**3GPP TSG RAN WG1 #100bis-e R1-2002428**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on UE features for additional MTC enhancements

Agenda Item: 6.2.5.1

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

# **Introduction**

This contribution summarizes the discussions and proposals in AI 6.2.5.1 regarding UE features for additional eMTC enhancements.

In R1-2001485 [1] which is the version after [100e-LTE-Rel-16-UEFeatures] email discussion, 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

Based on the discussions summarized in Section 2-14, following is the suggested list of issues to be discussed and priority order considering RAN2 impact especially for capability signaling design.

**FL proposal of list of issues/proposals and priority:**

* **1st priority issues (such as a certain FG is necessary or not):**
  + **[1-2]**
    - **Whether FG1-2 is a separate FG (i.e., remove bracket) or FG1-2 is removed and added as a component in FG1-1**
      * **Whether this issue should be discussed with [2-2] jointly or individually**
  + **1-3**
    - **Whether to introduce a separate FG for the combination of PUR and the larger UL TBS or to reuse the legacy capability signaling to support the combination**
  + **[1-7]**
    - **Whether FG1-7 is a separate FG (i.e., remove bracket) or FG1-7 is removed and added as a component in FG1-3/1-4/1-5/1-6**
      * **Whether this issue should be discussed with [2-4] jointly or individually**
  + **1-9**
    - **Whether FG1-9 is kept as a separate FG or FG1-9 is removed and added as a component in FG1-3/1-4/1-5/1-6**
      * **Whether this issue should be discussed with 2-5 jointly or individually**
  + **1-10**
    - **Whether to introduce separate FGs for the combinations of unicast multi-TB FGs with each legacy feature or to reuse the legacy capability signaling to support the combinations**
  + **1-15**
    - **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**
  + **1-23 to 1-26**
    - **Whether or not to introduce separate FGs for slot/symbol level resource reservation for FG1-23 to 1-26**
      * **Whether this issue should be discussed with 2-12 and 2-13 jointly or individually**
  + **1-35**
    - **Whether or not to introduce a separate FG for CSI-RS-based feedback with codebook subset restriction**
  + **Confirm following updates that seem acceptable**
    - **1-20**
      * **FG1-20 is removed**
    - **1-42**
      * **Leave this FG to RAN4 and remove FG1-42 from RAN1 UE feature list**
* **2nd priority issues (****that seem not have signaling impact and hence can be postponed):**
  + **1-4**
    - **Whether or not FG1-3 is a prerequisite for FG1-4**
  + **1-21 and 1-22**
    - **Whether or not to change FG name to "Multi-TB SC-MTCH in CEmodeA with scheduling gap" and "Multi-TB SC-MTCH in CEmodeB with scheduling gap"**
  + **1-29**
    - **Regarding to ‘Mandatory/Optional’ column, whether to change 'up to ran2' to 'optional without capability signalling'**

Companies are encouraged to check above FL proposals and to provide feedback if any in below.

