3GPP TSG-RAN WG1 Meeting #113 R1-2305956

Incheon, Korea, 22nd – 26th May 2023

**Agenda Item: 9.6.1**

**Title: FL summary #1 on Rel-18 RedCap UE complexity reduction**

**Source: Moderator (Ericsson)**

**Document for: Discussion, Decision**

# 1 Introduction

This feature lead (FL) summary (FLS) concerns the Rel-18 work item (WI) on enhanced support of reduced capability (RedCap) NR devices [1, 2]. The final FLS from the previous RAN1 meeting can be found in [3], and a RAN1 agreement summary is available in [4].

The core part of the WI [1] has the following objective and notes related to further reduced UE complexity:

|  |
| --- |
| **Complexity/cost reduction*** Further reduced UE complexity in FR1 [RAN1, RAN2, RAN4]
	+ UE BB bandwidth reduction
		- 5 MHz BB bandwidth only for PDSCH (for both unicast and broadcast) and PUSCH, with 20 MHz RF bandwidth for UL and DL
		- The other physical channels and signals are still allowed to use a BWP up to the 20 MHz maximum UE RF+BB bandwidth.
		- Support additional separate early indication(s) [RAN1, RAN2]
	+ UE peak data rate reduction
		- Relaxation of the constraint (*vLayers*·*Qm*·*f* ≥ 4) for peak data rate reduction
		- The relaxed constraint is, e.g., 1 (instead of 4).
		- The parameters (*vLayers*, *Qm*, *f*) can be as in Rel-17 RedCap.
	+ Both 15 kHz SCS and 30 kHz SCS are supported.
	+ Aim to define at most one Rel-18 RedCap UE type for further UE complexity reduction.
	+ The existing UE capability framework is used, and changes to capability signalling are specified only if necessary. By default, all UE capabilities applicable to a Rel-17 RedCap UE are applicable unless otherwise specified.

Notes:* The work defined as part of this WI is not to overlap with LPWA use cases.
* Coexistence with non-RedCap UEs and Rel-17 RedCap UEs should be ensured.
* This WI considers all applicable duplex modes unless otherwise specified.

Check in RAN#99 regarding:* Whether UE peak data rate reduction for UE is limited only with UE BB bandwidth reduction or standalone
 |

RAN#99 discussed whether UE peak data rate reduction (“PR1”) should be supported as a standalone feature or only in combination with UE BB bandwidth reduction (“BW3/PR3”) and endorsed the following proposal [5], where the different nicknames for the UE complexity reduction features (“PR1” and “BW3/PR3”) originate from TR 38.865 [6].

|  |
| --- |
| **Rel-18 eRedCap UE capable of 20MHz + PR1 and Rel-18 eRedCap UE capable of BW3/PR3 + PR1 are designed/targeted to same peak data rate, i.e., 10Mbps**Note 1: Peak data rate of “Rel-18 eRedCap: UE capable of 20MHz + PR1” and “Rel-18 eRedCap: UE capable of BW3/PR3 + PR1” is same including unicast and broadcast respectively.Note 2: PRB processing capability of “Rel-18 eRedCap: UE capable of 20MHz + PR1” is not limited to “25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS” and it corresponds to PRB size corresponding to 20 MHz.Note 3: The only difference between “Rel-18 eRedCap: UE capable of 20MHz + PR1” and “Rel-18 eRedCap: UE capable of BW3/PR3 + PR1” is Note 2 and *vLayers·Qm·f* in order to have the same peak rate.Note 4: The initial access procedure of Rel-18 eRedCap UE capable of 20MHz + PR1 is realized by following:* Same as Rel-18 eRedCap UE capable of BW3/PR3 + PR1
 |

This document summarizes contributions [7] – [36] submitted to agenda items 9.6 and 9.6.1, and contributions [37-39] submitted to another agenda item, and the following email discussion:

|  |
| --- |
| [113-R18-RedCap] Email discussion on eRedCap – Johan (Ericsson)* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, Tdoc number of the moderator summary for online session, etc
 |

The issues in this document are tagged and color coded with High Priority or Medium Priority. The issues that are in the focus of the initial round of the discussion are furthermore tagged FL1.

Follow the naming convention in this example:

* *eRedCapFLS1-v000.docx*
* *eRedCapFLS1-v001-CompanyA.docx*
* *eRedCapFLS1-v002-CompanyA-CompanyB.docx*
* *eRedCapFLS1-v003-CompanyB-CompanyC.docx*

If needed, you may “lock” a discussion document for 30 minutes by creating a checkout file, as in this example:

* Assume CompanyC wants to update *eRedCapFLS1-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *eRedCapFLS1-v003-CompanyB-CompanyC.checkout*
* CompanyC checks that no one else has created a checkout file simultaneously, and if there is a collision, CompanyC tries to coordinate with the company who made the other checkout (see, e.g., contact list below).
* CompanyC then has 30 minutes to upload *eRedCapFLS1-v003-CompanyB-CompanyC.docx*
* If no update is uploaded in 30 minutes, other companies can ignore the checkout file.
* Note that the file timestamps on the server are in UTC time.

In file names, please use the hyphen character (not the underline character) and include ‘v’ in front of the version number, as in the examples above and in line with the general recommendation (see slide 11 in [R1-2304302](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304302.zip)), otherwise the sorting of the files will be messed up (which can only be fixed by the RAN1 secretary).

To avoid excessive email load on the RAN1 email reflector, please note that there is NO need to send an info email to the reflector just to inform that you have uploaded a new version of this document. Companies are invited to enter the contact info in the table below.

**FL1 Question 1-1a: Please consider entering contact info below for the points of contact for this email discussion.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Point(s) of contact** | **Email address(es)** |
| FUTUREWEI | Vip Desai | vipul.desai@futurewei.con |
| Panasonic | Shotaro Maki | maki.shotaro@jp.panasonic.com |
| NTT DOCOMO | Mayuko Okano | mayuko.okano.ca@nttdocomo.com |
| Spreadtrum | Sicong Zhao | Sicong.zhao@unisoc.com |
| CATT | Yongqiang FEI | feiyongqiang@catt.cn |
| vivo | Lihui Wang |  wanglihui@vivo.com |

# 2 UE BB bandwidth reduction

2.0 Earlier agreements

RAN1 has made the following agreements for UE BB bandwidth reduction [4]:

|  |
| --- |
| **Initial BWP**Agreement:For a cell supporting both Rel-17 and Rel-18 RedCap UEs,* The Rel-18 RedCap UEs can share the same separate initial DL/UL BWP as the Rel-17 RedCap UEs.
* FFS: whether to support an additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs

Conclusion:There is no consensus to continue discussion on “whether additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs is allowed to be configured by the SIB in the cell”.**Number of PRBs**Agreement:For UE BB bandwidth reduction, for PUSCH, select the following option for the maximum number of PRBs that the UE can transmit per slot or per hop, if applicable:* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS

For UE BB bandwidth reduction, for PDSCH (for both unicast and broadcast), select the following option for the maximum number of PRBs that the UE can process per slot:* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS

Note: No intention to change the RAN4 RF specifications about maximum transmission PRB number**PUSCH bandwidth**Agreement:For UE BB bandwidth reduction, a UE is not expected to receive an UL grant in a DCI with a PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.Agreement:For UE BB bandwidth reduction, a UE is not expected to be configured with a CG grant with a PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.Agreement:For UE BB complexity reduction, a UE is not expected to receive an UL grant in a RAR or in a DCI scrambled with TC-RNTI with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.Agreement:For UE BB complexity reduction, a UE is not expected to perform 2-step RACH with a MsgA PUSCH resource spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.**UE post-FFT buffer size**Conclusion:For UE BB complexity reduction, for broadcast and unicast PDSCH, RAN1 does not assume that the UE post-FFT buffer size per slot is smaller than 20 MHz**Unicast PDSCH bandwidth**Agreement:* For UE BB complexity reduction, a UE is able to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
* The number of PRB scheduled in DCI is not larger than the maximum number of PRB agreed in previous agreement from 110b-e

**SIB1/OSI transmission**Conclusion:For UE BB complexity reduction, broadcast of separate SIB1/OSI (PDSCH) to Rel-18 RedCap UEs is not supported.Agreement:* For UE BB bandwidth reduction, for SIB1 (PDSCH),
	+ Allow the scheduling of SIB1 to be larger than 5 MHz (as in legacy operation). The scheduling of SIB1 PDSCH is allowed to be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
* For UE BB bandwidth reduction, for broadcast OSI (PDSCH),
	+ Allow the scheduling of broadcast OSI (PDSCH) to be larger than 5 MHz (as in legacy operation). The scheduling of OSI PDSCH is allowed to be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.

**Paging bandwidth**Agreement:From RAN1 perspective, for UE BB complexity reduction, for paging channel (PDSCH) to Rel-18 RedCap UEs, allow the scheduling of paging channel to be larger than 5 MHz (as in legacy operation). The scheduling of paging PDSCH is allowed to be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**RAR bandwidth, random access timeline, and early indication**Agreement:For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, the scheduling of RAR PDSCH is allowed to be larger than the maximum number of unicast PRBs that the UE can process per slot.* When the scheduling of RAR PDSCH is within the maximum number of unicast PRBs that the UE can process per slot, the legacy time between RAR reception and Msg3 transmission (not smaller than NT,1 + NT,2 + 0.5 ms) is applied.
* When the scheduling of RAR PDSCH is larger than the maximum number of unicast PRBs that the UE can process per slot,
	+ The UE receives the RAR and correspondingly transmits Msg3 if the TDRA for Msg3 in UL grant in RAR indicates that the time between RAR reception and Msg3 transmission is NOT smaller than NT,1 + NT,2 + 0.5 + X ms.
		- FFS: value(s) of X
	+ Otherwise, the UE behavior is up to the UE implementation.
* Note: it does not mean early indication is needed
* Note: it will not be used as example for unicast PDSCH

For the “FFS: value(s) of X”* X = [0.5/0.25 or 1/0.5 or 2/1] ms for 15/30kHz SCS
* Note: Single Value pair for X is to selected for SCSs

Agreement:Down-select one among the following options in RAN1#113:* Option 1:
	+ For the “FFS: value(s) of X”,
		- X = 0.5/0.25 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is not supported.
		- When Msg1 indication for Rel-17 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 2:
	+ For the “FFS: value(s) of X”,
		- X = 1/0.5 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is not supported.
		- When Msg1 indication for Rel-17 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 3:
	+ For the “FFS: value(s) of X”,
		- X = 1/0.5 ms for 15/30 kHz SCS
		- FFS: Whether legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is supported.
		- When Msg1 indication for Rel-18 eRedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 4:
	+ For the “FFS: value(s) of X”,
		- X = 0.5/0.25 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is supported.
		- When Msg1 indication for Rel-18 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).

Agreement:The potential timeline relaxations for the following cases are FFS:* For 2-step RACH:
	+ Case 2a: Between reception of fallbackRAR and transmission of Msg3
	+ Case 2b: Between reception of successRAR and transmission of corresponding HARQ-ACK
* For 4-step RACH:
	+ Case 4a: Between reception of RAR PDSCH in which UE does not correctly receive the transport block and upcoming transmission of PRACH
	+ Case 4b: Between reception of RAR with RAPID which is not associated with the corresponding PRACH transmission and upcoming transmission of PRACH

**Msg4 bandwidth**Agreement:Confirm the following working assumption by assuming that Msg3 indication is available:* For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
	+ The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.

Agreement:Final LS [R1-2304262](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2304262.zip) is endorsed**Simultaneous reception**Conclusion:For UE BB complexity reduction, there is no need to relax the requirements on simultaneous reception of two broadcast PDSCH transmissions for SIB1/OSI/paging/RAR.Conclusion:For UE BB bandwidth reduction, for autonomous SI acquisition, the following paragraph in TS 38.214 clause 5.1 still applies:* “The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI during a process of autonomous SI acquisition.”
* FFS: Msg4 PDSCH scheduled by TC-RNTI case
 |

2.1 Random access timeline and early indication

### 2.1.1 Msg2-Msg3 timeline and Msg1 indication

RAN1#112bis-e [4] agreed that a down-selection between four options related to Msg2-Msg3 timeline relaxation and potential separate early indication in Msg1 should take place in RAN1#113.

|  |
| --- |
| Agreement:For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, the scheduling of RAR PDSCH is allowed to be larger than the maximum number of unicast PRBs that the UE can process per slot.* When the scheduling of RAR PDSCH is within the maximum number of unicast PRBs that the UE can process per slot, the legacy time between RAR reception and Msg3 transmission (not smaller than NT,1 + NT,2 + 0.5 ms) is applied.
* When the scheduling of RAR PDSCH is larger than the maximum number of unicast PRBs that the UE can process per slot,
	+ The UE receives the RAR and correspondingly transmits Msg3 if the TDRA for Msg3 in UL grant in RAR indicates that the time between RAR reception and Msg3 transmission is NOT smaller than NT,1 + NT,2 + 0.5 + X ms.
		- FFS: value(s) of X
	+ Otherwise, the UE behavior is up to the UE implementation.
* Note: it does not mean early indication is needed
* Note: it will not be used as example for unicast PDSCH

Agreement:Down-select one among the following options in RAN1#113:* Option 1:
	+ For the “FFS: value(s) of X”,
		- X = 0.5/0.25 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is not supported.
		- When Msg1 indication for Rel-17 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 2:
	+ For the “FFS: value(s) of X”,
		- X = 1/0.5 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is not supported.
		- When Msg1 indication for Rel-17 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 3:
	+ For the “FFS: value(s) of X”,
		- X = 1/0.5 ms for 15/30 kHz SCS
		- FFS: Whether legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is supported.
		- When Msg1 indication for Rel-18 eRedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
* Option 4:
	+ For the “FFS: value(s) of X”,
		- X = 0.5/0.25 ms for 15/30 kHz SCS
		- Note: Legacy default TDRA table and Δ are reused.
	+ A network-configurable additional separate early indication in Msg1 for Rel-18 eRedCap UEs is supported.
		- When Msg1 indication for Rel-18 RedCap UEs is configured, it is used by Rel-18 eRedCap UEs (with or without UE BB bandwidth reduction).
 |

Among the submitted contributions, most contributions [8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 25, 26, 27, 31, 32, 34, 35, 36] express support for Option 3 or some slightly modified version of it. However, the contributions express different views on how to resolve the FFS on whether legacy default TDRA table Δ are reused or not.

