**3GPP TSG RAN WG1 #100bis-e R1-20xxxxx**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-LTE-UEFeatures-eMTC-02]

Agenda Item: 6.2.5.1

**Document for:** **Discussion and Decision**

# **Introduction**

This contribution summarizes the following email discussion in AI 6.2.5.1 regarding UE features for additional MTC enhancements.

[100b-e-LTE-UEFeatures-eMTC-02] Email discussion/approval on feature group structure for additional MTC enhancements (20th-24th April) – (DCM, Hiroki)

* Discuss whether to introduce a separate FG for the combination of FG1-3 and the larger UL TBS or to reuse the legacy capability signaling to support the combination
* Discuss whether to introduce separate FGs for the combinations of FG1-10/11/12/13 with each legacy feature or to reuse the legacy capability signaling to support the combinations
* Discuss whether to introduce a separate FG for multi-TB unicast HARQ multiplexing or to add multi-TB unicast HARQ multiplexing as component in FG1-11
* Discuss whether or not to introduce a separate FG for CSI-RS-based feedback with codebook subset restriction
* Confirm to keep FG1-1/3/4/5/6/8/10~19/21~41
* Confirm to remove FG1-20
* Confirm to remove FG1-42 to leave this FG to RAN4

# **1-3: PUR for full-PRB in CEmodeA**

In [1], FG1-3 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the eNB to know if the feature is supported** | **Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Capability interpretation for mixture of FDD/TDD** | **Note** | **Mandatory/Optional** |
| 1. LTE\_eMTC5 | 1-3 | PUR for full-PRB in CEmodeA | 1. PUR for full-RPB in CEmodeA | CEmodeA | Yes | N/A | UL data transmission will use EDT or connected mode instead of PUR in CEmodeA. | Per UE | Yes | N/A | RAN2 has agreed that PUR with UP and CP solutions have separate indications, but this is not captured in this RAN1 UE feature list.  FFS: Whether combination with max UL TBS 2984 bits requires a separate FG | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [4] | Ericsson | **Proposal 2 Introduce a separate indication for the combination of PUR and the larger UL TBS.** |

In addition, ZTE also provides the views on the signaling to indicate what combination of Rel-16 features are supported with legacy features

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 5:*** ***Re-use the legacy capability signalling to indicate these combination of feature support and clearly specify what combination of feature are supported.*** |

## 2.1 Discussion 1

**Companies are encouraged to provide views on whether to introduce a separate FG for the combination of FG1-3 and the larger UL TBS or to reuse the legacy capability signaling to support the combination.**

**Introducing the separate FG supported by: Ericsson, Qualcomm**

**Objected (i.e., reusing the legacy capability to support the combination) by: Huawei, HiSilicon, ZTE, Sanechips**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Introduce a separate FG for the combination with larger UL TBS for IODT reasons. |
| Qualcomm | We are OK with introducing this separate FG |
| ZTE,Sanechips | The legacy capability signaling can be used together to indicate combination of feature support. |
| Ericsson 2 | Regarding the ZTE/Sanechips comment above, it should be noted that a UE may very well have support implemented and (IODT) tested for the Rel-14 feature for larger UL TBS and the Rel-16 feature for PUR without necessarily have support implemented and (IODT) tested for the simultaneous combination of the two features. Therefore, a separate capability indication for this combination is desired. |
| Huawei, HiSilicon | We support to reuse legacy capability signaling.  We have many different features in different releases, if we consider all combinations and have separate FGs, there will be too many FGs. We don’t think this is the usual way to treat legacy features. |
| ZTE,Sanechip (2) | For the UE supporting rel-16 PUR, there are lots of legacy features it might also need to support. It is unrealistic to create FG to indicate combination support.  Suppose if we have to create a FG for large TBS+ PUR, and we know there's MPDCCH improvement which might also going to be supported by those PUR UEs, are we going to create different FGs for TBS+PUR, TBS+MPDCCH\_improvment, TBS+PUR+MPDCCH\_Improvement etc and what if there's another legacy feature enters the discussion? In the end we may end up with dozens of FGs and indications just for these features. |
| Ericsson 3 | Regarding the ZTE comment above, the simple answer is “No”. We will not introduce FGs for the additional combinations mentioned by ZTE. It will be enough to consider the combinations that are currently already on the table. The combinations already on the table represent feature combinations that are important but nontrivial to implement and test, and we want to ensure that they can realistically be deployed in the market by making sure that there is UE capability indication signaling support that facilitates a phased introduction of features and feature combinations. Without this, the feature combinations will probably not be possible to realize in the market due to IODT issues that should be relatively well understood by now. |