|  |  |
| --- | --- |
| Company | Comment |
| ZTE, Sanechips | 1-20: RAN1 has previous agreement to support scheduling gap  **Agreement** [36.213]  The following working assumption is confirmed: For unicast, scheduling gaps for multiple transport blocks is supported and a scheduling gap can be configured by [RRC and/or DCI].  The decision to remove this means to revert previous agreement ,which needs some discussion and a new agreement.  Note the conclusion (below) doesn't have any real binding power because the word "aim" is used, which means we can try that direction but it may not work and companies may not agree in the end.  **Conclusion** [No specification impact]  For unicast, aim to realize the scheduling gaps using the Rel-16 LTE-MTC WI feature for improved LTE-MTC resource reservation  We suggest to change to name of this discussion from "confirm to remove" to "discuss whether to not support scheduling gap for multi-TB unicast"  **1-21/1-22:** We think this should be discussed in first priority. At the least RAN1 need to clarify what it means to have two opposite capability (support and not support) as the components. (We assume the first component ' Multi-TB SC-MTCH scheduling in CEmodeA/B ' actually means ' Multi-TB SC-MTCH scheduling in CEmodeA/B without support scheduling gap')  Currently eNB has to assume "not support" for all the UE because there is no capability signaling to differentiate "not support" and "support". If this is the intention, then it renders the component "support" to be completely useless.  We suggest the in the components section two opposite capability component should be avoided. |
| FUTUREWEI | On the structure of handling, for 1-23 to 1-26 (on resource reservation topic), our preference is to treat both eMTC and NB-IoT resource reservation commonly aligned and in one place. In NB-IoT thread, this is referred to as 2-12 and 2-13. Further technical discussion can happen next week. |
| Qualcomm | We agree with the proposals from the moderator. We would rather not rediscuss the gaps for unicast. |
| Ericsson | We agree with the proposals from the moderator.  Regarding the above comment on 1-20: In our view, the practical outcome from RAN1#99 was that explicit unicast scheduling gaps are not supported and that UL gaps for UL early termination are realized using the UL resource reservation feature, so we support the removal of the unicast scheduling gap feature group from the list.  Regarding the above comment on 1-21/1-22: According to the current version of the feature list, any UE that supports a Multi-TB SC-MTCH feature must also support the associated scheduling gaps. The multi-TB scheduling and the scheduling gaps are listed as separate components for clarity, but the components are bundled into the same feature group, i.e. the same UE capability indication. We prefer to keep it like this but are open to discuss the name of the feature group at a later stage as suggested by the moderator or simply remove the list of components altogether since it doesn’t make any difference in practice.  Regarding the above comment on 1-23 to 1-26: We also prefer to aim for a common approach for LTE-MTC and NB-IoT, if possible. |
| Huawei, HiSilicon | We agree with the proposals from the moderator.  For 1-20, our understanding is that the discussion in this meeting is to based on the conclusion from RAN1#99 meeting.  For 1-21/1-22, our understanding is that a UE supporting the feature group will support all components in the feature group.  For 1-23/1-26, we also support that it can be jointly discussed with 2-12/2-13. |

# **Updated FL Proposals**

The moderator recommends following email discussions for FL Proposals 1, 2 and 3 (only if following condition is met).

* High priority items are recommended for discussion starting Monday, April 20th, 2020. Ideally, discussions on high priority items can be concluded by Friday, April 24, 2020.
* Medium priority items are recommended for discussion starting at the time that high priority items are (almost) converged before Monday, April 27th, 2020, otherwise starting at Monday, April 27th, 2020.
* Low priority items are recommended for discussion starting at Monday, April 27th, 2020 only if high and medium priority items are converged before Monday, April 27th, 2020. Otherwise, discussion on low priority items will be postponed to next RAN1 meeting.

**FL Proposal 1 (high priority): Email discussion/approval on feature group structure for both additional MTC enhancements and additional enhancements for NB-IoT (20th-24th April)**

* **Discuss whether FG[1-2] is a separate FG (i.e., remove bracket) or FG[1-2] is removed and added as a component in FG1-1**
  + **This issue is jointly discussed with FG[2-2]**
* **Discuss whether FG[1-7] is a separate FG (i.e., remove bracket) or FG[1-7] is removed and added as a component in FG1-3/1-4/1-5/1-6**
  + **This issue is jointly discussed with FG[2-4]**
* **Discuss whether FG1-9 is kept as a separate FG or FG1-9 is removed and added as a component in FG1-3/1-4/1-5/1-6**
  + **This issue is jointly discussed with FG2-5**
* **Discuss whether or not to introduce separate FGs for slot/symbol level resource reservation for FG1-23 to 1-26**
  + **This issue is jointly discussed with FG2-12 and 2-13**

**FL Proposal 2 (high priority): Email discussion/approval on feature group structure for additional MTC enhancements (20th-24th April)**

* **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 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 based on the conclusion in RAN1#99 meeting**
* **Confirm to remove FG1-42 to leave this FG to RAN4**

**FL Proposal 3 (low priority): Email discussion/approval on feature group details for additional MTC enhancements (TBD)**

* **Discuss whether or not FG1-3 is a prerequisite for FG1-4**
* **Discuss whether or not to change name of FG1-21 and 1-22 to "Multi-TB SC-MTCH in CEmodeA with scheduling gap" and "Multi-TB SC-MTCH in CEmodeB with scheduling gap"**
  + **This issue is jointly discussed with FG2-11**
* **Discuss whether or not to change 'up to ran2' to 'optional without capability signalling' regarding ‘Mandatory/Optional’ column of FG1-29**

