3GPP TSG-RAN WG2 Meeting #109bis-e [R2-2003842](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003842.zip)

Elbonia, 20 – 30 April 2020

**Agenda item: 4.5**

**Source: Nokia (RAN2 Vice-chair )**

**Title: Summary and discussion of LTE contributions in AI 4.5**

**Document for: Discussion and Decision**

# 1 Brief scope of the LTE Rel-16 contributions

This document contains the summary of documents from agenda items 7.4 (“Further performance enhancement for LTE in high speed scenario”), 7.5 (“Other LTE Rel-16 WIs”), 7.6 (“LTE TEI16 enhancements”), 7.8 (“DL MIMO efficiency enhancements for LTE”), 7.9 (“LTE-based 5G Terrestrial Broadcast”) as referenced in Section 4.

# 2 LTE Rel-16 topic summaries

## 2.1 TEI16

The documents in [1] and [2] are the only inputs to TEI16 topics.

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| --- | --- |
| **Tdoc(s), Title, Company** | **Proposal(s)** |
| 1a) [R2-2002888](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) LTE RLC out-of-order delivery configuration Samsung, LG Electronics Inc., Nokia, Nokia Shanghai Bell, Intel, Apple | **Discussed already in RAN2#109-e**Clarification that RLC out-of-order delivery should only be used when t-Reordering is configured for the UE to avoid data loss. |
| 1b) [R2-2002887](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip) CR on RLC out-of-order delivery configuration Samsung, LG Electronics Inc., Nokia, Nokia Shanghai Bell, Intel, Apple | **CR for above**Clarify that t-Reordering needs to be configured when RLC out-of-order delivery is used |

This topic was already discussed in RAN2#109-e but with not agreement, as shown below (from RAN2#109-e email discussion [202]):

**As conclusion of offline discussion [202] report in** [**R2-2001744**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001744.zip)**:**

**- The CRs** [**R2-2001726**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001726.zip) **and** [**R2-2001156**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001156.zip) **are agreed.**

**- The CR** [**R2-2001508**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001508.zip) **is not pursued (can be revisited if issues are identified)**

**- The CRs** [**R2-2001347**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001347.zip) **and** [**R2-2001351**](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2001351.zip) **are not pursued (can be revisited if issues are identified).**

The previous CRs were slightly different but still could not be agreed due to concerns from some companies. However, it seems that the content of the CRs is changed, the CRs are from only Rel-16 onwards, and there are more companies supporting the CRs. Therefore, it needs to be discussed if the revised versions could be agreeable.

**DISC S1\_1:** Discuss if the intent of [R2-2002888](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) is agreeable. If needed, provided updated revision to CR [R2-2002887](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip).

## 2.2 DL MIMO efficiency enhancements for LTE

The CRs in [3] and [4] relate to the DL MIMO WI as shown below:

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| --- | --- |
| **Tdoc, Title, Company** | **Proposal(s)** |
| 2) [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip), [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip): “Introduction of UE capabilities for DL MIMO efficiency enhancement”, Huawei, Hisilicon | **New input** Proposes how to capture the UE capabilities for the DL MIMO WI based on latest RAN1 progress (as per LS in [R1-2001485](http://3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_100_e/Docs/R1-2001485.zip)).  |

The capabilities seem straightforward, but may require checking. Therefore, it is proposed to attempt to endorse the current version as baseline pending any further updates from RAN1.

**Proposal S2\_1:** Endorse the CRs in [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip), [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) as baseline for UE capabilities of DL MIMO efficiency enhancements for LTE.

## 2.3 LTE-based 5G Terrestrial Broadcast

The CRs in [5], [6] and [7] all concern the 0.37 kHz SCS for LTE-based 5G Terrestrial Broadcast WI:

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| --- | --- |
| **Tdoc, Title, Company** | **Proposal(s)** |
| 3a) [R2-2003544](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003544.zip): “Discussion on MCCH configuration for 0.37kHz SCS”, Huawei, Hisiliconand[R2-2003545](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003545.zip): “Clarification on MCCH configuration for 0.37kHz SCS”, Huawei, Hisilicon | **New proposal** Discusses how to allow all subframes to carry MBMS in case of 0.37 kHz SCS (in dedicated MBMS carrier).  |
| 3b) [R2-2003364](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003364.zip): “Correction on the configuration of subframe #0 and #5 for MCH in MBMS dedicated cell”, Qualcomm Technologies  | **New proposal** Proposes to define new structure to allow configuration of subframes #0 and #5 as MBMS MCCH subframes. |

