1.0.0

Variant of RAN1-107-e-NWM-NR-R17-RedCap-03 Version 0.0.3

RAN1

3GPP TSG-RAN WG1 #107-e **R1-2112654**

e-Meeting, November 11th – 19th, 2021

Agenda Item: 8.6.2

Title: FL summary #2 on RAN1 aspects for RAN2-led features for RedCap

Source: Moderator (Apple)

Document for: Discussion, Decision

1 Introduction

This feature lead (FL) summary (FLS) concerns the Rel-17 work item (WI) for support of reduced capability (RedCap) NR devices [1]. Earlier RAN1 agreements for this WI are summarized in [2].

This document summarizes contributions [3] – [26] submitted to agenda item 8.6.2 and captures this email discussion on RAN1 aspects for RAN2-led features for RedCap:

Table 1:

[107-e-NR-R17-RedCap-03] Email discussion regarding RAN1 aspects for RAN2-led features – Hong (Apple) – 1st check point: November 15 – Final check point: November 19

In this round of the email discussion, please comment on the issues tagged 'FL1' before Friday 16:00 UTC .

2 Early indication of RedCap UEs

2.1 Early indication in 2-step RACH

2.1.1 Issue 1: Early indication for Redcap by MsgA PRACH in 2-Step RACH

The following was agreed in RAN1 105 e-meeting that 2-step RACH [2]:

Table 2:

Agreements:
Support 2-step RACH for RedCap UEs as an optional feature

- FFS details of early indication in MsgA, e.g.:
  - Separation of 2-step RACH resources or MsgA preambles
  - Separation of initial UL BWP
  - Using a new indication in MsgA PUSCH part
- Note: Discussion on 4-step RACH for early indication should be prioritised

In addition, the following was agreed in RAN1 106-e meeting to enable early indication of Redcap UEs in 4-step RACH procedure [2]:

Table 3:

Agreements:
Confirm the following working assumption with the modifications in red:

- For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
  - The early indication in Msg1 can be configured to be enabled/disabled via SIB
  - From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)
    - separate PRACH resource
    - PRACH preamble partitioning

Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2.

Many contributions [3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 19, 20, 21, 22, 23, 25] discussed the details of early indication for Redcap UEs for 2-step RACH. Majority companies prefer to leave MsgA PUSCH-based early indication to RAN2.

Companies' positions on support MsgA PRACH for early indication are briefly summarized in Table 4 below.

Table 4: Early indication of RedCap UEs in PRACH resource of 2-step RACH

Description	Yes		No	
	Companies	Num. of companies	Companies	Num. of companies

– Separate PRACH resource in Msg.A – PRACH preamble Partitioning in Msg.A	ZTE [6], Nokia [7], CATT [9], OPPO [10], China Telecom [11], Intel [12], Xiaomi [13], CMCC [14], Apple [16], IDC [19], Lenovo [20], Sharp [21], LGe [22], DCM [23].	14	Ericsson [3]	1

Support of early indication in MsgA preamble is clearly preferred by almost most companies, which is motivated by the potential use case where coverage recovery of MsgB PDSCH carrying fallback RAR when MsgA preamble is detected but MsgA PUSCH is not decoded correctly (or if MsgA PUSCH is not transmitted). To address the concern of usefulness of MsgA preamble, the feature can be specified to be configurable, which offers a full flexibility for gNB to enable/disable it by SIB.

<1st Round Comments>

Given the almost unanimously proposals for 2-step RACH and the configurability can address the concern of usefulness , FL therefore proposes the following for PRACH in 2-step RACH, which is aligned with the agreements made for 4-Step RACH

FL High Priority Proposal 1-1:

- **For 2-step RACH, support the early indication of RedCap UEs at least in MsgA PRACH.**
  - **The early indication in MsgA PRACH can be configured to be enabled/disabled via SIB.**
  - **From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP**
    - **separate MsgA PRACH resource**
    - **MsgA PRACH preamble partitioning**
- **Whether/how to support early indication of RedCap UEs in MsgA PUSCH in Rel-17 is up to RAN2.**

Companies are invited to provide feedback ('Yes' or 'No') with briefly justification if change is needed.

Feedback Form 1:

1 – HUAWEI Technologies Japan K.K. Agree
2 – vivo Communication Technology We do not see the need to support early indication by MSG A PRACH, the argument made for the fallback to 4-STEP RACH case due to MSG A PUSCH detection failure is not very convincing. MSG A PUSCH

detection failure is a low probabillity event while the cost of addressing such cornder case is high, as MSG A PRACH resource partition has to be done by the NW. It seems such concern is shared at least some NW vendors.

Therefore we think it should be sufficient to support MSG A PUSCH for early indication during 2-step RACH

3 – Nordic Semiconductor ASA

Agree

4 – Nokia UK

Agree

5 – Futurewei Technologies

Agree

6 – NEC Corporation

Agree

7 – Intel Corporation (UK) Ltd

[Intel]

Support the FL proposal.

@vivo: The fallback mechanism to 4-step RACH is already specified, and hence, in case conditions apply, a RedCap UE would also fallback to 4-step RACH. Given this, the proposal would allow the gNB to configure identification based on MsgA preamble IF the gNB chooses to do so. There is hardly any new impact to UE, and the handling at NW side is entirely up to gNB implementation.

8 – China Mobile Com. Corporation

Agree

9 – SHARP Corporation

Agree with FL proposal and prefer to delete the MsgA PUSCH part (i.e., ~~**Whether/how to support early indication of RedCap UEs in MsgA PUSCH in Rel-17 is up to RAN2.**~~) given RAN2 has already agreed to support early indication in Msg A PUSCH for 2 step.

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4. At least the dedicated LCID (i.e. the Msg3 early identification solution) can be supported for MsgA early identification. It is up to RAN1 on the need of dedicated preamble and/or dedicated PUSCH resource configuration.

10 – QUALCOMM JAPAN LLC.

We support the FL proposal

11 – LG Electronics France

We agree with FL proposal. MsgA PUSCH part can be deleted considering the following RAN2 agreement:

- *At least the dedicated LCID (i.e. the Msg3 early identification solution) can be supported for MsgA early identification. It is up to RAN1 on the need of dedicated preamble and/or dedicated PUSCH resource configuration.*

12 – TCL Communication Ltd.

Agree

13 – CATT

Support the proposal.

14 – ZTE Corporation

Agree.

15 – China Telecommunications

China Telecom Support

16 – Spreadtrum Communications

Support the proposal. Early indication in MsgA preamble part is required in two cases. One is that UE may transmit a PRACH preamble which is not mapped to a valid PUSCH occasion. Another is that the network fails to decode the MsgA PUSCH and falls back to 4-step RACH. In addition, it is natural to support early indication in MsgA preamble part when RedCap UE is configured with separate initial UL BWP which is not overlapping with the initial UL BWP for non-RedCap UE.

17 – NTT DOCOMO INC.

We support FL proposal.

As commented by Sharp and LGE, we can delete the bullet for MsgA PUSCH part.

As stated in the 1st sub-bullet, the early indication in MsgA PRACH can be configured to be enabled/disabled via SIB, and hence it is up to gNB whether to use this feature for the case when MsgA PUSCH is not detected or just rely on MsgA PUSCH indication.

