3GPP TSG-RAN WG1 Meeting #111 Draft R1-2212533

Toulouse, France, 14th – 18th November 2022

**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]. FLSs from the previous RAN1 meeting can be found in [3, 4, 5, 6], and a RAN1 agreement summary is available in [7].

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

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| **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.
	+ 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#98-e regarding:* Whether UE peak data rate reduction for UE is limited only with UE BB bandwidth reduction or standalone
* Whether or not/how a separate early indication can be supported
* Other restrictions of the WI (e.g., connectivity restrictions, band, etc.)
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This document summarizes contributions [10] – [37] submitted to agenda item 9.6.1 and the following email discussion:

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| [111-R18-RedCap] 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 – Johan (Ericsson) |

The issues in this document are tagged and color coded with High Priority or Medium Priority. The issues that are in the focus of this 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 12 in [R1-2210802](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_111/Docs/R1-2210802.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.**

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| **Company** | **Point(s) of contact** | **Email address(es)** |
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# 2 UE BB bandwidth reduction

2.1 Bandwidth of broadcast PDSCH

**Assumptions on UE Post-FFT buffer size**

The previous RAN1 meeting made an FFS regarding the UE post-FFT buffering “assumption” (for SIB1 PDSCH):

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| Agreement:For UE BB bandwidth reduction, for SIB1 (PDSCH),* Allow the scheduling of SIB1 to be larger than 5 MHz (as in legacy operation)
* FFS: UE post-FFT buffering “assumption”

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Several contributions [11, 12, 14, 15, 16, 19, 24, 28, 30, 33, 35] propose that post-FFT buffer size should not smaller than ~20 MHz. A few contributions [17, 19, 22] propose that the UE post-FFT buffer size can be less than 20 MHz (e.g., 5 MHz). One contribution [32] proposes that post-FFT size can be 20 MHz until PDCCH is decoded and 5 MHz after that.

Based on the above considerations, the following proposals can be considered.

**FL1 High Priority Proposal 2.1-1a: For UE BB bandwidth reduction, for broadcast PDSCH, RAN1 does not assume that the UE post-FFT buffer size is smaller than 20 MHz.**

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| **Company** | **Y/N** | **Comments** |
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**FL1 High Priority Proposal 2.1-2a: For UE BB bandwidth reduction, for unicast PDSCH, at least until PDCCH is decoded, RAN1 does not assume that the UE post-FFT buffer size is smaller than 20 MHz.**

* **FFS: the assumption on post-FFT buffer size after decoding PDCCH**

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| **Company** | **Y/N** | **Comments** |
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**Bandwidth of SIB1 and OSI**

The previous RAN1 meeting made the following agreements regarding bandwidth of SIB1 and OSI:

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| Agreement:For UE BB bandwidth reduction, for SIB1 (PDSCH),* Allow the scheduling of SIB1 to be larger than 5 MHz (as in legacy operation)
* FFS: UE post-FFT buffering “assumption”

Agreement: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)

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Some contributions [25, 28, 35] propose that broadcast of dedicated/separate SIB1/OSI (e.g., with bandwidth less than 5 MHz) to Rel-18 RedCap UEs should not be supported. However, one contribution [36] wants to discuss this aspect further. A couple of contributions [32, 37] have proposed that how to receive 20-MHz PDSCH for SIB1/OSI should be up to UE implementation.

Based on the above considerations, the following proposal can be considered.

**FL1 Medium Priority Proposal 2.1-3a: For UE BB bandwidth reduction, broadcast of separate SIB1/OSI (PDSCH) to Rel-18 RedCap UEs is not supported.**

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| **Company** | **Y/N** | **Comments** |
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**Bandwidth of Paging and RAR**

The previous RAN1 meeting made the following agreements regarding bandwidth of Paging and RAR:

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| Agreement:For UE BB bandwidth reduction, for paging channel (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of paging channel to be within 5 MHz
* Option 2: Allow the scheduling of paging channel to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous

Agreement:For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, down-select between the following options:* Option 1: Restrict the scheduling of RAR PDSCH to be within 5 MHz
* Option 2: Allow the scheduling of RAR PDSCH to be larger than 5 MHz (as in legacy operation)
* FFS: whether 5MHz is assumed to be physically contiguous
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For paging, majority of the contributions [11, 12, 13, 14, 15, 17, 20, 23, 24, 25, 26, 28, 29, 30, 31, 35] propose that Option 2 (i.e., allow the scheduling of paging channel to be larger than 5 MHz) should be supported. Some contributions [18, 19, 21, 22, 32, 36] support Option 1 (i.e., restrict the scheduling of paging channel to be within 5 MHz) instead.