It seems the intent of both is the same, but the approach is quite different. However, based on the description it seems there is an issue for the dedicated MBMS carrier with 0.37 kHz SCS configuration. The difference is that the CR in 3a) utilizes existing signalling with additional interpretation, whereas the CR in 3b) defines new signalling to solve the same issue. Since there are only two proposals, it is proposed to discuss whether one of the CRs can be adopted to resolve the identified issue.

**DISC S3\_1:** Discuss which approach can resolve the identified problem: Re-interpretation of existing signalling ([R2-2003545](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003545.zip)) or addition of new signalling ([R2-2003364](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003364.zip)).

# 3 Company comments to the contributions

## 3.1 TEI16 contributions

This section deals with DISC\_S1\_1:

***DISC S1\_1:*** *Discuss if the intent of* [*R2-2002888*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) *is agreeable. If needed, provided updated revision of* [*R2-2002887*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip)*.*

Companies are requested to provide comments in the tables 1 and 2 below (one row for each new comment to better keep track of the discussion – please don’t edit the previous comments.

|  |  |
| --- | --- |
| **Company** | **Is the intent of** [R2-2002888](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) **agreeable? If not, why?** |
| Qualcomm | The CR is about restricting network configuration. It is clear in current specification what is possible configuration and what is not. We do not list all the ‘bad’ configurations in the specification and as such rely on network on most part unless a configuration breaks the whole procedure as unintended consequence. In the case of RLC out of order delivery in LTE when configured, the UE behaviour is clear, and the specification is not broken. The performance in terms of per packet reliability will likely degrade, but other metrics e.g. latency will be improved with such configuration. Network should be allowed to configure as such if intended.Additionally, the feature in question is Rel-15. Having the correction only for Rel-16 creates interoperability for Rel-16 UE operating under Rel-15 eNB.Therefore, we think the CR for network configuration restriction is not needed. |
| Samsung | **Yes. The CR is not about restricting network configuration but about clarification of the intended network behaviour since the current specification may break the legacy principle of AM DRB as unintended consequence.****The network should not configure RLC out-of-order delivery for normal UM and AM DRBs without t-Reordering to enable LTE PDCP out-of-order delivery which Qualcomm is proposing.** **Such configuration is a new functionality RAN2 have never discussed before, which also breaks the principle of lossless delivery of AM DRB as possible data loss.****Note that there would be no interoperability issue for Rel-16 UE operating under Rel-15 eNB since such configuration has not been discussed in RAN2 and no related agreement has been made. If configured, then it would be a wrong network implementation.****As Qualcomm still propose a new functionality which RAN2 have never discussed before, the current RRC specification makes a reader get confused and misinterpret the RLC out-of-order delivery configuration. Hence, the CR is needed for clarification.****If any company support to allow RLC out-of-order delivery configuration to enable LTE PDCP out-of-order delivery with the risk of data loss, the proponent should provide the related agreement, if any.**  |
| LG | **If the PDCP t-Reordering is not configured and the RLC our-of-order delivery is configured, it causes the packet loss for AM DRBs and causes the HFN desync for UM DRBs.****Actually, we believe that the network would not configure the PDCP t-Reordering and RLC our-of-order delivery to a DRB, but it would be good to clarify it to prevent the bad configuration.** |
| Qualcomm2 | Thanks Samsung and LG for further clarifications. Just so that we are on the same page, let me clarify that we are not proposing any new functionality. But as clarified by various companies during the last RAN2 meeting also, RLC out of order delivery without duplication was discussed and agreed as part of the HRLLC WI and it shouldn’t be reverted now. And it seemed the proponents of the CR also agreed to this in the last meeting. Note also that there are already Rel-15 UE capabilities *rlc-AM-Ooo-Delivery* and *rlc-UM-Ooo-Delivery* independent to PDCP duplication or any other feature.Having said that, upon further checking the PDCP specification on potential HFN desync for UM, we are convinced there is a real issue. So, we now agree spec clarification would be beneficial and corrections need to be done to support proper behaviour.While we agree with all the observations in the discussion paper R2-2002888 and we agree correction is needed, we are not fully convinced with the proposal as it is because we think the proposal and the corresponding CR is insufficient (see below).  |
|  |  |