18 – Xiaomi Communications

Support

19 – VODAFONE Group Plc

Agree with the proposal

20 – Ericsson LM

No to the PRACH bullet, but Yes to the PUSCH bullet. Note that RAN2 has already agreed the following:

- *At least the dedicated LCID (i.e. the Msg3 early identification solution) can be supported for MsgA early identification. It is up to RAN1 on the need of dedicated preamble and/or dedicated PUSCH resource configuration.*

The early RedCap indication in MsgA enables (1) coverage recovery (without impact for non-RedCap UEs) of MsgB PDSCH carrying successRAR when MsgA preamble and PUSCH parts are detected/decoded correctly, (2) disabling of PUCCH frequency hopping for MsgB HARQ feedback, for e.g., when ROs/preambles are shared between RedCap and non-RedCap UEs in the different initial UL BWPs, (3) RRC connection rejection of RedCap UEs and prioritization of non-RedCap UEs over RedCap UEs, in the same way as for the 4-step RACH procedure, and (4) coverage recovery of MsgB PDSCH carrying fallbackRAR when MsgA preamble is detected but MsgA PUSCH is not decoded correctly.

The indication in MsgA PUSCH is enough to enable the cases (1), (2), and (3). The indication in MsgA preamble is needed only to enable case (4). However, it is a rather rare case that the MsgA preamble would be detected but MsgA PUSCH not decoded correctly, and in addition coverage compensation is only needed in certain deployment scenarios (similar to Msg2 in TR 38.875, i.e., only in 4 GHz band with 24 dBm/MHz and 1 Rx, and with 3 dB antenna efficiency loss). Moreover, 2-step RACH is only used in scenarios where TA is valid, which in practice means small cells or when in good coverage. This further reduces the need for MsgB coverage compensation. In the rare cases MsgB coverage compensation would still be needed in case (4), the lack of a MsgB in response would eventually trigger a re-attempt by the UE and therefore this case is already covered by legacy error handling mechanisms.

21 – Samsung Research America

Fine with the proposal.

<1st Round Summary>

Table 5: Summary of companies position

Yes		No	
Companies	Num.of Companies	Companies	Num.of Companies
HW, Nordic, Nokia, Futurewei, NEC, Intel, CMCC, Sharp, Qualcomm, LGe, TCL, CATT, ZTE, China Telecom, Spreadtrum, NTT DOCOMO, Xiaomi, Vodafone, Samsung	19	vivo, Ericsson (not for MsgA PRACH)	2

2.1.2 Issue 2: Early indication when fallbacks to 4-step RACH procedure

Contribution [22, LGe] brought up one issue related to early indication when a UE fallbacks from 2-step RACH to 4-step RACH procedure and transmits Msg3 to gNB. This may happen in a few cases [22]:

- Case 1: If MsgA PUSCH is not successfully received and gNB transmits a fallback RAR in MsgB to trigger the fallback.

- Case 2: When a UE re-transmits MSGA up to *msgA-TransMax*, it fallbacks to 4 step RACH.

The following was proposed for early indication of Redcap UEs in case of 4-step RACH fallback in [22]

- P1: When UE falls back from 2-step RACH to 4-step RACH upon receiving FallbackRAR MAC CE, MSG3 in 4-step RACH indicates early indication based on SIB configuration, regardless of whether/how early indication was indicated in MSGA in 2-step RACH (For Case 1).
- P2: When UE falls back from 2-step RACH to 4-step RACH due to msgA-TransMax, MSG1/MSG3 indicates early indication based on SIB configuration (for Case 2).

It is moderator's assessment that the P1/P2 has some dependency on the details of early indication in SIB configuration. For example, whether there is separate enabling for Msg-1 and Msg-3 early indication in SIB or Msg3 is a 'always-on' early indication regardless of Msg-1 enabling/disabling. Nevertheless, the following question was created to collect companies views on this regard.

<1st Round Comments>

FL1 High Priority Question 2-1: Which one of the proposals (i.e., P1, P2) above do you support for early indication when UE fallbacks from 2-step RACH to 4-step RACH?

- **NOTE: If none of them was agreeable, please provide your views w.r.t. early indication in case of 4-step RACH fallback, which is a valid scenario and UE behavior should be specified in moderator's point of view.**

Feedback Form 2:

1 – HUAWEI Technologies Japan K.K. Slightly prefer P2 and it seems clear that both Ps that SIB configuration should be responsible for handling the case
2 – vivo Communication Technology We share the moderator's assessment, we need to firstly discuss whether MSG 1 and MSG3 based early indication are configured independently. In addition, it is not decided yet in the UE feature session, whether a redcap UE capable of early indication should implement both MSG1 and MSG 3 based early indication together.
3 – Nordic Semiconductor ASA Since we left MSG3 early indication support and design to RAN2, fall-back aspects should be in RAN2 competence to decide. No need to discuss in RAN1

4 – Nokia UK

Prefer P2, since that emphasises the importance/flexibility/option of SIB configuration and retains the option of msg1 being used instead/in addition to msg3 early identification.

5 – Futurewei Technologies

Not clear why this was deemed a high priority question. P1 may not be aligned with RAN2. P2 may be ok, or we can leave to RAN2.

6 – NEC Corporation

It should be up to RAN2.

7 – Intel Corporation (UK) Ltd

[Intel]

Agree with Nokia on the use of P2.

Further, P2 should be extended to apply to ”Case 1” and not limited to ”Case 2”.

We also acknowledge that there is dependency on whether Msg3 indication is Always-ON or not; this aspect can be left up to RAN2.

Thus, we propose to agree on a generalized version of P2 for the MSG1 part, something like the following:

P2’: **When UE falls back from 2-step RACH to 4-step RACH upon receiving FallbackRAR MAC CE, or when** UE falls back from 2-step RACH to 4-step RACH due to msgA-TransMax, MSG1/~~**MSG3**~~ indicates early indication based on SIB configuration (for **Cases 1 and** 2). **Use of MSG3 indication is up to RAN2.**

8 – SHARP Corporation

P2 can be supported.

P1 can be supported if RAN2 agrees dedicated LCID should be always used in the Msg3 including the CCCH data.

9 – China Mobile Com. Corporation

In our understanding, when UE fall back from 2-step RACH to 4-step RACH, it is natural for UE to following the 4-step early identification condfigurations on SIB regardless of early identification configuration of 2-step RACH.

Both P1 and P2 follow such natural way, so it’s fine for both proposals.

There may be another issue. Currently for case 1, the 4-step RACH will start from Msg3, so it can rely on Msg3 for early indication based on SIB configuration. One case may be Msg1 based early indication is enabled for 4-step RACH, while Msg3 based early indication is disabled(depending on further discussion, if Msg3 is not always enabled for early indication), and MsgA based early indication is disabled. Then for case 1, although UE fallback to 4-step RACH, gNB can not identify it since Msg3 based early indication is not enabled. Even P1 can not solve such problem since it follows SIB configuration. However, it may be a corner case that Msg1 based early indication is enabled while MsgA based early indication is disabled, and this issue also depends on the outcome of Msg3 alway on issue, and can be considered later.

10 – TCL Communication Ltd.

Agree with vivo. We need to firstly discuss whether MSG 1 and MSG3 based early indication are configured independently.

11 – ZTE Corporation

Early indication for 2-step RACH to 4-step RACH should be independent, which depends on the NW configuration. When early indication is not indicated in MSGA in 2-step RACH, it is not necessary to mandate the gNB to configure the early indication for MSG3 in 4-step RACH when fallback happens. Therefore, P2 is preferred.

However, in P2, whether early indication of msg3 is based on SIB configuration or not is up to RAN2. It is better to change 'SIB configuration (for Case 2)' as 'gNB configuration (for Case 2) ' or just focus on msg1 related.

12 – CATT

We support P2 as it is a more robust solution and not against previous agreements.

