**3GPP TSG RAN meeting #91e RP-21xxxx**

**Electronic Meeting, March 16-26, 2021**

## Status Report to TSG

**Agenda item:** x.x.x

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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: 03/2022 | Performance part: 09/2022 | Testing part: | |
| **Overall Completion level** | Study Item: | Core part:  35% | 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?** | Yes |

*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:**

The TU is updated to align with the stage-3 freeze target of Rel-17 in 03/2022.

## 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#104-e meeting, 31 contributions ([1-31]) were submitted, and the following agreements were achieved.

For NB-IoT 16-QAM:

**Working Assumption**

The previous working assumption on the following TBS indices for downlink is updated with following modifications:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | | | | | |
| **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 14 | 256 | 552 | 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 for I\_SF > 7~~

**Agreement**

I\_SF>7 is not supported in Rel-17.

**Agreement**

Confirm the following 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 |  |  |  |

**Agreement**

DL 16-QAM is applicable for NPDSCH scheduled from a DCI with CRC scrambled by C-RNTI.

* At least C-RNTI from USS is supported, FFS if 16-QAM is applied to C-RNTI from CSS.
* FFS: Applicability of 16-QAM for PUR.

**Agreement**

Repetition is not used for 16-QAM in uplink.

**Agreement**

UL 16-QAM is applicable for NPUSCH scheduled from a DCI with CRC scrambled by C-RNTI.

* At least C-RNTI from USS is supported, FFS if 16-QAM is applied to C-RNTI from CSS.
* FFS: Applicability of 16-QAM for PUR or EDT.

**Agreement**

The soft buffer size for Cat. NB2 UEs supporting 16QAM for downlink is 12800 bits.

**Agreement**

The following working assumption is confirmed with following modifications:

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

**Agreement**

Repetition of 2 is NOT supported for 16-QAM in downlink.

**Agreement**

On the breaking point between QPSK and 16QAM for NPUSCH, the UL TBS entries only between 14 and 21 are used for 16QAM if 16QAM is configured.

**Agreement**

16-QAM can be used for 3 and 6 subcarriers NPUSCH format 1

**Agreement**

The NPDSCH EPRE in symbols with NRS can be different and can be the same with the NPDSCH EPRE in symbols without CRS and NRS.

* FFS on signaling details
* FFS for the handling on whether the PCI is different or the same

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

**Agreement**

The PDSCH scheduling delay for the PUCCH non-repetition case (i.e., PUCCH repetitions = 1):

* 2 BL/CE DL subframes.
* The PDSCH scheduling delay of 7 is expressed as:
  + 1 BL/CE DL subframe + 1 subframe + [3 subframes] + 1 subframe + 1 BL/CE DL subframe.
  + 1 subframe + [3 subframes] + 1 subframe + 2 BL/CE DL subframes.

**Agreement**

For the 14 HARQ processes feature, when PUCCH is used with 1 repetition and there is presence of non-BL/CE UL subframes (i.e., invalid UL subframes):

* The term surrounded by brackets in Solution 1 is resolved as 3 BL/CE UL subframes.

For support of a maximum DL TBS of 1736 bits:

**Agreement**

The number of soft channel bits is calculated based on the equation:



**Working Assumption: N=8**

**Conclusion**

“NOTE: It is RAN1 assumption that 1736 DL TBS feature is compatible with all other eMTC features applicable for HD-FDD Cat. M1 UEs in CE mode A. It is assumed that there’s no change to DCI formats, TBS tables and CQI tables.”

**Agreement**

The 1736 bits DL TBS feature is enabled by unicast RRC configuration.

**Agreement**

For a UE configured with “1736 bits DL TBS” and 64-QAM:

* If the UE is signaled with a TBS of up to and including 1736 bits, the UE shall apply the signaled TBS.
* If the UE is signaled with a TBS of greater than 1736 bits, the UE shall apply a TBS of 1736 bits.

#### 2.1.2 Remaining Open issues

* + Confirmation of TBS tables and breaking points for DL, details on DCI design, and FFSs on application of 16-QAM. [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]
  + Other aspects to support 16-QAM in DL, including details of signaling of the power allocation for NPDSCH for 16-QAM. [NB-IoT]
  + Details to support additional PDSCH scheduling delay for introduction of 14-HARQ processes in DL, for HD-FDD Cat M1 UEs, including DCI design, HARQ-ACK delay etc. [LTE-MTC]
  + Confirmation of the soft channel bits to support a maximum DL TBS of 1736 bits. [LTE-MTC]

## 2.2 RAN2

#### 2.2.1 Agreements

Contributions [32]– [61] were submitted to RAN2#113-e meeting. The list of agreements made in the meeting is captured in [62].

