**3GPP TSG RAN meeting #90e RP-20xxxx**

**Electronic Meeting, December 7-11, 2020**

## Status Report to TSG

**Agenda item:** 10.7.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | Additional enhancements for NB-IoT and LTE-MTC | | | | |
| included in this status report | Study Item:  No | Core part:  Yes | Performance part:  Yes | | Testing part:  No |
| **Acronym** | NB\_IOTenh4\_LTE\_eMTC6 | | | | |
| **Unique ID** | 860044 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-201306 | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item: | Core part: 09/2021 | Performance part: 03/2022 | Testing part: | |
| **Overall Completion level** | Study Item: | Core part:  25% | Performance Part: 0% | Testing part: | |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |  |
| --- | --- | --- |
| **Leading WG** | | RAN WG 1 |
| **Rapporteur** | **Name** | Yubo YANG  Emre YAVUZ |
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## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.  
 One time unit (TU) corresponds to ~ 2 hours in the meeting.  
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.  
 Note: If no Excel table is attached, then this means no time budget change.*

**Additional explanations/motivations for the time budget changes in the attached Excel table:**

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

NOTE: Agreements and Open issues impacted cross-TSG aspects shall be explicitly highlighted

## 2.1 RAN1

#### 2.1.1 Agreements

In RAN1#103-e meeting, 23 contributions ([1]-[23]) were submitted, and the following were achieved.

For NB-IoT 16QAM:

**Agreement**

At least for standalone and guard-band deployments, the maximum TBS to support 16-QAM for unicast in DL is 4968 bits with ISF=7.

**Agreement**

For inband deployment, the maximum TBS to support 16-QAM for unicast in DL is 3624 bits (ISF=7).

**Agreement**

Different breaking points (QPSK🡪16QAM) are used for standalone/guardband and inband deployments.

* FFS the details of the breaking point.

**Agreement**

Explicit or implicit signaling of power ratios of NPDSCH EPRE to NRS EPRE for the following cases is supported.

* NPDSCH in symbols without NRS and CRS
* NPDSCH in symbols with CRS (only for “In-band” deployment)
* NPDSCH in symbols with NRS

**Agreement**

For 16-QAM in NB-IoT, separate optional UE capabilities for UL and DL are supported:

* The support of 16QAM in DL is indicated by an optional UE capability signaling.
* The support of 16QAM in UL is indicated by an optional UE capability signaling.

**Agreement**

For 16-QAM in NB-IoT, separate UE-specific RRC signaling for UL and DL are supported:

* 16QAM for UL is configured by UE-specific RRC signaling.
* 16QAM for DL is configured by UE-specific RRC signaling.

**Working Assumption**

The following TBS indices are introduced for downlink

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **I\_TBS** | **I\_SF** | | | | | | | |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 14 | 256 | [552, 536] | 840 | 1128 | 1416 | 1736 | 2280 | 2856 |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2472 | 3112 |
| 16 | [328, 296] | 632 | 968 | 1288 | 1608 | 1928 | 2600 | 3240 |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 | 2856 | 3624 |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 | 3112 | 4008 |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2600 | 3496 | 4264 |
| 20 | 440 | 904 | 1384 | 1864 | 2344 | 2792 | 3752 | 4584 |
| 21 | 488 | 1000 | 1480 | 1992 | [2472, 2536] | 2984 | 4008 | 4968 |

* FFS: Support of legacy TBS indices with 16-QAM at least for some deployment modes.
* FFS: Mapping of (a subset of) TBS entries to modulation schemes for different deployment modes.
* FFS for I\_SF > 7

**Working Assumption**

The following TBS indices are introduced for uplink

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **I\_TBS** | **I\_RU** | | | | | | | |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 14 | 256 | 552 | 840 | 1128 | 1416 | 1736 | 2280 |  |
| 15 | 280 | 600 | 904 | 1224 | 1544 | 1800 | 2472 |  |
| 16 | 328 | 632 | 968 | 1288 | 1608 | 1928 | 2536 |  |
| 17 | 336 | 696 | 1064 | 1416 | 1800 | 2152 |  |  |
| 18 | 376 | 776 | 1160 | 1544 | 1992 | 2344 |  |  |
| 19 | 408 | 840 | 1288 | 1736 | 2152 | 2536 |  |  |
| 20 | 440 | 904 | 1384 | 1864 | 2344 |  |  |  |
| 21 | 488 | 1000 | 1480 | 1992 | 2536 |  |  |  |

**Working Assumption**

* For standalone and guardband deployments, the downlink TBS entries between 14 (TBS of 2856 for I\_SF=7) and 21 are used for 16QAM.
* For inband deployments, the downlink TBS entries between 11 (TBS of 2024 for I\_SF=7) and [17] are used for 16QAM.