Based on the above considerations, the following proposal can be considered.

**FL1 High Priority Proposal 2.1-4a: For UE BB bandwidth 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).**

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| **Company** | **Y/N** | **Comments** |
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For RAR, several contributions [11, 13, 14, 16, 20, 23, 25, 26, 27, 28, 30, 34] propose that Option 2 (i.e., allow the scheduling of RAR PDSCH to be larger than 5 MHz) should be supported. Slightly fewer contributions [17, 18, 19, 21, 22, 32, 33, 36, 37] wants to support Option 1 instead. A few contributions [12, 15, 31] propose the support that down-selection between the should be conditioned on the UE post-FFT buffer size and/or on whether separate Msg1 indication is available for Rel-18 RedCap UEs. One contribution [13] has proposed to extend the minimum time between RAR reception and Msg3 transmission when RAR bandwidth is larger than 5 MHz.

Based on the above considerations, the following proposal can be considered.

**FL1 High Priority Proposal 2.1-5a: For UE BB bandwidth reduction, for RAR (PDSCH) to Rel-18 RedCap UEs, allow the scheduling of RAR PDSCH to be larger than 5 MHz (as in legacy operation).**

* **FFS: whether/how to extend the minimum time between RAR reception and Msg3 transmission when RAR bandwidth is larger than 5 MHz**
* **FFS: the UE behavior if the minimum time between RAR reception and Msg3 transmission is not extended**

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| **Company** | **Y/N** | **Comments** |
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A few contributions [10, 22, 23] have proposed that resource allocation for broadcast PDSCH is assumed to be physically contiguous for broadcast PDSCH, whereas one contribution [26] have proposed that the allocation could also be non-contiguous. A couple of contributions [11, 12] have proposed that relaxed UE processing time should be supported when the PDSCH is larger than 5 MHz. One contribution [35] has proposed that if dedicated paging PDSCH for Rel-18 RedCap UEs is to be further considered in RAN1, an LS should be sent to RAN3 for their inputs.

2.2 Bandwidth of unicast PDSCH

Several contributions [10, 21, 23, 25, 28, 29, 30, 32, 33] propose that a UE should not be expected to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot. Some contributions [12, 13, 15, 16, 18, 24] propose that a UE can be expected to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot. One contribution [31] propose the down-selection between those options should be conditioned on the UE post-FFT buffer size. A few contributions [24, 16, 18] also propose that allocating number of RBs corresponding to more than 5 MHz should not be supported.

Based on the above considerations, the following proposal can be considered.

**FL1 High Priority Proposal 2.2-1a: For UE BB bandwidth reduction, a UE is not expected to receive a DL assignment in a DCI with a unicast PDSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot.**

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| **Company** | **Y/N** | **Comments** |
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2.3 Bandwidth of PUSCH and Msg3

The previous RAN1 meeting made the following agreements regarding bandwidth of PUSCH and Msg3:

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| 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.
* For UE BB bandwidth reduction, it is FFS whether a UE can be expected to receive an UL grant in a RAR with a Msg3 PUSCH resource allocation spanning a bandwidth of more than ~5 MHz per slot or per hop, if applicable.
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Most of the contributions [10, 11, 13, 14, 15, 21, 24, 26, 30, 31, 34, 36, 37] propose that a UE should not be 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. However, a few contributions [12, 22, 28] propose that the UE can be expected to receive such an UL grant or DCI. One contribution [25] proposes to study this aspect further for the case when RA-SDT is configured [25]. One contribution [10] also proposes that a UE should not be expected to be configured with a PUSCH occasion for 2-step RACH spanning a bandwidth of more than ~5 MHz per slot or per hop.