# **1-10 to 1-13: Multi-TB unicast for DL in CEmodeA**

In [1], FG1-10 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the eNB to know if the feature is supported** | **Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Capability interpretation for mixture of FDD/TDD** | **Note** | **Mandatory/Optional** |
| 1. LTE\_eMTC5 | 1-10 | Multi-TB unicast for DL in CEmodeA | 1. Multi-TB unicast scheduling for DL in CEmodeA | CEmodeA | Yes | N/A | Each DCI will schedule a single TB instead of multiple TBs in DL in CEmodeA. | Per UE | Yes | N/A | FFS: How to capture combinations of the unicast multi-TB FGs with the following legacy features:  1. Rel-14 feature for 2984 bits max UL TBS in 1.4 MHz in CE mode A  2. Rel-14 feature for new numbers of repetitions for PUSCH in CE mode A  3. Rel-14 feature for modulation restrictions for PDSCH/PUSCH in CE mode A  4. Rel-14 features for 5 or 20 MHz max PDSCH/PUSCH channel bandwidths in CE mode A/B  5. Rel-14 feature for dynamic HARQ-ACK delay for HD-FDD in CE mode A  6. Rel-15 features for flexible starting PRB for PDSCH/PUSCH in CE mode A/B | Optional with capability signalling |
| 1-11 | Multi-TB unicast for DL in CEmodeB | 1. Multi-TB unicast scheduling for DL in CEmodeB | CEmodeB | Yes | N/A | Each DCI will schedule a single TB instead of multiple TBs in DL in CEmodeB. | Per UE | Yes | N/A |  | Optional with capability signalling |  |
| 1-12 | Multi-TB unicast for UL in CEmodeA | 1. Multi-TB unicast scheduling for UL in CEmodeA | CEmodeA | Yes | N/A | Each DCI will schedule a single TB instead of multiple TBs in UL in CEmodeA. | Per UE | Yes | N/A |  | Optional with capability signalling |  |
| 1-13 | Multi-TB unicast for UL in CEmodeB | 1. Multi-TB unicast scheduling for UL in CEmodeB | CEmodeB | Yes | N/A | Each DCI will schedule a single TB instead of multiple TBs in UL in CEmodeB. | Per UE | Yes | N/A |  | Optional with capability signalling |  |

Regarding to FG1-10, following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | In our view, there is no need to support 2/4/5 together with multi-TB. 1, 3 and 6 seems easier to support. |
| [4] | Ericsson | **Proposal 5 Discuss which combinations of the multi-TB unicast features and the above listed legacy features that can be supported and which combinations (if any) that need to have separate capability indications.** |

In addition, ZTE also provides the views on the signaling to indicate what combination of Rel-16 features are supported with legacy features

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 5:*** ***Re-use the legacy capability signalling to indicate these combination of feature support and clearly specify what combination of feature are supported.*** |

## 3.1 Discussion 2

**Companies are encouraged to provide views on whether to introduce separate FGs for the combinations of FG1-10/11/12/13 with each legacy feature or to reuse the legacy capability signaling to support the combinations.**