P1 depends on the outcome of whether early indication in Msg1 and Msg3 can be bundled or separately configured. Generally, if the gNB can trigger a fallback RAR, it usually means the gNB already detects the MsgA PRACH correctly (although it fails to decode MsgA PUSCH). Hence, if early indication is already done in MsgA PRACH, there seems no need to do it again in fallback Msg3.

13 – Spreadtrum Communications

We agree with moderator and other companies that P1/P2 depends on how early indication is configured in SIB. We can leave it to RAN2.

14 – NTT DOCOMO INC.

RAN2 would be appropriate WG to discuss this issue

15 – Xiaomi Communications

We share similar observation with moderator. We can leave this issue to RAN2

16 – VODAFONE Group Plc

Similar view as Nordic

17 – Ericsson LM

P1/P2 are under the purview of RAN2.

18 – Samsung Research America

P1: We are not sure an agreement is needed as the UE would use legacy rules to transmit when the UE falls back to 4-step RACH. RAN2 can discuss this, along with P2.

<1st Round Summary>

- P1
  - **Leave to RAN2:** Nordic, NEC, Spreadtrum, DCM, Xiaomi, Vodafone, Ericsson (7)

- **Support:** CMCC (1)
- **Others:** Futurewei (may not align with RAN2), CATT (FFS), Samsung (the need of agreement is unclear)

– P2:

- **Leave to RAN2:** Nordic, Futurewei, NEC, DCM, Vodafone, Xiaomi, Ericsson, Spreadtrum (8)
- **Support:** Huawei, Nokia, Futurewei, Intel (modification), Sharp (5).
- **Pending based on progress of UE feature and details of Msg-1 and Msg-3 based configuration**: vivo, TCL (2)

Based on the responses above, it is clearly majority view to leave 'P1' for RAN2. On 'P2', slightly more companies prefer to leave it to RAN2, which is feasible for moderator since the RAN2 is expertise on procedure-related operation.

Having said that, moderator plan to close the discussion on **FL1 High Priority Question 2-1** and leave it to RAN2 to proceed. As usual, companies are invited to comment if there is different views on moderator proposal.

<2nd Round discussion>

Feedback Form 3: Please comment if you see the need to continue discussion on P1/P2 in RAN1 based on '1st round summary'

1 – vivo Communication Technology No need
2 – QUALCOMM JAPAN LLC. OK with the suggestion of moderator

Another interesting point raised in contribution [22, LGe] is the feasibility that 2-step RACH and 4-step RACH for RedCap UE can be configured in different initial UL BWPs (e.g., legacy initial UL BWP for 2 step RACH and separate UL BWP for 4 step RACH). If it is allowed, whether a UE is requested to switch from legacy initial UL BWP to separate UL BWP or vice versa when UE falls back from 2-step RACH to 4-step RACH.

<1st Round Comments>

FL1 High Priority Question 2-2: Which one of the following proposals do you support for 2-step and 4-step configuration in different initial UL BWPs?

– **Alt.1: A same RACH configuration (i.e., 2-step or 4-step) is shared for all of initial UL BWPs.**

– **Alt.2: No restriction, i.e., different RACH procedures can be configured for different initial UL BWPs, e.g., one with 2-step and the other with 4-step.**

- **Please kindly indicate whether BWP switching is triggered in Alt.2 if UE fallbacks from 2-step to 4-step RACH procedure.**

Feedback Form 4:

1 – HUAWEI Technologies Japan K.K.

The alts may need to be refined as our understanding is that even for the same initial UL BWP in legacy case, the configuration for 2-step RA and 4-step RA is not fully shared. From RAN1 perpective it is not clear why there is a case that legacy UL BWP is configured only for 2step RA since it seems that the BW of legacy UL BWP does not exceed RedCap UE max bandwidth.

2 – vivo Communication Technology

We think different RACH precedures can be configured for differnt initial UL BWPs, e.g. 4-STEP RACH configured in legacy initial UL BWP, while 2-STEP RACH configured in the seperate initial UL BWP for RedCap UEs. However, in this case, we think there is no need to support RACH procedure fallback by BWP switching (i.e. RedCap UE swtich back to the legacy initial UL BWP when fallback to 4-step RACH) as it may introduce unnecessary complication.

3 – Nordic Semiconductor ASA

There are no different initial UL BWPs for RedCap UEs. But if understanding is that legacy one is for non-RedCap and other for RedCap UEs, then we do not see need for restrictions.

4 – Nokia UK

We feel it is worth clarifying, if:

Opt A: Different RACH procedures can be configured for different initial UL BWPs.
Opt B: All RACH procedures that a UE may perform, use the same initial UL BWP.

Although different RACH procedures can be configured for different initial UL BWPs, e.g., one with 2-step and the other with 4-step, given that our current understanding is Opt B, the RedCap UE shall not switch from the separate initial UL BWP to the legacy initial UL BWP if it falls back from 2-step RACH procedure to 4-step RACH procedure.

5 – Futurewei Technologies

We have several questions/comments with this proposal

- Are these two separate initial UL BWPs?
- It is unclear whether the legacy BWP can be used if the size of legacy BWP exceeds the maximum RedCap BW.
- Is this initial BWP shared with legacy?
- Is early identification configured?

If the purpose is for early identification and 2-step RACH is optional for RedCap UEs, we probably cannot have Alt 1 where only 2 step RACH is used.

6 – Intel Corporation (UK) Ltd

[Intel]

There is no agreement on support of multiple initial UL BWP for RedCap UEs. So far, we only have a maximum of a single initial UL BWP for RedCap.

Therefore, if provided with configuration of a separate initial UL BWP for RedCap, all relevant RACH types for RedCap should be provided in the separate initial UL BWP; else, all RACH types for RedCap should be provided in the initial UL BWP shared with non-RedCap UEs.

7 – Apple Poland Sp. z.o.o.

Moderator clarification One quick clarification on the moderator proposal is that this refers to RACH procedure configurations for two initial UL BWPs, one for non-Redcap UEs and the other for RedCap UEs.

8 – SHARP Corporation

Different or same RA types can be configured for different UL BWPs. However, in our view, there is only one initial UL BWP applicable for RedCap UE at one time. RedCap UE should use RA type which are configured in the initial UL BWP configuration for the RedCap UE. RedCap UE can fallback from 2-step RA to 4-step RA only if both RA types are configured in the same initial UL BWP configuration for the RedCap UE. BWP switching between legacy initial UL BWP and separate initial UL BWP is not necessary.

9 – QUALCOMM JAPAN LLC.

On a cell that allows RedCap UE to access, we don't think a RedCap UE needs to support more than one initial UL BWPs.

If the question is about whether or not the RACH type configured for RedCap UE is associated with its initial UL BWP configuration, we don't think the answer purely depends on the initial UL BWP. In our view, it is problematic to configure ROs in the initial UL BWP of RedCap UE, if the initial DL BWP of RedCap UE does not include SSB and CSS for RA/paging.

On the other hand, if the initial DL BWP of RedCap UE includes SSB and CSS for RA and paging, the details of RACH type(s) configuration for RedCap UE are up to NW.

10 – TCL Communication Ltd.

We share the view of most companies that there is only one initial UL BWP applicable for RedCap UE at one time.

11 – ZTE Corporation

From the NW perspective, different RACH procedures can be configured for different initial UL BWPs with flexibility. However, the BWP switching seems to be not necessary in Alt.2 since legacy NR UE also does not support this kind of BWP switching.

