3GPP TSG-RAN WG1 Meeting #114 Draft R1-2308226

Toulouse, France, 21st – 25th August 2023

**Agenda Item: 9.6.1**

**Title: FL summary #3 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., 10 Mbps**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
 |

RAN#100 endorsed this working assumption regarding the peak data rate. The moderator summary can be found in [7].

|  |
| --- |
| Conclusion: Working assumption: The peak rate target is 10 Mbps regardless of what optional features the UE may support. (i.e., WGs can progress on this topic based on this assumption).No consensus about Proposal 3-3b. Revised WID will be handled in RAN #101. |

This document summarizes contributions [8] – [34] submitted to agenda items 9.6.1, and the following email discussion:

|  |
| --- |
| [114-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 previous FLS can be found in [35]. The issues in this document are tagged and color coded with High Priority, Medium Priority, and Low Priority, and the proposals that are in focus in this round are furthermore tagged FL6f.

Follow the naming convention in this example:

* *eRedCapFLS3-v000.docx*
* *eRedCapFLS3-v001-CompanyA.docx*
* *eRedCapFLS3-v002-CompanyA-CompanyB.docx*
* *eRedCapFLS3-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 *eRedCapFLS3-v002-CompanyA-CompanyB.docx*.
* CompanyC uploads an empty file named *eRedCapFLS3-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 *eRedCapFLS3-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 [R1-2306353](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_114/Docs/R1-2306353.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.

**FL6 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)** |
| vivo | Lihui Wang | wanglihui@vivo.com |
| ZTE, Sanechips | Youjun Hu | hu.youjun1@zte.com.cn |
| Panasonic | Shotaro Maki | maki.shotaro@jp.panasonic.com |
| MediaTek | Chiou-Wei Tsai | cw.tsai@mediatek.com |
| Spreadtrum | Sicong Zhao | sicong.zhao@unisoc.com |
| FUTUREWEI | Vip Desai | vipul.desai@futurewei.com |
| NTT DOCOMO | Mayuko Okano | mayuko.okano.ca@nttdocomo.com |
| Nokia, NSB | Rapeepat Ratasuk | rapeepat.ratasuk@nokia.com |
| Ericsson | Sandeep Narayanan Kadan Veedu | sandeep.narayanan.kadan.veedu@ericsson.com |
| DENSO CORPORATION | Takahiro Furuyama | takahiro.furuyama.j6k@jp.denso.com |
| LG Electronics | Seungjin Ahn | Seungjin.ahn@lge.com |
| Xiaomi | Xuemei Qiao | qiaoxuemei@xiaomi.com |
| NEC | Takahiro Sasaki | takahiro.sasaki@nec.com |
| Huawei, HiSilicon | Frank Yi LONG | frank.longyi@huawei.com |
| OPPO | Zhisong Zuo | zuozhisong@oppo.com |
| CMCC | Jiazhen Zhang | zhangjiazhen@chinamobile.com |
| CATT | Yongqiang Fei | feiyongqiang@catt.cn |
| SONY | Martin Beale | martin.beale@sony.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.**Msg2 bandwidth, Msg2-Msg3 timeline, and Msg1 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:* For the “FFS: value(s) of X”,
	+ X = 1/0.5 ms for 15/30 kHz SCS
* 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).
* When Msg1 indication for Rel-18 eRedCap UEs is not configured while Msg1 indication for Rel-17 RedCap UEs is configured, Rel-18 eRedCap UEs shall share the PRACH that is configured for Rel-17 RedCap UEs.
	+ Note: Rel-18 eRedCap UEs will be differentiated from Rel-17 RedCap UEs based on Msg3 of Rel-18 eRedCap UEs.
* Additional early indication in MsgA PRACH is not supported.

Agreement:* 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

**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.**MsgB bandwidth and timeline**Agreement:For UE BB bandwidth reduction, for 2-step RACH, assuming that MsgA PUSCH indication is transmitted:* The bandwidth of a MsgB scheduled with MSGB-RNTI should be limited in a similar way as Msg2.
	+ The same timeline relaxation as for the Msg2-Msg3 timeline (i.e., 1 slot for Msg2 PDSCH larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS) applies at least for the following cases:
		- Case 2a: Between reception of fallbackRAR and transmission of Msg3
		- Case 2b: Between reception of successRAR and transmission of corresponding HARQ-ACK
* The bandwidth of a MsgB scheduled with C-RNTI should be limited in a similar way as Msg4.

**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

Agreement:* For UE BB complexity reduction, for RRC\_IDLE and RRC\_INACTIVE, there is no need to relax the requirements on simultaneous reception of two PDSCH transmissions for SIB1 / OSI / paging / RAR / Msg4 scheduled by TC-RNTI for the case when Msg4 PDSCH is not larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
* Note: This means that the following paragraph in TS 38.214 clause 5.1 still applies for the case when Msg4 PDSCH is not larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS:
	+ “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.”

Agreement:Down-select between these options for handling of simultaneous reception during P-RNTI triggered SI acquisition 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.* Option 2: The UE may skip decoding of PDSCH [in slot n or n+1] scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n.
* Option 3: The prioritization between reception of PDSCH scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI 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 [be scheduled PDSCH/to decode PDSCH scheduled] with C-RNTI/MCS-C-RNTI/CS-RNTI if in the same cell, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.
* Option 7: No specification change
 |

2.1 Random access timeline

RAN1 has made several agreements related to random access timeline relaxation. For details, see agreements listed under headings *‘Msg2 bandwidth, Msg2-Msg3 timeline, and Msg1 indication’* and *‘MsgB bandwidth and timeline’* in the above Section 2.0. The discussion is captured in Section 2.1 in the RAN1#113 FLS [3].

It has been agreed that the following cases should have similar timeline relaxation as the Msg2-Msg3 timeline:

* Case 2a: Between reception of fallbackRAR and transmission of Msg3
* Case 2b: Between reception of successRAR and transmission of corresponding HARQ-ACK
* 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

Contributions [13, 20, 29, 32, 34] propose similar timeline relaxation for a few additional cases. The following proposed additional cases come from contribution [13]:

* Case 2c: Between reception of MsgB PDSCH scheduled by MSGB-RNTI in which UE does not correctly receive the transport block in the corresponding PDSCH within the window and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.
* Case 2d: Between reception of MsgB PDSCH scheduled by MSGB-RNTI with RAPID which is not associated with the corresponding PRACH transmission from the UE and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.

Companies are invited to comment on the following questions.

**FL1 High Priority Question 2.1-1a: Should the same timeline relaxation as for the Msg2-Msg3 timeline be used for Case 2c/2d above? If the answer is no, please elaborate in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| ZTE, Sanechips | Y |  |
| Nordic  | Y |  |
| QC | YES |  |
| CATT | Y |  |
| Panasonic | Y |  |
| MTK | Y |  |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| Ericsson | Y |  |
| LG  | Y | The previous agreements of 4-step RACH should be applied for the same cases of 2-step RACH. |
| Xiaomi1 | Y |  |
| NEC | Y |  |
| Samsung | Y |  |

Based on the above received responses, the following proposal can be considered.

**FL2 High Priority Proposal 2.1-1b:**

**For UE BB bandwidth reduction, for 2-step RACH, assuming that MsgA PUSCH indication is transmitted:**

* **The same timeline relaxation as for the Msg2-Msg3 timeline (i.e., 1 slot for Msg2 PDSCH larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS) applies at least for the following cases:**
	+ **Case 2c: Between reception of MsgB PDSCH scheduled by MSGB-RNTI in which UE does not correctly receive the transport block in the corresponding PDSCH within the window and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.**
	+ **Case 2d: Between reception of MsgB PDSCH scheduled by MSGB-RNTI with RAPID which is not associated with the corresponding PRACH transmission from the UE and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.**

The above proposal was treated in the Monday online session where the following agreement was made:

|  |
| --- |
| Agreement:For UE BB bandwidth reduction, for 2-step RACH, assuming that MsgA PUSCH indication is transmitted:* The same timeline relaxation as for the Msg2-Msg3 timeline (i.e., 1 slot for Msg2 PDSCH larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS) applies at least for the following cases:
	+ Case 2c: Between reception of MsgB PDSCH scheduled by MSGB-RNTI in which UE does not correctly receive the transport block in the corresponding PDSCH within the window and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.
	+ Case 2d: Between reception of MsgB PDSCH scheduled by MSGB-RNTI with RAPID which is not associated with the corresponding PRACH transmission from the UE and transmission of only PRACH according to Type-1 random access procedure or to transmit both PRACH and PUSCH according to Type-2 random access procedure.
 |

**FL1/FL3 Medium Priority Question 2.1-2a: Are there additional cases (other than Case 2c/2d) that should use the same timeline relaxation as the Msg2-Msg3 timeline? Please elaborate in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| LG  | N | In our view, there are no additional cases other than Case 2c/2d.  |
| vivo | N | Not found.  |

2.2 Simultaneous reception

RAN1 has made several agreements related to simultaneous reception of more than one PDSCH. For details, see agreements listed under heading *‘Simultaneous reception’* in the above Section 2.0. The discussion is captured in Section 2.2 in the RAN1#113 FLS [3].

### Autonomous SI acquisition

There is an FFS regarding Msg4 in the following conclusion for simultaneous reception during autonomous SI acquisition:

|  |
| --- |
| 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
 |

Contributions [13, 17] argue that there is no remaining issue and that the FFS can be considered resolved.

**FL1/FL3 Medium Priority Question 2.2.1-1a: Can the FFS be considered resolved? If the answer is no, please elaborate in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | Y | For RRC\_CONNECTED UE performing contention-based RACH, in Msg3 transmission, the C-RNTI MAC CE will be included in Msg3, and based on following TS 38.321, the Msg4 becomes a PDCCH carrying a UL grant which is scheduled by the C-RNTI. There is no Msg4 PDSCH for such case.**TS 38.321 5.1.5 Contention Resolution**Once Msg3 is transmitted the MAC entity shall:1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers: -------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------2> if the C-RNTI MAC CE was included in Msg3: 3> if the Random Access procedure was initiated for SpCell beam failure recovery or for beam failure recovery of both BFD-RS sets of SpCell (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or3> if the Random Access procedure was initiated by a PDCCH order and the PDCCH transmission is addressed to the C-RNTI; or 3> if the Random Access procedure was initiated by the MAC sublayer itself or by the RRC sublayer and the **PDCCH transmission is addressed to the C-RNTI and contains a UL grant for a new transmission**: 4> consider this Contention Resolution successful; 4> stop ra-ContentionResolutionTimer; 4> discard the TEMPORARY\_C-RNTI; 4> consider this Random Access procedure successfully completed |
| ZTE, Sanechips |  | In our initial understanding, the C-RNTI is not always carried via msg3 for contention-based RACH even in connected mode.Additionally, if FFS is removed, does it mean we do not need to consider this case? Or do we need another conclusion for SI colliding with msg3 scheduled by TC-RNTI. |
| Nordic  |  | Maybe would be worth to clarify how this works in legacy. Is legacy UE allowed to drop PDSCH with TC-RNTI while autonomously acquiring SI? I believe no reasonable UE would do such thing, if being in process of initial access waiting for MSG4. -> maybe no need to specify, if legacy NR managed without this case. |
| CATT | Y | In addition to vivo, we think the most important point of the original statement is that the autonomous SI acquisition does not impact unicast PDSCH reception in RRC\_CONNECTED mode. Even if TC-RNTI may be used in RRC\_CONNECTED mode (though we still do not spot this case), this seems not a new issue for normal UE, i.e. no spec handling for normal UE. Then we don’t need one for eRedCap, either. |
| Spreadtrum | Y |  |
| DOCOMO | Y |  |
| Nokia, NSB | Y |  |
| Ericsson | Y |  |
| LG | Y | In our view, there are no remaining issue on Autonomous SI acquisition. |
| Xiaomi1 | Y | In our view, the following conclusion aims to describe the overlapping between two PDSCHs. During RRC\_CONNECTED states, the Msg4 is only scheduled by DCI with CRC scrambled by C-RNTI, and there is no Msg4 scheduled by TC-RNTI.