**Introducing the separate FGs supported by: Ericsson**

**Objected (i.e., reusing the legacy capability to support the combinations) by: Huawei, HiSilicon, ZTE, Sanechips**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Introduce separate FGs for the combinations with 1, 2, 3 and 6 (but not 4 and 5) for IODT reasons. |
| Qualcomm | We have no strong view on what subset of the features may be needed, but the list from Ericsson seems reasonable. |
| ZTE,Sanechips | The legacy capability signaling can be used together to indicate combination of feature support. RAN1 recommends combinations with 1,2,3,6 are feasible. |
| Ericsson 2 | Regarding the ZTE/Sanechips comment above, it should be noted that a UE may very well have support implemented and (IODT) tested for the mentioned legacy Rel-14/15 features and the Rel-16 feature for multi-TB scheduling without necessarily have support implemented and (IODT) tested for the simultaneous combination of the features. Therefore, separate capability indications for these combinations are desired. |
| Huawei, HiSilicon | We support to reuse legacy capability signaling.  We have many different features in different releases, if we consider all combinations and have separate FGs, there will be too many FGs. We don’t think this is the usual way to treat legacy features. |
| ZTE,Sanechips (2) | Please see our views in section 2.1 |
| Ericsson 3 | Please see our views in section 2.1 |
| Nokia, NSB | We have no strong view here but we think it make sense to reuse legacy capability signaling. We agree that combination with 1,2,3,6 are reasonable. |

# **1-15: Multi-TB unicast HARQ bundling**

In [1], FG1-15 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the eNB to know if the feature is supported** | **Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Capability interpretation for mixture of FDD/TDD** | **Note** | **Mandatory/Optional** |
| 1. LTE\_eMTC5 | 1-15 | Multi-TB unicast HARQ bundling | 1. DL HARQ bundling for multi-TB unicast scheduling | 1-10 | Yes | N/A | Multi-TB unicast will not use HARQ bundling. | Per UE | Yes | N/A |  | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 3: Add separate feature group for ' Multi-TB unicast HARQ multiplexing, or at least to clarify that if this is included as a component in feature group 1-11 ' Multi-TB unicast for DL in CemodeB'.***  ***Proposal 4:*** ***Add the following note for 1-15 "FFS bundling support for TDD".*** |

## 4.1 Discussion 3

**Companies are encouraged to provide views on whether to introduce a separate FG for multi-TB unicast HARQ multiplexing or to add multi-TB unicast HARQ multiplexing as component in FG1-11.**

**Introducing the separate FG supported by: ZTE, Sanechips**

**Objected (i.e., adding multi-TB unicast HARQ multiplexing as component in FG1-11 or not supporting the feature) by: Ericsson**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | We have no strong preference at this point regarding this issue. |
| Qualcomm | We are a bit confused by this proposal. What is the meaning of HARQ multiplexing? |
| ZTE,Sanechips | Multi-TB unicast HARQ multiplexing is agreed in previous RAN1 meeting  Agreement For CE mode A, HARQ ACK/NACK feedback bundling or multiplexing on PUCCH can be enabled or disabled by [RRC and/or DCI], when multiple DL transport blocks are assigned by a single DCI. If the network does not enable it, each TB has its own separately encoded HARQ ACK/NACK feedback, i.e., no HARQ ACK/NACK feedback bundling or multiplexing. |
| Moderator | There is following suggestion from Qualcomm.  At least for FDD, I think it is not supported – for TDD, we are still finalizing the mechanism. My suggestion would be to not add this FG for now (since, as per today, there is no multiplexing defined), but we can revisit in May meeting after finalizing the TDD case. |
| Huawei, HiSilicon | We don’t think there is significant difference between the process by UE for bundling/multiplexing. Therefore, we don’t think we need a separate FG. It can be a component. |
| ZTE,Sanechips (2) | Separate FG or combine with bundling both are fine. |
| Ericsson 3 | We currently choose to indicate that we object to the introduction of this new FG, since according to the logic expressed by its only proponent (ZTE/Sanechips) in the replies in the other sections in this document, there should not be separate FGs for combinations with legacy features. We do not agree with this logic but think that we should be able to expect some consistency in this work. |
| ZTE,Sanechips (3) | HARQ Bundling or multiplexing for multiple TB are not legacy feature, it is different from rel-14 large TBS support. We don't understand what is the in-consistency issue here. |
| Nokia, NSB | We have no strong view here but we feel we don’t need a separate FG for the multiplexing. |