12 – CATT

In our understanding, even for non-RedCap UE, UL BWP switching is not allowed during RACH procedure (e.g from NUL to SUL). Hence, in principle, we prefer UL BWP switching is NOT allowed for RedCap UE during RACH procedure.

Come back to the alternatives, we think Alt.2 is more natural. However, we think more clarification is needed:

(1) RedCap UE shall choose RedCap-specific RACH resource in a first priority, for early indication.

(2) If both 2-step and 4-step RACH resources all includes RedCap specific RACH resources (i.e. 2-step RACH with separate preamble while 4-step RACH with separate RO resource) and the bandwidth of the two UL BWPs are no larger than max RedCap bandwidth, the RedCap UE shall choose one UL BWP based on other conditions, e.g. RSRP of SSB.

(3) Once the RedCap UE triggers RACH procedure, it shall not change the UL BWP, until after RACH procedure is ended.

13 – Spreadtrum Communications

We prefer a single initial UL BWP is used for 2-step and 4-step RACH for RedCap UE.

14 – NTT DOCOMO INC.

If separate initial UL BWP is configured to RedCap UEs, RedCap UEs use the RACH configuration for the initial UL BWP.

Otherwise, RedCap UEs use the RACH configuration for the initial UL BWP shared with non-RedCap UEs

15 – Xiaomi Communications

In our ounderstanding, RedCap just monitor one initial UL BWP. RedCap perform 2-step RACH and 4-step RACH in the same initial UL BWP

16 – Ericsson LM

If a separate initial UL BWP is configured, a RedCap UE will use the separate initial UL BWP (and not the legacy UL BWP) for random access (4-step or 2-step). Therefore, the question on same/different RACH configuration/procedures in "different initial UL BWPs" and "BWP switching" from legacy initial UL BWP to separate UL BWP for RedCap UEs is irrelevant.

17 – Samsung Research America

There is no agreement of multiple initial BWPs for RedCap UEs. For a separate initial UL BWP, it is up to network configuration which procedures to configure among the possible procedures that are supported for RedCap UEs.

<1st Round Summary>

Several companies [Vivo, Noridc, Sharp,ZTE, Ericsson] indicates that from NW perspective, there is no restriction on the PRACH configuration for initial UL BWP for non-Redcap UEs and separate initial UL BWP (if configured) for RedCap UEs, which is up to network scheduler. In addition, all companies seem share the view that there is no BWP switching caused by the 2-step RA to 4-step RA fallback operation.

Given the fact that it has been possible to configure different RACH procedure for different initial UL BWPs from ASN.1 signaling perspective, moderator suggests to close the discussion without conclusion or agreement.

Please only comment if **you disagree** to stop discussing on **RACH configuration issue above.**

<2nd round discussion>

Feedback Form 5: Please only comment if you disagree to stop discussing on 'RACH configuration issue above'.

1 – LG Electronics France

We still wonder if any combination of 2/4-step RACH on legacy/separate initial UL BWP can be configured

by gNB. For example, is it possible for gNB to configure the following configuration for 2/4-step RACH for RedCap UEs by SIB? Should RedCap UEs support the below configurations? Or, can we agree that RedCap UEs do not expect one or both of the below configurations?

- Config A
  - 4 step RACH only on a separate UL BWP for RedCap UEs
  - 2 step RACH only on a legacy UL BWP for RedCap UEs
- Config B
  - 4 step RACH only on a legacy UL BWP for RedCap UEs
  - 2 step RACH only on a separate UL BWP for RedCap UEs

<3rd round discussion>

Taking account the comments from proponent company (LGe) and unclear proposals made by moderator in the previous round, moderator suggest to have one more round on this issue above.

Based on the elaboration above, the following question is formulated for discussion

FL3 Question 2-3: Should RedCap UEs support the below configurations? Or, can we agree that RedCap UEs do not expect one or both of the below configurations?

- **Config A**
  - 4 step RACH only on a separate UL BWP for RedCap UEs
  - 2 step RACH only on a legacy UL BWP for RedCap UEs
- **Config B**
  - 4 step RACH only on a legacy UL BWP for RedCap UEs
  - 2 step RACH only on a separate UL BWP for RedCap UEs

Please also comment what's your view on the responsive working group for this issue

Feedback Form 6: Please comment on FL3 Question 2-3

1 – vivo Communication Technology

If separate initial UL BWP for RedCap UE is configured, all the RACH resource (2-step or 4-step or both) should be configured in the separate initial UL BWP and UE will not use the RACH resources configured in the legacy initial UL BWP as that are for non-RedCap UEs. According to such understanding, we think neither config-A nor config-B should be allowed.

2 – Nokia UK

We also share the Vivo understanding (neither config a or b apply) , since we do not see a strong reason to support the use, and additional complexity, of the legacy BWP for offloading certain REDCAP procedures when a separate REDCAP Initial UL BWP has been configured.

3 – Futurewei Technologies Neither config A nor config B should be allowed. If a RedCap UE has a separate UL BWP, it will not be using the legacy UL BWP. Likewise, if the RedCap UE is configured to use the legacy UL BWP, it will not be configured with a separate UL BWP.
4 – Ericsson LM We do not see a need to support Config A or B.
5 – Intel Corporation (UK) Ltd **[Intel]** Same view as Vivo and others - all RACH (2-step or 4-step or both) should be configured in the same initial UL BWP (separate or shared with non-RedCap UEs). Thus, UE may not expect either configuration A or configuration B.

2.2 Early indication in 4-step RACH

In RAN1 106 e-Meeting, the following was agreed:

Table 6:

Agreements:
Confirm the following working assumption with the modifications in red:

- For 4-step RACH, support the early indication of RedCap UEs at least in Msg1.
  - The early indication in Msg1 can be configured to be enabled/disabled via SIB
  - From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP (if supported)
    - separate PRACH resource
    - PRACH preamble partitioning
- Whether/how to support early indication of RedCap UEs in Msg3 in Rel-17 is up to RAN2.

RAN2 #115-e Meeting made the following agreement for Msg1-based and Msg3-based early identification:

Table 7:

Agreements:

- Msg1 identification which can be configured to be enabled/disabled can be specified from RAN2 point of view.

Agreements online:

- 1. A Msg3 early identification based on dedicated LCID is supported (if SA3 confirms there is no problem)

2.2.1 Issue 3: Msg1-based and Msg3-based early indication signalling

Contribution [10, 14, 19, 22] discussed how to enable Msg1-based early indication for Redcap device. Contributions [10, 19, 22] indicate that the presence of separate RACH resource for Redcap UEs implicitly enables the Msg1-based early indication. In [14], it was suggested that gNB can enable early identification by either Msg1 or Msg3 in SIB.

<1st Round Comments>

FL1 High Priority Proposal 3-1:

- **For 4-step RACH, the presence of separate RACH configuration for Redcap in SIB implicitly enables early indication for RedCap UEs.**

Companies are invited to provide feedback with briefly justification if change is needed.

Feedback Form 7:

1 – HUAWEI Technologies Japan K.K. Agree
2 – vivo Communication Technology We think this is network implementation issue, there seems to be no need to make an agreeement or capture anything in the spec.
3 – Nordic Semiconductor ASA Agree
4 – Nokia UK Agree
5 – Futurewei Technologies Seems ok, but also this agreement does not seem to be needed.
6 – NEC Corporation Agree
7 – SHARP Corporation We assume the early indication in the FL proposal refers to Msg1 early indication. Then we think the proposal seems to be not necessary. RAN2 has a similar agreement as below. Not necessary to make a similar RAN1 agreement. **RAN2#116-e** **For RedCap, Msg1 early identification is enabled/disabled implicitly by the presence of dedicate RACH configuration for Msg1 early identification.**

8 – QUALCOMM JAPAN LLC.