|  |
| --- |
| 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
 |

For overlapping reception between Msg4 and SI PDSCHs during RRC\_IDLE or RRC\_INACTIVE states, we already have the following agreement:

|  |
| --- |
| Agreement:* For UE BB complexity reduction, for RRC\_IDLE and RRC\_INACTIVE, there is no need to relax the requirements on simultaneous reception of two PDSCH transmissions for SIB1 / OSI / paging / RAR / Msg4 scheduled by TC-RNTI for the case when Msg4 PDSCH is not larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.
* Note: This means that the following paragraph in TS 38.214 clause 5.1 still applies for the case when Msg4 PDSCH is not larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS:
	+ “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.”
 |

Therefore, there is no need to discuss TC-RNTI case anymore.  |
| NEC | Y |  |
| Huawei, Hisilicon | Y |  |
| Samsung | Y |  |
| OPPO | Y | We also think Msg4 PDSCH scheduled by TC-RNTI case would not be issue, during the autonoetic SI acquisition. |
| CMCC | Y |  |
| Panasonic | Y |  |

Based on the above received responses, the following proposal can be considered, according to which the UE behavior is not specified in more detail than in the legacy case.

**FL4/FL5/FL6 Medium Priority Proposal 2.2.1-1b:**

* **Conclusion: For UE BB bandwidth reduction, for Msg4 PDSCH scheduled by TC-RNTI during a process of autonomous SI acquisition, no specification change.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| CATT | Y |  |
| vivo | Y |  |
| OPPO | Y |  |
| LG | Y | We support the conclusion |
| DOCOMO | Y |  |
| NEC | Y |  |
| Nokia, NSB | Y |  |
| Ericsson | Y |  |
| Samsung | Y |  |
| DENSO | Y |  |
| Panasonic | Y |  |

### P-RNTI triggered SI acquisition

RAN1#113 agreed to down-select between the following options for handling of simultaneous reception during P-RNTI triggered SI acquisition [3].

|  |
| --- |
| Agreement:Down-select between these options for handling of simultaneous reception during P-RNTI triggered SI acquisition 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.* Option 2: The UE may skip decoding of PDSCH [in slot n or n+1] scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n.
* Option 3: The prioritization between reception of PDSCH scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI 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 [be scheduled PDSCH/to decode PDSCH scheduled] with C-RNTI/MCS-C-RNTI/CS-RNTI if in the same cell, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.
* Option 7: No specification change
 |

The contributions submitted to this meeting express the following preferences:

* **Option 2:**
	+ 1st choice: [9, 12, 13, 18, 19, 20, 25, 27, 28, 33, 34]
	+ 2nd choice: [15, 23]
* **Option 3:**
	+ 1st choice: –
	+ 2nd choice: [13, 15, 23, 24]
* **Option 4:**
	+ 1st choice: [14, 15, 27]
	+ 2nd choice: [13, 17]
* **Option 7:**
	+ 1st choice: [10, 11, 17, 21, 22, 23, 24, 26, 29, 31, 32]
	+ 2nd choice: [9]

The following should be noted:

* For Options 2 and 4, different views are expressed regarding how to resolve the square brackets.
* For Options 2 and 3, [23] proposes to clarify that UE transmits NACK when it cannot decode unicast.
* For Option 3, [13] proposes to clarify whether the UE can drop both unicast PDSCH and SI PDSCH.

In the following question, the options have been updated in an attempt to address the above comments.

**FL1 High Priority Question 2.2.2-1a: Companies are invited to give each one of the following options a grade:**

* **Option 2a:**
	+ **The UE may skip decoding of PDSCH in slot n scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n. In this case, the UE transmits NACK.**
* **Option 2b:**
	+ **The UE may skip decoding of PDSCH in slot n or n+1 scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n. In this case, the UE transmits NACK.**
* **Option 2c:**
	+ **The UE may skip decoding of PDSCH in slot n+1 scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n. In this case, the UE transmits NACK.**
* **Option 3:**
	+ **The prioritization between reception of PDSCH scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI and SI PDSCH triggered by P-RNTI is up to the UE implementation. In this case, the UE receives at least one of them. If the UE does not receive the PDSCH scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI, it transmits NACK.**
* **Option 4a:**
	+ **During a process of P-RNTI triggered SI acquisition, the UE is not expected to be scheduled PDSCH with C-RNTI/MCS-C-RNTI/CS-RNTI if in the same cell, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.**
* **Option 4b:**
	+ **During a process of P-RNTI triggered SI acquisition, the UE is not expected to decode PDSCH scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI if in the same cell, another PDSCH scheduled with SI-RNTI partially or fully overlap in time.**
* **Option 7: No specification change**

**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 ofOptions 2a/2b/2c/3/4a/4b/7** | **Comments** |
| **2a** | **2b** | **2c** | **3** | **4a** | **4b** | **7** |
| Example | +1 | 0 | -1 | 0 | +1 | 0 | -1 |  |
| vivo | +1 | 0 | 0 | +1 | +1 | +1 | -1 | Option 7 is not preferred. It requests the eRedCap with BB BW reduction to decode both which beyond its capability.  |
| ZTE, Sanechips | +1 | +1 | +1 | -1 | 0 with update | 0 with update | -1 | We suggest to focus on option2 and option 7 firstly. It is quite diverge to select from all the detail options. If option2 is selected, then we can further discuss how to capture the details. Additionally, for option2, option2d can be considered:* **Option 2c:**
	+ **The UE may skip decoding of PDSCH in slot n and n+1 scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n. In this case, the UE transmits NACK.**

For option4a and 4b, we suggest to also make a update if option4 is further considered “**be scheduled PDSCH in slot n and slot n+1” or “decode PDSCH in slot n and n+1”** |
| Nordic | 1 | 1 | 1 | -1 | 0 | 0 | -1 |  |
| QC | -1 | -1 | -1 | -1 | -1 | -1 | +1 | Option 2b: the intention seems excluding unicast in both slot n and n+1. If so, the wording should be “**in slot n and n+1**”.Option 4b: what is the difference between 4b and 2a? Can FL please clarify? |
| CATT | -1 | -1 | -1 | -1 | -1 | 0 | 1 | In any case it is always possible that a UE does not correctly receive unicast PDSCH and provide NACK. The R18 RedCap UE can do so without spec change.Reusing FR2 rule may be acceptable. |
| Panasonic | 0 | 0 | 0 | 0 | 1 | 1 | -1 | Options 2a/2b/2c are OK. But we would not support to skip both unicast in slot n and n+1. The UE would be able to decode one of them since the SI does not require the immediate decoding. |
| MediaTek | +1 | +1 | +1 | +1 | 0 | 0 | -1 | It seems 2b should slot n *and* (instead of *or*) slot n+1  |
| Spreadtrum | -1 | -1 | -1 | 0 | -1 | -1 | +1 |  |
| FUTUREWEI | +1 | 0 | 0 | -1 | -1 | -1 | 0 |  |
| DOCOMO | 0 | -1 | -1 | 0 | -1 | -1 | +1 | In our understanding, for option 2a/2b/2c/3, there is a possibility that unicast PDSCH is scheduled in the same time domain resource with SI PDSCH and a UE may be able to decode both unicast PDSCH and SI PDSCH depending on the UE implementation. For this case, if the UE skip decode/reception of the unicast PDSCH, NACK should be transmitted to avoid misalignment of HARQ codebook. On the other hand, for option 4a and possibly for option 4b, it is not allowed that unicast PDSCH is scheduled in FDMed resource with SI PDSCH. |
| Sharp | -1 | -1 | -1 | -1 | 0 | -1 | 1 |  |
| Nokia, NSB | -1 | -1 | -1 | -1 | -1 | -1 | +1 |  |
| Ericsson | 0, but see comment | +1, but see comment | -1 | -1 | -1 | -1 | 0 | In general, we prefer Option 2. However, we think it’s important to first have consensus on what the legacy Capability 2 behavior (~ Option 2) is, and in particular, whether the UE is expected to NACK. If the legacy UE is not expected to send NACK, an eRedCap UE should not be expected to send NACK.Our understanding of the legacy behavior is that the UE is expected to send NACK only for Type-1 HARQ codebook.  |
| DENSO | +1 | +1 | +1 | -1 | 0 | +1 | 0 | We prefer Option 2a or 2b/2c with “**in slot n and n+1**”. For Option 4, we prefer 4b which reuse FR2 rules. Option 7 is also acceptable. |
| LG  | -1 | -1 | -1 | -1 | -1 | 0 | +1 | Option 7 is firstly preferred; we can also consider Option 4b.  |
| Xiaomi1 | -1 | -1 | -1 | -1 | -1 | -1 | +1 | We can’t see any difference between option 4b and 2a. Besides, we have one question on “**The UE may skip decoding of PDSCH in slot n**”. Does it mean that “The UE also may not skip decoding of PDSCH in slot n”? If so, the UE can also indicate ACK to the gNB. |
| NEC | 0 | 0 | 0 | 0 | 0 | 0 | +1 |  |
| Huawei, Hisilicon | -1 | -1 | -1 | -1 | -1 | -1 | +1 | The current proposal 2x are not clear enough with respect to the maximum number of drop of unicast PDSCH within a modification period (the period in current spec is configurable, 2ms, 4ms, 8ms or 16ms). In our understanding, it can be up to 1 drop rather than multiple drops within the modification period because only one of multiple SI reception occasions is performed by the UE within the modification period. If it is not clearly clarified, then a UE can skip multiple unicast PDSCHs and costs large performance lost, which should be avoided.

|  |
| --- |
| TS 38.3315.2.2.2.2 SI change indication and PWS notificationA modification period is used, i.e. updated SI message (other than SI message for ETWS, CMAS, positioning assistance data, and some NTN-specific information as specified in the field descriptions ) is broadcasted in the modification period following the one where SI change indication is transmitted. The modification period boundaries are defined by SFN values for which SFN mod m = 0, where m is the number of radio frames comprising the modification period. The modification period is configured by system information. If H-SFN is provided in *SIB1*, and UE is configured with eDRX,modification period boundaries are defined by SFN values for which (H-SFN \* 1024 + SFN) mod *m* = 0. |

 Similar comment to proposal 3 for the maximum drops. It is unclear for us what the difference between proposal 2a and proposal3, because the UE should receive one SI occasion during the modification period. For the SI occasion, the UE may or may not skip unicast PDSCH. For the remaining SI occasion, the UE receives unicast PDSCH and skip the SI reception. Therefore, proposal 2a and proposal 3 seem the same. Proposal 4 is the worst choice by putting too much restriction on gNB scheduling, since proposal 7 is feasible for UE implementation.  |
| Samsung | -1 | -1 | -1 | -1 | -1 | -1 | +1 |  |
| OPPO | -1 | -1 | -1 | -1 | -1 | 0 | 1 | We think several options actually lead to option 7. |

The table below shows the sum of the above grades for each option.

|  |  |
| --- | --- |
|  | **Options** |
| **2a** | **2b** | **2c** | **3** | **4a** | **4b** | **7** |
| Sum of grades | -4 | -6 | -8 | -12 | -10 | -7 | 7 |

Based on the above received responses, the following proposal can be considered.

