, a similar handling of Proposal 1 and Proposal 2 would make sense, whether we decide both in RAN, both in RAN1, etc.

18 – Nokia France

See general comments above. The discussion should start from the RAN1 FL's proposal 2.2-60, and continue in RAN1.

19 – NTT DOCOMO INC.

Since this aspect was discussed in the last RAN1 meeting with the package proposal 2.2-60 in R1-2108632, we think this should be discussed in the next RAN1 meeting with the proposal 2.2-60 as the starting point.

20 – LG Electronics Inc.

We are okay with the proposal.

Repeating our previous comments. We think the offloading should be supported in Rel-17 RedCap if time allows and the existing Rel-15/16 behavior should be reused if it aligns with the main objectives of the RedCap which are low complexity/cost and lower power.

We also agree that details can be left for the working group discussion.

21 – China Mobile Com. Corporation

The proposal is generally fine, but we think it is better to handle the whole packet together in RAN1 rather than to handle some of them in RAN plenary.

22 – Lenovo (Beijing) Ltd

We support offloading of RedCap UEs to a separate initial DL BWP. This is beneficial to guarantee the performance of non-RedCap UEs. On the other hand, it should be based on gNB configuration to enable/disable offloading.

The configuration of additional CORESET in the separate initial DL BWP can be discussed further in RAN1.

Feedback Form 3: Comments to Proposal 2 in RP-212127**1 – Xiaomi Communications**

we fully share with the same view. In Rel-15/16, working on one BWP without SSB is an optional UE capability. In Rel-17, We don't see the need to mandate the RedCap to work on the BWP without SSB. If

we go that way, there will be significant negative impact on the device power consumption due to frequency BWP switching for the t/f tracking and measurement. In addition, the RedCap devices are more sensitive to the power consumption due to small battery capacity.

On the other hand, some companies also raise the concern on configuring SSB in one BWP. It is stated that configuring SSB in one BWP would decrease the resource utilization efficiency and result in some resource fragment. In our view, that can be solved by proper configuration, e.g., prolong the SSB periodicity or let the RedCap and non-RedCap sharing the same BWP with SSB.

2 – Nordic Semiconductor ASA

Having SSB within active BWP during RRC connected state allows for reduced complexity implementation. It facilitates UE to maintain synchronization, it facilitates beam management, SSB is QCL-C/D source for TRS. Reduces frequency of retuning and such facilitates longer battery life. It is feasible to define gaps for UE to read serving cell CD-SSB burst, but this would require specification effort and would deteriorate the RedCap performance. Therefore, we believe that 2% overhead for 40MHz carrier, 20ms periodicity, 50% TDD split and 8 beams deployed is not a lot. Plus we are open to reduce SSB periodicity to 40ms this reducing overhead to be always < 1%.

3 – Ericsson LM

Regarding additional SSB transmissions in the separate initial DL BWP for RedCap discussed in Section 3, the overhead can be larger than the presented value depending on the scenario and system parameters. Beside overhead, another concern is that transmitting additional SSBs can result in an increased inter-cell interference.

Similar proposals are already under discussion in RAN1 as part of an FL compromise proposal that was discussed in the August RAN1 meeting (see Proposal 2.2-60 in R1-2108632). We prefer to continue the discussion on possible compromises that was started in the August RAN1 meeting rather than to make agreements regarding parts of a detailed solution on RAN plenary level.

4 – Classon Consulting

for FUTUREWEI It should be up to the network whether to transmit an SSB. There are some devices / traffic types that do not have battery issues or processing considerations.

5 – Apple Poland Sp. z.o.o.

Apple

We support the proposal.

On inter-cell interference concern, we do NOT think it is one valid point to against additional SSB, especially considering the side effect of Redcap power consumption and complexity if the SSB is not present, which is really critical for wearable due to smaller form factor. Note that since Rel-15 NR, from system perspective, multiple SSBs in a single cell have been supported which causes same inter-cell interference effect.

6 – Qualcomm Incorporated

We support agreeing on Proposal 2. The motivation is that the requirements for RedCap UEs should not be made any more onerous than the requirements for eMBB UEs. Doing otherwise would beat the purpose of introducing RedCap. In particular, features that are optional for eMBB UEs should not be made mandatory

for RedCap UEs, including operation in a BWP without SSB. Exceptions could be considered if there is strong motivation, but here, we fail to see any strong motivation as explained next:

1) Overhead arguments. If all RedCap UEs have to retune at the same time to receive SSB in another BWP, what is going to be transmitted in the RedCap BWP in place of the SSB and to whom? We don't understand the capacity arguments raised by infra vendors.

2) Power. For RedCap UEs, power savings are even more critical than for eMBB UEs due to battery size limitations. We assume that UEs in DRX would have their DRX On period configured close to SSBs. In this case, having to retune for SSB would necessary increase the UEs' total wake up time and reduce battery life as the result.

7 – Guangdong OPPO Mobile Telecom.

OPPO We are also OK with the proposal 2, but can accept only have proposal1 agreed for this moment.

8 – CATT

For the purpose of offloading, the most efficient way is to support working in an active BWP without SSB – otherwise, the cell has to transmit multiple series of SSB to achieve a real-balanced offloading (e.g. One SSB burst per 20 MHz). This will be an unacceptable cost. On the other hand, whether offloading only during initial access is beneficial, or whether offloading to only one 20MHz bandwidth at the edge of the whole carrier is meaningful, are still not well justified.

Anyway, we prefer to leave the detailed technical discussion to RAN1, rather than reach an agreement from RANP level.

9 – vivo Communication Technology

We support proposal 2. We failed to understand the justification to make RedCap UEs more complicated and power consuming than normal UEs, because of the concern on marginal overhead increase (1%).

10 – Facebook

We support proposal 2 considering the importance of power consumption for wearables.

11 – Panasonic Corporation

The mandatory transmission within the active BWP should not be required for the flexibility of the network operation except CSS for the paging is configured in the active BWP. When CSS for the paging is configured, SSB transmission should be mandatory as the UE after wake-up needs to be synchronized using SSB before the paging reception. We think UE power consumption concern would be applied to CSS for the paging but not for CSS for random access channel. On CSS for the paging, we also have the concern on RAN2 work load on how to distribute paging among multiple BWPs.

12 – Spreadtrum Communications

Supportive. We share the similar view as QC and Nordic. The power consumption should be considered for the BWP-without-SSB operations, e.g. AGC/sync/measurement. The network overhead can be controlled about 1%, and the additional NCD-SSD can provide more opportunities for intra-freq measurement and reduce inter-freq measurement. It is beneficial for mobility. Also it can save overhead of TRS/CSI-RS. By the way, we suspect that the current spec is enough for SSB in connected mode. If RedCap UE reports not supporting FG 6-1a, can gNB still configure a BWP without SSB? Is it an error case?