Given the RAN2 agreement cited by Sharp, we think it is not necessary for RAN1 to discuss this proposal again, if separate RACH configuration refers to separate ”PRACH” configuration valid for RedCap UE.

9 – China Mobile Com. Corporation

Agree with the proposal. If RAN2 has made such agreements as copied by SHARP, it may not necessary in RAN1.

10 – LG Electronics France

We agree with what Sharp commented.

11 – TCL Communication Ltd.

Agree

12 – ZTE Corporation

Comment from Sharp is valid.

13 – CATT

Agree with FL. Sharp’s comment on RAN2 agreement seems have the same meaning.

14 – Spreadtrum Communications

Agree.

15 – China Telecommunications

China Telecom Support. And we share the same view as SHARP.

16 – NTT DOCOMO INC.

Agree with Sharp

17 – Xiaomi Communications

Agree with Sharp’s comment

18 – Ericsson LM

No, this is up to RAN2, and RAN2 has by the way already made the following agreement in their “offline-110” email discussion:

- For RedCap, Msg1 early identification is enabled/disabled implicitly by the presence of dedicate RACH configuration for Msg1 early identification.

Also, the proposal does not seem to be in line with what has been agreed in RAN2 in their overall Rel-17 Msg1 indication discussion, where it is agreed to have the indication per preamble partition.

19 – Samsung Research America

RAN2 can address this issue in the ongoing discussion.

<1st Round Summary>

As pointed out by Sharp and Ericsson, RAN2 seems already made agreement that for RedCap, Msg1 early identification is enabled/disabled implicitly by the presence of dedicate RACH configuration for Msg1 early identification. With this agreement, it means Msg1-based early indication is enabled once the deviated RACH configuration is present in SIB, which covers the **FL1 High Priority Proposal 3-1.**

Therefore FL intends to close the discussion on Issue 3, please comment if you have different views.

<2nd Round Comments>

Feedback Form 8: Please comment if you want to continue discussing the issue 3, given the fact of RAN2 agreement mentioned above. Please provide brief justification.

3 Definition of Redcap UE Type

3.1 Issue 4: Redcap UE Type Definition

The WID stipulates that only one RedCap UE type should be specified [1]. Moreover, the following agreement was also made by RAN2 during RAN2#114-e [3].

Table 8:

Agreements:

1. […]
2. At least for early identification there will be only one RedCap UE (no need to define separate RedCap UE types for FR1 and FR2)
3. […]

With regards to the definition of the RedCap UE type, the following agreement was made by RAN1 during RAN1#106-e [4]:

Table 9:

Agreements:

- A RedCap UE type from RAN1 point of view supports a maximum bandwidth of 20MHz for FR1 and 100MHz for FR2
- Further discuss whether to capture also one or more of the following capabilities to RedCap UE type description
  - Supports either 1 or 2 Rx branches and corresponding maximum DL MIMO layers
  - Supports either FD-FDD or Type A HD-FDD operation for FR1 FDD bandsSupports
  - either DL up to 64 QAM or up to 256 QAM for FR1
  - Does not support CA/DC

Table 9 summarized companies' preference on Redcap UE type definition with brief notes:

Table 10:

Descriptions	'Yes', or Partially 'Yes'	'No'	Discuss in UE feature AI.
Adding the following components for Redcap device type definition: 1. Supports either 1 or 2 Rx branches and corresponding maximum DL MIMO layers 2. Supports either FD-FDD or Type A HD-FDD operation for FR1 FDD bands 3. Supports either DL up to 64 QAM or up to 256 QAM for FR1 4. Does not support CA/DC	ZTE [6]: Rx branches + MIMO layers, does not support CA/DC OPPO [10]: Add HD-FDD. Xiaomi [13]: Rx branches+HD-FDD+64QAM+ without CA/DC	Only capabilities related to initial access procedure need to be included in the minimum capability set for RedCap UEs: Huawei [4], vivo [5], Intel [12], Apple [16]	Ericsson [3], CATT [9], NEC [18], DCM[23], Samsung [15].

It was observed by moderator that preferences from companies were almost no change compared to RAN1 #106 e-Meeting. Instead continue debating here, it seems more efficient to discuss this under 'UE features for Redcap' AI. It is moderator's understanding that any components that agreed as part of 'basic feature groups' for Redcap device are essentially part of 'Redcap device type' as it can be assumed by network once UE claims to be 'Redcap device'.

<1st Round Comments>

FL1 High Priority Proposal 4-1:

- **Leave 'Redcap Device Type' definition to UE features of Redcap AI.**
  - **Note that: UE features that are defined as part of 'Basic feature group' for Redcap are included in the 'Redcap Device Type' definition.**

Feedback Form 9:

1 – HUAWEI Technologies Japan K.K. No need for UE feature to discuss this -which is supposed to discuss functional wise issue. RAN2 can continue the relevant discussion.
2 – vivo Communication Technology Since this is the last RAN1 meeting for the WI, we suggest to make a conclusion to close this issue. ***Proposed Conclusion:*** There is no consensus to include additional components beyond the maximum UE bandwidth to the RedCap UE type definition.
3 – Nordic Semiconductor ASA Agree
4 – Nokia UK Agree with FL proposal
5 – Futurewei Technologies Agree
6 – NEC Corporation Agree
7 – Intel Corporation (UK) Ltd **[Intel]** Support FL proposal.
8 – SHARP Corporation Agree with the FL proposal.

9 – QUALCOMM JAPAN LLC. We agree with the proposal of FL.
10 – China Mobile Com. Corporation Agree
11 – TCL Communication Ltd. Agree
12 – ZTE Corporation We are OK to leave it to UE feature AI. However, besides that the basic feature group can be defined as part of UE type, the component in 28-1 can be also viewed as the definition of RedCap UE type. Therefore, the following modification is suggested. **Note that: UE features that are defined as part of 'Basic feature group'** ***or 'component'*** **for Redcap are included in the 'Redcap Device Type' definition.**
13 – CATT Agree.
14 – Spreadtrum Communications Support the proposal.
15 – China Telecommunications China Telecom We are fine to leave it to UE feature AI.
16 – NTT DOCOMO INC. We support FL proposal
17 – Xiaomi Communications We share similar view with ZTE and support ZTE's update
18 – Ericsson LM Agree (or leave to RAN2)
19 – Samsung Research America We agree to conclude as Vivo suggested in this AI. This issue can be further discussed in UE features.

<1st Round Summary>

Companies position on this issue is summarized as below:

- Leave to RAN2: Huawei, Ericsson

- Conclude as 'without consensus': vivo, Samsung
- Leave to UE feature discussions (i.e., **FL1 High Priority Proposal 4-1**)
    - Nordic, Nokia, Futurewei, NEC, Intel, Sharp, Qualcomm, CMCC, TCL, ZTE (with modification), CATT, Spreadtrum, China Telecom, DCM, Xiaomi (support ZTE modification), Ericsson

Similar as in last meeting, **FL1 High Priority Proposal 4-1** was got major support. We can try it on GTW session with potential modification as proposed by ZTE.