**Table 1. Intent of the CR**

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| --- | --- |
| **Company** | **If the intent is agreeable, are there any issues with the proposed CR** [R2-2002887](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip)**?** |
| Samsung | To us, the current CR would be fine but still can be updated, if any concern. |
| Qualcomm2 | The proposed change in CR is insufficient because: * In PDCP spec, the condition to allow PDCP reordering in TS 36.323 section 5.1.2.1.4 does not allow PDCP to perform reordering function by itself just based on PDCP t-reordering being configured. This should be added to PDCP spec (as either referring to when t-reordering is configured for PDCP; or alternatively referring to when rlc-outoforderdelivery is configured for associated RLC).
* In RRC specification, conditional presence of PDCP t-reordering (Cond SetupS) should be updated to PDCP t-reordering be mandatory present when *rlc-OutofOrderDelivery* for associated RLC entity/entities is enabled.

The above changes should address the concerns from Samsung while not reverting what was already agreed in Rel-15. If above suggestions are agreeable, it is better to do corrections from Rel-15, not just Rel-16. |
| Samsung | Thanks for your understanding. Regarding QC’s proposed change, our opinion is as follows: * The t-reordering configuration does not make UE perform t-reordering in LTE and NR. It just configures the value of t-reordering timer when the UE uses t-reordering according to the condition of PDCP specification.
* As QC mentioned, the PDCP spec. specifies the condition when to use t-reordering as follows:

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| 5.1.2.1.4 Procedures for DRBs mapped on RLC AM or RLC UM, for LWA bearers and SLRB when the reordering function is usedFor DRBs mapped on RLC AM and RLC UM, for LWA bearers and when PDCP duplication is used, the PDCP entity shall use the reordering function as specified in this clause when:- the PDCP entity is associated with two RLC entities; or- the PDCP entity is configured for a LWA bearer; or- the PDCP entity is associated with one AM RLC entity after it was, according to the most recent reconfiguration, associated with two AM RLC entities or configured for a LWA bearer without performing PDCP re-establishment; or- the PDCP entity is configured with PDCP duplication.For SLRBs mapped on RLC UM, the PDCP entity shall use the reordering function as specified in this clause when:- the PDCP entity receives a PDCP SN which is not "0".The PDCP entity shall not use the reordering function in other cases. |

* Note that t-reordering should be configured if the PDCP entity use t-reordering, i.e. one of the above conditions is met.
* In this reason, our proposed change is as follows:

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| ***rlc-OutOfOrderDelivery***Indicates that out-of-order delivery from RLC to PDCP is configured for this RLC entity as specified in TS 36.322 [7]. E-UTRAN sets this field to TRUE only when the associated PDCP entity is configured with t-Reordering. |

* In this respect, it seems that we don’t need to have further change for PDCP t-reordering be mandatory present when *rlc-OutofOrderDelivery* for associated RLC entity/entities is enabled.
* Because our proposed change is that *rlc-OutofOrderDelivery* is set to TRUE only when the associated PDCP entity is configured with t-Reordering. It would be the same clarification as QC proposed.
* If QC has some concern on the configuration of t-reordering, then we can update our proposed CR as follows:

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| ***rlc-OutOfOrderDelivery***Indicates that out-of-order delivery from RLC to PDCP is configured for this RLC entity as specified in TS 36.322 [7]. E-UTRAN sets this field to TRUE only when the associated PDCP entity ~~is configured with~~ uses t-Reordering. |