13 – Intel Corporation (UK) Ltd

[Intel]

This proposal is again very similar to what was tabled as part of RAN1 discussions as a component of the compromise package proposal, and it is recommended that they are all discussed together instead of decisions in parts across RAN and RAN WG1. This will ensure coherent and contextual decisions. For instance, as it stands, it is not clear what is referred to by “a RedCap UE with baseline capability”, etc.

14 – Samsung Electronics Polska

Same as previous comment, this issue and proposal is better to be discussed in RAN 1.

We can understand the concerns from UE vendor. On the other hand, the concerns on NW vendor and the spec impact for potential SSB transmission in RRC IDLE/inactive should also be addressed. We think the latest FL’s proposal can be a good starting point, considering both RRC IDLE/inactive/connected mode.

15 – Deutsche Telekom AG

We agree with Samsung that this a detailed RAN1 discussion, not a RAN plenary one !

16 – TELECOM ITALIA S.p.A.

As stated before, the impact on the network is not negligible. Due to the fact that we are at the end of the Release, we do not support proposal 1 and 2

17 – Huawei Tech.(UK) Co.. Ltd

The costs of not mandating RedCap UEs to support an initial DL BWP without SSB are clear:

(1) Overhead of SSB in each RedCap initial DL BWP, reducing the efficiency of a TDD RedCap deployment. This overhead will grow as the number of RedCap UEs grows, due to needing more RedCap initial DL BWPs with SSB, making the cost to the network higher with an expanding market. If this feature is not introduced in Rel-17, the extra SSB overhead will be permanently present, since the lifetime of a RedCap device is expected to be long. This impedes a smooth roll out and rapid scaling-up of the RedCap ecosystem.

(2) The additional RedCap initial DL BWPs with SSB will fragment the remaining eMBB resources, making it harder to find the resources necessary for high peak rates that are a hallmark of 5G. Especially in UL, contiguous resources are highly desirable for most real-world UEs, and adding DL BWPs in a TDD system will impede that ability. The necessity of adding more such BWPs over time will make this problem worse as the RedCap market tries to grow, and may inhibit it from doing so.

It is necessary for Rel-17 RedCap UEs to be mandated to support an initial DL BWP without SSB, i.e. mandating FG 6-1a.

We don’t see the complexity nor power consumption increase: RF retuning and use of measurement gaps for SSB reception do not generate computational nor hardware complexity in a UE, and both these operations are anyway required to be supported in a Rel-17 RedCap UE. Retuning would occur so infrequently compared to a DRX cycle length as to make any power consumption difference extremely small, as reflected in the divergent RAN1 discussions on the point.

18 – Nordic Semiconductor ASA

(1) 5ms periodicity for RedCap UE non-cell-defining SSB would not be required, we talk about 40ms periodicity. And saying that 1% will eat peak data rates is false statement. (2) Moreover, for R17 we are

talking about one separate initial DL BWP mainly to offload random access. (3) For UEs supporting 6-1a RRC connected BWPs can be used after MSG4, we do not see any issue with eco-system as such (4) Finally, restricting RedCap UEs to operate within CORESET#0 BW (i.e. no offloading) is the baseline currently. If operators are OK with this, we are fine as well. :)

19 – Nokia France

We do not support this proposal. See general comments above. The discussion should start from bullet #4 of the RAN1 FL's proposal 2.2-6o, and continue in RAN1.

20 – NTT DOCOMO INC.

Since this aspect was discussed in the last RAN1 meeting with the package proposal 2.2-6o in R1-2108632, we think this should be discussed in the next RAN1 meeting with the proposal 2.2-6o as the starting point.

21 – LG Electronics Inc.

We also think it should not be mandated for RedCap UEs to live with the BWP without the SSB as the RF retuning has clearly a negative impact on the RedCap UEs in terms of power consumption and complexity. So, we are supportive of the Proposal 2, but details can be discussed in the working group.

22 – China Mobile Com. Corporation

Only supporting UE feature 6-1 means that the network will sacrifice network resources and reduce network performance(provide additional SSB) in order to avoid UE congestion, especially for uplink heavy and high data rate service. Then if UE feature 6-1a is optional, we propose an alternative way to reduce the network overhead issue, that is to remove the restriction of alignment of DL and UL center frequencies.

And for the proposal itself, a RedCap UE with baseline capability expects gNB to transmit an SSB within the active BWP. Does it means for UE with both baseline and optional capability, it will expect SSB within the active BWP? Or it means RedCap UE with baseline capability only will expect SSB within the active BWP?

23 – Lenovo (Beijing) Ltd

We are also wondering if it is good to discuss this proposal in RAN plenary. The discussion should be continued in RAN1 in our understanding.

2.2 Summary from Initial Round

Based on the discussion during the Monday GTW and also the responses to this thread, this is clearly a complex issue. About half of the companies providing feedback had the view that this is not a plenary issue and it would be best for the discussion to continue in RAN1. Given this situation, moderator's conclusion is that we are very unlikely to reach a consensus during this week and the discussion should be progressed in RAN1.

Moderator's conclusion from Initial Round:

Discussion of this issue to be progressed by RAN1. No further discussion in RAN plenary this week.

2.3 Intermediate Round

Companies may provide feedback to the moderator's conclusion from the Initial Round:

Feedback Form 4: Comments to moderator's conclusion from Initial Round

<p>1 – Nordic Semiconductor ASA</p> <p>As pointed out, this is not just RAN1 discussion. Instead, paging, OSI, SIB1, RAR delivery is in competence of RAN2. Hopefully moderator can agree. :) Based on moderator proposal, should also support of offloading in R17 be left up to RAN1/RAN2 to decide?</p>
<p>2 – Nokia France</p> <p>We agree with the Moderator's conclusion, this should be discussed in the WGs (where the feature lead's compromise proposal 2.2-6o in R1-2108632 can be used as a starting point).</p>
<p>3 – Ericsson LM</p> <p>We agree with the moderator's conclusion of the initial round.</p>
<p>4 – Qualcomm Incorporated</p> <p>It is not our preference to drop this discussion at the Plenary because with the current rate of progress, two more meetings in RAN1 don't seem sufficient. As mentioned before, we don't fully understand the concerns on overhead. The interference concerns are also not understood by us. Since SSBs collide with SSBs, there is no interference increase any more than it would be in any other BWP. If no downside identified, the proposals should be agreeable. Companies preferring to put the implementation burden on the UE, is not really a downside of the proposal.</p>
<p>5 – NTT DOCOMO INC.</p> <p>We agree with the Moderator's conclusion from Initial Round</p>
<p>6 – Intel Corporation (UK) Ltd</p> <p>[Intel] We agree with the Moderator's conclusion.</p>
<p>7 – ZTE Corporation</p> <p>Pros and cons analysis are varied from different companies. And these proposals are also related to massive RAN1 details. Due to the limited time in RAN plenary and current divergent situation, it is nature to further discuss these issues in RAN1. Therefore, we support the moderator's conclusion.</p>
<p>8 – vivo Communication Technology</p> <p>We agree with Nordic and Qualcomm, RAN plenary has the responsibility to resolve the deadlock problem in RAN1.</p>
<p>9 – Guangdong OPPO Mobile Telecom.</p> <p>OPPO We looking for a conclusion to accelerate the discussion in RAN1, as this is a bit longer pending. But we are OK to leave it further to RAN1, considering the procedure.</p>

<p>10 – InterDigital Communications</p> <p>We also agree with the Moderator’s conclusion.</p>
<p>11 – CATT</p> <p>Agree with the Moderator’s conclusion.</p>
<p>12 – Apple Poland Sp. z.o.o.</p> <p>Apple</p> <p>We agree that the discussions involve many technical details and difficult to conduct in RAN plenary. On the other hand, this issue was extensively discussed during several GTW sessions in last RAN1 meeting. Although technical pros/cons have been exhaustively listed and debated, companies positions are still hold and block RAN1 progress. Given this situation, keeping it in RAN1 seems not the right way to make progress. RAN plenary should step in.</p>
<p>13 – Xiaomi Communications</p> <p>This issue was extensively discussed in RAN1 but little progress was acheived. Considering this situation, we prefer to get some guidance or conclusion in RAN plenary to facilitate the discussion in RAN1.</p>
<p>14 – LG Electronics Inc.</p> <p>We can agree on the Moderator’s conclusion, but in our view at least some high-level part of the proposal such as whether to support the offloading for RedCap deserves RAN discussion and the conclusion thereof would help accelerating discussions in the WGs.</p>
<p>15 – China Mobile Com. Corporation</p> <p>Agree with the Moderator’s conclusion.</p>
<p>16 – Huawei Tech.(UK) Co.. Ltd</p> <p>We would also be OK with the proposal by a few companies that RAN can agree/conclude that offloading of RedCap is supported in Rel-17, whilst leaving the details to WGs.</p>
<p>17 – VODAFONE Group Plc</p> <p>Same views as LG, as there is only 2 meetings left, supporting offloading in high-level conclusion in plenary can be done while leaving the details to RAN1.</p>
<p>18 – Sony Europe B.V.</p> <p>Agree with the moderator’s conclusion. If this also needs to be discussed in other working groups too (RAN2 etc), then that is OK. We should not be using RAN plenary as a forum to continue deep technical discussions that should be happening in the working groups. We want to avoid the situation where RAN plenary meetings become a de facto extension of RAN1 meetings.</p>
<p>19 – Panasonic Corporation</p> <p>We agree Nordic Semiconductor comment that ”paging, OSI, SIB1, RAR delivery is in competence of RAN2”. These of non-Redcap in Rel.15 was mainly discussed in RAN2. To be discussed within WGs are ok but to clarify how to progress in each WGs to be determined in RAN plenary would be useful.</p>

20 – Spreadtrum Communications

We support to discuss CSS issue in RAN1 for more specific details. However, we also would like to discuss the SSB issue in RAN plenary to work out a wayforward for capability assumption of RedCap UE at gNB side, e.g. FG 6-1 is baseline capability of RedCap UE during initial access.

21 – MediaTek Inc.

We were ok with the original proposals and can accept to take it back to RAN1 if no agreement is possible (although our RRM measurements question wasn't answered I think).

Regarding agreeing to basic offloading now, we would prefer not to make a partial agreement, as that in itself was never proposed to this plenary, and the resulting impact on the UE depends on the Proposal 1/2 aspects in our understanding.

2.4 Summary from Intermediate Round

This discussion is scheduled for the Wednesday GTW and hence the following summary is targeted for discussion in that GTW. The summary will be further updated and opened for final round comments only after the GTW.

Based on the comments there remains a split between companies that would prefer this is returned to RAN1 and those that would like to make some progress in RAN in order to assist the WG. One aspect where RAN could give guidance is whether the solution should support "Offloading of RedCap UEs". Therefore I make a proposal below that can be a basis for discussion in the GTW.

It was also commented this is not only a RAN1 discussion but also RAN2 related considerations. While the moderator agrees that there some RAN2 aspects, this is predominantly a RAN1 discussion and it would be counter productive to try to involved RAN2 in the decision process as well.

Proposal for discussion in Wednesday GTW:

1. RAN plenary agrees that the RedCap solution should support offloading of RedCap UEs from the CORESET#0 BW.

3 RP-212138

RP-212138 discusses bands for RedCap UEs and makes the following proposals (note the proposal numbering was added by the email discussion moderator):

Proposal 1: UE with V2X capability should be allowed to support Redcap on Uu bands

- UE will support V2X in n47
- FFS redcap UE signaling concurrent operation capability with V2X

Proposal 2: Requirements for Redcap bandwidths and 1 and 2 Rx shall be added under Redcap WI for bandn79

Proposal 3: NR-U requirements for Redcap shall be specified

Proposal 4: Redcap UEs shall not support SUL bands

3.1 Initial Round

In the following feedback forms companies are invited to provide general comments to the contribution and also specific comments to the proposals.

Feedback Form 5: General comments to RP-212138

1 – Huawei Technologies France

In general, we think the content in the contribution is not aligned with the WF in RAN4#100e (R4-2115096), e.g. there is no tentative agreement as stated in the contribution. And we didn't see convincing justification that some bands under discussion should support RedCap but SUL cannot for the proposals.

Feedback Form 6: Comments to Proposal 1 in RP-212138 (UEs with V2X capability)

1 – Ericsson LM

Although we are fine with proposal 1, but RAN4 work load which is currently very high., needs to be considered Therefore, if there is not sufficient time than requirements for redcap can be defined in later release.

2 – MediaTek Inc.