Furthermore, a significant number of contributions [8, 9, 14, 20, 22, 24, 27, 28, 32, 36] support Option 4, a few contributions [8, 10, 22, 31] support Option 1, and a couple of contributions [17, 33] support Option 2.

**FL1 High Priority Question 2.1.1-1a: Companies are invited to give each one of the following options a grade:**

* **Option 1**
* **Option 2**
* **Option 3a = Option 3, and legacy default TDRA table** **and Δ are reused**
* **Option 3b = Option 3, and legacy default TDRA table** **and Δ are not reused (use comment field if needed)**
* **Option 4**

**Please use the following grade scale (where there is no restriction on the number of times a grade can be used).**

* **+1 = preferred**
* **0 = neutral/ok**
* **-1 = not preferred**

|  |  |  |
| --- | --- | --- |
| **Company** | **Grade (+1/0/-1) for each one of Options 1/2/3a/3b/4** | **Comments** |
| **1** | **2** | **3a** | **3b** | **4** |
| Example | +1 | 0 | -1 | 0 | +1 |  |
| Nordic | -1 | -1 | 1 | 0 | -1 |  |
| FUTUREWEI | -1 | -1 | +1 | 0 | +1 | We are open to supporting option 3b |
| Panasonic | -1 | -1 | +1 | 0 | 0 |  |
| DOCOMO | -1 | -1 | 0 | +1 | +1 | Especially for option 3a/3b, to enable Rel-18 eRedCap specific TDRA configuration for Msg3 other than the expansion of legacy default TDRA table and Δ, we suggest to introduce new RRC parameter in pusch-CofingCommon which is specific to Rel-18 eRedCap. |
| Spreadtrum | -1 | -1 | +1 | 0 | -1 |  |
| CATT | +1 | 0 | -1 | -1 | -1 | We may reconsider Msg1 early indication but MsgA PRACH early indication should not be supported. This should be a package.  |
| Lenovo | -1 | -1 | +1 | 0 | 0 |  |
| vivo | +1 | 0 | -1 | -1 | -1 |  |

### 2.1.2 UE behavior in the ‘otherwise’ case

Contribution [8] proposes to revise the highlighted bullet in the following earlier RAN1 agreement [4]-

|  |
| --- |
| Agreement:For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, the scheduling of RAR PDSCH is allowed to be larger than the maximum number of unicast PRBs that the UE can process per slot.* When the scheduling of RAR PDSCH is within the maximum number of unicast PRBs that the UE can process per slot, the legacy time between RAR reception and Msg3 transmission (not smaller than NT,1 + NT,2 + 0.5 ms) is applied.
* When the scheduling of RAR PDSCH is larger than the maximum number of unicast PRBs that the UE can process per slot,
	+ The UE receives the RAR and correspondingly transmits Msg3 if the TDRA for Msg3 in UL grant in RAR indicates that the time between RAR reception and Msg3 transmission is NOT smaller than NT,1 + NT,2 + 0.5 + X ms.
		- FFS: value(s) of X
	+ Otherwise, the UE behavior is up to the UE implementation.
* Note: it does not mean early indication is needed
* Note: it will not be used as example for unicast PDSCH
 |

The contribution proposes that the highlighted case can be treated in the same way as the other cases described in the following paragraph in clause 8.2 in TS 38.213:

|  |
| --- |
| If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window and LSBs of a SFN field in the DCI format 1\_0, if included and applicable, are not same as corresponding LSBs of the SFN where the UE transmitted PRACH, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit a PRACH. If requested by higher layers, the UE shall be ready to transmit a PRACH no later than $N\_{T,1}+0.75$ msec after the last symbol of the window, or the last symbol of the PDSCH reception, where $N\_{T,1}$ is a time duration of $N\_{1}$ symbols corresponding to a PDSCH processing time for UE processing capability 1 assuming $μ$ corresponds to the smallest SCS configuration among the SCS configurations for the PDCCH carrying the DCI format 1\_0, the corresponding PDSCH when additional PDSCH DM-RS is configured, and the corresponding PRACH. For $μ=0$, the UE assumes $N\_{1,0}=14$ [6, TS 38.214]. For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines $N\_{1}$ assuming SCS configuration $μ=0$. |

Companies are invited to comment on the following question.

**FL1 Medium Priority Question 2.1.2-1a: Should the highlighted bullet in the above agreement be revised to:**

* **Otherwise, the UE behavior is the same as if the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding RA-RNTI within the window (as specified in clause 8.2 in TS 38.213).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | N | Up to UE implementation is just fine.  |
| FUTUREWEI |  | In our understanding of the clause, there are 4 cases (two deal with DCI, one deals with incorrectly decoded PDSCH, and one deals with RAPID identification). The otherwise bullet in the agreement deals with processing. It seems to be unclear how the clause applies except possibly for the incorrectly decoded PDSCH. |
| DOCOMO | Y | We support to discuss the clarification on the highlighted case. |
| Spreadtrum | N | Up to UE implementation |
| CATT | N | Not urgent discussion. |
| vivo | N | No significant issue is found from earlier agreements. Hence no need to revise previous agreement.  |

### 2.1.3 Timeline in similar cases

RAN1#112bis-e made the following agreement [4] regarding timeline relation for other similar cases as the Msg2-Msg3 case described in previous sections.

|  |
| --- |
| Agreement:The potential timeline relaxations for the following cases are FFS:* For 2-step RACH:
	+ Case 2a: Between reception of fallbackRAR and transmission of Msg3
	+ Case 2b: Between reception of successRAR and transmission of corresponding HARQ-ACK
* For 4-step RACH:
	+ Case 4a: Between reception of RAR PDSCH in which UE does not correctly receive the transport gblock and upcoming transmission of PRACH
	+ Case 4b: Between reception of RAR with RAPID which is not associated with the corresponding PRACH transmission and upcoming transmission of PRACH
 |

Contributions [8, 15, 17, 22, 26, 28, 29, 31, 32] express that the same timeline relaxation should be used for these cases as in the Msg2-Msg3 case described in earlier sections.

Contributions [11, 14, 18, 35] express that the same timeline relaxation should be used for Case 2a/4a/4b as in the Msg2-Msg3 the case described in earlier sections. Contributions [14, 35] express that timeline relaxation does not apply to Case 2b.

Contributions [10, 13, 16, 33] express that the same timeline relaxation should be used for Case 4a/4b as in the Msg2-Msg3 case described in earlier sections. Contributions [10, 13, 16, 23, 33] express that Case 2a/2b depends on the outcome of the MsgB PDSCH bandwidth discussion.

**FL1 Medium Priority Proposal 2.1.3-1a:**

* **For UE BB bandwidth reduction, the same timeline relaxation as for the Msg2-Msg3 timeline applies at least for the following cases:**
	+ **Case 4a: Between reception of RAR PDSCH in which UE does not correctly receive the transport block and upcoming transmission of PRACH**
	+ **Case 4b: Between reception of RAR with RAPID which is not associated with the corresponding PRACH transmission and upcoming transmission of PRACH**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| Panasonic | Y |  |
| DOCOMO | Y |  |
| CATT | Y |  |
| vivo | Y |  |

Contribution [23] expresses that there are some additional similar cases to consider.