**FL2 High Priority Proposal 2.2.2-1b:**

**Select the following options for handling of simultaneous reception during P-RNTI triggered SI acquisition 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.**

* **Option 7: No specification change**

The above proposal was treated in the Monday online session without reaching a conclusion. The latest update on the Chair’s screen looked like this:

|  |
| --- |
| ConclusionAssuming that UE is not required to process PDSCH scheduled with SI-RNTI and the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI, for handling of simultaneous reception during P-RNTI triggered SI acquisition 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* No specification change
 |

**FL3 High Priority Question 2.2.2-1c: Companies are invited to comment further on the above issue. Please try to take comments received above and during the online session into account in your answers.**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | The main body of the conclusion that the “UE is not required to process” read contradicts with the subbullet of “no spec change” that “UE shall be able to decode” both by current spec. We propose to adopt option 2a.* **The UE may skip decoding of PDSCH in slot n scheduled with C-RNTI/MCS-C-RNTI/CS-RNTI but decodes SI PDSCH triggered by P-RNTI in slot n. In this case, the UE transmits NACK.**
 |
| ZTE, Sanechips | Comment 1: Agree with vivo for the conclusion, I guess no specification means the UE need to decode both PDSCHs, but it is conflicting with ‘Assuming that UE is not required to process...’Comment 2: First, we try to cite all the related spec in the following

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| In TS 38.214 clause 5.1On 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. Table 5.3-1: PDSCH processing time for PDSCH processing capability 1

|  |  |
| --- | --- |
|  | PDSCH decoding time *N1* [symbols] |
| *dmrs-AdditionalPosition* = 'pos0' in *DMRS-DownlinkConfig* in*dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* if either higher layer parameter is configured, and in *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* if either higher layer parameter is configured | *dmrs-AdditionalPosition* ≠ 'pos0' in *DMRS-DownlinkConfig* in any of *dmrs-DownlinkForPDSCH-MappingTypeA*, *dmrs-DownlinkForPDSCH-MappingTypeB, dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2, dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2,* or if none of the higher layer parameters is configured  |
| 0 | 8 | *N1,0* |
| 1 | 10 | 13 |
| 2 | 17 | 20 |
| 3 | 20 | 24 |
| 5 | 80 | 96 |
| 6 | 160 | 192 |

Table 5.3-2: PDSCH processing time for PDSCH processing capability 2

|  |  |
| --- | --- |
|  | PDSCH decoding time *N1* [symbols] |
| *dmrs-AdditionalPosition* = 'pos0' in *DMRS-DownlinkConfig* in *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* if either higher layer parameter is configured, and in *dmrs-DownlinkForPDSCH-MappingTypeA-DCI-1-2* and *dmrs-DownlinkForPDSCH-MappingTypeB-DCI-1-2* if either higher layer parameter is configured |
| 0 | 3 |
| 1 | 4.5 |
| 2 | 9 for frequency range 1 |

 |

Within the bandwidth, the NR UE can decode two PDSCHs. However, for capability 2, due to the processing timeline limitation, the UE still may skip the PDSCH decoding. The same logic for eRedCap UE, if the scheduled PDSCH is within the UE capability, the eRedCap UE may decode both. But if the scheduled PDSCH exceeds the UE capability, due to the processing timeline limitation, UE may need to skip one of the PDSCH. Therefore, ‘UE may skip decoding PDSCH’ is aligned with the NR UE logic.For option7, the spec would require the UE to decode both. We do not know how to achieve that. Even the UE can report NACK, but the UE still is unable to decode both. Therefore, we think option7 would require all the UE vendors to implement decoding both, but at least we are unable to achieve that especially for UE only support BB bandwidth reduction. Comment 3: Option7 has the following disadvantages1. It is unrealistic/hard for the eRedCap UE decode two PDSCHs exceeding the UE capability especially considering the continuous scheduling for the typical traffic model.
2. Decoding both PDSCHs may cause the P-RNTI triggered PDSCH missing. If ETWS/CMAS information is carried and missed, it would cause more serious society impacts.
3. If decoding both PDSCHs is required, it may cause no complexity reduction for eRedCap UE.
4. The capability of eRedCap UEs is different from NR and R17 RedCap UEs. The eRedCap UE needs more processing time (like RAR timeline relaxation) to decode both PDSCHs. The current specifications do not reflect the processing delay and corresponding impact on timeline of unicast PDSCH scheduled in slot n and/or n+1.
5. If option7(case1) is supported, the case2(C-RNTI scheduled PDSCH can be larger than 5MHz) also should be supported. And also, RAR timeline relaxing is not needed.

Comment4:@QC @Xiaomi1: regarding the difference between option4b and 2a, for option4b, the UE always would NOT decode the unicast PDSCH when they are overlapped. For option2a, UE may skip decoding of PDSCH in slot n, or UE may not skip, so, in some cases, the UE can decode both especially when there is no continuous unicast PDSCH scheduling. |
| CATT | OK. Whenever UE fail to decode unicast PDSCH, by any reason (including processing capability limit), the UE can always feedback a NACK. So the specification does not need change.The online concern comes from HW, in my understanding, is that ‘whenever SIB is transferred during P-RNTI, for ALL SIBs duration, the R18 RedCap UE may just skip unicast PDSCH decoding, but actually the UE should only skip one unicast PDSCH since only one SIB is targeting’. Maybe the following update can be considered.**Assuming that UE is not required to process the targeted PDSCH scheduled with SI-RNTI and the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI, for handling of simultaneous reception during P-RNTI triggered SI acquisition when the total number of PRBs for the targeted 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*** **No specification change**
 |
| Samsung | We are OK for this conclusion.UE can buffer the PDSCH scheduled with SI-RNTI and postpone its decoding for above case. |
| Panasonic | Before trying to down-select from the Options above, RAN1 may need to reach the common assumption about the eRedCap UE’s processing capability. The candidates of the possible processing capability may be as follows:* Assumption I: A eRedCap UE can process ALL below:
	+ PDSCH scheduled with SI-RNTI in the slot n
	+ PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI in the slot n
	+ PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI in the slot n+1
* Assumption II: A eRedCap UE can process BOTH below:
	+ PDSCH scheduled with SI-RNTI in the slot n
	+ ONE of PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI in the slot n and that scheduled in the slot n+1
* Assumption III: A eRedCap UE can process ONLY ONE of below:
	+ PDSCH scheduled with SI-RNTI in the slot n
	+ PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI in the slot n and(/or) that scheduled in the slot n+1

In our view, the eRedCap UE would have the capability of the Assumption II.For the last updated conclusion, we share vivo and ZTE comment 1. |
| DOCOMO | Based on the discussion at the online session, per our understanding, it was argued the above behavior in the discussed conclusion can be supported without any specification impact. Indeed, from NW point of view, nothing is different between 1) the cases when a UE failed decoding the unicast PDSCH and send a NACK, or 2) the case when a UE even don’t process/decode the unicast PDSCH but send a NACK.However, expected UE behavior is not the same between the cases 1) and 2). If the case 2) is allowed without specification change, i.e., a UE decode both SI PDSCH and unicast PDSCH, NW expects from the specification description that a UE may be able to successfully decode the unicast PDSCH and would schedule a unicast PDSCH in FDMed resource with SI PDSCH even though the UE cannot decode the unicast PDSCH. This scheduling of unicast PDSCH is redundant and NW should know whether there is a possibility that a UE can successfully decode the unicast PDSCH or cannot process/decode at all. In fact, the case 2) is not expected for legacy UE, and hence the case 2) (if supported) should be clearly captured in spec which is not the same as legacy UE behavior. |
| Ericsson | We are fine with Option 2a or Option 2b, but we don’t need to state that UE transmits NACK in either of these options. Note that this is also not explicitly stated in the spec for Capability 2 UEs. Nevertheless, we would be fine with stating that eRedCap UE transmits NACK if there is a consensus that Capability 2 UEs also needs to send NACK.  |
| LG | As a few other companies pointed out, the conclusion itself is self-contradicting. So, it is hard support the conclusion as it is.We would like to further point out that Option 7 is a legacy behavior, which would be assumed as baseline eRedCap UE behavior unless there is an agreement otherwise, which is clearly stated in WID. In our view, from the eRedCap in Rel-18 in general, we don’t expect a drastic complexity reduction after some compromise with other aspects, such as system impacts, spec impact, etc. To us, this is just one of the compromises that we could make in the same spirit. So, we don’t support the Conclusion above and still Option 7 No spec change is preferred. |
| Spreadtrum | We have different understanding as vivo for the conclusion, the current spec “UE shall be able to decode” means there is no scheduling restriction from NW side. But when such a case happens, the UE is not required to process…For HW’s concerns online, CATT’s version is OK for us. In addition, the conclusion presented online reads like the UE is no required to process both SI-PDSCH and unicast PDSCH, we don’t think this is the intension, so we have the following suggestions on top of CATT’s version**Assuming that UE is not required to process the targeted PDSCH scheduled with SI-RNTI ~~and~~ or the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI, for handling of simultaneous reception during P-RNTI triggered SI acquisition when the total number of PRBs for the targeted 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****No specification change**If the above cannot agreed, we think option 7 is the best choice. |
| SONY | We did not like the proposed conclusion (from Monday’s online session) in the first place. The introductory text of “Assuming that UE is not required to process PDSCH scheduled with SI-RNTI and the PDSCH scheduled with C-RNTI, MCS-C-RNTI, or CS-RNTI,” is presumably talking about simultaneous decoding of some of these types of PDSCH. The eRedCap UE presumably needs to decode these types of UE at one time or another.In terms of the options:2a: OK. UE processing requirement is not increased.2b: OK. UE processing requirement is not increased.2c: Not keen. We think the issue is about receiving two PDSCH in the same slot. We are not so concerned about receiving two PDSCHs in adjacent slots (i.e. 2c does not address the UE’s processing corner case).3: Not keen. How would the gNB know whether the NACK was due to an “error on the channel” or due to the UE implementation being able to process two PDSCHs at the same time. We think that this would be difficult for the gNB to deal with.4a: Do not support. Do not understand why we are mixing up SI-PDSCH scheduled with P-RNTI and SI-PDSCH scheduled by SI-RNTI. Is there a typo?4b: Do not support. Do not understand why we are mixing up SI-PDSCH scheduled with P-RNTI and SI-PDSCH scheduled by SI-RNTI. Is there a typo?7: Do not support. This would mean that the eRedCap UE would have to operate in the same manner as a legacy UE. The big problem with this is that the eRedCap UE is not a legacy UE and is not capable of decoding the P-RNTI scheduled PDSCHs and the “unicast” PDSCHs at the same time. This would create a corner case for eRedCap that would increase the processing requirements for the R18 eRedCap UE. We do not support this. |
| NEC | Share view with Samsung. |
| Nokia, NSB | As discussed in the online session, it seems the first part of the text is contradictory to the conclusion that specification change is not needed. Our preference is not to introduce any scheduling restriction at the network and therefore we support Option 7 and prefer the original 2.2.2-1b FL proposal.  |
| OPPO | We support this conclusion.Reading the text of 5.1 214, RedCap UE actually do not discard PDSCH. It just may not have enough time to process the data. Thus, buffering the PDSCH scheduled with SI-RNTI and postponing its decoding are all possible.BTW, it could be fully aware by gNB and should not exceed the PDSCH limit for RedCap UE. |
| Nordic | If UE buffer, then buffer complexity will be increased, just for this single case. Not acceptable.Conclusion:If processing capability of BW3/PR3 is exceeded due to collision of SI and unicast PDSCH, UE is allowed to skip unicast PDSCH and report NACK. |