* However, as many companies already co-sourced the original CR, we prefer to have the original one if this is acceptable to QC.
* We have no strong opinion and are fine to do this correction from Rel-15.
 |
| Ericsson | We don’t think we need any CR. In general, network configuration restrictions or network implementations should not be specified. In this case, if configuration is incorrect, the UE does not break, it just leads to data loss. There are also millions of other erroneous configuration combinations that would lead to data loss, and no restrictions are configured for those either. |
| Qualcomm3 | Unfortunately, the explanation does not address the concern.The main question is this: **In LTE, should a “normal” DRB (that does not satisfy any of the yellow highlighted conditions in PDCP spec shown above) be allowed to be configured with RLC out of order if for that DRB PDCP reordering is used?** As you know, this is possible in NR.Clearly, we think it should be possible if network wants. And we explain ablove how spec can be corrected so that this is possible without any data loss.And from your comments my undertanding is you do not want to allow it although * 1) it appeared you were ok with it in the last meeting as long as there is no data loss,
* 2) my suggestions above totally resolve the issues you raised in the paper (about data loss) and the issue LG raised (about HFN desync), and
* 3) this is what is meant by *RLC out of order is independent of duplication*, hence independent UE capabilites were introduced (separately for AM and UM RLC).

So, apologies to repeat again but we should correct the specification to correctly enable the previously agreed functionality, instead of removing any functionality with a correction/clarification.Having said that, if the answer to above question is NO – your CR is fine. If the answer is YES - the changes I suggested above are needed. I hope this is clear. Now, I hope other companies can comment as well on the above question. |
| Samsung | Now, I understand your point and am fine with QC’s suggestion. The additional change would be as follows (36.323 and 36.331):

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| 5.1.2.1.4 Procedures for DRBs mapped on RLC AM or RLC UM, for LWA bearers and SLRB when the reordering function is usedFor DRBs mapped on RLC AM and RLC UM, for LWA bearers and when PDCP duplication is used, the PDCP entity shall use the reordering function as specified in this clause when:- the PDCP entity is associated with two RLC entities; or- the PDCP entity is configured for a LWA bearer; or- the PDCP entity is associated with one AM RLC entity after it was, according to the most recent reconfiguration, associated with two AM RLC entities or configured for a LWA bearer without performing PDCP re-establishment; or- the PDCP entity is configured with PDCP duplication.- the PDCP entity is associated with one RLC entity configured with *rlc-OutOfOrderDelivery*. |

– *PDCP-Config*The IE *PDCP-Config* is used to set the configurable PDCP parameters for data radio bearers.*PDCP-Config* information element-- ASN1STARTPDCP-Config ::= SEQUENCE { discardTimer ENUMERATED { ms50, ms100, ms150, ms300, ms500, ms750, ms1500, infinity } OPTIONAL, -- Cond Setup rlc-AM SEQUENCE { statusReportRequired BOOLEAN } OPTIONAL, -- Cond Rlc-AM rlc-UM SEQUENCE { pdcp-SN-Size ENUMERATED {len7bits, len12bits} } OPTIONAL, -- Cond Rlc-UM headerCompression CHOICE { notUsed NULL, rohc SEQUENCE { maxCID INTEGER (1..16383) DEFAULT 15, profiles SEQUENCE { profile0x0001 BOOLEAN, profile0x0002 BOOLEAN, profile0x0003 BOOLEAN, profile0x0004 BOOLEAN, profile0x0006 BOOLEAN, profile0x0101 BOOLEAN, profile0x0102 BOOLEAN, profile0x0103 BOOLEAN, profile0x0104 BOOLEAN }, ... } }, ..., [[ rn-IntegrityProtection-r10 ENUMERATED {enabled} OPTIONAL -- Cond RN ]], [[ pdcp-SN-Size-v1130 ENUMERATED {len15bits} OPTIONAL -- Cond Rlc-AM2 ]], [[ ul-DataSplitDRB-ViaSCG-r12 BOOLEAN OPTIONAL, -- Need ON t-Reordering-r12 ENUMERATED { ms0, ms20, ms40, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220, ms240, ms260, ms280, ms300, ms500, ms750, spare14, spare13, spare12, spare11, spare10, spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1} OPTIONAL -- Cond SetupS

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| *SetupS* | The field is mandatory present in case of setup of or reconfiguration to a split DRB or LWA DRB and in case that the associated RLC entity is configured with *rlc-OutOfOrderDelivery*. The field is optionally present upon reconfiguration of a split DRB or LWA DRB or upon DRB type change from split to MCG DRB or from LWA to LTE only, need ON. Otherwise the field is not present. |