**FL1 Medium Priority Question 2.1.3-2a: What (if any) other similar cases should be considered?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| DOCOMO | Similar timeline relaxation to case 4a/4 should be applied between MsgB PDSCH and PRACH or MsgA retransmission for 2-step RACH corresponds to the following case in 38.213 section 8.2A.

|  |
| --- |
| If the UE does not detect the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window, or if the UE detects the DCI format 1\_0 with CRC scrambled by the corresponding MsgB-RNTI within the window and LSBs of a SFN field in the DCI format 1\_0, if applicable, are not same as corresponding LSBs of the SFN where the UE transmitted the PRACH, or if the UE does not correctly receive the transport block in the corresponding PDSCH within the window, or if the higher layers do not identify the RAPID associated with the PRACH transmission from the UE, the higher layers can indicate to the physical layer to transmit only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure [11, TS 38.321]. |

 |
| CATT | N |
|  |  |

### 2.1.4 Early indication in MsgA PRACH

A few contributions [8, 18, 31] propose to support additional separate early indication in MsgA PRACH (at least if it is also supported in Msg1), whereas a couple of other contributions [15, 33] express that it is not needed. This question can be treated with low priority until the Msg1 case has been resolved.

**FL1 Low Priority Question 2.1.4-1a: Should additional separate early indication in MsgA PRACH be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | N |  |
| FUTUREWEI |  | Can wait until Msg1 case is resolved |
| DOCOMO | Y | But we are fine to differ the discussion until the progress on Msg1-based separate early indication. |
| CATT | N |  |
| Lenovo | Y | Same view with DOCOMO |
| vivo | N |  |

2.2 Simultaneous reception

For simultaneous reception of multiple broadcast channels, 38.214 clause 5.1 specifies the following:

|  |
| --- |
| The UE in RRC\_IDLE and RRC\_INACTIVE modes shall be able to decode two PDSCHs each scheduled with SI-RNTI, P-RNTI, RA-RNTI or TC-RNTI, with the two PDSCHs partially or fully overlapping in time in non-overlapping PRBs. |

For simultaneous reception of a unicast channel and a broadcast channel, 38.214 clause 5.1 specifies the following:

|  |
| --- |
| On a frequency range 1 cell, the UE shall be able to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI and, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI that partially or fully overlap in time in non-overlapping PRBs, unless the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI requires Capability 2 processing time according to clause 5.3 in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI.On a frequency range 2 cell, the UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI if in the same cell, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI during a process of autonomous SI acquisition. |

RAN1 has made the following conclusions [4]:

|  |
| --- |
| Conclusion:For UE BB complexity reduction, there is no need to relax the requirements on simultaneous reception of two broadcast PDSCH transmissions for SIB1/OSI/paging/RAR.Conclusion:For UE BB bandwidth reduction, for autonomous SI acquisition, the following paragraph in TS 38.214 clause 5.1 still applies:* “The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI during a process of autonomous SI acquisition.”
* FFS: Msg4 PDSCH scheduled by TC-RNTI case
 |

### Autonomous SI acquisition

The contributions express the following views regarding the FFS for Msg4 during autonomous SI acquisition.

* Contributions [8, 11, 14, 15, 18] propose that Msg4 PDSCH scheduled by TC-RNTI should be treated in the same say as unicast PDSCH (i.e., “The UE is expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, CS-RNTI, or TC-RNTI during a process of autonomous SI acquisition”).
* Contributions [11, 13, 22, 33] propose that the UE should decode the Msg4 PDSCH in this case, but that the decoding priority should be specified if the Msg4 PDSCH is scheduled with more than 25 PRBs for 15 kHz or more than 12 PRBs for 30 kHz SCS.
* Contribution [10] proposes that for autonomous SI acquisition, the UE is not required to process a Msg4 PDSCH scheduled with more than 25 PRBs for 15 kHz SCS or more than 12 PRBs for 30 kHz SCS.
* Contribution [12] argues that according to the previous agreement, if Msg4 is wider than 5MHz, the UE is not required to process Msg4 and that no further agreement is needed.
* Contribution [32] proposes to extend the earlier RAN1 conclusion to say that “For UE BB complexity reduction, there is no need to relax the requirements on simultaneous reception of two broadcast PDSCH transmissions for SIB1/OSI/paging/RAR/PDSCH is scheduled with TC-RNTI”.
* Contributions [9, 26, 28] propose to leave this case up to UE implementation.
* Contribution [20] propose to wait for RAN2’s reply to the LS in [40].

Companies are invited to provide further comments below.

**FL1 Medium Priority Question 2.2.1-1a: Companies are invited to express their preference regarding the UE behavior in case of Msg4 PDSCH decoding during a process of autonomous SI acquisition (considering the arguments provided in the contributions listed above).**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nordic  | We support also: Contributions [8, 11, 14, 15, 18] propose that Msg4 PDSCH scheduled by TC-RNTI should be treated in the same say as unicast PDSCH |
| Panasonic | No spec change would be needed. It means that the reception of Msg4 is up to UE implementation.as well as the legacy UE behavior. We do not see the reason why only eRedCap UE with BB BW reduction is mandated to receive Msg4 in this case. |
| CATT | Buffer SI and decode Msg4, and provide HARQ-ACK feedback for Msg4. No spec change. |
| vivo | We do not think additional agreement is needed given following already made agreement: Agreement:Confirm the following working assumption by assuming that Msg3 indication is available:* For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
	+ The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
 |

### P-RNTI triggered SI acquisition

RAN1#112bis-e discussed this proposal for P-RNTI triggered SI acquisition without reaching a conclusion [3]:

|  |
| --- |
| High Priority Proposal 2.5-2a:* Conclusion: For UE BB bandwidth reduction, for P-RNTI triggered SI acquisition, the following paragraph in TS 38.214 clause 5.1 still applies:
	+ “On a frequency range 1 cell, the UE shall be able to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI and, during a process of P-RNTI triggered SI acquisition, another PDSCH scheduled with SI-RNTI that partially or fully overlap in time in non-overlapping PRBs, unless the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI requires Capability 2 processing time according to clause 5.3 in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI.”
	+ FFS: the Msg4 PDSCH case
 |

Contributions [8, 10, 11, 12, 13, 14, 15, 16, 20, 23, 26, 28, 32, 33, 34, 35] present their views on simultaneous reception during P-RNTI SI acquisition. Contribution [10] proposes to consider the following options:

* Option 1: The UE prioritizes reception of unicast PDSCH over SI PDSCH triggered by P-RNTI.
* Option 2: The UE may skip decoding of unicast PDSCH but decodes SI PDSCH triggered by P-RNTI.
* Option 3: The prioritization between reception of unicast and SI PDSCH triggered by P-RNTI is up to the UE implementation.
* Option 4: During a process of P-RNTI triggered SI acquisition, the UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI if in the same cell, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.

Companies are invited to comment on the above list of options.