**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#113-e agreements:   * Neighbour cells measurement (detection and measurements) are performed only on the anchor carrier. * The solution is optional   R2-2102165 LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state LS\_Out Rel-17 To: RAN4. NB\_IOTenh4\_LTE\_eMTC6-Core |

**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#113-e agreements:   * Select between one of the options: * Option 1: UE selects a paging carrier based on a rule configured by the network * Option 2: NW configures a specific paging carrier * Working assumption: For both options, when coverage changes, mechanism that requires UE to report the update of coverage is not introduced. |

RAN2 agreed to have an email discussion until the next meeting

* [Post113-e][xxx][NBIOT/eMTC R17] Paging carrier selection (Huawei)

Scope: Details and pros and cons of the 2 options.

Intended outcome: Report to the next meeting.

Deadline: long

**NB-IoT: 16-QAM for unicast in UL and DL**

No discussion.

**eMTC: 14-HARQ processes in DL, for HD-FDD Cat M1 UEs**

No discussion.

#### 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 16-QAM.
* 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

In RAN3#111-e meeting, 1 contribution [63] were submitted to provide the updated work plan and noted.

#### 2.3.1 Agreements

There was no other 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

In RAN4#98-e meeting, 1 contribution [64] were submitted to provide the updated work plan.

#### 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, including to extend the NB-IoT channel quality reporting based on the framework of Rel-14—16, to support 16-QAM in 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. R1-2101280 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Huawei, Ericsson
2. R1-2100253 Support of 16QAM for unicast in UL and DL in NB-IoT Huawei, HiSilicon
3. R1-2100507 Support of 16-QAM for NB-IoT Nokia, Nokia Shanghai Bell
4. R1-2100567 Discussion on UL and DL 16QAM for NB-IoT ZTE
5. R1-2100581 Consideration on CQI report and Repetition applicability for 16QAM in R17 MediaTek Inc.
6. R1-2100762 Support 16QAM for NBIoT Lenovo, Motorola Mobility
7. R1-2101324 Design considerations to support 16-QAM for NB-IOT Sierra Wireless, S.A.
8. R1-2101509 Support of 16-QAM for NB-IoT Qualcomm Incorporated
9. R1-2101698 Support of 16-QAM for unicast in UL and DL in NB-IoT Ericsson
10. R1-2101868 Feature lead summary #1 on 104-e-LTE-Rel17\_NB\_IoT\_eMTC-01 Moderator (Huawei)
11. R1-2102030 Feature lead summary #2 on 104-e-LTE-Rel17\_NB\_IoT\_eMTC-01 Moderator (Huawei)
12. R1-2100254 Support of 14-HARQ processes in DL for HD-FDD MTC UEs Huawei, HiSilicon
13. R1-2100508 Support of 14-HARQ processes in DL for eMTC Nokia, Nokia Shanghai Bell
14. R1-2100568 Support additional PDSCH scheduling delay for introduction of 14-HARQ processes in DL for eMTC ZTE
15. R1-2101325 Design considerations to support 14-HARQ Feature for LTE-M Sierra Wireless, S.A.
16. R1-2101510 Support of 14 HARQ processes and scheduling delay Qualcomm Incorporated
17. R1-2101699 Support of 14 HARQ processes in DL in LTE-MTC Ericsson, AT&T, SoftBank, Telefónica, Verizon
18. R1-2101845 Feature Lead Summary [104-e-LTE-Rel17\_NB\_IoT\_eMTC-02] 1st check point Moderator (Ericsson)
19. R1-2101846 Feature Lead Summary [104-e-LTE-Rel17\_NB\_IoT\_eMTC-02] 2nd check point Moderator (Ericsson)
20. R1-2101847 Feature Lead Summary [104-e-LTE-Rel17\_NB\_IoT\_eMTC-02] 3rd check point Moderator (Ericsson)
21. R1-2100255 Support of a max DL TBS of 1736 bits in LTE-MTC Huawei, HiSilicon
22. R1-2100509 Support of a maximum DL TBS of 1736 bits for eMTC Nokia, Nokia Shanghai Bell