- It was actually agreed (not tentatively) in RAN4 for RedCap UE not to support n47. RAN4 also agreed that V2X is not in scope of the RedCap RRM work.
- V2X support was never discussed in the scope of RedCap (neither during the SI nor the WI phase).
- Specifying this now would seem to result in a device that has 2 Rx antennas for sidelink but is only required to support a single Rx antenna for Uu operation - which seems a bit strange.

Given the above points, and the fact that reverting agreements would mean we are up-scoping at a time when companies are proposing down-scoping of Rel-17 items, we suggest not to approve Proposal 1 as part of Rel-17. We would be fine to discuss it in further in Release 18.

3 – Apple Poland Sp. z.o.o.

Apple

We have same understandings as MTK on the RAN4 agreements: i.e., Redcap does not support n47 and RAN4 also agreed that V2X is not in the scope of RRM for Redcap.

Considering the TU left and work load in RAN4, we prefer that Redcap does NOT support V2X at least in this release.

4 – CATT

We support adopting V2X to RedCap in principle. We are also fine to consider it in Rel-18, if RAN4 workload is too heavy in Rel-17.

5 – Panasonic Corporation

Although we think the combination between V2X and RedCap is important for pedestrian UEs, we recognize RAN4 situation and support the view to consider it in Rel-18.

6 – Spreadtrum Communications

We share the view and observation from Ericsson and MTK. We prefer to discuss it further in later release.

7 – QUALCOMM JAPAN LLC.

As proponents, we think this is an important use case that should be supported. We do not understand why there would be additional workload for this since there are no changes needed to current V2X operation. A Redcap UE can support multiple bands and also it can support n47 in which it will behave just like a normal V2X UE without any changes.

To MTK, we do not see the issue with the number of receivers. RedCap UEs can also support 2Rx in our understanding. n47 is a high band and will require smaller antennas anyway.

8 – China Mobile Com. Corporation

As we commented online, we prefer to not consider V2X for RedCap UE in Rel-17

9 – vivo Communication Technology

We think the we can probably decouple the signaling support (RAN1/2) and performance requirements (RAN4), for example, we can allow a Rel-17 UE to indicate both RedCap and V2X related capabilities from RAN1 and RAN2 specification perspective, while whether and how to finalize the performance requirements can be decided by RAN4 considering the overall work load situation.

10 – Intel Corporation (UK) Ltd**[Intel]**

For proposal 1 we would like to check on the expected number of RX chains to be supported on band n47 for RedCap type of devices.

11 – Samsung Electronics Polska

To keep UE design flexibility, existing signaling framework shall be maintained, i.e., UE is allowed to report optional features and corresponding operating bands independently. However, it has to be clarified that no additional RAN1 design and corresponding RAN4 requirements for UE supporting concurrent operation of RedCap and V2X at least in Rel-17 timeframe.

12 – Deutsche Telekom AG

We think a Redcap UE can support SL on Band n47 (this is a feature discussed in 5GAA for the VRU)

We think it is clear that a Redcap UE can operate the following:

- Redcap on Uu (any band)
- Redcap on SL (n46)
- Redcap on Uu, while non-Redcap on SL
- Redcap on SL (n46), while non-Redcap Uu

13 – LG Electronics Deutschland

We support proposal 1. For the issue of V2X capability in n47 for RedCap UE, our understanding is that RedCap UE support a band combination of a Uu band (e.g. n77) and a sidelink band in n47. If that is the case, we think the use case is valid since a RedCap device such as a smart watch can participate in V2X operation in n47 as a VRU (Vulnerable Road User). However given that the current sidelink WI does not have RedCap specific objectives in its WID, the sidelink operation including the UE capability in n47 should be the same as that of a normal sidelink UE. This means that we can simply add a band combination of concurrent Uu RedCap and Sidelink operation in the existing RAN4 V2X concurrent band-combo WI which does not require much time completing RAN4 work in Rel-17.

14 – TELECOM ITALIA S.p.A.

Support Mediatek. It is too late now to add objectives in Rel 17

15 – ZTE Wistron Telecom AB

If the required RAN4 workload can be accommodated by the planned TUs for this WI, then we are fine with the proposal.

16 – Huawei Technologies France

Redcap UE is not allowed in the ITS band, which is a dedicated band for V2X. The statement of tentative agreement is not aligned with the RAN4 agreed WF. As for RedCap support in non-ITS band(s), it is up to UE implementation as long as there is no additional specification impact.

17 – Nokia France

We have not seen a sufficiently urgent use case to include RedCap support for n47, given the workload in RAN4.

**Feedback Form 7: Comments to Proposal 2 in RP-212138
(TDD band n79)**

1 – Nordic Semiconductor ASA

Yes

2 – Ericsson LM

We are fine to support n79 for redcap and smaller BWs (20 MHz and smaller) can be added for n79.

3 – MediaTek Inc.

As this is a pure spectrum item it seems reasonable to include band n79 for RedCap and define 20MHz bandwidth for this band. Regarding the Ericsson comment, we would like to understand if there is really a demand for smaller bandwidths than 20MHz if the only reason for 20MHz channel bandwidth is due to UE bandwidth limitation.

4 – CATT

We are fine to define 20MHz in n79 for RedCap. But we do not find strong motivation to define bandwidth smaller than 20MHz.

<p>5 – Apple Poland Sp. z.o.o.</p> <p>Apple</p> <p>Ok to add band n79 for Redcap device.</p>
<p>6 – vivo Communication Technology</p> <p>We support proposal 2.</p>
<p>7 – Spreadtrum Communications</p> <p>We support proposal 2. We see no reason to exclude n79. Smaller BWs (20 MHz and smaller) requirements can be added for n79.</p>
<p>8 – QUALCOMM JAPAN LLC.</p> <p>We support proposal 2. the technical details related to the addition of n79 can be sorted out in RAN4.</p>
<p>9 – Intel Corporation (UK) Ltd</p> <p>[Intel]</p> <p>We support Proposal 2.</p>
<p>10 – Samsung Electronics Polska</p> <p>In general, to enable RedCap operation in any frequency bands without 10/20MHz channel bandwidth, RAN4 has to specify the 10MHz/20MHz channel bandwidth for NR operating first. If 10MHz/20MHz is only introduced for RedCap operation, RAN4 has to further study the corresponding requirements and impact to RAN4 spec, e.g., sync raster, to support 10/20MHz bandwidth in existing frequency band.</p>
<p>11 – Deutsche Telekom AG</p> <p>We do not see what is so specific for n79 ?</p> <p>Similar to Samsung, if Redcap with limited CBW should operate on a band which does not support 10/20 MHz RAN4 needs to define the channel bandwidth. This SHALL NOT result in the discussion that lower than required CBW is possible on certain bands for non-Redcap !</p>
<p>12 – ZTE Wistron Telecom AB</p> <p>Yes, we are fine to add n79 support. As clarified in GTW, the technical issue needs to be resolved with the addition of lower channel bandwidths.</p>
<p>13 – Huawei Technologies France</p> <p>Operators are requesting 10, 20, 30MHz channel bandwidth for band n79 under a dedicated WI. The related discussion is ongoing. The Requirements for 2Rx will be discussed in the WI on adding channel bandwidths. RAN4 has agreed the 2.5dB REFSSENS relaxation for all TDD 1Rx bands. We are fine to consider n79 for RedCap UE, but no need to have parallel discussion on requirements in RedCap WI for n79.</p>
<p>14 – NTT DOCOMO INC.</p> <p>We support Proposal 2</p>