4 Other aspects

4.1 Issue 5: Criterion to determine the RedCap identity

Contribution [5, vivo] proposed to discuss the criterion that a UE declares itself as RedCap UE when camping on or accessing a given cell. More specifically, whether the bandwidth of target cell can be used as criterion for Redcap UE type declaration. For example, as specified in Table 5.3.5-1 of TS 38.101-1 for FR1 (also cited below), the NR band n39/n40 where the maximum bandwidth for non-RedCap UE is up to 40MHz and 2Rx. For a cell operating in the band of n39/n40 with maximum channel bandwidth of 20MHz, contribution [5] indicates that when a UE capable of maximum bandwidth of 20MHz accesses this cell, the UE should not declare itself as RedCap UE. The UE should not be barred by the cell operating with 20MHz bandwidth and the UE should use the same RACH resources as legacy UE to initiate the random access.

Table 11: Table 5.3.5-1 for FR1 in TS 38.101-1 [5]

	NR band / SCS / UE Channel bandwidth												
NR Band	SCS kHz	5 MHz	10[1,2] MHz	15[2] MHz	20[2] MHz	25[2] MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n39	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes					
	30		Yes	Yes	Yes	Yes	Yes	Yes					
	60		Yes	Yes	Yes	Yes	Yes	Yes					
n40	15	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
	30		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
	60		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		

Based on the analysis above, two proposals were brough up in [5, vivo] for discussion:

- **P1 [5]:** Relative criterion that the comparison on maximum channel bandwidth for a UE can support and the cell is operating (i.e. by locationAndBandwidth) should be used by the UE to determine whether it is a RedCap UE or not.
- **P2 [5]:** UE declaration of RedCap/non-RedCap should be band-specific.

On P2, moderator's view is that it should be handled in Redcap UE feature agenda.

<1st Round Comments>

FL1 High Priority Question 5-1: Can we agree 'P1' and 'P2' listed above?

Please provide brief justification for your answer. Please use the format e.g., 'P1 is ok. P2 is NOT ok' if different preference for them.

Feedback Form 10:

1 – HUAWEI Technologies Japan K.K. We consider P1 can be also handled in RAN2 as there is paralell discussion on going while RedCap report/identification could be part of UE feature discussion, per UE or per band for example.
2 – vivo Communication Technology Fine to discuss P2 in the UE feature session. For P1, if a 2Rx RedCap UE try to access an NW with 20MHz system BW on a FDD band, in this case the RedCap UE can behave the same as a non-RedCap UE, therefore unclear to us why such RedCap UE has to indicate itself as RedCap, e.g. during the initial access procedure. This would be harmful for the system performance as such a 2Rx RedCap UE will be treated the same as a 1Rx RedCap (which is truly RedCap in this particular scenario).
3 – Nordic Semiconductor ASA P1: Disagree, We prefer identification by indicating support of Basic RedCap FG P2: Disagree, RedCap UE should be Redcap in all bands.
4 – Nokia UK Agree with Huawei – this discussion is better handled in other places.
5 – Futurewei Technologies We support that, for the purposes of initial access, a RedCap UE that is just as capable as a non-RedCap UE in that band can perform initial access as a non-RedCap UE. This UE may still inform the network that it is a RedCap UE during the capability exchange; it is then up to the network at that point whether the UE is treated differently.
6 – NEC Corporation RAN1 does not seem appropriate to discuss this.

7 – Intel Corporation (UK) Ltd

[Intel]

P1 is NOT ok.

P2 is NOT ok.

Same reasons as mentioned by Nordic.

8 – SHARP Corporation

Agree with Huawei and Nokia.

9 – QUALCOMM JAPAN LLC.

P1 and P2 are about the details of UE capability signaling, which is in the scope of RAN2.

10 – China Mobile Com. Corporation

Although RedCap UEs may have the same Rx number as non RedCap UE for a channel bandwidth equal or smaller than 20MHz, they may still have antenna efficiency loss. So if gNB has enabled early indication for RedCap UEs, it may be safe to follow the same behavior as 1Rx RedCap UEs, and then after capability reporting, it is up to gNB to do proper handling.

11 – ZTE Corporation

We agree neither of them. Obviously, it is problematic for a RedCap UE to pretend as a non-RedCap UE in some bands. for example, how the 'non-RedCap' UE (actually is RedCap UE) interpret the cell barring info for RedCap?

Anyway, this issue also could be solved in the UE feature AI discussion.

12 – Spreadtrum Communications

Both P1 and P2 are not ok. We share the same view with Nordic.

13 – CATT

We do not see clear benefit of P1 and P2, but foresee some potential problems (e.g. pretend to be a normal UE and configured with CA/DC in this bands).

Tend to disagree in RAN1 or leave it to RAN2.

14 – NTT DOCOMO INC.

This can be discussed in UE feature discussion

15 – Xiaomi Communications

We share similar view with Nordic, neither of them is agreeable to us.

16 – Ericsson LM

No, P1/P2 belong to the UE feature list discussion or can be left to RAN2/RAN4.

17 – Samsung Research America Both P1 and P2 should be handled in RAN2/UE features.

<1st Round Comments>

Companies positions indicated in the 1st round can be briefly summarized as follows:

- P1:
  - **Belong to RAN2 scope:** HW, Nokia, NEC, Sharp, Qualcomm, Ericsson, Samsung (7)
  - **No:** Nordic, Intel, Futurewei, CMCC, ZTE, Spreadtrum, CATT, Xiaomi (8).
- P2:
  - **Discussed in UE feature:** HW, Vivo, Nokia, Sharp, DoCoMo, Ericsson (6)
  - **No:** Nordic, Intel, ZTE, Spreadtrum, CATT, Xiaomi (6)
  - **Belong to RAN2 scope:** Samsung (1)

It is clear that neither P1/P2 gets sufficient support. On 'P1', companies prefer to either leave for RAN2 or conclude not to support it. On 'P2', companies indicate either to leave it to 'UE feature' session or simply draw conclusion of 'not support'.

Based on the comments in 1st round, moderator plans to **close the discussion on this issue** and suggest proponent company directly bringing P1 to RAN2. On 'P2', the discussion seems already ongoing in UE feature agenda.

<2nd Round Discussion>

Feedback Form 11: Please comment on 'close discussion on Issue 5' proposed by Moderator

1 – vivo Communication Technology OK to continue the discussion in UE feature session or RAN2.
2 – QUALCOMM JAPAN LLC. Thanks Moderator, and we agree with your suggestion.
3 – Nokia UK Support Moderator proposal to close discussion here on this issue.

4.2 Issue 6: Early Indication of Redcap UEs in other non-initial access cases

Contribution [22, LGe] indicates that in Rel-15, UE can perform contention-based RACH for beam failure recovery, radio link failure or handover. It was proposed in [22] to discuss the need to support Msg-1 based early indication for Redcap when performing these operations.

In addition, contribution [22] discussed the need to identify the Redcap UEs for on-demand SI acquisition.

<1st Round Comments>

FL1 High Priority Question 6-1: Which of listed P1/P2 below are agreeable? Please provide brief justification for your answers.

- P1: Support MSG1 based early indication for contention-based RACH in case of BFR, RLF and HO.
- P2: REDCAP specific RACH resources can be configured for gNB to transmit on-demand SI message.

Feedback Form 12:

1 – HUAWEI Technologies Japan K.K. We would like to understand whether there is additional specificaiton impact for support of the above P1 and P2 proposals.
2 – vivo Communication Technology P1: The early indication functionality is supposed to be used during initial access procedure. The necessity of extending early indication after the initial access procedure is unclear. P2. It is not clear why differnt RACH resouce should be allocated for different UE types for the purposed of on-demand SI request.
3 – Nordic Semiconductor ASA For P1 : e.g. in BFR gNB configure Preamble index to UE, not sure any spec change is needed For P2 : agree with VIVO, and if RAN2 sees need, can introduce, this aspect is not in RAN1 competence
4 – Nokia UK Support the principle of both P1 and P2, though we wonder if P1 needs the following clarifications: (a) That it is optionally configured (b) That it does not preclude other methods of early indication
5 – Futurewei Technologies Unclear why this is a high priority proposal. P1: While CBRA in case of BFR, RLF, and HO is supported, it is presumed that the RedCap UE will use the RACH configuration provided by the network. It is up to the network to ensure that the CBRA resources has the proper configuration for Msg1 early identification. P2: this is in the domain of RAN2
6 – Intel Corporation (UK) Ltd **[Intel]** Share the same questions as vivo and others.