**FL1 Medium Priority Question 2.2.2-1a: Can the above list of options be used as a basis for further discussion and down-selection? If you think the list should be updated somehow, please elaborate in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Option 5  | *For PR3 UE****,*** *when UE is scheduled to receive in RRC connected mode a non-overlapping SI and unicast PDSCH (if any) spanning more than 5MHz in a slot n, UE is not required to receive in slot n+1.* |
| Panasonic | Y in principle | For options 1-3, “unicast PDSCH” should be replaced with “the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI” as in the TS 38.214. For example, Option 2 can be updated as follows:• Updated Option 2: The UE may skip decoding of the scheduled ~~unicast~~ PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI but decodes SI PDSCH triggered by P-RNTI.Among 4 options, we prefer (updated) Option 2. |
| CATT |  | One clarification question, does ‘prioritize A’ mean ‘drop B’ in the proposal?We think the UE shall be able to decode both, by proper implementation, e.g. buffer SI but decode unicast PDSCH + provide HARQ-ACK at first. |
| vivo | Y | It is good to align companies understanding on above case **when the total number of PRBs for the PDSCH scheduled with SI-RNTI and the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI is larger than the maximum number of PRBs that the UE can process per slot.** Reply to CATT: my understanding is ‘prioritize A’ means ‘B may or may not be dropped’ |

### 2.2.3 Unicast transmission and RAR

Contributions [16, 33] propose that decoding of RAR PDSCH should be prioritized over unicast PDSCH. The following proposal from contribution [33] can be considered.

**FL1 Medium Priority Proposal 2.2.3-1a: If a PDSCH is scheduled with RA-RNTI or MSGB-RNTI in slot n, UE is not expected to decode another PDSCH scheduled with C-RNTI, SI-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI,**

* in the same slot (i.e. slot n) if the PDSCH scheduled with RA-RNTI or MSGB-RNTI is not greater than 25/12 PRBs with 15/30kHz SCS;
* in slots n and n+1 if the PDSCH scheduled with RA-RANTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS.

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y | Similar should apply in our opinion also for SI + unicast |
| CATT |  | This is a very corner case, if not completely impossible: For contention based RACH, the UE receiving RAR does not access the cell so no UE-specific RNTI is allocated to the UE.For contention free RACH, typically the UE is adjusting TA or HO to another cell. In either case it seems no unicast PDSCH will be sent to this UE. |
| vivo |  | There may be issues and we are open to discuss.  |

### 2.2.4 Unicast transmission in HD-FDD

Contribution [39] proposes that a Rel-18 eRedCap HD-FDD UE should be capable of processing one additional unicast DCI scheduling PUSCH (as in TDD).

**FL1 Low Priority Question 2.2.4-1a: Should a Rel-18 eRedCap HD-FDD UE be able to process one additional unicast DCI scheduling PUSCH (as in TDD)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y | There is a clear benefit for network spectral efficiency |
|  |  |  |
|  |  |  |

2.3 Msg3 PUSCH bandwidth

Contribution [16] proposes that the UE can restart the PRACH procedure if Msg3 is scheduled with more than 25 PRBs for 15 kHz SCS or more than 12 PRBs for 30 kHz SCS.

**FL1 Medium Priority Proposal 2.3-1a:**

* **For UE BB bandwidth reduction, if Msg3 PUSCH is scheduled with more than 25 PRBs for 15 kHz or more than 12 PRBs for 30 kHz, the UE can restart the PRACH procedure.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| FUTUREWEI |  | Perhaps this question seems be part of the clause cited in question 2.1.2-1a (related to RAPID identification)  |
| CATT |  | We already agree that the UE is not expected to be scheduled with >5MHz Msg3. Sounds like a natural outcome. It seems just like a natural result without further conclusion. |
| vivo | N | The proposal contradicts with following agreements:Agreement:For UE BB complexity reduction, a UE is not expected to receive an UL grant in a RAR or in a DCI scrambled with TC-RNTI with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.In addition, we recall that when above agreements for Msg.3 BW was made, all companies seem sharing the understanding that the TBS for Msg.3 is typically small, e.g. 56bits, the number of PRBs corresponding to 5MHz is sufficient even for non-RedCap UEs.  |

2.4 Msg4 PDSCH bandwidth

Contribution [18] proposes to revise the earlier RAN1 agreement [4] on Msg4 PDSCH bandwidth to distinguish Msg4 PDSCH transmissions scheduled by different RNTIs.

**FL1 Medium Priority Proposal 2.4-1a:**

* **Revise the following RAN1 agreement:**
	+ **Confirm the following working assumption by assuming that Msg3 indication is available:**
		- **For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.**
			* **The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**
* **to:**
	+ **Confirm the following working assumption by assuming that Msg3 indication is available:**
		- **For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH scheduled by TC-RNTI with resource allocation spanning a bandwidth of more than ~5 MHz per slot.**
			* **The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**
			* **For Msg4 PDSCH scheduled by C-RNTI, limit its bandwidth in the same way as for unicast PDSCH.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| FUTUREWEI |  | While the intent seems clear, the sub-bullets should be revised as shown in blue (the second bullet deals with TC-RNTI while the lowest bullet deals with C-RNTI)* + **Confirm the following working assumption by assuming that Msg3 indication is available:**
		- **For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH scheduled by TC-RNTI with resource allocation spanning a bandwidth of more than ~5 MHz per slot.**
			* **The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**

**For UE BB complexity reduction, for Msg4 PDSCH scheduled by C-RNTI, limit its bandwidth in the same way as for unicast PDSCH.** |
| Panasonic | Y |  |
| CATT |  | Seems not urgent but OK.  |
|  |  |  |

2.5 MsgB PDSCH bandwidth

RAN1#112bis-e made the following agreement regarding the Msg4 PDSCH bandwidth [4]:

|  |
| --- |
| Agreement:Confirm the following working assumption by assuming that Msg3 indication is available:* For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
	+ The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
 |

RAN1#112bis-e also sent an LS in [40] to inform RAN2 about the following case, to consider, if needed, the UE behavior in the RAN2 specifications, and ask RAN2 for feedback if any:

* For UE BB complexity reduction, the case when the UE detects a DCI scheduling a Msg4 PDSCH transmission with a larger bandwidth than it can receive or process

RAN1#112bis-e also discussed this proposal on MsgB PDSCH bandwidth without reaching a conclusion [3]:

|  |
| --- |
| Medium Priority Proposal 2.9-1b:Assuming that MsgA indication is available,* For UE BB complexity reduction, a UE is able to receive a MsgB PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.
	+ The UE is not required to process a MsgB PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
 |

Contributions [8, 11, 12, 13, 34] express that the MsgB bandwidth should be limited in a similar way as Msg4 (i.e., as in the above RAN1#112bis-e Proposal 2.9-1b).

Contributions [9, 10, 15, 16, 20, 28, 32] express that the MsgB bandwidth should instead be limited in a similar way as Msg2 (i.e., allowing a larger number of PRBs).

Contributions [14, 18] express that the MsgB successRAR bandwidth should be limited in a similar way as Msg4 but that the MsgB fallbackRAR bandwidth should be limited in a similar way as Msg2.

Contribution [33] expresses that the bandwidth of a MsgB scheduled with MSGB-RNTI should be limited in a similar way as Msg2 but that the bandwidth of a MsgB scheduled with C-RNTI should be limited in a similar way as Msg4.

Contribution [17] argues that the MsgB bandwidth requires further consideration due to its difference compared to both Msg2 and Msg4.