I also hope other companies check this. |
| Qualcomm4 | To Samsung: Thank you for your consideration. Yes, the latest suggested changes are ok for us in principle i.e., there may be minor editorial or wording suggestions (e.g., ‘or’ missing in 36.323 suggested change), but in general those changes resolve our concerns. |
| Ericsson | We would be fine with the latest proposal from Samsung. |
| Qualcomm6 | Thanks to Samsung for providing draft CRs. We are fine with the CRs in general with minor comments as below:1. We should mark both RAN and UE in both the cover pages because the PDCP operation is symmetrical and there will be impact to both UE and network.
2. In the added text in both CRs, we should use “… associated with **at least** one RLC entity configured with… ” to cover all the possible cases.
3. We can have the CRs from Rel-15.
4. With the changes in RRC CR in the condition *SetupS,* it seems the change in field description of rlc-OutOfOrderDelivery is redundant. (The conditional presence indicates that PDCP reordering timer is mandatory present when RLC out of order is configured, not present otherwise.)
 |
| Samsung | Thanks to Qualcomm for careful review. Based on your comment 1, 3 and 4, I will update the CRs for Rel-16 and draft new CRs for Rel-15. I agree to Comment 4 since there would be no need for the clarification of RLC OOD if we have a PDCP CR and the corresponding change for in RRC CRRegarding your comment 2, No strong opinion on this. However, I think the current PDCP and RRC specifications already covers "the PDCP enitty associated with two RLC entities case for t-Reordeing", regardless of RLC OOD as follows: 36.3235.1.2.1.4 Procedures for DRBs mapped on RLC AM or RLC UM, for LWA bearers and SLRB when the reordering function is usedFor DRBs mapped on RLC AM and RLC UM, for LWA bearers and when PDCP duplication is used, the PDCP entity shall use the reordering function as specified in this clause when:- the PDCP entity is associated with two RLC entities; or- the PDCP entity is configured for a LWA bearer; or- the PDCP entity is associated with one AM RLC entity after it was, according to the most recent reconfiguration, associated with two AM RLC entities or configured for a LWA bearer without performing PDCP re-establishment; or- the PDCP entity is configured with PDCP duplication.36.331

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| --- | --- |
| *SetupS* | The field is mandatory present in case of setup of or reconfiguration to a split DRB or LWA DRB. The field is optionally present upon reconfiguration of a split DRB or LWA DRB or upon DRB type change from split to MCG DRB or from LWA to LTE only, need ON. Otherwise the field is not present. |

So, I think it would be enough to have "associated with one RLC entity configured with RLC OOD", i.e. “at least” would be redundant. |

**Table 2. Details of the CR**

**Conclusions:** TBA

## 3.2 DL MIMO efficiency enhancements for LTE

This section deals with the capability signalling that is proposed to be endorsed as per Proposal S2\_1 as shown below:

***Proposal S2\_1:*** *Endorse the CRs in* [*R2-2003546*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip)*,* [*R2-2003547*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) *as baseline for UE capabilities of DL MIMO efficiency enhancements for LTE.*

Companies are requested to indicate if there are any issues that require discussion within the CRs [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip), [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) in the summary in the table below.

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| --- | --- |
| **Company** | **Issues to discuss for UE capability CRs in** [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip), [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) |
| Qualcomm | The capabilities are still under discussion in RAN1. Specifically for DL MIMO enh, the LS from RAN1 has this extra statement (highlighting added) * As mentioned above, attached LTE features list is intermediate versions and there are a number of FFS points and brackets included in the lists. In addition, LTE MIMO part is an intermediate version without consensus, and hence there would be capability changes on the part. RAN1 kindly would like to ask RAN2 to design capability signaling corresponding to feature groups without such FFS point/bracket and not in LTE MIMO part first although they may also be updated after further discussion in RAN1. An updated LTE features list will be shared after RAN1#100bis-e meeting.