Based on the responses received above and during the Monday online session, the following proposal can be considered.

**FL4 High Priority Proposal 2.2.2-1d:**

* **Adopt the following TP for 38.214 clause 5.1 for handling of simultaneous reception during P-RNTI triggered SI acquisition 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.**
	+ **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 or the UE indicates *supportOfRedCap-r18* but not FG 48-2, in which case the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI.**

The above proposal was treated in the Wednesday online session where the following agreement was made:

|  |
| --- |
| Agreement:* For handling of multiple reception in a slot during P-RNTI triggered SI acquisition 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 scheduled in the slot is larger than the maximum number of PRBs that the UE can process per slot, the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI.
 |

### Msg2/MsgB reception

Contributions [13, 15, 17, 18, 20, 23, 32, 34] discuss prioritization of Msg2/MsgB PDSCH over another PDSCH. The following proposal from contribution [34] can be considered.

**FL1/FL3 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** |
| vivo | Y with update | Suggest following change for the 1st sub-bullet* **in the same slot (i.e., slot n) if the PDSCH scheduled with RA-RNTI or MSGB-RNTI is partially or fully overlap in time ~~not greater than 25/12 PRBs with 15/30kHz SCS~~,**
 |
| ZTE, Sanechips | Y | The original version is better, since overlapping does not mean UE can not process especially when the PRB number does not exceed the limitation. |
| Nordic | Y |  |
| QC |  | We support the spirit of this proposal. But we don’t support the proposal in its current formulation. We think in a same slot n, UE is not expected to decode unicast PDSCH, if NW schedule Msg2/MsgB. But we don’t see the need to exclude unicast in next slot n+1. Therefore, we support the following updated proposal.**Updated 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.~~
 |
| CATT | N | For the 1st bullet, if the PDSCH scheduled with RA-RNTI or MSGB-RNTI is not greater than 25/12 PRBs with 15/30kHz SCS, what is the difference between R18 RedCap UE case and Rel-17 RedCap UE? Why we put restriction only for R18 RedCap UE but not R17?For the 2nd bullet, the Msg3 scheduling timeline is already relaxed. |
| MediaTek | Y |  |
| FUTUREWEI |  | Can the proposal be rephrased (it seems both bullets are applicable for the same slot)**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 slot~~s n and~~ n+1 if the PDSCH scheduled with RA-RANTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS. |
| DOCOMO | N | The current spec as below is sufficient.

|  |
| --- |
| The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time. |

The processing time of RAR PDSCH would be extended when the number of PRBs for the PDSCH exceed 5MHz and not tight. Thus, we don’t see the need to restrict the scheduling in n+1 slot. |
| Ericsson | Y | Also fine with Qualcomm’s revision |
| LG | N | We don’t think there is a need for spec update for this. So far, we have not considered n+1 slot for decoding in simultaneous reception. |
| Xiaomi1 |  | In the current spec in TS 38.214 Clause 5.1, it only states the case of simultaneous reception between RAR/MsgB PDSCH and unicast/MBS PDSCH.

|  |
| --- |
| The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.  |

So, just as legacy UE behavior, we can’t see any problem to schedule both PDSCH scheduled by RA-RNTI and PDSCH scheduled by C-RNTI in the same slot without any overlapping if the RAR or MsgB PDSCH is not lager than 25/12 PRBs. So, for the first sub-bullet, we suggest to modify as follows:* partially or fully overlap in time ~~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,

That is to say, the same rule can be used between eRedCap supporting 48-1 and non-eRedCap for the case of RAR/MsgB PDSCH not larger than 25/12 PRBs.For the second sub-bullet, except for the overlapping between RAR/MsgB PDSCH and unicast/MBS PDSCH, other broadcast channels with larger than 25/12 PRBs, such as SIB1, OSI, paging and so on, should also be revisited whether there is a need to further define the UE behavior in the “slot n+1”. |
| Huawei, Hisilicon | N |  |
| Samsung | N | No specification impact for this issue since current spec can be reused. |
| CMCC | N | In same slot n and overlapping case, Msg2/MsgB is prioritized over unicast PDSCH. Since processing time of RAR is extended when it is larger than 5MHz, there is need to exclude unicast in slot n+1.  |
| ZTE, Sanechips | Y | For the second subbullet, if RAR scheduled in Slot n is larger than 25/12 PRBs, the processing time of eRedCap UE will increase by up to 1/0.5 ms, i.e. additional one slot. As a result, the processing time for unicast PDSCH scheduled in Slot n+1 will overlap with the RAR processing time. For this case, the eRedCap UE should skip the unicast PDSCH in Slot n+1 to guarantee RAR decoding.  |
| CATT2 | N | To make it more clear, we use the figures in out tdoc:1) Below is current spec. UE is not expect to decode unicast PDSCH.2) Below is the 1st sub-bullet in this proposalHowever, as we mentioned, BOTH PDSCHs are within 5 MHz, so there is no difference with R17 RedCap UE. No need to relax on top of Rel-17 RedCap.3) Below is the 2nd sub-bullet in this proposalHowever, we already relax the processing time. Any again we think even UE may or may not decode unicast PDSCH, if not, UE can transmit NACK. Nothing broken. |
| Panasonic |  | As commented to the **Question 2.2.2-1c**, the common assumption of the UE processing capability would help this discussion. |
| Ericsson2 | Y | We think the UE should be allowed to skip decoding of unicast PDSCH in slots n and n+1 if RAR PDSCH is larger than 25/12 PRBs. Otherwise, it may not be consistent with the RA processing timeline relaxation of FG 48-1 UEs.  |
| Spreadtrum | N | Similar understanding as DCM, Xiaomi and Samsung. The current spec is sufficient. |
| SONY | Y | Agree with Ericsson |
| Nokia, NSB | N | In our view, there is no need to introduce further decoding restriction beyond what we have already agreed to. Therefore, we think the current specification is fine. |
| OPPO | N | We also think it may not be specifically treated. |

Based on the above received responses, the following proposal can be considered.

**FL4 Medium Priority Proposal 2.2.3-1b:**

* **For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is not greater than 25/12 PRBs with 15/30kHz SCS, 38.214 clause 5.1 still applies, i.e.:**
	+ **“The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.”**
* **For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS,**
	+ **The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI in the same nor next slot if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.**

The above proposal was treated in the Wednesday online session where the following agreement was made:

|  |
| --- |
| Agreement:* For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is not greater than 25/12 PRBs with 15/30kHz SCS, 38.214 clause 5.1 still applies, i.e.:
	+ “The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.”
 |

Companies are invited to comment on the following proposal which was discussed in the Wednesday offline session:

**FL5 Medium Priority Proposal 2.2.3-1c:**

* **For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS,**
	+ **The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI ~~partially or fully overlap in time~~ in the same slot.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| CATT |  | Maybe OK. Just to follow the same principle of the agreement yesterday regarding P-RNTI triggered SIB case.  |
| vivo | Y |  |
| CMCC |  | If unicast is scheduled before RAR in a slot, UE can decode unicast first and then decode RAR, prefer wording “partially or fully overlap in time”. |
| OPPO | Y | We are fine to have this treated same way as “is not greater than 25/12 PRB…” |
| LG | N | “partially or fully overlap in time” should be added. We share similar view with CMCC. |
| DOCOMO | N | We share the same view with CMCC and LG. If the unicast PDSCH is before the RAR PDSCH without overlap in time domain, a UE can decode both. Therefore,” partially or fully overlap” should not be deleted. |
| NEC | N | Share view with CMCC, LG and DOCOMO. |
| Nokia, NSB |  | We support having the same treatment as the case when PDSCH is within 5MHz and also prefer to keep the existing wording of “partially or fully overlap in time”. |
| Ericsson | Y |  |
| SONY | N | We prefer the formulation in proposal 2.2.3-1b, which addresses the issue that the BW-limited redcap UE is not capable of processing a BW greater than 5MHz in a single slot.The original intention / objective of the BW-limited UE was that it could only process 5MHz of bandwidth. Companies have reluctantly made compromises that, in certain circumstances, allow the UE to process more than 20MHz, provided that there is some mitigation for the UE (like that it could process the 20MHz bandwidth-worth of physical resource over more than a single slot, or that the UE can drop decoding of one of two simultaneous channels). These compromises rely on the mitigations.In the case we have here, the UE has to decode a 20MHz PDSCH scheduled with RA-RNTI. The BW-limited RedCap UE needs more than one slot to do this. The issue is the same as for the RAR -> Msg3 case: the BW-limited RedCap UE needs to channel estimate and decode (LDPC etc) the PDSCH. The physical channel processing for this takes an extra slot. RAN1 has accepted this concept in previous meetings (when we made agreements about RAR->Msg3) The issue is not about post-FFT buffer. The BW-limited eRedCap UE is hence unable to decode another PDSCH in the same slot or the next slot. We do not want to create a corner case that increases the complexity of the BW-limited RedCap UE.We think the proposal should hence read:* **For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS,**
	+ **The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI in the same or next slot if another PDSCH in the same cell is scheduled with RA-RNTI or MSGB-RNTI ~~partially or fully overlap in time~~ ~~in the same slot~~.**

[note: * we think the yellow-highlighted “is” needs adding whatever we conclude
* I think we shouldn’t be using “nor” in these sorts of sentences. “nor” gets lonely without a “neither”]
 |
| Samsung | Y |  |

Based on the above received responses and the discussion in the Thursday offline session, the following proposal can be considered.