**FL1 High Priority Proposal 2.3-1a: For UE BB bandwidth 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.**

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| **Company** | **Y/N** | **Comments** |
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2.4 Initial BWP

The previous RAN1 meeting made the following agreements regarding initial BWP:

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| 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
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Several contributions [11, 12, 15, 21, 23, 25, 28, 30, 35] propose that an additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs. A couple of contributions [20, 31] propose that an additional separate initial DL/UL BWP should be supported, at least optionally. A couple of contributions [12, 15] brought up the case where a cell supports Rel-18 RedCap UEs but not Rel-17 RedCap UEs and propose that it should be possible to configure a separate initial DL/UL BWP for Rel-18 RedCap UEs in such cells.

**FL1 Medium Priority Proposal 2.4-1a: For a cell supporting both Rel-17 and Rel-18 RedCap UEs,**

* **Configuration of an additional separate initial DL/UL BWP specific to Rel-18 RedCap UEs is not supported.**

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| **Company** | **Y/N** | **Comments** |
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**FL1 Medium Priority Proposal 2.4-2a: For a cell supporting Rel-18 RedCap UEs but not Rel-17 RedCap UEs,**

* **Configuration of a separate initial DL/UL BWP specific to Rel-18 RedCap UEs is supported.**
	+ **The detailed signaling solution is up to RAN2 (e.g., whether to reuse the Rel-17 signaling).**

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| **Company** | **Y/N** | **Comments** |
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2.5 Maximum number of PRBs

The previous RAN1 meeting made the following agreements regarding number of PRBs:

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| Agreement:For UE BB bandwidth reduction, for PUSCH, down-select between the following options for the maximum number of PRBs that the UE can transmit per slot or per hop, if applicable:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

For UE BB bandwidth reduction, for PDSCH (at least for unicast), down-select between the following options for the maximum number of PRBs that the UE can process per slot:* Option 1: 28 PRBs for 15 kHz SCS and 14 PRBs for 30 kHz SCS
* Option 2: 27 PRBs for 15 kHz SCS and 13 PRBs for 30 kHz SCS
* Option 3: 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS

Same option will be selected for both PDSCH (at least for unicast) and PUSCH. |

Several of the contributions [10, 11, 15, 17, 21, 22, 25, 26, 27, 28, 36, 37] support Option 4 for the maximum number of PRBs that the UE can transmit/process per slot for PUSCH/unicast PDSCH. Some contributions [10, 13, 18, 19, 23, 30, 36, 37] prefer Option 3, and a few contributions [14, 24, 29] prefer Option 1 or Option 2. One contribution [37] propose to define scheduling restriction for Rel-18 Redcap UEs in RB-symbols units instead of PRBs, and one contribution [35] propose to apply the same option for unicast and broadcast PDSCH. One contribution [32] propose that RBG size should follow 5 MHz to provide a finer scheduling granularity for unicast PDSCH/PUSCH.

**FL1 High Priority Proposal 2.5-1a:**

**For UE BB bandwidth reduction, for PUSCH, down-select between the following options 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**
* **Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS**

**For UE BB bandwidth reduction, for PDSCH (for both unicast and broadcast), down-select between the following options 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**
* **Option 4: 25 PRBs for 15 kHz SCS and 11 PRBs for 30 kHz SCS**

**Same option will be selected for both PDSCH and PUSCH.**

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| **Company** | **Y/N** | **Comments** |
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2.6 Other aspects

**Solutions to reduce UE Post-FFT buffer size**

* Support semi-static configuration of the 5-MHz frequency location for PDSCH (for unicast and/or broadcast) and/or PUSCH [17, 22, 23].
* Support cross-slot scheduling for unicast and/or broadcast PDSCH [10, 17, 22].
* Support solutions to minimize the post-FFT buffer size [36].
* Do not pursue solutions to reduce post-FFT buffer size: [12, 25, 29, 33].