Given the above situation, we do not think we need to endorse the CR set yet. |
| Lenovo | We agree with Qualcomm that there is no need to endorse the CRs now due to the ongoing RAN1 discussion. Nonetheless, some comments can be made which can be taken into account in the next update:* In the description of the capabilities their inter-dependencies should be clarified, e.g. support of addSRS-SymbolsFrequencyHopping-r16, addSRS-SymbolsAntennaSwitching-r16 is dependent on the support of addSRS-SymbolsNormal-r16.
* Furthermore, each “addSRS” capability is dependent on the support of virtualCellID-r16 or vice versa.
 |
| Ericsson | We also think it might be a bit premature for these CRs. They should be postponed and we can come back at next meeting. |

**Table 3. Issues to be discussed for UE capabilities fo DL MIMO efficiency enhancements for LTE**

**Conclusions:** TBA

## 3.3 LTE-based 5G Terrestrial Broadcast

This section deals with the discussion as per DISC S3\_1as shown below:

***DISC S3\_1:*** *Discuss which approach can resolve the identified problem: Re-interpretation of existing signalling (*[*R2-2003545*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003545.zip)*) or addition of new signalling (*[*R2-2003364*](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003364.zip)*).*

Companies are requested to indicate in case there are objections to the proposals in the summary in the table below.

|  |  |
| --- | --- |
| **Company** | **Which approach should be taken and why: Re-interpretation of existing signalling or addition of new signalling?** |
| Qualcomm | In our understanding, proposals in 3a) and 3b) are not the same. Proposed changes in 3a) address mainly the issue of scheduling the MCCH whereas proposal in 3b) addresses the issue of scheduling MTCH. In both cases, we think network should be provided flexibility to schedule the MCCH and MTCH in the MBMS slot when subcarrier spacing of 0.37kHz is used.If 3a) is not agreed, there will be ambiguity whether a 3ms MBMS slot carries MCCH or not in case the slot falls on boundary of two SFNs, i.e., 3ms MBMS slot includes three subframes (#9 of SFN1 and #0,#1 of SFN2) and if SFN1 carries the MCCH but SFN2 does not, then there is ambiguity. In this case network may indicate #9 does not carry MCCH and resolve the ambiguity but we think it is OK to keep the flexibility for network to schedule MCCH in #9.If 3b) is not agreed, then 7 out of 13 3ms-MBMS slots cannot be used to schedule MTCH. This is huge performance degradation for subcarrier spacing of 0.37kHz to schedule MTCH in all 13 3ms-MBMS slots, new signalling is needed (i.e., to schedule MTCH in subframe #0 and #5 in dedicated MBMS). The reason we need new signalling is as follows:1. Currently, there is no signalling to schedule MTCH in #0 and #5.
2. RAN2 already agreed that if any subframe in 3ms-MBMS slot is non-MBSFN subframe, then whole 3ms-MBMS slot is not valid and cannot be used. So, any MBMS slot including subframe #0 and #5 in dedicated MBMS cell are wasted in the configured MBMS area. Each MBMS area needs to configure separately MBSFN bitmap including #0 and #5.