23. R1-2100569 DL TBS increase for eMTC ZTE
24. R1-2100869 Support of 1736 bit maximum DL TBS for eMTC Sony
25. R1-2101326 Design considerations to support DL TBS of 1736 bits for LTE-M Sierra Wireless, S.A.
26. R1-2101511 Support of larger TBS for eMTC Qualcomm Incorporated
27. R1-2101700 Support of a maximum DL TBS of 1736 bits in LTE-MTC Ericsson
28. R1-2101908 Feature Lead Summary [104-e-LTE-Rel17\_NB\_IoT\_eMTC-03] 1st check point Moderator (Sony)
29. R1-2100570 Channel quality report for 16QAM in NB-IoT ZTE
30. R1-2101278 Channel quality reporting in NB-IoT to support 16QAM Huawei, HiSilicon
31. R1-2101701 Compendium of 16-QAM simulation results in UL and DL for NB-IoT Ericsson
32. R2-2100324 Further considerations on measurement in connected mode ZTE Corporation, Sanechips
33. R2-2100325 draft LS on measurement in connected mode for NB-IoT ZTE Corporation, Sanechips
34. R2-2100326 Paging carriers configuration and selection ZTE Corporation, Sanechips
35. R2-2100512 Paging carrier selection procedure based on CEL Nokia, Nokia Shanghai Bell
36. R2-2100513 Analysis on Re-establishment time components and Solutions for Faster re-establishment Nokia, Nokia Shanghai Bell
37. R2-2100670 Further discussion on the corresponding measurement before RLF Spreadtrum Communications
38. R2-2100671 Further discussion on enhanced paging carrier selection and NPRACH carrier selection Spreadtrum Communications
39. R2-2101043 Neighbour cell measurements in RRC\_CONNECTED Huawei, HiSilicon
40. R2-2101044 Paging carrier selection improvements Huawei, HiSilicon
41. R2-2101045 Summary of contributions on Paging carrier selection improvements Huawei
42. R2-2101046 Discussion on 16-QAM for NB-IoT Huawei, HiSilicon
43. R2-2101047 Support of 14 HARQ Processes in DL, for HD-FDD Cat M1 Ues Huawei, HiSilicon
44. R2-2101056 Impact on Static Devices THALES
45. R2-2101113 Neighbor cell measurements triggering before RLF Lenovo, Motorola Mobility
46. R2-2101156 Support for NB-IoT carrier selection based on the coverage level Qualcomm Incorporated
47. R2-2101157 Way forward for connected mode neighbour cell measurement in NB-IoT Qualcomm Incorporated
48. R2-2101329 On the solution for reduction of RLF detection time Nokia Solutions & Networks (I)
49. R2-2101395 NB-IoT carrier selection and configuration based on coverage level Ericsson
50. R2-2101396 Reducing time taken for reestablishment procedures in NB-IoT Ericsson
51. R2-2101397 Summary of NB-IoT AI 9.1.2 neighbor cell measurements before RLF Ericsson
52. R2-2101398 Support of 16-QAM for unicast in UL and DL in NB-IoT Ericsson
53. R2-2101399 draft LS Measurements for Reducing time for RRC Reestablishment Ericsson
54. R2-2101552 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Ericsson
55. R2-2101836 Measurement before radio link failure MediaTek Inc.
56. R2-2101839 Carrier selection enhancement MediaTek Inc.
57. R2-2102154 "Summary of Email Discussion [AT113-e][304][NBIOT/eMTC R17] Neighbour cell measurements before RLF" Ericsson
58. R2-2102155 Summary of [AT113-e][305][NBIOT R17] Paging carrier selection improvements Huawei
59. R2-2102156 [Draft] LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state Ericsson
60. R2-2102163 [Draft] LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state Ericsson
61. R2-2102165 LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state RAN2
62. R2-2102164 RAN2 agreements for Rel-17 NB-IoT and LTE-MTC Ericsson (Rapporteur)
63. R3-210795 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Huawei, Ericsson
64. R4-2102233 Work plan of Rel-17 enhancements for NB-IoT and LTE-MTC Huawei, Ericsson

28.01.2021 minor adaptations for RAN #91e

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