**FL6 Medium Priority Proposal 2.2.3-1d:**

* **For UE BB bandwidth reduction, when PDSCH scheduled with RA-RNTI or MSGB-RNTI is greater than 25/12 PRBs with 15/30kHz SCS, down-select between the following options:**
	+ **Option 1: 38.214 clause 5.1 still applies, i.e.:**
		- **“The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI if another PDSCH in the same cell scheduled with RA-RNTI or MSGB-RNTI partially or fully overlap in time.”**
	+ **Option 2:**
		- **The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI in the same slot if another PDSCH in the same cell is scheduled with RA-RNTI or MSGB-RNTI ~~partially or fully overlap in time~~.**
	+ **Option 3:**
		- **The UE is not expected to decode a PDSCH scheduled with C-RNTI, MCS-C-RNTI, G-RNTI for multicast or broadcast, MCCH-RNTI, G-CS-RNTI or CS-RNTI in the same or next slot if another PDSCH in the same cell is scheduled with RA-RNTI or MSGB-RNTI ~~partially or fully overlap in time~~.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| LG | 1 | We don’t have a serious concern on complexity increase by following the existing UE behavior. |
| CATT | 1 or 2 | Option 1 is most preferred. Option 2 may be a compromise.For Option 3, it is not aligned with the spirit of Wednesday agreement. We fail to understand why slot n+1 is needed in this case but not the following case.

|  |
| --- |
| Agreement:For handling of multiple reception in a slot during P-RNTI triggered SI acquisition 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 scheduled in the slot is larger than the maximum number of PRBs that the UE can process per slot, the UE may skip decoding of the scheduled PDSCH with C-RNTI, MCS-C-RNTI, or CS-RNTI. |

 |
| SONY | 3 | A BW-limited UE cannot process the 20MHz RA-PDSCH within a single slot. Processing 20MHz-worth of bandwidth in a UE takes more time for a UE capable of 5MHz-worth of processing. The 20MHz of received resources needs processing 5MHz-chunk by 5MHz-chunk. This processing needs to be done serially. We feel that this is the understanding that previous agreements have been based on. |
| DENSO | 1 | We think the current specification is sufficient since the RAR PDSCH processing timeline is already relaxed. |
| Panasonic | Option 1 or 2 | Option 1 as the first preference, Option 2 as the second preference. |
| Ericsson | 2 and/or 3 | One possibility could be to have separate indications to report Option 2 and Option 3 capabilities, which would correspond to a separate UE capability for random access timeline relaxation in connected mode. Note that the proposal concerns the UE behavior in connected mode (not initial access). |
| NEC | 1 | We are just not in favor of change of expression (i.e. from “partially or fully overlap in time” 🡪 in the same slot) because there could be unexpected side effect. If skip in the “next slot” is agreed, more precise expression like Msg2 🡪 Msg3 timeline relaxation is preferable, e.g. X ms from the end of RAR PDSCH symbol. |
| OPPO | 1 | We still think the UE can fulfil the timeline with option1. We are OK to have option2. However, the Option3 need more time to be justified. |
| DOCOMO | Option 1 | Based on the offline discussion, we share the same understanding with Nokia and other companies that the restriction in the next slot is unnecessarily restrictive. Therefore, option 3 is not acceptable for us.As pointed by Qualcomm at the offline session, we are not sure why a UE cannot proceed the upper cases while cannot the below case if option 3 is supported.Unless clarified, we still don’t see the need for scheduling restriction on the next slot of RAR PDSCH. |

### 2.2.4 MBS reception

Contributions [29, 32] discuss simultaneous reception or prioritization of MBS PDSCH and another PDSCH.

**FL1 Low Priority Question 2.2.4-1a: Should the UE receive MBS PDSCH and another PDSCH simultaneously under some circumstances? If the answer is yes, please comment on those circumstances in the comment field. If the answer is no, please comment on how the UE should prioritize between the two PDSCHs.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| QC | Yes | On high level, we think reception of MBS PDSCH + unicast PDSCH is similar to reception of SIB/Paging + unicast PDSCH. Therefore, this functionality should be supported. There could be some minor differences such as multicast could be with >1 MIMO and higher than 64QAM, where SIB/Paging could not. Those secondary points can be discussed.  |
| DOCOMO |  | Need clarification whether/how to support but can be discussed after the progress in section 2.4. |
| LG | Yes | We think that if UE supports fdm-BroadcastUnicast-r17 or fdm-MulticastUnicast-r17 in RRC CONNECTED in a slot are partially or fully overlapping in time domain and non-overlapping in frequency domain, this issue need to be discussed at some point of time within Rel-18.Suggestion from DOCOMO is fine. |

2.3 Msg3/MsgA PUSCH bandwidth

Contributions [17, 21, 22, 23, 28, 29, 32, 31] discuss what the UE behaviour should be if Msg3/MsgA PUSCH is scheduled with more than 25 PRBs for 15 kHz SCS or more than 12 PRBs for 30 kHz SCS.

**FL1/FL3 Medium Priority Question 2.3-1a: Companies are invited to express their preference regarding the UE behavior for the potential case that MsgA PUSCH is scheduled with more than 25 PRBs for 15 kHz SCS or more than 12 PRBs for 30 kHz SCS.**

* **Option 1: The UE occupies a portion of PRBs within one legacy MsgA PUSCH occasion.**
* **Option 2: The UE has a separate MsgA PUSCH frequency domain resource configuration.**
* **Option 3: The UE falls back to 4-step RACH procedure.**
* **Option 4: No need to specify UE behavior (please elaborate in the comment field on what this means).**

**This question focuses on MsgA PUSCH, but if your answer is relevant also for Msg3 PUSCH, please indicate it in the comment field.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option(s)** | **Comments** |
| vivo | Opt.4 | Early indication in Msg.A PUSCH for Rel-18 eRedCap is supported. gNB will not configure the PRBs Msg.A PUSCH for Rel-18 eRedCap lager than 25/12 PRBs for 15/30 kHz SCS. |
| Nordic  | Op. 4 | to us this seems an error case which should not happen |
| QC | Option 4 | It was agreed PR3 UE’s UL PUSCH cannot exceed 5Mhz. It is NW’s responsibility to make sure the scheduled/configured Msg3/MsgA transmission is within 5Mhz.  |
| CATT | 4 | Option4, R18 RedCap UE does not expect this case. |
| MediaTek | 4 |  |
| DOCOMO | Opt.4 | Similar view with vivo. eRedCap UE does not expect that MsgA is scheduled with larger BW than 5MHz. But we are open to discuss other options. |
| Sharp |  | For a eRedcap UE mac entity, if no separate eRedCap feature indication, it may check if a 2-step resource for redcap is available by considering its bandwidth. RAN1 should define a clear behavior for further RAN2 discussion. So option4 should be precluded and option 1/2/3 can be considered furtherly.  |
| Nokia, NSB | 4 | We agree with other companies that this is not expected by the UE |
| Ericsson | Option 4 (in RAN1) | Can be up to RAN2 to specify UE behavior, if needed.  |
| LG | Option 3 | When it comes to Msg3 PUSCH bandwidth, some exceptional cases can be considered without early indication. Especially, because the early indication is not supported in 2-step RACH, gNodeB does not have the way how to check whether UEs is Rel-18 eRedCap or not, when Msg A PUSCH is not decoded successfully. |
| Xiaomi1 | 4 | For the MsgA PUSCH channel bandwidth, we have the following agreements.

|  |
| --- |
| 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. |

In our view, the above agreement just mean that 2-step RACH will not be performed for the case of MsgA PUSCH with larger than 25/12 PRBs. Actually, there is no spec impact in RAN1 but it may have some MAC spec impact in RAN2. So, we suggest to send the related LS to RAN2 to take above agreement into consideration when performing RACH procedure. |
| Huawei, Hisilicon | Opt.4 | About MsgA PUSCH, an agreement was made in RAN1#112 as the following:“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.” |
| Samsung | Opt.4 |  |
| OPPO | Option 4 | This covered by the UE capability of Rel-18, UE should not process that. |
| CMCC | 4 |  |
| Panasonic | 4 | The past agreement mentioned by the companies should be respected. |
| LG2 |  | We share similar view with Sharp, RAN1 might need to check it to RAN2 |
| Spreadtrum  | 4 |  |
| NEC | 4 | Because of the former RAN1 agreement mentioned by companies. |

Based on the above received responses, the following proposal can be considered.

**FL4/FL5/FL6 Medium Priority Proposal 2.3-1b:**

* **Send an LS to RAN2 to ask them to consider the Rel-18 eRedCap UE behavior for the potential case that MsgA PUSCH is configured with more than 25 PRBs for 15 kHz SCS or more than 12 PRBs for 30 kHz SCS in their specifications, if needed.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| CATT | N | We feel no strong need to bother RAN2 since we already have the agreement mentioned by Xiaomi… Otherwise, what does it mean by ‘a UE is not expected to’? It is not ‘a UE is not required to’… |
| vivo | N | Agree with xiaomi that RAN1 made the agreement, it means that 2-step RACH will not be performed (eRedCap is not required to perform the transmission) for the case of MsgA PUSCH with larger than 25/12 PRBs. 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. |
| CMCC | N |  |
| OPPO | N | We already conclude in RAN1 as Xiaomi and vivo commented. It seems should also send LS to RAN2 and tell them we already have agreements, instead. |
| LG | Y | But, if majority view is “not needed”, we can accept any option agreed by RAN1. |
| DOCOMO |  | We are fine to send an LS.Similar clarification, i.e., whether any spec change is required in RAN2, may be necessary for Msg3 as well if Msg1 separate early indication is not configured? |
| Nokia, NSB |  | In our view, LS is not needed as the behavior is clear from earlier RAN1 agreement that this is not expected by UE. |
| Ericsson | Y |  |
| SONY | N | Agree with vivo / Xiaomi / OPPO |
| Samsung | Y |  |
| Sharp | Y | it is necessary info for mac entity to determine whether a RA resource is available |
| DENSO | Y | We have similar view with DOCOMO. |

2.4 MBS PDSCH bandwidth

Contributions [9, 12, 13, 14, 15, 17, 18, 20, 21, 22, 23, 27, 29, 31, 32] discuss the maximum bandwidth for various MBS PDSCH cases.