7 – SHARP Corporation

Agree with Futurewei.

On P1, network can have a proper configuration on the RACH resources given the corresponding RACH resources are dedicatedly provided by the network.

P2 should be RAN2's scope.

8 – QUALCOMM JAPAN LLC.

CBRA-based BFR, RLF and HO are procedures of an RRC connected UE, which should not be mixed with early indication of RedCap UE in RRC idle state. Therefore, we don't think it is necessary to support P1.

P2 can be optionally supported by RRC idle/connected RedCap UE, if the initial/active DL BWP of RedCap UE includes SSB and CORESET#0 (or Type0/0A CSS) and the initial/active UL BWP of RedCap UE includes PRACH resoures valid for RedCap UE.

9 – LG Electronics France

Regarding P1, we could clarify whether RedCap UE can perform CB-RACH using separate RACH resource and/or separate initial UL BWP in case of failure cases. (Probably, for HO, UE could rely on RACH configuration received from HO command.) If RedCap UE can perform RACH using separate RACH resource and/or separate initial UL BWP in case of failure case, we want to make sure that proper configuration is available for the failure cases.

Regarding P2, we could clarify whether RedCap specific ROs can be configured e.g. in *SI-RequestConfig* especially for a separate UL BWP where RedCap UE performs RACH.

10 – ZTE Corporation

Neither of them need to be addressed in RAN1 at present. They should be deprioritized.

11 – Spreadtrum Communications

We share the same opinion with Futurewei.

P1: it is up to network configuration.

P2: it is up to RAN2.

12 – CATT

For P1, we have the same understanding with Futurewei.

For P2, at least from gNB's view, it is unnecessary, since transmission of SIB is cell-level and gNB does not care about the UE type of the UE who triggers the OSI. We do not see the motivation to draw a conclusion/agreement in RAN1. If there is really a need, it should be up to RAN2.

13 – NTT DOCOMO INC.

P1: We don't see the necessity of early indication for connected mode UE

P2: It is up to RAN2

14 – China Mobile Com. Corporation

We share similar view as CATT.

15 – Ericsson LM For both P1 and P2, the benefit of RedCap-specific solutions is unclear to us, and we agree with Nordic that P2 can be discussed in RAN2 instead of RAN1.
16 – Samsung Research America Similar to several above comments, the need for an agreement is unclear (P1) and RAN2 can discuss (P2).

<1st Round Comments>

Views from companies can be categorized as follows:

- P1:
  - **No:** Vivo (unclear motivation), Futurewei/Spreadtrum/CATT/CMCC(up to network configuration), Nordic, Intel, Sharp, Qualcomm (no need for RRC_CONNECTED UEs), ZTE, DCM, Ericsson, Samsung
  - **Yes:** Nokia (support in principle, optionally configured), LGe
  - **Others:** Huawei (any spec impact?)
- P2:
  - **No:** vivo (unclear motivation), Intel
  - **Leave to RAN2:** Futurewei, Nordic,Sharp, ZTE, Spreadtrum, CATT, DoCoMo, CMCC, Ericsson, Samsung
  - **Yes:** Nokia, LGe

In Moderator understanding, the key part of 'P1' is to allow configuration of Redcap-specific RACH resource for certain legacy procedures including RLM, HO and BFR. Hence, leaving it to network configuration maybe insufficient if the ASN.1 IE is not supported in RRC signaling. Nevertheless, based on the inputs on P1, moderator's plan is to close discussions in RAN1 on this issue and proponent companies can directly trigger discussion in RAN2.

On P2, almost all of companies indicate either 'not to support or 'leave it for RAN2', as summarized above. This is also preferred by moderator since the SIB acquisition, including on-demand SIB procedure, is maintained by RAN2.

In summary, moderator proposed to stop discussion on P1/P2 in RAN1 and invite companies to comment on this.

<2nd Round Discussion>

Feedback Form 13: Please comment if you have concern on stopping discussion on P1/P2

1 – vivo Communication Technology OK to stop

2 – QUALCOMM JAPAN LLC.

Thanks Moderator, and we agree with you.

4.3 Issue 7: SIB information update for Redcap UEs

Contribution [28, Xiaomi] discussed how to notify Redcap UEs and non-Redcap UEs regarding SIB update. In current NR, when there is update of system information, paging will be triggered to notify the change of the system information. In paging DCI, the short message field is used to notify the change of system information. When there is update of RedCap-dedicated IE or non-RedCap dedicated IE, paging DCI carrying the indication of system information medication will be broadcasted. And then all UEs will update the system information by acquiring the new SIBs. However, from the perspective of power saving, it is not good for all UEs to update the system information. To solve this problem, the following options was proposed to improve the power efficiency during system information updating:

- *Option 1: Define separate systeminfoModification field in paging DCI.*
- *Option 2: Paging messages of RedCap devices and non-RedCap devices are not multiplexed in the same paging resource.*

<1st Round Comments>

FL1 High Priority Question 7-1:Which of listed options below are agreeable? Please provide brief justification for your answers, especially for Opt.3.

- *Option 1: Define separate systeminfoModification field in paging DCI.*
- *Option 2: Paging messages of RedCap devices and non-RedCap devices are not multiplexed in the same paging resource.*
- *Option 3: None of them.*

Feedback Form 14:

1 – vivo Communication Technology

In general there is always the case where a specific set of SIB IEs are only interested/applicable to a specific set of UEs, e.g. UEs supporting a particular feature but not for other UEs, in this case it might be beneficial to not bother all the UEs to read the SI update if only the specific set of SIB is changed. This is not an new issue due to introduction of RedCap UEs in the system, we do not see strong justification to optimize specifcially for RedCap UEs cases.

However, if seperate initial DL BWP is configured for RedCap UEs for paging monitoring, then Option 2 is automatically possible.

2 – Nordic Semiconductor ASA

Also do not see strong motivation here, and again more in RAN2 competence

3 – Nokia UK

Defer to RAN2.

4 – Futurewei Technologies

We are unclear why this is a high priority proposal. This topic is in the domain of RAN2

5 – NEC Corporation

RAN1 should not discuss this. It is fully up to RAN2.

6 – Intel Corporation (UK) Ltd

[Intel]

Agree with others than this should be left to RAN2.

7 – SHARP Corporation

We understand the intention to separately notify Redcap UEs and non-Redcap UEs regarding SIB update. However, SI update is an infrequent event. Therefore, further optimization is not needed. Furthermore, if paging CSS is configured in the separate initial DL BWP for RedCap UEs, then the network can also separately notify RedCap UEs and non-RedCap UEs regarding SI update.

8 – QUALCOMM JAPAN LLC.

When RedCap-specific initial/non-initial DL BWP is configured, RedCap UE has to meet the general requirements for receiving SI update and/or PWS notification in idle/inactive/connected state. Therefore, ensuring the reliable delivery of SI update is a high priority issue. To this end, paging CSS and SSB should be configured in the initial DL BWP of idle/inactive RedCap UE, whereas dedicated RRC signaling can be used to deliver the SI update for connected RedCap UE.