Feedback Form 8: Comments to Proposal 3 in RP-21238 (un-licensed bands)

1 – Xiaomi Communications

We support this proposal. In our view, supporting RedCap working on the unlicensed band is helpful, especially for some industrial scenario.

2 – RadiSys

We support this proposal. It is useful for IoT devices.

3 – Nordic Semiconductor ASA

We support, 20Mhz is LBT BW in n46, we do not see any issues for RedCap UE working in unlicensed spectrum.

4 – Ericsson LM

We are fine to support NR-U bands for redcap. The redcap requirements in NR-U will be defined for only 20 MHz channel BW since LBT bandwidth is 20 MHz.

5 – MediaTek Inc.

- New RRM core requirements would be required for a RedCap UE operating in a system with LBT. This has not been proposed until now in RAN4. This would be in addition to band-specific RF requirements work for 1Rx UE.
- RAN4 has agreed (in R4-2115358) that existing features combined with RedCap would not be assumed in its RRM work, unless explicitly identified and justified.
- Unlicensed spectrum operation was never explicitly addressed in the overall RedCap work in our understanding, so it is not so clear that the overall design fully caters for that.

Given the above, we do not believe that it is justifiable to adopt Proposal 3 at this late stage of Rel-17. It can be considered further as part of Rel-18 in our view.

6 – CATT

We support proposal 3 in principle. We are also fine to consider it in Rel-18, if RAN4 workload is too heavy in Rel-17.

7 – Apple Poland Sp. z.o.o.

Apple

From RAN4 RRM perspective, the discussion about requirements for RedCap on NR-U band would be deferred until all the other baseline requirement would be finalized in R17, according to the agreement in approved WF R4-2115358. Unless new agreement would be made in RAN4, our view is that support of NRU for Redcap is agreed in RAN4 to be de-prioritized at least in Rel-17.

8 – Panasonic Corporation

Although we see the importance of the combination between RedCap in unlicensed band, we recognize RAN4 decision and to support the view to consider it in Rel.18.

9 – Spreadtrum Communications

We support proposal 3. NR-U bands can be supported by RedCap UEs optionally. It is beneficial to expand the market of RedCap.

10 – China Mobile Com. Corporation

Introduce unlicensed for RedCap will bring large work load, should not be included in Rel-17

11 – QUALCOMM JAPAN LLC.

We do not see any issues with having RedCap UEs be supported in NR-U bands. To Mediatek: can you point to any issues that would not allow a RedCap UE to work in a NR-U band? even though this was not explicitly considered, it was never left out. our understanding is that by default, new features apply to unlicensed band operation also.

12 – vivo Communication Technology

Similar comment as to proposal 1

We think the we can probably decouple the signaling support (RAN1/2) and performance requirements (RAN4), for example, we can allow a Rel-17 UE to indicate both RedCap and NRU related capabilities from RAN1 and RAN2 specification perspective, while whether and how to finalize the performance requirements can be decided by RAN4 considering the overall work load situation.

13 – Intel Corporation (UK) Ltd

[Intel]

We support Proposal 3.

14 – Samsung Electronics Polska

As our comments in proposal 1, signaling of supporting unlicensed bands and RedCap feature can be reported independently if UE support both RedCap in licensed bands and NR-U in unlicensed. However, in our understanding, we don't think supporting RedCap in unlicensed bands is within the scope of WI. We prefer to not specify the NR-U requirement for RedCap in R17 WI.

15 – Deutsche Telekom AG

Similar to samsing we believe supoort of Redcap on unlicensed bands is not supported with the current WI. A topic which can be deferred to Rel-18 ...

16 – TELECOM ITALIA S.p.A.

Support Mediatek. It is too late now to add objectives in Rel 17

17 – Huawei Technologies France

NR-U as a feature, whether it is included in the RedCap WI scope is not clear. Apparently, it has RAN4 spec impact. As commented by other companies, at least RRM requirements need more work. Priority or whether to support NR-U in Rel-17 can be further discussed with consideration of RAN4 workload and corresponding spec impact.

18 – ZTE Wistron Telecom AB

Similar consideration, if the required RAN4 works can be accommodated by the planned TUs for the WI, then it is fine to add unlicensed operation support.

19 – Nokia France

We agree with this proposal.

20 – MediaTek Inc.

Answering Qualcomm’s question: We have not had time to fully analyze if there are other issues as it was only raised as a consideration very recently.

21 – Lenovo (Beijing) Ltd

We support that RedCap can be applied to NR-U, but the solutions on licensed carriers can be reused for NR-U.

Feedback Form 9: Comments to proposal 4 in RP-212138 (SUL bands)

1 – Xiaomi Communications

We support this proposal considering the following reasons

- (1) Supporting SUL will increase the device cost. According to the information from our product department, supporting SUL may require additional hardware (e.g., transceiver) based on current SUL framework
- (2) In our understanding, the support of SUL is to guarantee the UL coverage. But in Rel-17, coverage enhancement was set to improve the UL coverage and it is also assumed that the coverage enhancement solutions can be reused for RedCap. From this point, the UL coverage would not be an issue.

Thus, from the above two aspects, we think the motivation of supporting SUL is weak

2 – Nordic Semiconductor ASA

We support. Even though SUL is operated as secondary carrier within a single cell, UE must support two BWPs and additional hardware. Furthermore, as mentioned by QC in online, UE must keep two BWPs active at the same time due to dynamic switching of UL carrier in a cell. Finally, as mentioned by Xiaomi, UL coverage is already addressed in RedCap WID.

3 – Ericsson LM

We are fine with this proposal to explicitly exclude SUL support from the Rel-17 RedCap WI scope. The WID already stipulates that CA and DC should not be supported by RedCap UEs and that the WI should focus on SA mode and single connectivity with operation in a single band at a time, so SUL support does not seem to be in the spirit of the intended WI scope.

