**3GPP TSG RAN meeting #89e RP-20xxxx**

**Electronic Meeting, September 14 - 18, 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:  15% | 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 |
| **Company** | Huawei  Ericsson |
| **Email** | yangyubo1@huawei.com  emre.yavuz@ericsson.com |

## 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#102-e meeting, 22 contributions [1-22] were submitted, and the following agreements were made:

For support of 16-QAM for NB-IoT:

**Agreement**

At least for standalone and guard-band deployments, the maximum TBS to support 16-QAM for unicast in DL is select one option from following:

* Option 1: 4968 bits with *ISF*=7
* Option 2: 5072 bits with *ISF*=7
* Option 3: 5736 bits with *ISF*=7
* FFS on *ISF*>7 for this maximum TBS

FFS for inband deployments

**Agreement**

Further study on TBS/MCS table design, resource assignment and TBS allocation to support 16QAM in DL considering at least:

* MCS field size
* Achievable code rates
* Avoidance of link-adaptation issues (i.e., large SINR differences between different entries within one TBS row or between different entries in adjacent TBS rows)
* The break point between different modulation schemes
* Impacts of deployment modes
* Indication of modulation scheme for retransmissions
* Applicability of repetitions
* UE data rate

**Agreement**

Further study on TBS/MCS table design, resource assignment and TBS allocation to support 16QAM in UL based at least on the following:

* MCS field size
* Achievable code rates
* Avoidance of link-adaptation issues (i.e., large SINR differences between different entries within one TBS row or between different entries in adjacent TBS rows)
* Throughput/UE data rate increase while keeping the max TBS from Rel-16
* The break point between different modulation schemes
* Indication of modulation scheme for retransmissions
* Applicability of repetitions
* Applicability to different number of subcarriers

**Agreement**

For DL power allocation, support signaling the ratio of NPDSCH EPRE to NRS EPRE. FFS signaling details, including how/whether to signal the ratio for the following cases

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

**Agreement**

Adopt the following evaluation assumptions for support of 16QAM in DL and UL for NB-IoT

<Simulation assumptions for DL>

|  |  |
| --- | --- |
| **Parameter** | **Value/Description** |
| Operation mode for DL | Stand-alone, Guard-band, and In-band with 2 or 4 CRS ports |
| Number of antennas | 1T or 2T, 1R |
| Channel model | AWGN |
| Frequency Resource | 1 PRB |
| Number of repetitions | Baseline number of repetitions = 1  (Companies can provide results for other repetition) |
| Modulation Order | QPSK, 16-QAM |
| Noise Estimation | Ideal |
| Channel Estimation | Realistic |
| Frequency Offset | 0 |
| Time Offset | 0 |

<Simulation assumptions for UL>

|  |  |
| --- | --- |
| **Parameter** | **Value/Description** |
| Number of antennas | 1T, 2R |
| Channel model | AWGN |
| Frequency Resource | 12-tone |
| Number of repetitions | Baseline number of repetitions = 1  (Companies can provide results for other repetition) |
| Modulation Order | QPSK, 16-QAM |
| Noise Estimation | Ideal |
| Channel Estimation | Realistic |
| Frequency Offset | 0 |
| Time Offset | 0 |

For support of 14-HARQ processes for eMTC:

**Agreement**

Introduce a new RRC configuration parameter to enable 14 HARQ processes.

**Agreement**

For a UE configured with 14 HARQ processes, a PDSCH scheduling delay of 2 BL/CE DL subframes and 7 [FFS subframes type(s)] is supported at least in the PUCCH non-repetition case:

* FFS details of signaling.
* FFS other delay values to account for the presence of non-BL/CE subframes in the PUCCH non-repetition case.
* FFS if the 14 HARQ processes feature is supported in PUCCH repetition case.

**Working Assumption**

Introduce a new optional UE capability to support 14 HARQ processes

#### 2.1.2 Remaining Open issues

* + For NB-IoT, down-selection of the maximum TBS to support 16-QAM for unicast in DL, and detailed design on TBS/MCS table to support 16-QAM for unicast in 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]
  + Detailed 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 [23] – [39] were submitted to RAN2#111-e meeting. The list of agreements made in the meeting is captured in [40].

#### 2.2.1 Agreements

**Organisational**

RAN2 discussed the organisational aspects and made the following agreements:

|  |
| --- |
| RAN2#111-e agreements:   * Will maintain a document similar to the one used in R16 for capturing agreements. * The endorsed report can be provided in R2-2008309. * [Post111-e][350][NBIOT/eMTC R17] Capture the agreements (Ericsson)   + Scope: Capture the agreements.   + Intended outcome: endorsed report in R2-2008309   + Deadline: Friday, 2020-09-04 13:00 UTC |

**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#111-e agreements:   * Study current RLF procedure to understand the time taken to select the cell for access. Start and end points FFS. * Support neighbour cell measurements in RRC\_CONNECTED, at least for intra-frequency.   + FFS inter-frequency   + FFS whether measurements are done on the anchor carrier   + FFS how neighbour cell measurement is triggered   + FFS how to perform neighbour cell measurements * Working assumption: Neighbour cell measurement results are not reported to the network in RRC\_CONNECTED.   + FFS whether and when other information can be sent |