**FL1 Medium Priority Question 2.5-1a: Companies are invited to express their preference regarding the MsgB PDSCH bandwidth (considering the arguments provided in the contributions listed above).**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nordic  | 5MHz as all PUSCH so far. |
| FUTUREWEI | The proposal presumed that MsgA indication was available and also is related to section 2.1.4. It seems the behavior for MsgB PDSCH bandwidth when MsgA indication is not available needs to be examined first |
| Panasonic | As MsgB can contain the messages to multiple UEs and is support scaling factor of *Ninfo*, it would be reasonable that the MsgB is allowed to be scheduled larger than 25/12 PRBs for 15/30 kHz SCS. |
| CATT | Still think it is reasonable to consider different handling methods for successRAR (as for Msg4) or fallbackRAR (as for Msg2), if we consider that MsgA PUSCH may fail.Otherwise, Msg4-like handling directly – the gNB shall be aware with the accessing UE is a Rel-18 RedCap UE. Just as other PDSCH. |
| vivo | As shown in the following MsgB MAC PDU structure, MsgB bandwidth should instead be limited in a similar way as Msg2 (i.e., allowing a larger number of PRBs) **MSGB MAC PDU with MAC SDU(s)** |

2.6 MBS PDSCH bandwidth

RAN1#112bis-e discussed potential restriction of the bandwidth for broadcast and multicast MBS PDSCH transmissions without reaching a conclusion [3]. Based on contributions [8, 18], the following proposals for broadcast and multicast, respectively, can be considered.

**FL1 Medium Priority Proposal 2.6-1a: For broadcast MBS PDSCH, allow the scheduling to be larger than 5MHz (as in legacy operation). The PDSCH repetition case is FFS.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Panasonic | Y | Whether MBS PDSCH is capable or not is not able to be known to the network for IDLE mode as which UE support broadcast MBS PDSCH is not informed. Therefore, if the RedCap UE support MBS PDSCH, it should be same as non-RedCap UE. |
| CATT | Y |  |
|  |  |  |

**FL1 Medium Priority Proposal 2.6-2a: For multicast MBS PDSCH, the number of PRBs scheduled in DCI is not larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Panasonic | Y | Should be restricted as the unicast. The multicast retransmission is UE specific and it should be limited to the capability. |
| CATT | FFS |  |
|  |  |  |

# 3 UE peak data rate reduction

3.0 Earlier agreements

RAN1 has made the following agreements for UE peak data rate reduction [4]:

|  |
| --- |
| Agreement:* UE peak data rate reduction is supported at least as an add-on to UE BB bandwidth reduction,
	+ The constraint *vLayers*·*Qm*·*f* ≥ 4 is relaxed to *vLayers*·*Qm*·*f* ≥ X.
	+ FFS: the value of X
* If UE peak data rate reduction is supported as a standalone feature,
	+ The constraint *vLayers*·*Qm*·*f* ≥ 4 is relaxed to *vLayers*·*Qm*·*f* ≥ Y.
	+ FFS: the value of Y
	+ Note: Whether this option is supported will be decided in RAN plenary.

Agreement:* The minimum DL peak rate target (for FD-FDD) is 10 Mbps based on peak data rate calculation according to 38.306.
* The same value for X is used for DL and UL

Agreement:For the relaxed constraint X in the following earlier RAN1 agreement, down-select between X = 3 and X = 3.2. |

RAN#99 discussed whether UE peak data rate reduction (“PR1”) should be supported as a standalone feature or only in combination with UE BB bandwidth reduction (“BW3/PR3”) and endorsed the following proposal [5], where the different nicknames for the UE complexity reduction features (“PR1” and “BW3/PR3”) originate from TR 38.865 [6].

|  |
| --- |
| **Rel-18 eRedCap UE capable of 20MHz + PR1 and Rel-18 eRedCap UE capable of BW3/PR3 + PR1 are designed/targeted to same peak data rate, i.e., 10Mbps**Note 1: Peak data rate of “Rel-18 eRedCap: UE capable of 20MHz + PR1” and “Rel-18 eRedCap: UE capable of BW3/PR3 + PR1” is same including unicast and broadcast respectively.Note 2: PRB processing capability of “Rel-18 eRedCap: UE capable of 20MHz + PR1” is not limited to “25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS” and it corresponds to PRB size corresponding to 20 MHz.Note 3: The only difference between “Rel-18 eRedCap: UE capable of 20MHz + PR1” and “Rel-18 eRedCap: UE capable of BW3/PR3 + PR1” is Note 2 and *vLayers·Qm·f* in order to have the same peak rate.Note 4: The initial access procedure of Rel-18 eRedCap UE capable of 20MHz + PR1 is realized by following:* Same as Rel-18 eRedCap UE capable of BW3/PR3 + PR1
 |

RAN1#112bis-e discussed this proposal on the values of X and Y without reaching a conclusion [3]:

|  |
| --- |
| High Priority Proposal 3.1-1h:* For UE peak data rate reduction with UE BB bandwidth reduction,
	+ The 10-Mbps peak rate target corresponds to *vLayers*·*Qm*·*f* = 3.2
* For UE peak data rate reduction without UE BB bandwidth reduction,
	+ The 10-Mbps peak rate target corresponds to *vLayers*·*Qm*·*f* = 0.8
	+ This is assuming 20 MHz bandwidth in the 38.306 peak rate expression.
* FFS: Whether the 10-Mbps peak rate target is a minimum peak rate or a fixed peak rate.
 |

The reason for the deadlock in RAN1#112bis-e was that companies had two different understandings of the RAN#99 decision listed in the introduction of this contribution. The question is whether the 10-Mbps peak rate target should be understood as a fixed peak rate target for all Rel-18 eRedCap UEs (regardless of what optional features they might support) or a minimum peak rate target (that might be exceeded by UEs that support optional features such as MIMO).

3.1 Relaxed constraints

As a potential way forward, companies are invited to consider the following updated proposal. Note that combinations with optional features is treated separately in the next section in this document.

**FL1 High Priority Proposal 3.1-1a:** **Agree the following (without any intention to indicate one way or the other whether the 10-Mbps peak rate target is a minimum peak rate or a fixed peak rate):**