**FL1/FL3 Medium Priority Question 2.4-1a: Companies are invited to comment on whether the UE should support that the following cases are scheduled in DCI with a number of PRBs larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS.**

* **Case 1: Broadcast MBS PDSCH**
	+ **Case 1a: Without PDSCH in consecutive slots and without PDSCH repetition**
	+ **Case 1b: With PDSCH in consecutive slots and/or with PDSCH repetition**
* **Case 2: Multicast MBS PDSCH**
	+ **Case 2a: Without HARQ feedback**
	+ **Case 2b: With HARQ feedback**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Case 1a and Case 1b: YesCase 2a and Case 2b: No, given Multicast MBS PDSCH targets for connected UEs |
| ZTE, Sanechips | We are OK to discuss the MBS. However, since we actually have not the clear support for MBS in Rel-17 RedCap, if Rel-18 RedCap UE support MBS, does it mean Rel-17 RedCap UE also support it and the specification change also should be considered if needed? |
| Nordic  | Case 1a we can consider, but the rest of cases answer is NO, because this case would result in increase of UE’s complexity.  |
| QC | Case 1a: # PRBs can be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCSCase 1b: # PRBs cannot be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCSCase 2a: We think the formulation of this case is not good enough. We should differentiate two sub-cases under 2a, one is with PDSCH repetition, and one is without PDSCH repetition. * Case 2a1: without HARQ feedback and without PDSCH repetition: # PRBs can be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS
* Case 2a2: without HARQ feedback but with PDSCH repetition: # PRBs cannot be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS

Basically, case 2a1 is similar to case 1a. Case 2a2 is similar to case 1b. Case 2b: # PRBs cannot be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS |
| CATT | Case 1a: YCase 1b: YCase 2a: N, (this would lead to obvious performance and poor QoS)Case 2b: N, (eRedCap UE is not able to feedback with legacy PUCCH timeline, but we cannot extend timeline in this case).  |
| FUTUREWEI | R17 redcap UE can indicate support of MBS, by default R18 redcap can also do soThe RedCap UE can receive broadcast MBS in the CONNECTED state. There may have to be restrictions. To avoid all these complications/exception cases, a simple rule should apply: # PRBs cannot be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS |
| DOCOMO | Case 1: Yes. RNTI which schedules broadcast MBS PDSCH would be shared with legacy UEs and thereis no corresponding UL transmission for the PDSCH. Therefore, the same principle as SI PDSCH or paging PDSCH can be applied.Case 2: No. G-RNTI and G-CS-RNTI can be configured separately between legacy UEs and eRedCap UEs. Therefore, even if the number of PRB is restricted for eRedCap, multicast MBS PDSCH can be scheduled without any restriction on BW. In addition, even when the HARQ feedback is disabled, HPN field is included in DCI, and hence NW needs to know when the HPN can be reused. In the current specification for NTN, when the HARQ feedback is disabled, the HPN can be reused after Tproc,1, i.e., there is processing time requirement even when the HARQ feedback is disabled. Therefore, if larger number of PRB allocation than 5MHz is allowed, this processing time requirement needs to be extended similar to RAR PDSCH processing. |
| Sharp | for broadcast MCCH , it is ok for case1a/1b.for broadcast MTCH, case 1a is ok. |
| Nokia, NSB | Case 1a and 1b: YesCase 2a: Yes. However, we don’t have strong view on this one and would be fine to go with No if that is the majority view.Case 2b: No |
| Ericsson | Larger than 25/12 PRBs: Cases 1aNot larger than 25/12 PRBs: Case 2bNo strong preference for 1b and 2a |
| DENSO | Case 1a and Case 1b: YesCase 2a and Case 2b: NoAs QC pointed out, if there is concern about repetition case, we prefer to focus on the repetition case of broadcast and multicast in RRC\_INACTIVE (Case 1b and 2a2) firstly, and then clear the HARQ case of multicast in RRC\_CONNECTED. |
| LG | Broadcast MBS PDSCH can be scheduled lager than 5MHz BW regardless of Case1a or Case 1b. Multicast MBS PDSCH without HARQ feedback (Case 2a) can be scheduled lager than 5Mhz BW similar to the Broadcast MBS PDSCH, but the multicast MBS PDSCH with HARQ feedback (Case 2b) should not be scheduled lager than 5Mhz BW, i.e., should be regarded the same as unicast PSCH. |
| Xiaomi1 | Case 1a: YCase 1b: YCase 2a: Y. We can’t observe the performance degradation with lager than 25/12 PRBs for multi-cast PDSCH since the soft combination can be performed just like other broadcast channels. Case 2b: No.  |
| Huawei, Hisilicon | Case 1a and 1b: YCase 2a: Y (there is no timeline requirement just like Case 1a and 1b)Case 2b: N |
| Samsung | Case 1a and 1b: YesCase 2a: We are neutral for this case.Case 2b: No |
| CMCC | Case 1a and Case 1b: YCase 2a and Case 2b: N |
| Panasonic | We assume that the ‘UE’ here is the eRedCap UE with the capability of the MBS. Then our view is:Case 1a/1b/2a: YCase 2b: N |
| LG2 | Thanks @DOCOMO for your commentWe share similar view with HW According to 5.1 in TS 38.214, Tproc,1 can be required with the same HARQ process ID scheduled in consecutive slots.

|  |
| --- |
| When HARQ feedback for the HARQ process ID is disabled, the UE is not expected to receive another PDCCH carrying a DCI scheduling a PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process or to receive another PDSCH without corresponding PDCCH for the given HARQ process that starts until Tproc,1 after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process |

In our view, this might not be an issue, if multiple different HARQ process IDs (=>2 at least) are scheduled in consecutive slots. Then, it is thought that Multicast MBS PDSCH with HARQ Feedback disabled and Broadcast MBS PDSCH are not different structurally and if Multicast MBS PDSCH with HARQ Feedback disabled is constrained less than 5MHz, the same principle should be applied for Broadcast MBS PDSCH in the respect of G-RNTI.Additionally,Case 2 can be dependent on RRC state. Recently, it was agreed in RAN2 that MBS Multicast PDSCH is supported in RRC\_INACTIVE under the only condition of HARQ Feedback disabled in Rel-18, it is different from MBS Multicast PDSCH in Rel-17 not to be supported in RRC\_INACTIVE. So, it can be considered that Case 2 differentiate two sub-cases. One is in RRC\_CONNECTED, the other is in RRC\_INACTIVE.  |
| Spreadtrum | Case 1a and Case 1b: YesCase 2a and Case 2b: No |
| SONY | Case 1a: Acceptable. We assume that the UE can process the “large” PDSCH using the “consecutive slot”.1b, 2a, 2b: Not acceptable. This increases the UE processing requirement. |
| DOCOMO2 | @LGE, Thanks for your comment. We agree with LGE that different HPN can be used in the consecutive slot or within Tproc,1 and nothing is concerned for this case. However, we would like to point out that there is a processing time requirement to be scheduled with the **same** HPN when HARQ feedback is disabled. For example, according to the current specification, if a multicast PDSCH with HPN=1 is scheduled without HARQ feedback, another PDSCH with the same HPN=1 can be scheduled after Tproc,1 from the multicast PDSCH. However, if larger PRB than 5MHz can be allowed to be allocated for eRedCap, eRedCap UE may not be able to process this multicast PDSCH within Tproc,1, and then this processing time requirement needs to be extended.In addition, there is no HPN field in DCI format 4\_0 even when it is scrambled with G-RNTI as well as DCI scrambled with SI-RNTI or P-RNTI while there is HPN field in DCI format 4\_1/4\_2. Therefore, the different solution can be applied between broadcast MBS PDSCH and multicast MBS PDSCH. |

For convenience, the cases mentioned above (including Cases 2a1/2a2 proposed by Qualcomm) are listed here:

* Case 1a: Broadcast MBS PDSCH without PDSCH in consecutive slots and without PDSCH repetition
* Case 1b: Broadcast MBS PDSCH with PDSCH in consecutive slots and/or with PDSCH repetition
* Case 2a: Multicast MBS PDSCH without HARQ feedback
	+ Case 2a1: Multicast MBS PDSCH without HARQ feedback and without PDSCH repetition
	+ Case 2a2: Multicast MBS PDSCH without HARQ feedback but with PDSCH repetition
* Case 2b: Multicast MBS PDSCH with HARQ feedback

Based on the above received responses, the following proposal can be considered.

**FL4/FL5/FL6 Medium Priority Proposal 2.4-1b:**

* **For UE BB bandwidth reduction, the number of PRBs scheduled in DCI can be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS for the following cases:**
	+ **Case 1a: Broadcast MBS PDSCH without PDSCH in consecutive slots and without PDSCH repetition**
	+ **Case 1b: Broadcast MBS PDSCH with PDSCH in consecutive slots and/or with PDSCH repetition**
* **For UE BB bandwidth reduction, the number of PRBs scheduled in DCI cannot be larger than 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS for the following cases:**
	+ **Case 2a: Multicast MBS PDSCH without HARQ feedback**
		- **Case 2a1: Multicast MBS PDSCH without HARQ feedback and without PDSCH repetition**
		- **Case 2a2: Multicast MBS PDSCH without HARQ feedback but with PDSCH repetition**
	+ **Case 2b: Multicast MBS PDSCH with HARQ feedback**
* **Note: For UE without BB bandwidth reduction, no special restriction other than data rate restriction.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| CATT | Y | Fine with this simple solution. Do not want to make more complex situations for RedCap + MBS combo. |
| vivo | Y |  |
| CMCC | Y |  |
| FUTUREWEI | N | The note needs to be revised because the applicability of the note is too broad• Note: For UE without BB bandwidth reduction, no special restriction other than data rate restriction for broadcast MBS PDSCH and for multicast MBS PDSCH.It is very difficult to understand the cases for broadcast: Does it say it is always allowed to have the number of RBs > 5 MHz? It is unclear what the behavior should be in a UE receiving broadcast MBS > 5 MHz in connected mode.Is it clear that: “PDSCH in consecutive slots” implies “MBS PDSCH in consecutive slots” and “PDSCH repetition” implies “MBS PDSCH repetition” |
| OPPO | Y | We are generally ok for case 1a/1b can have larger RBs, and 2a/2b cannot.The Note seems not needed and may lead to misunderstanding, it can could be deleted. |
| LG | N | We propose that Case 2a1 and Case 1a can be combined into one for Broadcast MBS PDSCH and Multicast MBS PDSCH, if Case 1a can be scheduled larger than 5MHz. (“PDSCH in consecutive slots” can be applied for MBS Multicast PDSCH)In addition, if Case 1a cannot be scheduled larger than 5MHz BW, Case 2a1 cannot also be scheduled larger than 5MHz BW. We think that Case 2a1 and Case 1a may be similar structurally.  |
| DOCOMO | Y | We don’t see the need to allow larger BW than 5MHz for case 2a. |
| Nokia, NSB | Y | While our preference is for PDSCH to be larger than 5MHz for case 2a, we are OK with this proposal. |
| Ericsson | Y |  |
| SONY | N | Case 1b cannot be supported by a BW-limited RedCap UE as it will not be able to “over-process” the consecutive PDSCH in time (the processing of a PDSCH in slot n will collide with the processing of the PDSCH in slot n+1).  |
| Samsung | Y |  |
| Sharp | N | we have similary view as sony. |
| DENSO | Y |  |
| Panasonic | OK |  |

# 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 UE peak data rate reduction with UE BB bandwidth reduction,
	+ The 10-Mbps peak rate target corresponds to a *vLayers*·*Qm*·*f* of 3.2
* For UE peak data rate reduction without UE BB bandwidth reduction,
	+ The 10-Mbps peak rate target corresponds to a *vLayers*·*Qm*·*f* of 0.75
	+ This is assuming 20 MHz bandwidth in the 38.306 peak rate expression.
* Note: This does not imply that downlink MIMO and 256 QAM are not supported
 |

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., 10 Mbps**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
 |

RAN#100 endorsed this working assumption regarding the peak data rate. The moderator summary can be found in [7].

|  |
| --- |
| Conclusion: Working assumption: The peak rate target is 10 Mbps regardless of what optional features the UE may support. (i.e., WGs can progress on this topic based on this assumption).No consensus about Proposal 3-3b. Revised WID will be handled in RAN #101. |

3.1 Relaxed constraints

Contributions [9, 11, 12, 14, 15, 16, 17, 18, 19, 21, 22, 24, 25, 27, 28, 30, 32, 33, 34] discuss the relaxed constraints for peak data rate reduction.