# **[1-2]: Group WUS with group resource alternation**

In [1], FG1-2 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 | [1-2] | Group WUS with group resource alternation | 1. Group WUS with group resource alternation | 1-1 | Yes | N/A | If UE does not support group resource alternation and the eNB enables group resource alternation, UE falls back to Rel-15 MWUS when Rel-15 MWUS is configured or no MWUS when Rel-15 MWUS is not configured. | Per UE | Yes | N/A | FFS: whether to keep this feature group 1-2 separately or put it as a component of FG 1-1 | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | We propose to make this a separate feature, mainly because of IODT (it is expected that this resource alternation will not be deployed initially). |
| [4] | Ericsson | **Proposal 1 Keep GWUS with/without group resource alternation as two separate FGs.** |
| [5] | Huawei, HiSilicon | Proposal 1: FG 1-2 (Group resource alternation) is a component in feature 1-1. |

**Based on above, following points should be discussed for FG[1-2].**

* **Whether FG1-2 is a separate FG (i.e., remove bracket) or FG1-2 is removed and added as a component in FG1-1**
  + **Whether this issue should be discussed with [2-2] jointly or individually**

# **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.*** |

**Based on above, following points should be discussed for FG1-3.**

* **Whether to introduce a separate FG for the combination of PUR and the larger UL TBS or to reuse the legacy capability signaling to support the combination**

# **1-4: PUR for full-PRB in CEmodeB**

In [1], FG1-4 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 | 1-4 | PUR for full-PRB in CEmodeB | 1. PUR for full-PRB in CEmodeB  2. Potential UE-specific cyclic shift for DMRS | CEmodeB | Yes | N/A | UL data transmission will use EDT or connected mode instead of PUR in CEmodeB. | 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 1-3 should be a prerequisite for 1-4 | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | We don’t see any issues if this is not a prerequisite, although most likely UEs that support this in mode B will also support it in mode A. |
| [4] | Ericsson | **Proposal 3 Add PUR CE mode A support as a prerequisite for PUR CE mode B support.** |

**Based on above, following points should be discussed for FG1-4.**

* **Whether or not FG1-3 is a prerequisite for FG1-4**

# **[1-7] PUR serving cell RSRP TA validation**

In [1], FG1-7 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 | [1-7] | PUR serving cell RSRP TA validation | 1. Serving cell RSRP for TA validation for PUR | 1-3 or 1-4 | Yes | N/A | PUR will not use serving cell RSRP for TA validation. | Per UE | Yes | N/A | TA validation mechanisms based on ‘Serving cell changes’ and ‘TA timer for idle mode’ (and ‘TA always valid’) are mandatory for PUR UEs.  FFS: whether to keep this feature group 1-7 separately or put it as a component of FG 1-3//1-4/1-5/1-6 | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | We propose to make it separate |
| [4] | Ericsson | **Proposal 4 Discuss whether there is enough reason from IODT point of view to keep PUR serving cell RSRP TA validation as a separate feature group.** |
| [5] | Huawei, HiSilicon | Proposal 2: FG 1-7 (Serving cell RSRP for TA validation) is a component of FG 1-3/1-4/1-5/1-6. |

**Based on above, following points should be discussed for FG1-7.**

* **Whether FG1-7 is a separate FG (i.e., remove bracket) or FG1-7 is removed and added as a component in FG1-3/1-4/1-5/1-6**
  + **Whether this issue should be discussed with [2-4] jointly or individually**

# **1-9: PUR L1 ACK**

In [1], FG1-9 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 | 1-9 | PUR L1 ACK | 1. L1 ACK for PUR | 1-3 or 1-4 | Yes | N/A | PUR will not use L1 ACK. | Per UE | Yes | N/A |  | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [5] | Huawei, HiSilicon | Proposal 3: FG 1-9 (L1 ACK) is a component of FG 1-3/1-4/1-5/1-6. |

**Based on above, following points should be discussed for FG1-9.**

* **Whether FG1-9 is kept as a separate FG or FG1-9 is removed and added as a component in FG1-3/1-4/1-5/1-6**
  + **Whether this issue should be discussed with 2-5 jointly or individually**

# **1-10: 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 |

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

|  |  |  |
| --- | --- | --- |
| [2] | 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.*** |