* **For UE peak data rate reduction with UE BB bandwidth reduction,**
	+ **The 10-Mbps peak rate target corresponds to** *vLayers*·*Qm*·*f* **= 3.2**
* **For UE peak data rate reduction without UE BB bandwidth reduction,**
	+ **The 10-Mbps peak rate target corresponds to** *vLayers*·*Qm*·*f* **= [0.75 or 0.8]**
	+ **This is assuming 20 MHz bandwidth in the 38.306 peak rate expression.**
* **~~FFS: Whether the 10-Mbps peak rate target is a minimum peak rate or a fixed peak rate.~~**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y | We can compromise to this |
| FUTUREWEI |  | While we are fine with the values of 3.2 and [0.75 or 0.8], due to a different understanding of the target, RAN will need to discuss  |
| Panasonic | Y | We can accept the proposal for the progress.If the value of X or Y cannot be agreed, another possibility is to directly discuss the combinations of {*vLayers*, *Qm*, *f*} considering the achievable peak rate as in the table below:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *vLayers* | *Qm* | BW3/PR3+PR1 peak rate [Mbps](Minimum *f* is selected to achieve 10 Mbps) | 20MHz+PR1 peak rate [Mbps](Minimum *f* is selected to achieve 10 Mbps) | Rel-17 RedCap min. peak rate [Mbps]*vLayers*·*Qm*·*f* ≥ 4 |
| Rel-18eRedCap:Potential capability report | 1 | 2 | *N/A*(Cannot achieve 10 Mbps) | 11.3/10.9 (*f*=0.4) | - |
| 1 | 4 | 10.7/10.3 (*f*=0.8) | 22.7/21.8 (*f*=0.4) | - |
| 1 | 6 | 15.0/14.4 (*f*=0.75) | 34.0/34.7 (*f*=0.4) | - |
| 1 | 8 | 10.7/10.3 (*f*=0.4) | 45.4/43.7 (*f*=0.4) | - |
| 2 | 4 | 10.7/10.3 (*f*=0.4) | 45.4/43.7 (*f*=0.4) | - |
| 2 | 6 | 16.1/15.4 (*f*=0.4) | 68.1/65.5 (*f*=0.4) | - |
| 2 | 8 | 21.4/20.5 (*f*=0.4) | 90.7/87.3 (*f*=0.4) | - |
| Rel-17RedCap:Min. capability report | 1 | 6 | - | - | 63.8/61.4 (*f*=0.75) |
| Note: xx/yy [Mbps] corresponds to the peak rate for 15/30 kHz SCS |

 |
| DOCOMO | Y |  |
| Spreadtrum |  | Fine with the values here. In addition, according to RANP’s conclusion, the 10-Mbps peak rate target is a fixed peak rate. In order to avoid possible ambiguities, the FFS should be changed to the following note:**Note: The 10-Mbps peak rate target is a fixed peak rate.** |
| CATT | Y | It is a good idea to leave ‘fixed’ or ‘minimum’ to RANP, if we really want RAN1 progress. |
| Lenovo | Y |  |
| vivo | Y |  |

For UE peak data rate reduction without UE BB bandwidth reduction, for the *vLayers*·*Qm*·*f* value corresponding to 10 Mbps peak rate, some contributions [12, 15, 18, 20, 25, 28, 29, 35] propose that the value should be 0.75, whereas other contributions [8, 9, 10, 11, 13, 14, 16, 21, 22, 34] propose that the value should be 0.8. A few contributions [16, 23, 26, 33, 36] express that it should be one of those two values.

**FL1 High Priority Question 3.1-2a: For UE peak data rate reduction without UE BB bandwidth reduction, for the *vLayers*·*Qm*·*f* value corresponding to 10 Mbps peak rate, should the value be 0.75 or 0.8?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Value(0.75 or 0.8)** | **Comments** |
| Nordic  | 0.75 | because it does fulfil 10Mbits peak rate for both 15 and 30kHz SCS |
| FUTUREWEI |  | We can be ok with either value, as long as only one value as in agreements. Slight preference for 0.8 if two layers. |
| Panasonic |  | Either is fine. |
| DOCOMO | 0.75/0.8 | Given that the difference on complexity reduction is marginal, we are fine with either value. |
| Spreadtrum | 0.75 | 0.8 is also fine for us, if 2Rx is needed. |
| CATT |  | Tend to 0.8 which can avoid new scaling factor (even for 2Rx UE). But anyway either one should work. Difference on cost is marginal. |
| vivo |  | Finer either value, but slightly prefer 0.8 since it can allow 2Rx/2 layer transmission.  |

3.2 Combinations with optional features

Many contributions [8, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24, 26, 28, 29, 32, 33, 35, 36] discuss the peak rate target for Rel-18 eRedCap UEs that support optional features. Regardless of the peak rate target discussion, now is probably a good time to start discussing what combinations with optional features that Rel-18 eRedCap UEs should be able to support.

**FL1 High Priority Question 3.2-1a: Which ones (if any) of the following features should Rel-18 eRedCap UEs be able to support as optional features?**

* **Potential optional feature 1: DL MIMO**
* **Potential optional feature 2: DL 256QAM**
* **Potential optional feature 3: Peak rate scaling factors (*f*) higher than the minimum value**

|  |  |  |
| --- | --- | --- |
| **Company** | **Potential optional feature(s)** | **Comments** |
| Nordic  |  | F1 can be useful for coverage and spectral efficiency, F2 for improved spectral efficiency, and F3 is controversial 😊  |
| FUTUREWEI | 1,2 | UEs should have the options to support such features. For #3, it is unclear what values need to be supported |
| Panasonic |  | This discussion would strongly be related to the determination whether 10 Mbps is a fix peak rate or minimum peak rate. If 10 Mbps is a fixed peak rate, the motivation to support features 1-2 would be quite low.For feature 3, we are not sure the meaning of “the minimum value” of the *f*. |
| DOCOMO |  | In principle, Rel-18 eRedCap UE can support these features depending on its UE capability same as legacy UEs. Thus, we don’t see the strong need to restrict the available optional capabilities so far. |
| Spreadtrum |  | This question is not very clear to us, especially we combine this question with proposal 3.1-1a. Is it means that the peak data rate can be higher than 10Mbps, if the features listed here are supported?  |
| CATT | 1, 2,  | Up to UE vendor’s interest. |
| vivo |  | Share Panasonic’s views.  |

# 4 Higher-layer parameters

Contribution [7] provides the initial rapporteur input on higher layer signaling for RAN1 aspects of Rel-18 eRedCap. The contribution expresses that the agreements made so far do not result in any new or modified configuration parameters, but that depending on the outcome of the discussion on additional separate early indication in Msg1/MsgA PRACH, there may or may not be a need for Rel-18 eRedCap specific PRACH configuration parameters. The contribution also expresses that it might be relevant to capture the following RAN1 agreements [4] in higher-layer parameter descriptions, either for configuration parameters or capability signaling:

* **Initial BWP:** For a cell supporting both Rel-17 and Rel-18 RedCap UEs, the Rel-18 RedCap UEs can share the same separate initial DL/UL BWP as the Rel-17 RedCap UEs.
* **Unicast PDSCH bandwidth:** For UE BB complexity reduction, a UE is able to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot. The number of PRB scheduled in DCI is not larger than the maximum number of PRB agreed in previous agreement from 110b-e
* **Msg4 PDSCH bandwidth:** For UE BB complexity reduction, a UE is able to receive a Msg4 PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot. The UE is not required to process a Msg4 PDSCH with a larger number of PRBs than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
* **Msg3 PUSCH bandwidth:** For UE BB complexity reduction, a UE is not expected to receive an UL grant in a RAR or in a DCI scrambled with TC-RNTI with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.
* **MsgA PUSCH bandwidth:** For UE BB complexity reduction, a UE is not expected to perform 2-step RACH with a MsgA PUSCH resource spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.
* **CG PUSCH bandwidth:** For UE BB bandwidth reduction, a UE is not expected to be configured with a CG grant with a PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.

Thus, it might be worth discussing in RAN1 whether and how to capture and communicate the above agreements.

**FL1 High Priority Question 4-1a:**

* **Do you agree that the RAN1 agreements made so far do not result in new or modified higher-layer parameters that need to be captured as part of the overall Rel-18 higher-layer parameter list from RAN1?**
* **If you think that some of the earlier RAN1 agreements need to be captured in the higher-layer parameter list from RAN1, please elaborate in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| Nordic  | Y |  |
| DOCOMO | Y |  |
| CATT | Y | So far no new HL parameter is needed. |
| vivo | Y |  |

# 5 Other aspects

The submitted contributions bring up the following other aspects which are not covered in any other section in this FLS.