**Coverage compensation**

* FFS/discuss need for performance enhancements for broadcast PDSCH [20, 25].
* Broadcast PDSCH can be repeatedly transmitted with different number of allocated PRBs in multiple slots [17].
* Discuss whether to support SIB1 PDSCH repetition for Rel-18 RedCap UEs [36].
* Do not support coverage enhancements for broadcast PDSCH [33].
* Support frequency hopping for Rel-18 RedCap UEs to maintain coverage and average interference over 20-MHz bandwidth for PDSCH/PUSCH transmission [32].

**Simultaneous reception of multiple DL/UL channels**

* Rel-18 RedCap 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 [13].
* Simultaneous reception of PDSCH (limited to 5MHz in baseband) and SSB/PDCCH/CSI-RS within the BWP is supported for BWP of up to 20 MHz; Simultaneous reception of two PDSCH transmissions (e.g., unicast and broadcast) is supported; FFS whether UE behavior needs to be specified or it can be left to UE implementation when the total frequency allocation is larger than 5 MHz [25].
* Simultaneous transmission of PUSCH (limited to 5 MHz in baseband) and PUCCH within the BWP is supported for BWP of up to 20 MHz [25].
* A Rel-18 RedCap UE cannot support reception of two broadcast PDSCHs or one broadcast PDSCH plus one unicast PDSCH which are multiplexed in a FDM manner in a slot if the two PDSCHs span more than 5 MHz [17].
* In RRC\_IDLE and RRC\_INACTIVE, when paging PDSCH is scheduled in RB resource greater than 5 MHz, which PDSCH among paging, RACH messages, and SIB to be prioritized for reception and processing is either (1) up to UE implementation or (2) reception and processing of RACH messages is prioritized over that of paging messages, and reception and processing of paging messages is prioritized over that of SIB messages [35].

**FDRA optimizations**

* Support FDRA optimization for Rel-18 RedCap UEs [17, 19, 32].
* Do not support FDRA optimization for Rel-18 RedCap UEs [35, 37].
* Discuss whether/how to support FDRA optimization [33, 36].
* FDRA of PDSCH/PUSCH within 5 MHz should be indicated based on BWP bandwidth up to 20 MHz [30].

**Miscellaneous**

* When intra-slot PUCCH FH in separate initial UL BWP is disabled UE generates two base sequences for the PUCCH as if intra-slot FH is enabled for the PUCCH transmission [31].
* Support the disabling of PUCCH frequency hopping in the connected state [10].
* Support enhancements on the user multiplexing capacity for common PUCCH [36].
* Discuss whether scheduling of Msg4 PDSCH can be larger than 5 MHz [12].
* Send an LS to RAN2 asking whether NW is aware of UE type, i.e., whether the paged UE is Rel-18 RedCap or not, and whether it is feasible/desirable to have separate paging configuration for Rel-18 RedCap UEs [33].
* Disable interleaved VRB-to-PRB mapping for Rel-18 RedCap UEs [33].
* Center frequencies of uplink BWP and downlink BWP pairs are aligned in TDD as in legacy [35].
* Support reception schemes where PDSCH transmission bandwidth is confined to UE’s processing bandwidth of 5 MHz, and where PDSCH transmission bandwidth can be wider than UE’s processing bandwidth [35].
* Configuring more than one PDCCH monitoring occasion per SSB in a PO is not considered for Rel-18 RedCap UEs operating in licensed spectrum [35].

# 3 UE peak data rate reduction

The previous RAN1 meeting made the following agreements regarding UE peak data rate reduction:

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| 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.
 |

Peak rate targets are mentioned in several contributions [13, 14, 15, 27, 31, 37]. Most prefer to target 10 Mbps as suggested in the Justification in the WID [1], whereas a few contributions propose to target around 6 Mbps. Some contributions propose that the peak rate target should apply to FD-FDD.