**Based on above, following points should be discussed for FG1-10.**

* **Whether to introduce separate FGs for the combinations of unicast multi-TB FGs with each legacy feature or to reuse the legacy capability signaling to support the combinations**

# **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".*** |

**Based on above, following points should be discussed for FG1-15.**

* **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**

# **1-20: Multi-TB unicast scheduling gaps**

In [1], FG1-20 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 | 1-20 | Multi-TB unicast scheduling gaps | 1. Scheduling gaps for multi-TB unicast scheduling | 1-10 or 1-11 or 1-12 or 1-13 | Yes | N/A | Multi-TB unicast will not use scheduling gaps. | Per UE | Yes | N/A | FFS: Whether to support these scheduling gaps or not | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | We understand that the following agreement makes this feature unnecessary:  Conclusion [No specification impact]  For unicast, aim to realize the scheduling gaps using the Rel-16 LTE-MTC WI feature for improved LTE-MTC resource reservation |
| [4] | Ericsson | **Proposal 6 Do not support explicit scheduling gaps for multi-TB unicast.** |
| [5] | Huawei, HiSilicon | Proposal 4: The FG 1-20 (scheduling gaps) is not needed. |

**Based on above, following updates for FG1-20 would be acceptable.**

* **FG1-20 is removed**

# **1-21 and 1-22: Scheduling gap for Multi-TB SC-MTCH**

In [1], FG1-21 and FG1-22 are 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 | 1-21 | Multi-TB SC-MTCH in CEmodeA | 1. Multi-TB SC-MTCH scheduling in CEmodeA  2. Potential scheduling gaps for multi-TB SC-MTCH scheduling in CEmodeA | CEmodeA,  and SC-PTM | Up to RAN2 | N/A | UE will not be able to receive SC-PTM transmissions using multi-TB scheduling in CEmodeA. | Per UE | Yes | N/A | The basic multicast (SC-PTM) functionality was introduced for LTE-M/NB-IoT in Rel-14 without capability signaling. | Up to RAN2 |
| 1-22 | Multi-TB SC-MTCH in CEmodeB | 1. Multi-TB SC-MTCH scheduling in CEmodeB  2. Potential scheduling gaps for multi-TB SC-MTCH scheduling in CEmodeB | CEmodeB,  and SC-PTM | Up to RAN2 | N/A | UE will not be able to receive SC-PTM transmissions using multi-TB scheduling in CEmodeB. | Per UE | Yes | N/A | The basic multicast (SC-PTM) functionality was introduced for LTE-M/NB-IoT in Rel-14 without capability signaling. | Up to RAN2 |

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

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 1: UE supporting multi-TB SC-MTCH should support scheduling gap.***   * ***Change FG name to "Multi-TB SC-MTCH in CEmodeA with scheduling gap" and "Multi-TB SC-MTCH in CEmodeB with scheduling gap".*** |

**Based on above, following points should be discussed for FG1-21 and FG1-22.**

* **Whether or not to change FG name to "Multi-TB SC-MTCH in CEmodeA with scheduling gap" and "Multi-TB SC-MTCH in CEmodeB with scheduling gap"**

# **1-23 to 1-26: Subframe/slot/symbol-level resource reservation**

In [1], FG1-23 to FG1-26 are 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 | 1-23 | Resource reservation for DL in CEmodeA | 1. Subframe/slot/symbol-level time-domain resource reservation in DL in CEmodeA  2. RBG-level frequency-domain resource reservation in DL in CEmodeA | CEmodeA | Yes | N/A | Whole DL subframe(s) may need to be configured as invalid in order to avoid NR collision. | Per UE | Yes | N/A | FFS: Whether to have separate indications for subframe/slot/symbol levels | Optional with capability signalling |
| 1-24 | Resource reservation for DL in CEmodeB | 1. Subframe/slot/symbol-level time-domain resource reservation in DL in CEmodeB  2. RBG-level frequency-domain resource reservation in DL in CEmodeB | CEmodeB | Yes | N/A | Whole DL subframe(s) may need to be configured as invalid in order to avoid NR collision. | Per UE | Yes | N/A | FFS: Whether to have separate indications for subframe/slot/symbol levels | Optional with capability signalling |
| 1-25 | Resource reservation for UL in CEmodeA | 1. Subframe/slot/symbol-level time-domain resource reservation in UL in CEmodeA | CEmodeA | Yes | N/A | Whole UL subframe(s) may need to be configured as invalid in order to avoid NR collision. | Per UE | Yes | N/A | FFS: Whether to have separate indications for subframe/slot/symbol levels | Optional with capability signalling |
| 1-26 | Resource reservation for UL in CEmodeB | 1. Subframe/slot/symbol-level time-domain resource reservation in UL in CEmodeB | CEmodeB | Yes | N/A | Whole UL subframe(s) may need to be configured as invalid in order to avoid NR collision. | Per UE | Yes | N/A | FFS: Whether to have separate indications for subframe/slot/symbol levels | Optional with capability signalling |