**Initial BWP**

* Support an additional separate initial BWP [17, 26].
* Do not support an additional separate initial BWP [14, 15].

**FDRA optimization**

* In the case where the RBG size for FDRA is large (e.g., 16 RBs in 15 kHz SCS, 8 RBs in 30 kHz SCS), consider enhancements to increase the efficiency in terms of DL/UL frequency resource utilization [23].
* For unicast, the FDRA indications and RBG sizes can be based on 5-MHz sub-bands [30].
* Discuss whether/how to use potential spare bits in FDRA field in RAR UL grant [13].
* There is no need to consider potential optimization of FDRA indications [15].

**SRS bandwidth**

* The SRS bandwidth does not need to be limited to 5 MHz [15, 17]
* Continue to discuss SRS bandwidth reduction to 5 MHz [26].

**Other functionality**

* Support 60 kHz SCS [14, 15].
* Consider enhancements of user multiplexing capacity for common PUCCH [23, 32].
* Support frequency hopping at least for unicast PUSCH [30].
* Consider options for support of 5-MHz MsgA PUSCH resource allocation [18].
* Enable UE to buffer none or a partial bandwidth for potential PDSCH within the activated BWP depending on the UE capabilities or circumstances such as other channel scheduling [15].

To be able to focus on more pressing issues, the above aspects could be down-prioritized in this meeting.

**FL1 Medium Priority Question 5-1a: Is there a need to treat any of the issues listed above in this meeting?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| DOCOMO | Y | **Common PUCCH capacity**We prefer to consider enhancement on common PUCCH capacity for Rel-18 eRedCap. Given that the number of UEs is expected to be largely increased if NW accommodate both Rel-17 and Rel-18 RedCap, we have a concern on capacity on random access. Thus, we prefer to make it sure common PUCCH would not be a bottleneck for random access. |
|  |  |  |
|  |  |  |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| [1] | [RP-223544](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Docs/RP-223544.zip) | Revised WID on Enhanced support of reduced capability NR devices | Ericsson |
| [2] | [R1-2300177](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112/Docs/R1-2300177.zip) | WI work plan for Rel-18 RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2304261](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2304261.zip) | FL summary #6 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [4] | [R1-2303938](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2303938.zip) | RAN1 agreements for Rel-18 NR RedCap | Rapporteur (Ericsson) |
| [5] | [RP-230778](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_99/Docs/RP-230778.zip) | Proposal for PR1 in eRedCap | Moderator (CMCC) |
| [6] | [TR 38.865 V18.0.0](https://ftp.3gpp.org/Specs/archive/38_series/38.865/38865-i00.zip) | Study on further NR RedCap UE complexity reduction (Release 18) | RAN1 |
| [7] | [R1-2304336](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304336.zip) | Initial input on higher layer signalling for Rel-18 eRedCap | Rapporteur (Ericsson) |
| [8] | [R1-2304338](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304338.zip) | Further RedCap UE complexity reduction | Ericsson |
| [9] | [R1-2304359](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304359.zip) | Discussion on R18 RedCap complexity | FUTUREWEI |
| [10] | [R1-2304491](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304491.zip) | Discussion on further UE complexity reduction | Vivo |
| [11] | [R1-2304526](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304526.zip) | Discussion on further UE complexity reduction | ZTE, Sanechips |
| [12] | [R1-2304569](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304569.zip) | Discussion on enhanced support of RedCap devices | Spreadtrum Communications |
| [13] | [R1-2304629](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304629.zip) | Discussion on potential solutions to further reduce UE complexity | Huawei, HiSilicon |
| [14] | [R1-2304742](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304742.zip) | Discussion on further complexity reduction for Rel-18 RedCap UE | CATT |
| [15] | [R1-2304758](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304758.zip) | RedCap UE Complexity Reduction | Nokia, Nokia Shanghai Bell |
| [16] | [R1-2304802](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304802.zip) | Complexity reduction for eRedCap UE | Intel Corporation |
| [17] | [R1-2304860](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304860.zip) | Discussion on further complexity reduction for eRedCap UEs | China Telecom |
| [18] | [R1-2304912](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304912.zip) | Discussion on further complexity reduction for eRedCap UEs | Xiaomi |
| [19] | [R1-2304974](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304974.zip) | UE complexity reduction | Lenovo |
| [20] | [R1-2305024](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305024.zip) | Discussion on Rel-18 RedCap UE | NEC |
| [21] | [R1-2305046](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305046.zip) | On eRedCap complexity reduction | Sony |
| [22] | [R1-2305105](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305105.zip) | Discussion on further reduced UE complexity | CMCC |
| [23] | [R1-2305142](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305142.zip) | Discussion on further UE complexity reduction for eRedCap | LG Electronics |
| [24] | [R1-2305158](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305158.zip) | Considerations for further UE complexity reduction | Sierra Wireless. S.A. |
| [25] | [R1-2305254](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305254.zip) | Further RedCap UE complexity reduction | Apple |
| [26] | [R1-2305287](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305287.zip) | UE complexity reduction for eRedCap | Panasonic |
| [27] | [R1-2305308](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305308.zip) | Discussion on complexity reduction for eRedCap UE | Sharp |
| [28] | [R1-2305348](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305348.zip) | UE complexity reduction for eRedCap | Qualcomm Incorporated |
| [29] | [R1-2305449](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305449.zip) | Further consideration on reduced UE complexity | OPPO |
| [30] | [R1-2305525](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305525.zip) | Further UE complexity reduction for eRedCap | Samsung |
| [31] | [R1-2305567](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305567.zip) | Discussion on UE complexity reduction | DENSO CORPORATION |
| [32] | [R1-2305607](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305607.zip) | Discussion on further UE complexity reduction for eRedCap | NTT DOCOMO, INC. |
| [33] | [R1-2305647](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305647.zip) | On eRedCap UE complexity reduction | MediaTek Inc. |
| [34] | [R1-2305709](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305709.zip) | Discussion on UE complexity reduction | Transsion Holdings |
| [35] | [R1-2305853](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305853.zip) | On further complexity reduction of NR UE | Nordic Semiconductor ASA |
| [36] | [R1-2305868](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305868.zip) | Considerations for Rel-18 eRedCap UE complexity reduction | Sequans Communications |
| [37] | [R1-2304512](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2304512.zip) | Discussion on UE features for R18 eRedCap | Vivo |
| [38] | [R1-2304795](https://protect2.fireeye.com/v1/url?k=31323334-501d5122-313273af-454445555731-6a29f45c73e71788&q=1&e=e0ee06db-124c-4391-9101-c2aedc536ab9&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2FTSG_RAN%2FWG1_RL1%2FTSGR1_113%2FDocs%2FR1-2304795.zip) | On support of legacy features for Rel-18 eRedCap UEs | Ericsson |
| [39] | [R1-2305855](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_113/Docs/R1-2305855.zip) | On eRedCap features | Nordic Semiconductor ASA |
| [40] | [R1-2304262](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2304262.zip) | LS on Msg4 PDSCH transmission to Rel-18 eRedCap UEs | RAN1, Ericsson |