Therefore, we think both sets of proposals / CRs are needed. After the proposal is agreed, we can discuss exact wordings of the CRs. |
| HW | Firstly we share the same view with Qualcomm that these two contributions solve different issues. For the issue proposed in 3a), some clarificaiton is needed to indicate whether a 3ms MBMS slot can carry MCCH or not if we reuse current bitmap with the granulairy of subframe. For the issue mentioned in 3b), we have some concern.In Rel-14, for dedicated MBMS cell, when allocating MBSFN subframes in four consecutive radio frames, except the CAS and some additional non-MBSFN subframes as shown below, all other subframes can be used as MBMS subframe. NonMBSFN-SubframeConfig-r14 ::= SEQUENCE { radioFrameAllocationPeriod-r14 ENUMERATED {rf4, rf8, rf16, rf32, rf64, rf128, rf512}, radioFrameAllocationOffset-r14 INTEGER (0..7), subframeAllocation-r14 BIT STRING (SIZE(9))}while for mixed cell, in Rel-14, subframe #4 and subframe #9 are added as MBMS subframes on top of sunframe #1, #2, #3, #6, #7, #8. Therefore, in Rel-14, subframe#0 and subframe#5 are already supported to be used as MBMS subframes for dedicated MBMS cell while for mixed cell, subframe #0 and subframe #5 are not supported to be MBMS subframes. So if we reuse what we have in Rel-14, suframe #0 and subframe #5 can already be set as MBMS subframes for dedicated MBMS cell. The propsosed changes are not needed.  |
| Ericsson | We support the intention with both CRs. Exact wordings may be discussed later. |
| Qualcomm4 | To Huawei: This is true subframe #0 and #5 can be configured as MBSFN subframes. We hope we made this clear in the CR cover sheet as well. What we need to understand more is that there is restriction imposed by the scheduling of MCCH on the MBSFN subframes corresponding to a given MBSFN area.The MCCH needs to use fourFrames and fourFrames-v1430 to schedule the MTCH. Now even the subframe #0 and #5 are MBSFN subframes, MCCH cannot schedule MTCH in those subframes which now makes all the 7 out of 13 MBMS time slots wastage. Hence the need of 3b).Hope this clarifies the concern. |
| HW | To Qualcomm: I think I get the point now, please correct me if my understanding is still not correct.fourFrames and fourFrames-v1430 are used to configure MBMS subframes for mixed cell and in Rel-14, originally only subframe #1, #2, #3, #6, #7, #8 are able to be configured as MBMS subframe and then extended to include subframe #4 and subframe #9. So in Rel-14, subframe #0 and subframe #5 are not able to be configured as MBMS subframe. Then in Rel-16, reusing this configutation will result in some slot as invalid since we agreed that only when all 3 subfames are MBMS subframes can a slot be considered as a MBMS slot. So in order to improve resource efficiency, it is proposed to configure subframe #0 and subframe #5 to be used as MBMS subframes. But I still have some questions:1. This enhancement is for mixed cell case, right? Since for dedicated MBMS cell, it is already able to configure subrame #0 and subframe #5 as MBMS subframes.
2. Suframe #0 and suframe #5 are used to transmit and SIB and synchronous signal I think that is the reason why in Rel-14 they are not used as MBMS subframes, so in Rel-16, does the situation change?
 |
| Qualcomm5 | To Huawei’s question: The CRs are only for MBMS dedicated cell, and has nothing to do with mixed cell case, as indicated in the title and in the reason for change. The MBSFN configuration is 2 steps:1st step: SIB2 provides the overall MBSFN configuration. Here, we can configure all subframes as MBSFN (since for dedicated cell, we signal them through non-MBSFN field).2nd step: we assign the subframe to MBSFN areas. Here, due to error in r14, it is not possible to assign subframe #0 and #5 to any area (this 2nd step is inside MCCH).It would indeed be possible to correct it from Rel 14, but the penalty of not being able to configure sf 0/5 inside MCCH was not very high. What has changed in rel16 is when subcarrier spacing of 0.37kHz (i.e., MBMS slot length of 3 ms) is used, the throughput is reduced by 53.8% (i.e., only 6 MBMS slots out of 13 MBMS slots are usable for MCH) as explained in the coverpage. This is a very big problem of resource underutilization/wastage which needs to be corrected. |
| HW | To Qualcomm:Thanks Umesh, I not get your point, then we support the intention. Exact wordings may be discussed later.  |
| Qualcomm6 | Thank you Huawei for the comment and confirming that we need are on the same page.Now moving to the exact details of CRs, we think following needs to be done for the revisions.For R2-2003364 (QC CR): based on Huawei’s comment above, it is beneficial to clarify that this is for dedicated cell case, i.e., add the following yellow highlighted text:commonSF-Alloc-v16xy CommonSF-AllocPatternList-v16xy OPTIONAL, -- Need OR***commonSF-Alloc***Indicates the subframes allocated to the MBSFN area. E-UTRAN always sets this field to cover at least the subframes configured by *SystemInformationBlockType13* for this MCCH, regardless of whether any MBMS sessions are ongoing. E-UTRAN includes *commonSF-Alloc-v16xy* only when the cell is a MBMS-dedicated cell. If E-UTRAN includes *commonSF-Alloc-v1430* and/or *commonSF-Alloc-v16xy*, it includes the same number of entries, and listed in the same order, as in*commonSF-Alloc-r9*.For R2-2003545 (Huawei CR): To avoid confusion due to what “consider” means, we suggest rewording the added text from: “If *subcarrierSpacingMBMS* indicates 0.37kHz subcarrier spacing, if any subframe corresponding to a valid slot can carry MCCH, it is considered that this valid slot can carry MCCH.” to the following:When *subcarrierSpacingMBMS* indicates 0.37 kHz subcarrier spacing, a valid MBMS slot can carry MCCH if any of the MBSFN subframe associated with the slot is configured to carry MCCH.Hope the above suggestions are acceptable to all. |
| HW | Thanks Qualcomm for the suggestions. We have one question for clarification.For this sentence, “If E-UTRAN includes *commonSF-Alloc-v1430* and/or *commonSF-Alloc-v16xy*, it includes the same number of entries, and listed in the same order, as in *commonSF-Alloc-r9*.” is it necessary, as v1430 and v16xy are noncritical extension of r9 which are of course used on top of r9? For your suggestion on R2-2003545 (Huawei CR), we are fine with it and will provide an updated version in the draft folder. |
| Qualcomm7 | Regarding Huawei’s comment: yes it is correct understanding that v1430 and v16xy are noncritical extension of r9, however they should be 1:1 mapped, and this was missing in Rel-14. I don’t think the NCE by default means 1:1, i.e., you can have different number of values in two lists unless explicitly captured. Hence, we have similar restrictions in e.g., If E-UTRAN includes *freqBandInfo-v10l0* it includes the same number of entries, and listed in the same order, as in *freqBandInfo-r10*.Revised version of the CR R2-2003364 is provided in the drafts folder. |