* For UE peak data rate reduction without UE BB bandwidth reduction, several contributions, e.g., [9, 11, 17, 19, 22, 32, 34], note that the agreed *vLayers*·*Qm*·*f* value of 0.75 is feasible and achieves 10 Mbps for the non-MIMO case but less suitable in the MIMO case. In the MIMO case, existing (*vLayers, Qm, f*) values can achieve a *vLayers*·*Qm*·*f* value of 0.8 (which corresponds to a peak data rate slightly higher than 10 Mbps) but not 0.75 (without introducing a new *scalingFactor (f)* value).
* Several contributions [11, 12, 16, 18, 21, 30] express that since the peak data rate is fixed, some or all the existing peak data rate related parameters (*vLayers, Qm, f*) may not be needed.
* Some contributions [19, 24, 25, 34] note that this topic is related to whether optional features (MIMO, 256QAM, *scalingFactor (f)* values lower than 1) are supported. This question is discussed in Section 3.2.

Companies are invited to comment on the following question. Note that combinations with optional features is treated separately in Section 3.2 in this document.

**FL1 High Priority Question 3.1-1a: Assuming a fixed peak data rate (10 Mbps), do you agree that the UE does not need to signal some or all existing peak data rate related parameters (*vLayers, Qm, f*)? Please elaborate.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | Y |  |
| ZTE, Sanechips |  | If the UE does not report this, it seems to change the legacy behavior and also has impacts on RAN2. alternatively, supporting a peak data rate larger than 10Mpbs or not supporting 2DL MIMO layers could be the candidates options. |
| Nordic | Y | if peak rate is THE peak rate, RAN2 can easily hard-code values for ***vLayers, Qm, f*** foreRedCap. Alternatively, RAN2 can restrict values that are allowed to be reported by eRedcap.  |
| QC | No | We still prefer UE follow the unified reporting framework to report all parameters ***vLayers, Qm, f.*** A new f=0.375 can be introduced for vLayers =2 |
| CATT |  | We slightly prefer not to change legacy bebavior. RedCap UE shall report v, Q, f as legacy UE. |
| Panasonic | Y | The reporting parameters of ***Qm, f*** are both optional since Rel-15, thus omitting the reporting would not impact RAN2. |
| MediaTek |  | We would like to clarify a question first. Question: For a band with a (maximum) CBW of 5MHz (with 25 PRBs with 15kHz), what is the v\*Q\*f value that a PR1 UE should indicate in order to support 10Mbps? Is it still 0.75? Or it should be around 0.75\*(106/25) ~= 1.0 instead?  |
| Spreadtrum | No | We also still prefer UE to report all parameters ***vLayers, Qm, f.***  |
| FUTUREWEI |  | We understand the spirit of the proposal but we would like to avoid changing legacy signaling from the RAN1 perspective. |
| DOCOMO |  | It should be clarified how the NW can know the exact peak rate of an eRedCap UE without reporting *Qm* and *f*. is the peak rate would be the value when *vLayers, Qm, f* is 0.75 for UE without BB BW reduction and the value when *vLayers, Qm, f* is 3.2 for UE with BB BW reduction? |
| Nokia, NSB |  | We think that it not be necessary for UE to signal Qm and f. However, we don’t have a strong view and would be fine with keeping legacy procedure. |
| Ericsson | Y |  |
| LG | Y |  |
| Xiaomi1 | Y in general  | Considering that *a* fixed peak data rate is specified, there is no need to use the formula to calculate anymore. So, *Qm and f* shouldn’t to be report. But, *vLayer****s*** needs to be reported to indicate the maximum supported MIMO layers. The first two parameters are only used for peak data rate calculation. |
| NEC | Y |  |
| Samsung | Y |  |
| OPPO | Y | We see the 3 parameters are not meaningful in chat case. And would be some simple setting.  |

Based on the above received responses, perhaps the following proposal can be considered.

**FL2 High Priority Proposal 3.1-1b:**

**For a Rel-18 eRedCap UE, down-select between the following options:**

* **Option 1: The UE does not need to signal peak data rate related parameters corresponding to *Qm* and *f* but signals parameter corresponding to *vLayers*.**
	+ **FFS whether or not definitions of parameters corresponding to *vLayers*, *Qm* and *f* need to be updated in TS 38.306**
* **Option 2: The UE needs to signal peak data rate related parameters corresponding to *vLayers*, *Qm* and *f*.**
	+ **No new values for the above parameters will be introduced for Rel-18 eRedCap.**
	+ **For FG 48-2, when *vLayers* = 2, the 10-Mbps peak rate target corresponds to a *vLayers*·*Qm*·*f* of 0.8 (instead of 0.75).**

The above proposal was treated in the Monday online session where the following agreement was made:

|  |
| --- |
| Agreement* The UE needs to signal peak data rate 10-Mbps related parameters corresponding to *vLayers*, *Qm* and *f*.
	+ No new values for the above parameters will be introduced for Rel-18 eRedCap.
	+ For FG 48-2, when *vLayers* = 2, the peak rate target corresponds to a *vLayers*·*Qm*·*f* of 0.8 (instead of 0.75).
 |

**FL4 High Priority Proposal 3.1-1c:**

* **Send LS to RAN2 (cc RAN4) to inform about RAN1 agreements on peak rate reduction with 38.306 impact.**

The above proposal was treated in the Wednesday online session where the following agreement was made:

|  |
| --- |
| Agreement:* Send LS to RAN2 (cc RAN4) to inform about RAN1 agreements on peak rate reduction with 38.306 impact.
 |

**FL6 High Priority Proposal 3.1-1d:**

* **Agree the draft LS in** [**eRedCapDraftLS-v000.docx**](https://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN1/Inbox/drafts/9.6%28NR_redcap_enh%29/LS/eRedCapDraftLS-v000.docx)

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| LG | Y |  |
| CATT | Y |  |
| DENSO | Y |  |
| Panasonic | Y |  |
| FUTUREWEI |  | We provided some updates on top of MediaTek’s edits.A suggestion is to include the agreements as well. |
| Ericsson | Y | We would also be fine with similar updates for FG 48-2 as for FG 48-1 as in [eRedCapDraftLS-v002-MTK-FUTUREWEI.docx](http://10.10.10.10/ftp/RAN/RAN1/Inbox/drafts/9.6%28NR_redcap_enh%29/LS/eRedCapDraftLS-v002-MTK-FUTUREWEI.docx).  |
| NEC | Y in principle | It would not be so clear what “This” is meant. It could be rephrased, for example, 25 PRB for $μ=0$ or 12 PRB for $μ=1$ is always assumed for $N\_{PRB}^{BW}$ for all bands. And in TS 38.306, instead of peak data rate, “the approximate maximum data rate” is used. We prefer to use the existing terminology. |
| OPPO | N | “This is assuming 20 MHz bandwidth in the…”, has this agreed in UE feature discussion? If not, we may not have that bullet |
| DOCOMO | Y but… | Similar to the case “For UE peak data rate reduction without UE BB bandwidth reduction (i.e., FG 48-2)”, clarification on the number of PRB applied to  would be necessary “For UE peak data rate reduction with UE BB bandwidth reduction (i.e., FG 48-1)”. For this case, should be 25/12 PRBs for 15/30 kHz SCS regardless of the UE supported maximum bandwidth in the given band or band combination. |

3.2 Combinations with optional features

Several contributions [12, 13, 18, 24, 27, 34] discuss combinations with optional features, especially MIMO and 256QAM. Contribution [12] also suggests allowing a 2-Rx UE without MIMO, since the MIMO support may not provide much benefit for the UE due to the cap on the peak data rate (10 Mbps).

**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: 2 Rx branches with DL MIMO**
* **Potential optional feature 2: 2 Rx branches without DL MIMO**
* **Potential optional feature 3: DL 256QAM**

|  |  |  |
| --- | --- | --- |
| **Company** | **Potential optional feature(s)** | **Comments** |
| vivo | 1, 2 | We did not much see the need of supporting 256QAM. But we are fine with optionally supporting it.  |
| ZTE, Sanechips | 1, 2 |  |
| Nordic |  | We do not see a need to preclude those optional features. But baseline should remain as 1Rx and 64QAM.  |
| QC | Feature 1 and 3 | It seems not a correct statement that “MIMO support may not provide much benefit for the UE due to the cap on the peak data rate (10 Mbps)” In our view, 2Rx/2L MIMO have at least the following clear benefits. * 2Rx can support same data rate with lower SNR (3dB Rx combining gain), so there is clear benefit of 2 Rx.
* In terms of peak rate (or any data rate), 2L MIMO can support it with half bandwidth (by doubling spectrum efficiency). Hence there is clear benefit of 2L as well.

By the way, a regular UE can report DL MIMO layers 1,2,4,8. Not sure why we need restrict eRedcap UE’s MIMO capability reporting, if a UE can support 2L MIMO. Similar view on high mod order 256 QAM. Optional feature 1 and 3 should be supported with UE capability of course. We think the way to phrase question maybe should be flipped: what is the justification to restrict to only 1L given a 2Rx UE already implemented 2 Rx? |
| CATT | 1, 3 | In general we think it is up to UE to implement optional features. However, we have similar concern with QC for feature 2, but in a different angle: In R17, the max DL MIMO layer is aligned with Rx (so as the SIB1 cell bar indication for 2Rx UE). But now feature 2 is creating the case that UE’s max DL MIMO layer# is not aligned with SIB1 cell barring Rx#.  |
| Panasonic | None | Considering peak rate target 10 Mbps, the strong need is not seen to support the 2-Rx or 256QAM transmission. Also, allowing fewer types of UE (i.e., less variation of the capability) would help the cost reduction of the UE thanks to the economics of the scale. |
| Spreadtrum | 1, 3 |  |
| FUTUREWEI |  | The entire proposal is ill phrased. We do not need a positive agreement for Opts. 1 and 3 to continue to be optionally supported, that is already there by default. Opt. 2 on the other hand is a different behavior from rel-17 and we do not support it. |
| DOCOMO | 1,2,3 |  |
| Nokia, NSB | 1, 3 | We agree that 1 and 3 are already optionally supported per WID. We do not support 2. |
| Ericsson | 1, 2, 3 |  |
| DENSO | 1,3 |  |
| LG | 1, 3 | By default, we think that all features on Rel-18 eRedCap UEs can be supported optionally. We are open for further discussion on Option 2. |
| Xiaomi1 | 1,2,3 | Except for the BB bandwidth reduction and peak data rate reduction, there is no objective to relax other features on basis of RedCap in the Rel-18 eRedCap WID, so both option 1,2,3 can be optionally supported by the eRedCap.  |
| NEC | 1, 3 |  |
| Samsung | 1, 2 |  |
| OPPO | 3 | It is simple to support 256QAM than MIMO. |

Based on the above received responses, perhaps the following conclusion can be considered.