4 – Classon Consulting

for FUTUREWEI Whether or not to include SUL in the list of constrained/ prevented capabilities was *already* discussed last December in GTW and [90E][07][RedCapWIscoping]. The approved WID list includes ”carrier aggregation, dual connectivity and wider bandwidths”, but SUL was removed from the draft

WID after discussion. Recall that these three were included because of the strong operator desire to restrict the peak data rate of RedCap UEs. It was not a complexity related discussion. SUL was not prohibited because it is a coverage enhancement feature, different than CA. We do not agree to add SUL now into the list of prohibited features and do not agree with this proposal.

We are sympathetic that some vendors feel they could not implement a RedCap UE supporting SUL cheaply. However, SUL is different than CA in that only one at a time is active, and the peak data rate is not increased. If some vendors feel they can implement SUL cheaply enough to succeed in the market they can do so. The operator interest is clear enough that we should not agree to stop supporting SUL bands.

5 – CATT

We think SUL can be optionally supported by RedCap UE. Besides the benefit on coverage and offloading, we observe that:

- SUL is treated as part of a single cell, and is not related to CA or DC.
- SUL does not have the risk brought by UL CA, i.e. mimicking low-end NR UE, which is the main reason to forbid CA/DC for RedCap UE. The transmission in SUL or NUL of a single cell is a binary choice.

6 – Apple Poland Sp. z.o.o.

Apple

SUL band cannot operate by itself and needs to pair with a normal NR band which may imply a CA-like implementation in UL. We are ok with Proposal 3 to exclude it for Redcap.

7 – Facebook

We think SUL can be optional supported for better uplink performance in some scenarios.

8 – QUALCOMM JAPAN LLC.

Supporting SUL implies additional hardware complexity due to its similarities with CA. Since CA was left out, this should also be not applicable to RedCap UEs. CA is also optional so the we do not see this as a valid argument. Also, SDL was mentioned before but SDL is not supported for RedCap UEs because CA is not supported.

9 – China Mobile Com. Corporation

CA is aimed to improve the throughput, which violates the purpose and use cases of RedCap. Different from CA, SUL is to improve the UL performance in both idle and connected mode, which is important for RedCap UEs. We cannot exclude SUL just because CA is not supported. SUL can be optional support for RedCap UEs. And we are open to discuss whether the 0us switching period can still be applied for RedCap.

10 – Deutsche Telekom AG

Similar to CMCC we think that the aim of SUL shall only be on UL improvements, not improving the UL datarates. We see a benefit of using especially UL in lower bands to improve UL coverage. We proposed a full UL/DL decoupling as part of our Rel-18 contributions which aims to the same direction.

We think we can find a clear definition of the support of SUL ONLY for coverage improvements (disallowing the SUL aggregation to increase the UL datarates ...)

11 – Huawei Technologies France

SUL is different from CA. SUL does not increase redcap peak data rate compared to FDD 20MHz redcap, while CA does. Basic SUL band combination includes a TDD carrier and an SUL carrier; this does not involve any DL or UL carrier aggregation. Rel-15 UE feature 6-16 about SUL is only for the UE to operate on the SUL or UL carrier via semi-static configuration on a basic SUL band combination, and dynamic switching between SUL and UL (i.e. Rel-15 UE feature 6-18) is a separate optional UE capability. Rel-17 RedCap UE operation on basic SUL band combination without dynamic switching is similar to Rel-17 RedCap UE operation on a FDD or TDD band, in terms of complexity. For SUL, only single Tx is supported at a time. Even in the background info in the contribution, we can see clear demand for SUL from operators. In addition, it should be noted that the max CBW for both SUL and TDD NUL band is 20MHz. Clearly, depriving SUL support for Rel-17 RedCap UEs from specification puts Redcap on TDD bands in disadvantage to FDD bands.

Therefore, with comparable implementation complexity, comparable data rate with 20MHz FDD bands, and strong demands from operators, we see no reason that SUL band should be excluded from the RedCap UE. We disagree with the proposal 4 in RP-212138.

12 – ZTE Wistron Telecom AB

We support to explicitly exclude SUL support considering that CA is excluded, but we are open to discuss to include both SUL and CA support at the same time. It seems that there is some misaligned understanding on CA. Actually there is one CA UL configuration where only one UL is configured: a) only one UL is transmitted at a time, and b) if the only one UL is configured at the lower band, then it also enhances UL coverage, c) similar complexity. We don't see any reason for that SUL can be included, but CA with one UL configuration cannot be included.

13 – Nokia France

We agree with this proposal.

14 – NTT DOCOMO INC.

We are fine with this proposal to explicitly exclude SUL support from the Rel-17 RedCap WI scope. Also, it is important to conclude whether to support SUL for RedCap in this meeting for efficient discussion in WG meetings.

3.2 Summary from Initial Round

Regarding Proposal 1 (n47)

A number of companies commented that the RAN4 document R4-2115096, which according to the draft meeting report from RAN4#100 was approved, clearly stated that n47 is not supported with no mention of the agreement being tentative. The moderator has checked this document and confirms that the agreement taken by RAN4 is clear.

Company views were split, approximately evenly, in 3 directions, with one group supporting the proposal, one group against the proposal, and the third group who were interested to support this case but did not consider that it should be discussed further discussed for Rel-17. Based on this feedback, the moderators view is that there is insufficient motivation or support to overturn a WG agreement, and therefore RAN4 agreement should stand.

Regarding Proposal 2 (n79)

There was widespread support for the proposal to support n79 for RedCap UEs. It was also commented that this requires narrower channel bandwidths to be supported for n79 and that there also is a separate WI under discussion to add this. However, while there is clear support to allow n79 to be supported by RedCap UEs, it is not clear to the moderator under which WI the work on new BWs is expected to be performed.

Regarding Proposal 3 (unlicensed)

Views from companies were roughly evenly split between those that support the proposal and those that did not support it or felt that there was insufficient time within Rel-17 to do the work. Given this split and the fact that the RAN4#100e outcome was to request contributions to the next meeting, the moderator's conclusion is that no conclusion should be made at this RAN plenary, and let RAN4 continue their discussions.

Regarding Proposal 4 (SUL)

View from companies were roughly evenly split between those that support the proposal and those that did not support. Given this split and the fact that the RAN4#100e outcome was to request contributions to the next meeting, the moderator's conclusion is that no conclusion should be made at this RAN plenary, and let RAN4 continue their discussions.