In our view, optimization of paging PDCCH/message is a secondary goal for RedCap UE, and the details need to be discussed in RAN2 as well.

9 – China Mobile Com. Corporation

Agree with vivo, and considering that SI update is not frequent, optimization of paging is not prefered.

10 – LG Electronics France

This could be deferred to RAN2.

11 – ZTE Corporation

This issue also involves with the discussion of 8.6.1.1. However, the details should be deferred to RAN2.

12 – CATT

We do not think optimization of paging is needed in RAN1's perspective. Hence, Option 3 is preferred.

But if separate initial DL BWP is configured with paging CSS, it is eventually the case of Option 2.

13 – NTT DOCOMO INC.

RAN2 would be appropriate WG to discuss

14 – Xiaomi Communications Since RedCap UEs are more sensitive to power consumption and power saving is also one objective for RedCap WI, it is better to avoid power consumption in vain. Based on current design, when the system information update is only for non-RedCap, RedCap devices have to perform the unnecessary update, that is a kind of power waste. Considering most companies commented this can be leave to RAN2, we are OK to leave this issue to RAN2
15 – Ericsson LM These proposals can be discussed in RAN2 instead of RAN1.
16 – Samsung Research America Discussion in RAN2 would be more appropriate.

<1st Round Comments>

The following summaries companies views on paging enhancement proposal for Redcap:

- Defer to RAN2: Nordic, Nokia, Futurewei, NEC, Intel, Qualcomm, LGe, CATT, DCM, Ericsson, Samsung
- Others:
  - Three companies i.e., vivo, Sharp and CATT, state that Redcap-specific paging notification for SIB update has been possible if a separate initial DL BWP is configured for Redcap UE for paging monitoring i.e., Type-2 CSS.

The proponent company [Xiaomi] is also flexible to leave this issue for RAN2 discussion. Therefore, moderator would stop continue discussing on this issue unless triggering by RAN2 later.

4.4 Issues deprioritized by Moderator

Measurements for Redcap with reduced number of Rx branches

This issue was brought up in RAN1 106-bis e-meeting and was extensively discussed over email. In accordance with the responses in [27], major companies (17 companies) indicate that this should be handled in RAN2 and RAN4. Only two companies prefer to discuss this in RAN1. To avoid duplicated comments and discussions, moderator therefore propose to defer this issue and interested companies can directly brought this to responsible WG e.g., RAN2/RAN4. If RAN1 inputs are necessary, they can always send LS to RAN1 to collect inputs as business usual.

Need of separate SIB1 for Redcap

Contribution [14, CMCC] [15, Samsung] [18, NEC] discussed the need of separate SIB1 for Redcap. It was indicated in [14] that a SIB1 should be shared by RedCap and non-RedCap UEs if the TBS limit restriction of SIB is satisfied. While contribution [15,18] prefer to leave this for RAN2 to discuss. This issue was

extensively discussed in the RAN1 106-bis e-meeting. As documented in moderator's summary [27], leaving it for RAN2 was acceptable for all companies. Therefore, this discussion was deprioritized at this moment and intended to leave it for RAN2 to handle. Of course, the discussion will pursue if RAN2 requests inputs from RAN1 e.g., by LS.

SSB/CORESET#0 and initial UL/DL Configuration

Contribution [24] discussed various aspects for Redcap device, including system information configuration (e.g., PUCCH resource), BWP Configuration (e.g., CORESET#0/SSB in a separate initial DL BWP and associated CSS for Redcap device) and L2 buffer size reduction. These topics have been handled in other Redcap agendas already (e.g., AI 8.6.1.1 and AI 8.6.1.3) and it is reasonable to continue discussing over there to avoid duplicated efforts.

RA-RNTI Overlapping handling

One contribution [26] provides different solutions to address the RA-RNTI collision issue. However, the following was agreed in RAN1 106-e meeting to leave this problem for RAN2 [2]:

Table 12:

Conclusion: – Whether there is RA-RNTI overlapping issue and how to address RA-RNTI overlapping issue in the early indication of RedCap UEs in Msg1 in Rel-17 is up to RAN2.

<1st Round Comments>

Companies are invited to provide comment if you have any concerns on deprioritizing the issues above by moderator:

Feedback Form 15:

1 – QUALCOMM JAPAN LLC. We are fine with the conclusion of the moderator.

5 Conclusion

The following was approved over email:

Agreement

- For 2-step RACH, support the early indication of RedCap UEs at least in MsgA PRACH.
  - The early indication in MsgA PRACH can be configured to be enabled/disabled via SIB.
  - From RAN1 perspective, the following methods can be used for early indication both for shared initial UL BWP and separate initial UL BWP
    - separate MsgA PRACH resource
    - MsgA PRACH preamble partitioning

Figure 1:

6 References

1. RP-211574 Revised WID on support of reduced capability NR devices Ericsson
2. R1-2110385 , RAN1 agreements for Rel-17 NR RedCap Rapporteur (Ericsson)
3. R1-2110771 RAN1 aspects for RAN2-led features for RedCap Ericsson
4. R1-2110802 RAN1 aspects of RedCap UE type and identification Huawei, HiSilicon
5. R1-2111021 Remaining issues on higher layer support for RedCap vivo, Guangdong Genius
6. R1-2111068 Higher layer support of Reduced Capability NR devices ZTE, Sanechips
7. R1-2111131 Higher layer support of Reduced Capability NR Devices Nokia, Nokia Shanghai Bell
8. R1-2111202 Discussion on RAN1 aspects for RAN2-led features for RedCap TCL Communication Ltd.
9. R1-2111264 Discussion on higher layer support of RedCap CATT
10. R1-2111324 Mechanism in higher&PHY layer for Reduced Capability NR Devices OPPO
11. R1-2111433 Remaining issues on RAN1 aspects for RAN2-led features for RedCap China Telecom
12. R1-2111503 On RAN1 aspects for RAN2-led features for RedCap Intel Corporation
13. R1-2111580 Discussion on the remaining issues of higher layer related topics for RedCap Xiaomi
14. R1-2111615 Discussion on higher layer support of RedCap UE CMCC
15. R1-2111746 RAN1 aspects for RAN2-led features for RedCap Samsung
16. R1-2111882 RAN1 aspects for RAN2-led features for RedCap Apple
17. R1-2111883 FL summary #1 on RAN1 aspects for RAN2-led features for RedCap Moderator (Apple)
18. R1-2111958 Discussion on RAN1 aspects for RAN2-led features for RedCap NEC
19. R1-2111965 RAN1 aspects of RAN2-led RedCap features InterDigital, Inc.
20. R1-2112007 RAN1 aspects for RAN2-led features for RedCap Lenovo, Motorola Mobility
21. R1-2112017 RAN1 aspects for RAN2-led features for RedCap Sharp
22. R1-2112058 RAN1 aspects for RAN2-led features for RedCap LG Electronics

23. R1-2112115 Discussion on RAN1 aspects for RAN2-led features for RedCap NTT DOCOMO, INC.
24. R1-2112225 Cross Layer Design Considerations for RedCap Device Qualcomm Incorporated
25. R1-2112330 RAN1 aspects for RAN2-led features for RedCap Panasonic Corporation
26. R1-2112389 Remaining issue on higher layer support of Redcap UE WILUS Inc.
27. R1-2110451 FL summary #2 on RAN1 aspects for RAN2-led features for RedCap Moderator (Apple)
28. R1-2111581 Discussion on the transmission of system information for RedCap Xiaomi