**Agreement**

Repetitions larger than 2 are not supported in case of 16QAM for downlink

* FFS: Whether repetition of 2 is supported or not

**Agreement**

16QAM can be used at least for multi-tone transmission with 12 subcarriers.

* FFS: 3 and 6 subcarriers.

For support of additional PDSCH scheduling delay for introduction of 14-HARQ processes for eMTC:

**Agreement**

The following working assumption is confirmed

Introduce a new optional UE capability to support 14 HARQ processes

**Agreement**

The design of the 14 HARQ processes feature accounts for the presence of non-BL/CE UL and DL subframes in the PUCCH non-repetition case.

* FFS: PDSCH scheduling delays
* FFS: HARQ-ACK delays
* FFS: Configurable/dynamic set of PDSCH delays/HARQ-ACK delays

**Agreement**

For the support of 14 HARQ processes, the solution to assign PDSCH scheduling delays should be able to minimize unnecessary waste of subframes derived from the presence of non-BL/CE DL subframes and non-BL/CE UL subframes.

* The following solutions will be further investigated:
  + The indication of subframe types for the PDSCH scheduling delay of 7 are:
    - 1 BL/CE DL subframe + 1 subframe + 3 [BL/CE UL subframes] + 1 subframe + 1 BL/CE DL subframe.
    - 1 subframe + 3 [BL/CE UL subframes] + 1 subframe + 2 BL/CE DL subframes.
  + Configurable delays including other values than 2 and 7.
* Other solutions are not precluded.

**Agreement**

For the support of 14 HARQ processes, the solution to assign HARQ-ACK delays should aim to maximize the number of HARQ processes that can be scheduled in presence of non-BL/CE DL subframes and non-BL/CE UL subframes.

* Different percentages of presence of non-BL/CE subframes can be analyzed as to represent typical scenarios and determine which HARQ-ACK delays should be included.

#### 2.1.2 Remaining Open issues

* + For NB-IoT, confirmation and down-selection of TBS tables for UL and DL, and details of MCS tables for UL and DL. [NB-IoT]
  + Extend the NB-IoT channel quality reporting based on the framework of Rel-14—16, to support 16-QAM in DL. [NB-IoT]
  + Investigation and down-selection of solutions to support additional PDSCH scheduling delay for introduction of 14-HARQ processes in DL, for HD-FDD Cat M1 UEs. [LTE-MTC]
  + Add a Rel-17 optional UE capability to support a maximum DL TBS of 1736 bits for HD-FDD Cat. M1 UEs in CE mode A only. [LTE-MTC]

## 2.2 RAN2

Contributions [24] – [44] were submitted to RAN2#112-e meeting. The list of agreements made in the meeting is captured in [45].

#### 2.2.1 Agreements

**NB-IoT neighbour cell measurements and corresponding measurement triggering before RLF**

RAN2 discussed NB-IoT neighbour cell measurements and corresponding measurement triggering before RLF and made the following agreements:

|  |
| --- |
| RAN2#112-e agreements:   * Enhancements to the random-access procedure are not considered. * The solution includes reduction of the time between declaration of RLF and the start of the random-access procedure (points C and D) * FFS whether the solution includes reduction of the time between out-of-sync detection and declaration of RLF (points B and C) |

**NB-IoT carrier selection based on the coverage level and associated carrier specific configuration**

RAN2 discussed NB-IoT carrier selection based on the coverage level and associated carrier specific configuration and made no agreements.

#### 2.2.2 Remaining Open issues

* For NB-IoT, support of NB-IoT neighbour cell measurements and corresponding measurement triggering before RLF
* For NB-IoT, support of NB-IoT carrier selection based on the coverage level and associated carrier specific configuration
* For NB-IoT, RAN2 aspects of support of 16QAM.
* For eMTC, RAN2 aspects of support of additional PDSCH scheduling delay to support 14-HARQ processes in DL.
* For eMTC, RAN2 aspects of support of DL TBS of 1736 bits for HD-FDD Cat. M1 UEs in CE mode A.