Moderator's conclusions from Initial Round:

1. No change to RAN4#100 agreement regarding n47 support for RedCap UEs (i.e n47 is not supported by RedCap UEs). No further discussion of this proposal in RAN#93e.
2. n79 can be supported by RedCap UEs.
3. Proposal 3 is not agreed. Discussion on unlicensed supported by RedCaps UEs to continue in RAN4.
4. Proposal 4 is not agreed. Discussion on SUL band support by RedCaps UEs to continue in RAN4.

3.3 Intermediate Round

Comments are invited to the moderator's conclusions from Initial Round. Regarding the band n79 support, the moderator would like to understand from companies in which WI (RedCap or some other) they expect will do the work to define new BWs for band n79.

Feedback Form 10: Comments to moderator's conclusion from Initial Round

1 – Nordic Semiconductor ASA

Regarding P4, we believe this is not RAN4 issue, instead RAN1 should discuss. If conclusion cannot be reached in RAN this week. And let us re-iterate that UL coverage is already handled by R17 UL coverage enhancements applicable to RedCap UEs. Also let us re-iterate that in SUL two UL BWPs are active at the same time one on primary carrier and one on secondary carrier, same as CA -> increases memory demand. And due to 0 switching time two PLLs for UL need to be running, this not only being more expensive/complex, but also consuming more power. SUL is against the spirit of RedCap WID to achieve low complex and low power consuming implementations.

2 – Ericsson LM

We also do not think that P4 is RAN4 issue. There is impact on other WGs. But above all the current WID does not support SUL. RAN4 has been discussing this for several meetings but no conclusion has been reached. It has also taken lot of RAN4 time in both RF and RRM without any conclusion. So in our view this should be discussed in RAN during rest of the week to draw the conclusion.

3 – Nokia France

Regarding n79, this could be done in the RedCap WI.

Regarding proposals 3 and 4, as stated by the Moderator, in both cases views are roughly evenly split between inclusion and non-inclusion. Given this situation, it is highly unlikely that agreement will be reached easily in RAN4, and a significant amount of time will be wasted. It is very important to manage the RAN4 workload efficiently, and therefore for the sake of good work management and saving time in RAN4 we propose that, rather than continuing discussion in RAN4, neither unlicensed nor SUL should be supported in Rel-17 (even though this wasn't precisely our first choice!).

4 – NTT DOCOMO INC.

We agree with Nordic and Ericsson that P4 is not only RAN4 issue. It is important to conclude whether to support SUL for RedCap in this meeting for efficient discussion in WG meetings.

5 – Intel Corporation (UK) Ltd

[Intel] Proposal 2 (n79): We agree with moderator proposal. The work on the definition of new CBW for n79 can be done as a part of the ongoing “Basket WID on adding channel bandwidth support to existing NR bands”. The new CBW are already included in the revised WID RP□211931 and are under discussion in this plenary meeting.

6 – QUALCOMM JAPAN LLC.

For Proposal 1 it seems that there is still a misunderstanding of our proposal. Also, looking at the comments in the initial round, it seems companies understood that we are proposing to introduce RedCap support for V2X which is not actually true. Our proposal is not against the RAN4 agreement but more of a clarification. What we are proposing is that a UE can be RedCap in Uu bands and also support V2X in n47. V2x support is based on Rel.16/17 requirements, no changes needed. As of now there is no such thing as V2X Redcap. To give a simple example, a UE can support Band n1 and n47, this UE will be Redcap in n1 and a “normal V2X” UE in n47. Perhaps the proposal should be reworded as:

- A UE can be RedCap UE in any Uu band and also support V2X in n47
 - o UE will have to meet all the V2X requirements defined in Rel.16/17
 - o No changes to any V2X related requirements for RedCap

This proposal has no impact on RAN4 so there should be no arguments that this will have any impact on RAN4 load.

For proposal 2, we agree.

For Proposal 3, what would be the technical discussion in RAN4. Companies arguing that support for unlicensed will create issues should bring up some examples of these issues.

For Proposal 4, we do not see the point of continuing this discussion in RAN4 since this is not a RAN4 technical issue. This also has impact on other WGs.

7 – Guangdong OPPO Mobile Telecom.

For proposal 1, we support N47 as this is only band issue, not different air interface.

The proposal 3, we also think it is supportable for unlicensed band. This is not much complexity for RedCap UE work in the band.

8 – vivo Communication Technology

For Proposal 3, we prefer that RAN plenary to have a clear guidance on support of unlicensed spectrum for RedCap, RAN4 can work on the details.

9 – CATT

We are fine with the moderator's arrangement for P1 to P3. However, P4 is not only a RAN4 issue, but better to be concluded a.s.a.p.

Just kindly remind, forbidding RedCap to support CA/DC was to alleviate the operators' concern on turning RedCap UE into so-called low-end NR UE, not to reduce cost/complexity. SUL does not have such risk, so it is unnecessary to forbid it for RedCap.

Regarding to the increased complexity brought by SUL, we think it is natural cost when a UE is implementing something optional. But it is unreasonable to preclude SUL as an optional feature. UE vendors can of course determine whether to implement something optional (e.g. SUL) by their own judgment on the trade-off.

10 – Xiaomi Communications

We are fine with the P1 to P3. But for P4, it is not only one RAN4 issue, it is one issue impacting the RedCap WI scope. We prefer to resolve this issue in RAN plenary.

11 – Apple Poland Sp. z.o.o.

Apple

Agree P1/P2/P3 from Moderator.

On P4, we are open to discuss and conclude SUL support in this plenary

12 – TELECOM ITALIA S.p.A.

ok with moderator's conclusion on proposal 1

on proposal 3, we do not agree to go back to RAN4. There is clearly no agreement to continue. RAN4 is overloaded. Therefore we recommend to stop the discussion on inclusion of RedCap in unlicensed bands (cause: no agreement)

13 – LG Electronics Deutschland

With Qualcomm's explanation on P1, it seems no change to existing RAN4 agreement should be OK as proposed by moderator. As for the modified P1, if there is no spec. impact to RAN4, we think this needs no more discussion at least in RAN4 perspective. One clarification on modified P1, if RedCap UE support V2X in n47, does it mean that RedCap UE should stop Uu communication or it can have concurrent Uu and Sidelink operation? The latter case is fine for us but the former case needs further discussion at least in RAN1 or RAN2 since this requires switching operation from Uu to Sidelink for RedCap UE.

14 – ZTE Wistron Telecom AB

For n79, the work could be conducted in the existing basket WI.