# **1-35: CSI-RS-based feedback with codebook subset restriction**

In [1], FG1-35 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the eNB to know if the feature is supported** | **Need for the UE to know if the feature is supported (only for V2X WI, where the PC5-RRC capability signalling is delivered between the UEs)** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Capability interpretation for mixture of FDD/TDD** | **Note** | **Mandatory/Optional** |
| 1. LTE\_eMTC5 | 1-35 | CSI-RS-based feedback for non-BL UE | 1. CSI-RS-based feedback for non-BL UE in CEmodeA  2. Codebook subset restriction for CSI-RS-based feedback for non-BL UE in CEmodeA | CEmodeA | Yes | N/A | CSI feedback will be based on CRS. | Per UE | Yes | N/A | FFS: Whether to have a separate FG for CSI-RS-based feedback with codebook subset restriction | Optional with capability signalling |

Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 6:***  ***No separate FG for CSI-RS-based feedback with codebook subset restriction.*** |
| [3] | Qualcomm | We propose to separate this. |
| [4] | Ericsson | **Proposal 11 Introduce a separate indication for codebook subset restriction for CRS-RS-based feedback.** |

## 5.1 Discussion 4

**Companies are encouraged to provide views on whether to introduce a separate FG for CSI-RS-based feedback with codebook subset restriction.**

**Introducing the separate FG supported by: Ericsson, Qualcomm**

**Objected (i.e., not introducing the separate capability) by: Huawei, HiSilicon, ZTE, Sanechips**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Introduce a separate FG for IODT reasons. |
| Qualcomm | Introduce a separate FG |
| ZTE,Sanechips | No need to introduce separate FG |
| Huawei, HiSilicon | We support to not introduce a separate capability. |
| Nokia, NSB | We have no strong view here but slight preference to have separate FG. |

# **Confirmation on other FGs**

In [1], there are following feature groups for additional eMTC enhancements.

* 1-1 Group WUS without group resource alternation
* [1-2] Group WUS with group resource alternation
* 1-3 PUR for full-PRB in CEmodeA
* 1-4 PUR for full-PRB in CEmodeB
* 1-5 PUR for sub-PRB in CEmodeA
* 1-6 PUR for sub-PRB in CEmodeB
* [1-7] PUR serving cell RSRP TA validation
* 1-8 PUR frequency hopping
* 1-9 PUR L1 ACK
* 1-10 Multi-TB unicast for DL in CEmodeA
* 1-11 Multi-TB unicast for DL in CEmodeB
* 1-12 Multi-TB unicast for UL in CEmodeA
* 1-13 Multi-TB unicast for UL in CEmodeB
* 1-14 Multi-TB unicast TB interleaving
* 1-15 Multi-TB unicast HARQ bundling
* 1-16 Multi-TB unicast UL sub-PRB
* 1-17 Multi-TB unicast UL early termination
* 1-18 Multi-TB unicast DL 64QAM
* 1-19 Multi-TB unicast frequency hopping
* 1-20 Multi-TB unicast scheduling gaps
* 1-21 Multi-TB SC-MTCH in CEmodeA
* 1-22 Multi-TB SC-MTCH in CEmodeB
* 1-23 Resource reservation for DL in CEmodeA
* 1-24 Resource reservation for DL in CEmodeB
* 1-25 Resource reservation for UL in CEmodeA
* 1-26 Resource reservation for UL in CEmodeB
* 1-27 Subcarrier puncturing for DL in CEmodeA
* 1-28 Subcarrier puncturing for DL in CEmodeB
* 1-29 DL quality report in Msg3 in Idle
* 1-30 DL quality report in Connected
* 1-31 MPDCCH performance improvement with precoder cycling in CEmodeA
* 1-32 MPDCCH performance improvement with precoder cycling in CEmodeB
* 1-33 MPDCCH performance improvement with CSI-based mapping
* 1-34 MPDCCH performance improvement with reciprocity-based candidates in TDD
* 1-35 CSI-RS-based feedback for non-BL UE
* 1-36 ETWS/CMAS indication in connected mode for non-BL UE in CEmodeA
* 1-37 ETWS/CMAS indication in connected mode for non-BL UE in CEmodeB
* 1-38 LTE control region use for MPDCCH in CEmodeA
* 1-39 LTE control region use for MPDCCH in CEmodeB
* 1-40 LTE control region use for PDSCH in CEmodeA
* 1-41 LTE control region use for PDSCH in CEmodeB
* 1-42 RSS-based measurement improvement