**FL2 High Priority Proposal 3.2-1b:**

* **Conclusion: For Rel-18 eRedCap UEs, the following features are still supported as optional features:**
	+ **Potential optional feature 1: 2 Rx branches with DL MIMO**
	+ **Potential optional feature 3: DL 256QAM**

The above proposal was treated in the Monday online session where the following conclusion was made:

|  |
| --- |
| Conclusion* For Rel-18 eRedCap UEs, the following features are still supported as optional features:
	+ 2 Rx branches with DL MIMO
	+ DL 256QAM
 |

# 4 Detailed spec text proposals

The submitted contributions bring up some specification text aspects not covered elsewhere in this document.

**FL1/FL3 Low Priority Question 4-1a: Should the following proposal be treated in this meeting?**

* **Contribution [**[**9**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306435.zip)**] proposes to revert clause 17.1 title in the 38.213 draft specification to “RedCap procedures” to reflect that the clause applies to both Rel-17 and Rel-18 RedCap UEs.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FUTUREWEI | Y |  |
| vivo |  | If time allows, we can discuss this correction.  |
| CATT |  | But it is already stated in 17.1 that: ‘In this clause, the term 'UE' refers to a RedCap UE that indicates supportOfRedCap or supportOfRedCap-r18.’ |
| Ericsson |  | In the endorsed 38.213 CR ([R1-2306286](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_113/Docs/R1-2306286.zip)), clause 17.1 (‘First RedCap UE procedures’) states that “In this clause, the term 'UE' refers to a RedCap UE that indicates *supportOfRedCap* or *supportOfRedCap-r18*” and clause 17.1A (‘Second RedCap UE procedures’) states that “In this clause, the term 'UE' refers to a RedCap UE that indicates *supportOfRedCap-r18*.”. This seems clear enough for now. We are open to discuss potential further alignment between RAN1 and RAN2 terminology, but it does not seem to have the highest priority at this point. |
| NEC |  | Share view with CATT and Ericsson. The specification is neither ambiguous nor broken. |
| Nokia, NSB |  | We have no strong view but we think the current specification is clear. |

**FL1/FL3 Low Priority Question 4-2a: Should the following proposal be treated in this meeting?**

* **Contribution [**[**24**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307554.zip)**] proposes to specify in 38.214 that the maximum 25 PRBs for 15 kHz SCS and 12 PRBs for 30 kHz SCS for PUSCH and PDSCH allocated to the 5MHz eRedCap UE should not be exceeded.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| FUTUREWEI |  | We would like to avoid duplicating specifications  |
| OPPO | Yes | We should make that rule captured. The current agreements still open more ways to capture.  |
| vivo |  | Share FUTUREWEI’s views.  |
| Ericsson |  | This topic can be revisited once it has been decided (in the UE feature discussion under agenda item 9.16.8) whether the random access timeline relaxation applies to both FG 48-1 and FG 48-2 or only to FG 48-1. |
| NEC |  | Share view with FUTUREWEI. It could be captured for example in TS 38.306. |

**FL1/FL3 Low Priority Question 4-3a: Should the following proposal be treated in this meeting?**

* **Contribution [**[**31**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307855.zip)**] provides a 38.213 TP for clarification of the random access timeline relaxation’s (i.e., X’s) dependency on the SCS.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| QC | Yes | This is a simple clarification which follow the legacy of existing specification.  |
| Sharp | Yes |  |
| LG | Yes | We share similar view with QC. |
| vivo |  | If time allows, we can discuss this correction. |
| CATT | N | Not critical. The current spec is clear. Also note that, there is a 0.5 ms bias in the timeline formula by natural, it is more convenient to add 1ms and 0.5ms (for SCS=15/30kHz) on top of it, which becomes 1.5 ms and 1 ms as current representation. |
| Ericsson | Yes |  |
| Nokia, NSB |  | We have no strong view and would be OK to accept this clarification. |

# 5 Other aspects

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

**Common PUCCH**

* Consider enhancements of user multiplexing capacity for common PUCCH [23, 29].
* Do not think PUCCH will become the bottleneck during random access [22].
* Impacts would need to be carefully considered before deciding to do this [32].

**CSI reporting**

* Consider making PUCCH resources not necessary for CSI reports [8].
* Consider making CSI reporting optional in TDD systems [8].

**FDRA optimization**

* Discuss whether/how to use potential spare bits in FDRA field in RAR UL grant [10].
* For unicast, the FDRA indications and RBG sizes can be based on 5-MHz sub-bands [26].

**Frequency hopping**

* Support frequency hopping at least for unicast PUSCH [26].
* Study how to improve Msg3 frequency hopping range [28].

**HD-FDD scheduling**

* HD-FDD UE is capable of processing one additional unicast DCI scheduling PUSCH, as in TDD [33].

**Msg2-Msg3 timeline**

* Consider PUSCH TDRA in *pusch-ConfigCommon* specific to Rel-18 eRedCap UEs [12, 23].
* Consider additional timing extension for Msg3 to meet the minimal gap requirement [31].

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

**FL1/FL3 Medium Priority Question 5-1a: Is there a need to treat any of the issues listed above in this meeting?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comments** |
| vivo | N | This is last RAN1 meeting for the WI finalization, focus should be given for more essential issues.  |
| Nordic  | Y | HD-FDD aspect has close to zero spec impact and in our opinion is essential for having spectral efficient HD-FDD |
| CATT | N | We have more than 10 FL proposals to address in this meeting. |
| DOCOMO | Y | We prefer to consider common PUCCH capacity enhancement. The easiest way to ensure the common PUCCH capacity for non-RedCap, Rel-17 RedCap and Rel-18 eRedCap is to introduce additional PRB offset specific to Rel-18 eRedCap. However, it would cause PUSCH peak rate degradation for legacy UEs. Therefore, we prefer to consider two sequence generation without FH which can enables multiplexing with CS with non-RedCap UEs. |
| Nokia, NSB | N | We should prioritize FL proposals first before looking at these issues. |
| Ericsson | Y | **Msg2-Msg3 timeline**As analysed in [12], due to RAN1#113 decision to relax the Msg2-Msg3 timeline, scheduling flexibility of eRedCap UEs is significantly reduced. The scheduled flexibility can be improved by enabling the network to configure the relaxed timeline specifically for eRedcap UEs, i.e., by having a eRedCap-specific *PUSCH-TimeDomainResourceAllocationList* in *pusch-ConfigCommon* in SIB1. This allows for better scheduling flexibility for eRedcap UEs without impacting regular NR UEs or Rel-17 RedCap UEs. |
| Xiaomi1 | N | Share similar view with CATT that we may not have enough time to discuss it in this meeting. |
| GDCNI | Y | CSI Reporting:In order to minimize the resources consumed for RedCap applications, CSI reporting is an area that offers improvements in overall resource efficiency. [8] contains discussion of this important aspect of resource  |
| LG | Y | We are open to discuss whether/how to use potential spare bits in FDRA field in RAR UL grant, common PUCCH capacity enhancement or Msg2-Msg3 timeline. |
| Spreadtrum | N | These issues are not essential. |
| NEC | N | Agree with companies that RAN1 should focus on high priority issues. |

# 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] | [R1-2305959](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_113/Docs/R1-2305959.zip) | FL summary #4 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |
| [4] | [R1-2306261](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_113/Docs/R1-2306261.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] | [RP-231488](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_100/Docs/RP-231488.zip) | Moderator summary #2 on Rel-18 eRedCap WID revisions | Moderator (Ericsson) |
| [8] | [R1-2306390](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306390.zip) | CSI report of Reduced Capability Devices | GDCNI |
| [9] | [R1-2306435](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306435.zip) | Discussion on R18 RedCap complexity | FUTUREWEI |
| [10] | [R1-2306529](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306529.zip) | Discussion on potential solutions to further reduce UE complexity | Huawei, HiSilicon |
| [11] | [R1-2306656](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306656.zip) | Discussion on enhanced support of RedCap devices | Spreadtrum Communications |
| [12] | [R1-2306683](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306683.zip) | Further RedCap UE complexity reduction | Ericsson |
| [13] | [R1-2306761](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306761.zip) | Discussion on further UE complexity reduction | Vivo |
| [14] | [R1-2306917](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306917.zip) | Redcap complexity reduction | Sony |
| [15] | [R1-2306996](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2306996.zip) | UE complexity reduction for eRedCap | Panasonic |
| [16] | [R1-2307002](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307002.zip) | Discussion on Rel-18 RedCap UE | NEC |
| [17] | [R1-2307098](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307098.zip) | Discussion on further complexity reduction for Rel-18 RedCap UE | CATT |
| [18] | [R1-2307138](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307138.zip) | Discussion on further UE complexity reduction | ZTE, Sanechips |
| [19] | [R1-2307206](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307206.zip) | Discussion on further reduced UE complexity | CMCC |
| [20] | [R1-2307289](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307289.zip) | Further RedCap UE complexity reduction | Apple |
| [21] | [R1-2307395](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307395.zip) | Discussion on further complexity reduction for eRedCap UEs | Xiaomi |
| [22] | [R1-2307417](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307417.zip) | RedCap UE Complexity Reduction | Nokia, Nokia Shanghai Bell |
| [23] | [R1-2307482](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307482.zip) | Discussion on further UE complexity reduction for eRedCap | NTT DOCOMO, INC. |
| [24] | [R1-2307554](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307554.zip) | Further consideration on reduced UE complexity | OPPO |
| [25] | [R1-2307622](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307622.zip) | Discussion on further complexity reduction for eRedCap UEs | China Telecom |
| [26] | [R1-2307689](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307689.zip) | Further UE complexity reduction for eRedCap | Samsung |
| [27] | [R1-2307757](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307757.zip) | Discussion on UE complexity reduction | DENSO CORPORATION |
| [28] | [R1-2307764](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307764.zip) | Discussion on UE complexity reduction | Transsion Holdings |
| [29] | [R1-2307791](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307791.zip) | Discussion on further UE complexity reduction for eRedCap | LG Electronics |
| [30] | [R1-2307841](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307841.zip) | Considerations for further UE complexity reduction | Semtech Neuchatel SA |
| [31] | [R1-2307855](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307855.zip) | Discussion on complexity reduction for eRedCap UE | Sharp |
| [32] | [R1-2307937](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2307937.zip) | UE complexity reduction for eRedCap | Qualcomm Incorporated |
| [33] | [R1-2308021](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2308021.zip) | On further complexity reduction of NR UE | Nordic Semiconductor ASA |
| [34] | [R1-2308039](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2308039.zip) | On eRedCap UE complexity reduction | MediaTek Inc. |
| [35] | [R1-2308224](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_114/Docs/R1-2308224.zip) | FL summary #1 on Rel-18 RedCap UE complexity reduction | Moderator (Ericsson) |