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

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 2: The capability signalling can be used to indicate support for slot/symbol level granularity in Rel-16 MTC enhancement. For subframe level, legacy indication can be used.*** |
| [4] | Ericsson | **Proposal 7 Introduce two separate indications for DL resource reservation in CE mode A with subframe-level and slot-/symbol-level granularity, respectively.**  **Proposal 8 Introduce two separate indications for DL resource reservation in CE mode B with subframe-level and slot-/symbol-level granularity, respectively.**  **Proposal 9 Introduce two separate indications for UL resource reservation in CE mode A with subframe-level and slot-/symbol-level granularity, respectively.**  **Proposal 10 Introduce two separate indications for UL resource reservation in CE mode B with subframe-level and slot-/symbol-level granularity, respectively.** |
| [5] | Huawei, HiSilicon | **Proposal 5：Separate indication to slot/symbol level resource reservation in feature groups from 1-23 to 1-26 is not supported.** |
| [3] | Qualcomm | We propose to have separate indication (for 1-23 to 26) |

**Based on above, following points should be discussed for FG1-23 to FG1-26.**

* **Whether or not to introduce separate FGs for slot/symbol level resource reservation for FG1-23 to 1-26**
  + - * **Whether this issue should be discussed with 2-12 and 2-13 jointly or individually**

# **1-29: DL quality report in Msg3 in Idle**

In [1], FG1-29 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 | 1-29 | DL quality report in Msg3 in Idle | 1. Using 2 bits in Msg3 in Idle  2. Using 4 bits in Msg3 in Idle | CEmodeA | Up to RAN2 | N/A | The eNB will have to rely on other information, e.g. CSI reports if available. | Per UE | Yes | N/A | It is up to RAN2 whether to have separate capabilities for CE mode A and B. | Up to RAN2 |

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

|  |  |  |
| --- | --- | --- |
| [2] | ZTE | ***Proposal 7:*** ***Change 'up to ran2' to 'optional without capability signalling' for FG 1-29 ' DL quality report in Msg3 in Idle'.*** |

**Based on above, following points should be discussed for FG1-29.**

* **Regarding to ‘Mandatory/Optional’ column, whether or not to change 'up to ran2' to 'optional without capability signalling'**

# **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.** |

**Based on above, following points should be discussed for FG1-35.**

* **Whether or not to introduce a separate FG for CSI-RS-based feedback with codebook subset restriction**

# **1-42: RSS-based measurement improvement**

In [1], FG1-42 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 | 1-42 | RSS-based measurement improvement | 1. RSS-based measurement improvement | Rel-15 RSS | Up to RAN4 | N/A | Measurements will be based on CRS only (not RSS). | Per UE | Yes | N/A | It is up to RAN2/RAN4 whether to have separate capabilities for Idle and Connected.  FFS: Whether it might also be relevant to consider separate capabilities for CE mode A and B  FFS: Consider removing this row since it will be part of the RAN4 UE feature list. | Up to RAN4 |

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

|  |  |  |
| --- | --- | --- |
| [3] | Qualcomm | We would like to leave all this to RAN4. |
| [4] | Ericsson | **Proposal 12 Do not introduce separate capabilities for RSS-based measurement improvements in CE mode A and B.**  **Proposal 13 Remove the RSS-based measurement improvements from the RAN1 UE feature list since they will be captured in the RAN4 UE feature list.** |

**Based on above, following updates for FG1-42 would be acceptable.**

* **Leave this FG to RAN4 and remove FG1-42 from RAN1 UE feature list**

# **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