For P3/P4, throwing the ball back to RAN4 would not be any helpful given the current sided views, except a waste of RAN4's time and efforts. In particular, as other companies comments, P4 is a cross-WG topic, so the plenary this week is a right place to resolve and conclude these issues.

15 – China Mobile Com. Corporation

For P1, as explained by Qualcomm, if it does not request RedCap support for V2X, but to clarify a n47 V2X UE can also support RedCap on Uu band, we are wondering what is the impact on RAN4 requirements, and would this be a realistic case?

For P2, we support.

For P3, we don't support unlicensed RedCap in Rel-17. At least RRM requirements will be impacted if we add unlicensed support.

For P4, we don't buy the argument that SUL is not supported for RedCap because CA is not supported. As we commented in the initial round, CA is aimed to improve the data rate which violates the purpose of introducing RedCap of reducing bandwidth. SUL is aimed to improved th UL coverage in both idle and connected mode, which is important for RedCap UE. We support to conclude in this plenary meeting to support SUL for RedCap in Rel-17.

16 – MediaTek Inc.

- MediaTek supports P2 from the moderator.
- For P1, we agree with the moderator proposal. V2X has never been discussed in association with RedCap and was never in scope of the Rel-17 WI. RAN4 has confirmed this in their latest agreements. There are many issues that would need to be evaluated such how this device is supposed to operate, how many antennas should be assumed, and impact on Uu band antenna support. Adding this to the Rel-17 scope would seem strange given that down-scoping is being discussed at the same time, and given that it was highlighted in June that RAN4 has no spare time available.
- For P3, this will require extra work from RAN4 at least that is not band-specific - new RRM requirements. This was never requested until now in our understanding. As NR-U was never explicitly included in the WI scope, this would also need evaluation as to the impacts - so more work from companies. it is unclear if this is just a RAN4 evaluation issue, and quite late in the Release to ask companies to assign resources to this. So it seems most reasonable in our view to agree already now not to support this, and come back to this in Rel-18 where we can have a more structured discussion.

17 – Ericsson LM

Ericsson2 comments:

On n79 (P2): the requirements for redcap can be defined under Redcap WI. At this RAN the basket WI for existing BW (NRBW Bands) the new BWs (10, 20, 30 MHz (15-30-60 kHz), 70, 90 MHz (30-60 kHz)) are included for n79. Once they are done (e.g. by December) then RAN4 can develop the n79 requirements for redcap (e.g. 10 and 20 MHz with 1 Rx) under Redcap WI like for other bands.

On NR-U bands (P3): Our understanding is that Redcap UE can support NR-U bands. The question is how much work is needed to develop requirements. There will be only NR-U SA requirements for redcap. RAN4 can assess the work in Q4 and report to RAN in December.

18 – Huawei Technologies France

Looking at the comments, there seems to be different levels of impact to the RAN4 work from the 3 types of bands being discussed, where clearly additional specification work has been identified for supporting unlicensed bands for a RedCap UE. On the other hand, the amount of work (if any) for supporting an ITS or SUL band for a RedCap UE is minimal, while there is additional UE complexity for supporting an ITS band or an SUL band (as with any additional optional feature that a UE may choose to support or not support). It seems the main concern on ITS band is about concurrent operation of SL on ITS band and RedCap Uu link on a licensed band, and for SUL the main concern is on increasing the UL peak rate beyond what is intended for a RedCap UE. Therefore, limiting RedCap UE not to support concurrent transmission of SL on ITS band and Uu link on licensed band, and limiting SUL to 20 MHz UL (on the TDD NUL carrier and on the SUL carrier), should address the concerns about the optional support of ITS band and SUL band by a RedCap UE.

Therefore, we propose the following package proposal:

The following implementation is allowed for a device

- The device operates as RedCap UE on a Uu band
- The device operates as regular V2X UE on a ITS band

Concurrent operation as RedCap UE on a Uu band and as regular V2X UE on an ITS band is not supported in Rel-17.

Note: There is no additional specification impact.

For RedCap support in unlicensed spectrum, task RAN4 to provide a list of additional specification work, RAN to make a decision on whether to support RedCap in unlicensed spectrum for Rel-17 at RAN#94e.

SUL is supported for RedCap UEs

- The maximum bandwidth supported by the RedCap UE on the SUL carrier is 20MHz
- The maximum bandwidth supported by the RedCap UE on the TDD carrier paired with the SUL carrier is 20MHz
- Support of SUL band is UE capability for Rel-17 RedCap UEs

19 – Classon Consulting

for FUTUREWEI Agree with CATT comment on SUL

20 – Panasonic Corporation

On P4 SUL, it is not only RAN4 but RAN1 involvement. The other is ok with us.

3.4 Summary from Intermediate Round

This discussion is scheduled for the Wednesday GTW and hence the following summary is targeted for discussion in that GTW. The summary will be further updated and opened for final round comments only after the GTW.

From the comments received there is clear desire for RAN plenary to try to make progress on these items to reduce RAN4 discussion time.

On P1, Qualcomm make a clarification as to their intention and it seems worthwhile to ask get company feedback to this proposal during the Wednesday GTW

On P2, there seems to be no remaining controversy. The new BWs for n79 will be defined as part of an update to the current basket WI for adding new BWs to bands, so the task for the RedCap WI will be to add the RedCap sepecific requirements for n70 (e.g. related to 10 and 20 MHz with 1 Rx).

P3 and P4 remain controversial with a split of views. This will indeed consume time in the RAN WGs (RAN4 and/or RAN1) if sent back for decision, and further time to progress the details if either is agreed. Given the late stage of Rel-17, the moderator's proposal is to not agree to either of these in Rel-17.

Proposal for discussion in Wednesday GTW:

1. Clarified proposal from the proponent to be discussed:
 - o A UE can be RedCap UE in any Uu band and also support V2X in n47
 - o Such a UE will have to meet all the V2X requirements defined in Rel.16/17 (No changes to any V2X related requirements for RedCap)
 - o [Moderator's understand is that this proposal would have not impact to RAN4 work but could have implications for RAN2, e.g. UE capability signalling]
2. Band n79 can be supported by RedCap UEs. RedCap WI will add the RedCap specific requirements for n79 (e.g. related to 10 and 20 MHz with 1 Rx).
 - o Note: Update to "Basket WID on adding channel bandwidth support to existing NR bands" to add new CBWs to n79 is being discussed separately.
3. Unlicensed bands cannot be supported by RedCaps UEs in Rel-17
4. SUL bands cannot be supported by RedCaps UEs in Rel-17