## 2.3 RAN3

#### 2.3.1 Agreements

There was no discussion in RAN3.

#### 2.3.2 Remaining Open issues

* Support of NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration (e.g. maximum repetitions UL/DL, DRX configurations, etc.)

## 2.4 RAN4

#### 2.4.1 Agreements

There was no discussion in RAN4.

#### 2.4.2 Remaining Open issues

* For NB-IoT, specify 16-QAM for unicast in UL and DL. [NB-IoT]
* For NB-IoT, specify signaling for neighbor cell measurements and corresponding measurement triggering before RLF, to reduce the time taken to RRC reestablishment to another cell, without defining specific gaps. [NB-IoT]
* For UEs supporting PUSCH sub-PRB resource allocation, study and if found feasible, specify support power reduction for PRACH, PUCCH, and full-PRB PUSCH, with a maximum reduction of e.g. 3 dB below sub-PRB PUSCH power. [LTE-MTC]
* Specify necessary performance requirements, measurement accuracy requirements and test cases related to the above-mentioned enhancements and core requirements. [NB-IoT][LTE-MTC]

## 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

NOTE: This section only needs to be filled in for WI/SIs where there is a corresponding relevant WI/SI in SA/CT.

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

NOTE: This section should also flag any critical dependencies that need TSG attention.

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

1. R1-2007618 Support of 16QAM for unicast in UL and DL in NB-IoT Huawei, HiSilicon
2. R1-2008073 Support of 16-QAM for NB-IoT Nokia, Nokia Shanghai Bell
3. R1-2008697 Discussion on UL and DL 16QAM for NB-IoT ZTE
4. R1-2008920 Support 16QAM for NBIoT Lenovo, Motorola Mobility
5. R1-2008930 Support of 16-QAM for unicast in UL and DL in NB-IoT Ericsson
6. R1-2008969 Further considerations on support of 16QAM for NB-IOT MediaTek Inc.
7. R1-2009112 Support of 16-QAM for NB-IoT Qualcomm Incorporated
8. R1-2009125 Design considerations to support 16-QAM for NB-IOT Sierra Wireless, S.A.
9. R1-2009477 Feature lead summary #1 on [103-e-LTE-Rel17\_NB\_IoT\_eMTC-01] Moderator (Huawei)
10. R1-2009658 Feature lead summary #2 on [103-e-LTE-Rel17\_NB\_IoT\_eMTC-01] Moderator (Huawei)
11. R1-2009730 Feature lead summary #3 on [103-e-LTE-Rel17\_NB\_IoT\_eMTC-01] Moderator (Huawei)
12. R1-2007619 Support of 14-HARQ processes in DL for HD-FDD MTC UEs Huawei, HiSilicon
13. R1-2008074 Support of 14-HARQ processes in DL for eMTC Nokia, Nokia Shanghai Bell
14. R1-2008698 Support additional PDSCH scheduling delay for introduction of 14-HARQ processes in DL for eMTC ZTE
15. R1-2008931 Support of 14 HARQ processes in DL in LTE-MTC Ericsson, Telefónica, Verizon, SoftBank, AT&T, Telstra
16. R1-2009113 Support of 14 HARQ processes and scheduling delay Qualcomm Incorporated
17. R1-2009124 Design considerations to support 14-HARQ Feature for LTE-M Sierra Wireless, S.A.
18. R1-2009513 Feature Lead Summary [103-e-LTE-Rel17\_NB\_IoT\_eMTC-02] Moderator (Ericsson)
19. R1-2009514 Feature Lead Summary#2 [103-e-LTE-Rel17\_NB\_IoT\_eMTC-02] Moderator (Ericsson)
20. R1-2009515 Feature Lead Summary#3 [103-e-LTE-Rel17\_NB\_IoT\_eMTC-02] Moderator (Ericsson)
21. R1-2007620 Channel quality reporting in NB-IoT to support 16QAM Huawei, HiSilicon
22. R1-2008699 DL TBS increase for eMTC ZTE
23. R1-2008932 On the support of a maximum DL TBS of 1736 bits in LTE-MTC Ericsson
24. R2-2008937 Impact on Static devices THALES
25. R2-2009058 Further consideration on measurement in connected mode ZTE Corporation, Sanechips
26. R2-2009059 Further consideration on multi carriers configuration and selection ZTE Corporation, Sanechips
27. R2-2009146 Discussion on the corresponding measurement before RLF Spreadtrum Communications
28. R2-2009147 Discussion on enhanced paging carrier selection and multi carrier configuration Spreadtrum Communications
29. R2-2009180 NB-IoT carrier selection and configuration based on coverage level Ericsson
30. R2-2009268 Enhancements for Re-establishment time reduction Nokia, Nokia Shanghai Bell
31. R2-2009269 Analysis on carrier selection options for NB-IoT Nokia, Nokia Shanghai Bell
32. R2-2009731 Neighbour cell measurements in RRC\_CONNECTED Huawei, HiSilicon
33. R2-2009732 Paging carrier selection based on CEL and on DRX Huawei, HiSilicon
34. R2-2009788 Report for [Post111-e][923][NBIOT R17] RLF Enhancements (Qualcomm) Qualcomm Incorporated
35. R2-2009789 Way forward for connected mode neighbour cell measurement in NB-IoT Qualcomm Incorporated
36. R2-2009790 Support for NB-IoT carrier selection based on the coverage level Qualcomm Incorporated
37. R2-2009876 Neighbor cell measurements triggering before RLF Lenovo, Motorola Mobility
38. R2-2010076 Reducing time taken for reestablishment procedures in NB-IoT Ericsson
39. R2-2010077 NB-IoT carrier selection and configuration based on coverage level Ericsson
40. R2-2010249 Discussion on Total Interruption Time ETRI
41. R2-2010460 Measurement before radio link failure MediaTek Inc.
42. R2-2010470 Carrier selection enhancement MediaTek Inc.
43. R2-2010905 [draft] LS on NB-IoT connected mode neighbour cell measurements Qualcomm
44. R2-2010906 [AT112-e][302][NBIOT R17] Carrier selection (Ericsson) Ericsson
45. R2-2010911 RAN2 agreements for Rel-17 NB-IoT and LTE-MTC Document Rapporteur (Ericsson)