**FL1 High Priority Proposal 3-1a: The peak rate target is 10 Mbps based on peak data rate calculation according to 38.306 assuming FD-FDD with 1Rx without 256QAM.**

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| **Company** | **Y/N** | **Comments** |
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Several contributions [10, 11, 12, 13, 17, 19, 22, 23, 25, 26, 27, 33] suggest a value of X around 3 or slightly higher. Some [15, 16, 30, 31] propose a lower value around 2. Some [18, 37] propose an even lower value than 2. Some contributions [10, 14, 24] indicate that the exact value of X should be determined after the maximum number of PRBs has been decided.

**FL1 Medium Priority Proposal 3-2a: Agree as a working assumption that X is ~3 and revisit the exact value later.**

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| **Company** | **Y/N** | **Comments** |
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Several contributions [12, 19, 22, 26, 27] suggest a value of Y around 1 or even slightly lower, assuming the feature is supported as a standalone feature. However, several contributions [17, 25, 28, 30, 36] propose that UE peak data rate reduction is not supported as a standalone feature, whereas some [27, 33] express that it can be considered as a standalone feature and that RAN1 can indicate to the RAN plenary that it is feasible with minimum specification impact. The RAN1 agreement from the previous meeting already notes that it will be decided in RAN plenary whether this option is supported.

# 4 Early indication

**Early indication in Msg1/MsgA PRACH**

Some contributions [12, 13, 14, 20, 22, 24, 25, 27, 28] support sharing the same early indication in Msg1/MsgA PRACH between Rel-17 and Rel-18 RedCap UEs.

Regarding the potential introduction of a separate early indication in Msg1/MsgA PRACH for Rel-18 RedCap UEs, several contributions [10, 11, 13, 15, 16, 19, 20, 21, 31, 32, 33, 35] support it, while some contributions [12, 14, 17, 23] oppose it or do not see it as necessary.

**FL1 Medium Priority Question 4-1a: Is a separate early indication in Msg1 for Rel-18 RedCap UEs needed?**

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| **Company** | **Y/N** | **Comments** |
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**Early indication in Msg3/MsgA PUSCH**

Some contributions [12, 20, 24, 25, 27, 28] support sharing the same early indication in Msg3/MsgA PUSCH between Rel-17 and Rel-18 RedCap UEs.

Regarding the potential introduction of a separate early indication in Msg3/MsgA PUSCH for Rel-18 RedCap UEs, several contributions [10, 11, 14, 15, 16, 17, 19, 20, 21, 22, 30, 33] support it, while some contributions [12, 14] oppose it or do not see it as necessary.

**FL1 Medium Priority Question 4-2a: Is a separate early indication in Msg3 for Rel-18 RedCap UEs needed?**

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| **Company** | **Y/N** | **Comments** |
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# 5 Other aspects

**Cell barring**

* Support sharing of the cell barring indication between Rel-17 and Rel-18 RedCap UEs [14].
* Support separate cell barring indication and/or IFRI for Rel-18 RedCap UEs [16].
* FFS whether to support separate cell barring indication; final decision up to RAN2 [14].

**Feature group / UE type / capability reporting**

* Reuse Rel-17 RedCap UE capabilities and RRC parameters for Rel-18 RedCap UEs with necessary clarification and modification if any [20].
* BB bandwidth for PDSCH and PUSCH is an identification for the new Rel-18 RedCap UE type [16].
* RAN1 defines one new Rel-18 RedCap UE type for further UE complexity reduction [25].
* Introduce a new UE capability parameter with functional components for Rel-18 RedCap UEs [25].

**Miscellaneous**

* Reduce BD/CCE limits for Rel-18 Redcap UEs to half; a Rel-18 RedCap UE monitors only one common SS per slot [37].
* Network support for Rel-18 RedCap UEs is indicated in SI [27].
* Discuss whether to specify coverage recovery techniques for Rel-18 RedCap UEs [36].
* Specify support for NCD-SSB for RedCap UEs in idle/inactive mode [15].
* For FR2, further complexity reduction solutions can be considered in Rel-18 phase [15].