**Table 3. Resolving the issue of MCCH allocation for 0.37 kHz SCS in MBMS carrier**

**Conclusions:** TBA

# 4 Conclusions

**Agreements proposed to be agreed in this meeting (from all sub-topics)**

**Proposal S2\_1:** Endorse the CRs in [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip), [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) as baseline for UE capabilities of DL MIMO efficiency enhancements for LTE.

**Open items proposed to be further discussed in this meeting (from all sub-topics)**

**DISC S1\_1:** Discuss if the intent of [R2-2002888](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) is agreeable. If needed, provided updated revision to CR [R2-2002887](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip).

**DISC S3\_1:** Discuss which approach can resolve the identified problem: Re-interpretation of existing signalling ([R2-2003545](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003545.zip)) or addition of new signalling ([R2-2003364](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003364.zip)).

# 5 List of referenced documents

[1] [R2-2002887](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002887.zip) CR on RLC out-of-order delivery configuration Samsung, LG Electronics Inc., Nokia, Nokia Shanghai Bell, Intel, Apple CR Rel-16 36.331 16.0.0 4240 - F TEI16

[2] [R2-2002888](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2002888.zip) LTE RLC out-of-order delivery configuration Samsung, LG Electronics Inc., Nokia, Nokia Shanghai Bell, Intel, Apple discussion TEI16

[3] [R2-2003546](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003546.zip) Introduction of UE capabilities for DL MIMO efficiency enhancement Huawei, Hisilicon CR Rel-16 36.331 16.0.0 4272 - F LTE\_DL\_MIMO\_EE-Core

[4] [R2-2003547](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003547.zip) Introduction of UE capabilities for DL MIMO efficiency enhancement Huawei, Hisilicon CR Rel-16 36.306 16.0.0 1756 - F LTE\_DL\_MIMO\_EE-Core

[5] [R2-2003364](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003364.zip) Correction on the configuration of subframe #0 and #5 for MCH in MBMS dedicated cell Qualcomm Technologies Int CR Rel-16 36.331 16.0.0 4259 - F LTE\_terr\_bcast-Core

[6] [R2-2003544](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003544.zip) Discussion on MCCH configuration for 0.37kHz SCS Huawei, Hisilicon discussion

[7] [R2-2003545](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109bis-e/Docs/R2-2003545.zip) Clarification on MCCH configuration for 0.37kHz SCS Huawei, Hisilicon CR Rel-16 36.331 16.0.0 4271 - F LTE\_terr\_bcast-Core