09.11.2020 minor adaptations for RAN #90e

31.08.2020 minor adaptations for RAN #89e

20.04.2020 minor adaptations for RAN #88e

18.02.2020 minor adaptations for RAN #87e

14.11.2019 minor adaptations for RAN #86

18.08.2019 minor adaptations for RAN #85

12.05.2019 minor adaptations for RAN #84

27.02.2019 minor adaptations for RAN #83

21.11.2018 completion levels with colours added (for RAN #82)

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects (for RAN #81)

v04.80 21.05.2018 minor adaptations for RAN #80

v04.79 26.02.2018 minor adaptations for RAN #79

v04.78 18.11.2017 minor adaptations for RAN #78

v04.77 06.08.2017 minor adaptations for RAN #77

v04.76 15.05.2017 minor adaptations for RAN #76

v04.75 31.01.2017 minor adaptations for RAN #75

v04.74 28.10.2016 minor adaptations for RAN #74

v04.73 01.09.2016 adaptations for RAN #73 (time units in extra Excel table, RAN6 reporting included)

v04.72 26.05.2016 adaptations for RAN #72 (introduction of NR & GERAN TUs)

v04.71 10.02.2016 minor adaptations for RAN #71

v04.70 30.10.2015 minor adaptations for RAN #70

v04.69 12.08.2015 minor adaptations for RAN #69

v04.68 21.05.2015 minor adaptations for RAN #68

v04.67 01.02.2015 minor adaptations for RAN #67

v04.66 16.11.2014 minor adaptations for RAN #66

v04.65 16.08.2014 minor adaptations for RAN #65

v04.64 22.05.2014 minor adaptations for RAN #64

v04.63 24.01.2014 restructuring for RAN #63 to cover Core & Perf. in one doc file

v03.62 11.11.2013 section 1.2.3 adapted for RAN #62

v03 11.08.2013 section 1.2.3 added on time budget

v02 07.05.2010 history added, some spelling corrections

v01 13.11.2009 First version of the template