# References

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| --- | --- | --- | --- |
| [1] | [RP-222675](https://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_97e/Docs/RP-222675.zip) | New WID on enhanced support of reduced capability NR devices | Ericsson |
| [2] | [R1-2208361](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208361.zip) | WI work plan for Rel-18 RedCap | Rapporteur (Ericsson) |
| [3] | [R1-2210248](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210248.zip) | FL summary #1 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [4] | [R1-2210249](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210249.zip) | FL summary #2 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [5] | [R1-2210250](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210250.zip) | FL summary #3 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [6] | [R1-2210251](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210251.zip) | FL summary #4 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [7] | [R1-2210637](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110b-e/Docs/R1-2210637.zip) | RAN1 agreements for Rel-18 NR RedCap | Rapporteur (Ericsson) |
| [8] | [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 |
| [9] | [RP-222633](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_97e/Docs/RP-222633.zip) | Moderator’s summary for discussion [97e-15-R18-RedCap] | Moderator (Ericsson) |
| [10] | [R1-2210833](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2210833.zip) | Continued discussion on R18 RedCap complexity techniques | FUTUREWEI |
| [11] | [R1-2210868](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2210868.zip) | Discussion on potential solutions to further reduce UE complexity | Huawei, HiSilicon |
| [12] | [R1-2211017](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211017.zip) | Discussion on UE further complexity reduction | Vivo, Guangdong Genius |
| [13] | [R1-2211099](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211099.zip) | UE complexity reduction for eRedCap | Panasonic |
| [14] | [R1-2211208](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211208.zip) | Discussion on further complexity reduction for eRedCap UE | CATT |
| [15] | [R1-2211240](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211240.zip) | Discussion on enhanced support of RedCap devices | Spreadtrum Communications, H3C |
| [16] | [R1-2211372](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211372.zip) | Discussion on further complexity reduction for eRedCap UEs | Xiaomi |
| [17] | [R1-2211409](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211409.zip) | Discussion on complexity reduction for eRedCap UE | Intel Corporation |
| [18] | [R1-2211470](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211470.zip) | Technologies for further reduced UE complexity | OPPO |
| [19] | [R1-2211517](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211517.zip) | Discussion on UE complexity reduction | Transsion Holdings |
| [20] | [R1-2211531](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211531.zip) | Discussion on UE complexity reduction | China Telecom |
| [21] | [R1-2211571](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211571.zip) | UE complexity reduction | Lenovo |
| [22] | [R1-2211620](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211620.zip) | UE complexity reduction for eRedCap | Sony |
| [23] | [R1-2211690](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211690.zip) | Discussion on further UE complexity reduction | CMCC |
| [24] | [R1-2211757](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211757.zip) | Further RedCap UE complexity reduction | Ericsson |
| [25] | [R1-2211759](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211759.zip) | RedCap UE Complexity Reduction | Nokia, Nokia Shanghai Bell |
| [26] | [R1-2211820](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211820.zip) | Further RedCap UE complexity reduction | Apple |
| [27] | [R1-2211850](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211850.zip) | Considerations for further UE complexity reduction | Sierra Wireless. S.A. |
| [28] | [R1-2211856](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211856.zip) | Discussion on UE complexity reduction | Sharp |
| [29] | [R1-2211875](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211875.zip) | Discussion on Rel-18 RedCap UE | NEC |
| [30] | [R1-2211902](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211902.zip) | Discussion on further UE complexity reduction | ZTE, Sanechips |
| [31] | [R1-2211993](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2211993.zip) | Discussion on further UE complexity reduction for eRedCap | NTT DOCOMO, INC. |
| [32] | [R1-2212055](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212055.zip) | Further UE complexity reduction for eRedCap | Samsung |
| [33] | [R1-2212127](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212127.zip) | UE complexity reduction for eRedCap | Qualcomm Incorporated |
| [34] | [R1-2212175](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212175.zip) | Discussion on UE complexity reduction | DENSO CORPORATION |
| [35] | [R1-2212246](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212246.zip) | On eRedCap UE complexity reduction | MediaTek Inc. |
| [36] | [R1-2212300](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212300.zip) | Discussion on further UE complexity reduction for eRedCap | LG Electronics |
| [37] | [R1-2212416](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_111/Docs/R1-2212416.zip) | On further complexity reduction of NR UE | Nordic Semiconductor ASA |