* RAN2 agreed to have an email discussion on RLF Enhancements for NB-IoT (rapporteur: Qualcomm) until the next meeting

**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 the following agreements:

|  |
| --- |
| RAN2#111-e agreements:   * Paging carrier selection Improvements based on CE level is considered * Paging carrier selection Improvements based on DRX cycle may be considered   + whether DRX cycle is considered as part of CE level (Rmax) or can be also considered separately * Enhancements for NPRACH Carrier selection carrier may be considered * Paging carrier selection Improvements solely based on WUS or GWUS is not considered * FFS service based |

#### 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

**RAN3#109-e**

The work plan was submitted for information [41], and it was noted.

#### 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

#### 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. R1-2006447 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Huawei, Ericsson
2. R1-2005304 Support of 16QAM for unicast in UL and DL in NB-IoT Huawei, HiSilicon
3. R1-2005479 Discussion on UL and DL 16QAM for NB-IoT ZTE
4. R1-2005529 Support of 16-QAM for NB-IoT Nokia, Nokia Shanghai Bell
5. R1-2005557 Support of 16-QAM for unicast in UL and DL in NB-IoT Ericsson
6. R1-2005648 Considerations on support of 16QAM for NB-IOT MediaTek Inc.
7. R1-2005837 Support 16QAM for NBIoT Lenovo, Motorola Mobility
8. R1-2005941 Design consideration to support 16-QAM for NB-IOT Sierra Wireless, S.A.
9. R1-2005974 Initial discussion on support of 16 QAM for NB-IoT Beijing Xiaomi Software Tech
10. R1-2006192 Support of 16-QAM for NB-IoT Qualcomm Incorporated
11. R1-2007239 Feature lead summary on 102-e-LTE-Rel17\_NB\_IoT\_eMTC-01 Moderator (Huawei)
12. R1-2005305 Support of 14-HARQ processes in DL for HD-FDD MTC UEs Huawei, HiSilicon
13. R1-2005480 Support additional PDSCH scheduling delay for introduction of 14-HARQ processes in DL for eMTC ZTE
14. R1-2005530 Support of 14-HARQ processes in DL for eMTC Nokia, Nokia Shanghai Bell
15. R1-2005558 Support of 14 HARQ processes in DL in LTE-MTC Ericsson
16. R1-2005940 Design considerations to support 14-HARQ for LTE-M Sierra Wireless, S.A.
17. R1-2005973 Initial discussion on support of additional PDSCH scheduling delay for introduction of 14 HARQ processes in DL for eMTC Beijing Xiaomi Software Tech
18. R1-2006193 Support of 14 HARQ processes and scheduling delay Qualcomm Incorporated
19. R1-2007265 Feature Lead Summary: [102-e-LTE-Rel17\_NB\_IoT\_eMTC-02] Moderator (Ericsson)
20. R1-2005481 DL TBS increase for eMTC ZTE
21. R1-2006448 Channel quality reporting in NB-IoT to support 16QAM Huawei, HiSilicon
22. R1-2006463 On the support of a maximum DL TBS of 1736 bits in LTE-MTC Ericsson
23. R2-2007696 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Ericsson, Huawei
24. R2-2006833 Reducing time taken for reestablishment procedures in NB-IOT Ericsson
25. R2-2006834 Cell measurement in connected mode for NB-IoT ZTE Corporation, Sanechips
26. R2-2007342 Discussion on RLF enhancements Huawei, HiSilicon
27. R2-2007472 Neighbor cell measurements triggering before RLF Lenovo, Motorola Mobility
28. R2-2007569 Connected mode neighbor cell measurement in NB-IoT Qualcomm Incorporated
29. R2-2007619 Clarification on Agenda Item – 9.1.2 THALES
30. R2-2007951 Measurement before radio link failure Shanghai Chen Si Electronics
31. R2-2008097 Analysis on Re-establishment time reduction Nokia, Nokia Shanghai Bell
32. R2-2008310 Report of [AT111-e][308][NBIOT/eMTC R17] RLF enhancements Qualcomm
33. R2-2006832 NB-IoT carrier selection and configuration based on coverage level Ericsson
34. R2-2006835 Enhancements on multi carrier configuration and selection ZTE Corporation, Sanechips
35. R2-2007343 Use cases and scenarios of carrier specific configuration Huawei, HiSilicon
36. R2-2007354 Analysis on carrier selection options Nokia, Nokia Shanghai Bell
37. R2-2007570 Support for NB-IoT carrier selection based on the coverage level Qualcomm Incorporated
38. R2-2007957 Carrier selection enhancement Shanghai Chen Si Electronics
39. R2-2008311 [AT111-e][309][NBIOT/eMTC R17] Carrier selection (Ericsson) Ericsson
40. R2-2008309 RAN2 agreements for Rel-17 additional enhancements for NB-IoT and LTE-MTC Rapporteur (Ericsson)
41. R3-204670 Work plan for Rel-17 Additional enhancements for NB-IoT and LTE-MTC (Huawei, Ericsson)

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