## 6.1 Discussion 5

**The proposal is to confirm that FG1-1/3/4/5/6/8/10~19/21~41 are kept.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Yes, we are fine with the proposal, with the understanding that 1-2, 1-7, 1-9, 1-20, 1-23, 1-24, 1-25 and 1-26 are discussed separately in another email discussion, and with the understanding that this first review round only concerns which FGs should be present in the feature list, not the contents of the fields (prerequisites, optionality, etc.). |
| Qualcomm | We agree |
| ZTE,Sanechips | FG 1-9 L1-ACK depends on the discussion result of another email thread. So, it is better to review it after all discussion are finished. |
| Moderator | ZTE's comment is about FG1-9, but the proposal does not include FG1-9 since it is under the discussion in other email discussion as mentioned by Ericsson. Also, Ericsson's comment is aligned with my intention that this proposal is just about which FGs should present in the features list and detailed descriptions for the FG can be discussed even after confirming the FG is present. In that sense, I think there should be no problem on this proposal since there is no concern on confirming listed FGs in the proposal so far. |
| Huawei, HiSilicon | The table seems Ok except FG 1-9 is also under discussion, so we suggest to put brackets for 1-9 also. |

## 6.2 Discussion 6

**The proposal is to confirm that FG1-20 is removed.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Yes, remove FG 1-20, since the UL gaps needed for UL early termination can be arranged using the UL resource reservation feature, i.e. FG 1-20 is not needed. |
| Qualcomm | 1-20 does not exist as an explicit feature, and thus should be removed. |
| ZTE,Sanechips | Oppose remove FG1-20. Need new agreement to revert previous agreement. We should avoid arbitrarily interpreting previous ran1 meeting conclusion, otherwise we need to rewrite all the specification. |
| Huawei, HiSilicon | It can be removed according to the conclusion. |
| Nokia, NSB | It can be removed |

## 6.3 Discussion 7

**The proposal is to confirm that FG1-42 is removed to leave this FG to RAN4.**

**Companies are encouraged to provide views if there is a concern or comment on the proposal.**

|  |  |
| --- | --- |
| Company | Comment |
| Ericsson | Yes, remove FG 1-42 to avoid duplicate/contradicting/confusing information to RAN2 since this feature will anyway be adequately covered in the RAN4 UE feature list. |
| Qualcomm | No strong view, either way current FG1-42 has a lot of FFS to be filled by RAN4 |
| ZTE,Sanechips | We suggest follow legacy approach. For Rel-15 it is handled by RAN1. |
| Huawei, HiSilicon | We are fine to remove it and leave it to be handled by RAN4. |
| Nokia, NSB | No strong view here but slight preference to remove it and leave to RAN4 to handle. |

# **Conclusion**

TBD

# **References**

[1] R1-2001485 RAN1 UE features list for Rel-16 LTE after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001857 Discussion on UE features for additional MTC enhancements ZTE

[3] R1-2002181 UE features for eMTC Qualcomm Incorporated

[4] R1-2002510 On the RAN1 UE feature list for Rel-16 LTE-MTC Ericsson

[5] R1-2002604 Rel-16 UE features for LTE-MTC Huawei, HiSilicon