3GPP TSG-RAN WG2 Meeting #117-e draftR2-2203587

**Electronic Meeting, Feb 21st - Mar 3rd 2022**

**Source: Document Rapporteur (Ericsson)**

**Title: RAN2 agreements for Rel-17 NB-IoT and LTE-MTC**

**Agenda Item: 9.1.1**

**Document for: Endorsement**

# 1 Introduction

This document lists RAN2 agreements made for Rel-17 “Additional enhancements for NB-IoT and LTE-M” work item (WI code NB\_IOTenh4\_LTE\_eMTC6; WID in [RP-201306](http://3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_88e/Docs/RP-201306.zip)), until and including the RAN2#117-e, Feb 21st – Mar 3rd 2022.

NOTE: Email agreements for CRs/specific topics are not listed in this document.

# 2 Additional enhancements for NB-IoT and LTE-MTC

## 2.1 Organizational

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| 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

RAN2#112-e agreements: None (except for this document, see clause 5)RAN2#113-e agreements: None (except for this document, see clause 5)RAN2#113bis-e agreements: None (except for this document, see clause 5)RAN2#114-e agreements: None (except for this document, see clause 5)RAN2#115-e agreements: None (except for this document, see clause 5)RAN2#116-e agreements: None (except for this document, see clause 5)RAN2#116bis-e agreements: None (except for this document, see clause 5)RAN2#117-e agreements:* WI is complete from RAN2 point of view.
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## 2.2 NB-IoT neighbour cell measurements and corresponding measurement triggering before RLF

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| 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#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)

RAN2#113-e agreements:* Neighbour cells measurement (detection and measurements) are performed only on the anchor carrier.
* The solution is optional

[R2-2102165](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_113-e/Docs/R2-2102165.zip) LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state LS out Rel-17 To: RAN4. NB\_IOTenh4\_LTE\_eMTC6-CoreRAN2#113bis-e agreements: NoneRAN2#114-e agreements:* The criteria to start measurements is based on a combination of serving cell quality threshold (option b) and variance of the serving cell quality (option c)
* Configuration of the criteria to start the measurements is supported.
	+ - FFS whether any further information needs to be provided by NW
* FFS whether any assistance information from UE is needed.
* FFS if/how to support ‘early’ RLF.

RAN2#115-e agreements:* The configuration of the criteria for starting the measurements include a serving cell NRSRP threshold. FFS how to address variance (as agreed last meeting)
* It is useful to have a shorter T310 timer for UEs supporting this enhancement, but FFS whether this is best achieved with the existing dedicated signalling or based on a new condition
* Prioritisation of carriers/cells to measure is left to the UE implementation.
* FFS: whether to provide a separate criteria for inter-frequency measurements (i.e., needing re-tuning) considering that they will take longer and should start earlier.
* Legacy relaxed monitoring criteria is reused to address the variance part of the criteria to start the measurements.
	+ - FFS: Whether it is enabled by the provision of separate SSearchDeltaP and TSearchDeltaP parameters from RRC\_IDLE.
* The conditions where the UE is required to perform measurements are specified. No requirement on when to stop measurements is needed.
* The configuration of the criteria for starting the measurements is provided via broadcast signalling.
* Provision of information regarding which cells/carriers to be considered is not supported. It is up to UE implementation to choose and prioritize carrier/cell list for measurement.
* Report of the cells measured in RRC\_IDLE to assist measurement configuration is not supported.
* Report of information about connected measurements during the RRC Connection re-establishment procedure for network optimisation is not supported.
* There is no need to specify which subframes can be used for measurements beyond them not being needed for PDCCH monitoring or data transmission / reception.
* Support for connected mode measurement is optional with capability signalling.
* FFS: Whether to support an indication from the UE that it starts/ stops performing measurement

RAN2#116-e agreements:* NW signals two separate thresholds for intra- and inter-frequency measurements.
* The values of s-SearchDeltaP and TSearchDeltaP may be different in RRC\_CONNECTED and RRC\_IDLE, they are signalled in a separate set of parameters.
* s-SearchDeltaP has the same value range as the existing RRC\_IDLE parameter
* FFS how to specify the state change
* [FFS] An indication that the UE starts measurement is not introduced.
* No enhancement is introduced to have a shorter T310 timer for mobile UEs supporting connected mode measurement.
* For RRC\_CONNECTED state, TSearchDeltaP is configured via SIB.
* Working assumption: For RRC\_CONNECTED state, TSearchDeltaP range is 10 – 60 seconds.
* For RRC\_CONNECTED state, no default value for TSearchDeltaP.
* No limit for how long UE can remain in relaxed neighbour cell monitoring state while it is in RRC\_CONNECTED state.
* For RRC\_CONNECTED state, the RRC\_IDLE state SSearchDeltaP is not used if the RRC\_CONNECTED state SSearchDeltaP is not provided.
* Relaxed neighbour cell monitoring is enabled in RRC\_CONNECTED state if TSearchDeltaP and SSearchDeltaP for RRC\_CONNECTED state are provided.

RAN2#116bis-e agreements:* Confirm that early RLF for NB-IoT is not supported in Release 17.
* Value for *TSearchDeltaP* is [15s, 30s, 45s, 60s]
* Neighbour cell monitoring in RRC\_CONNECTED has no impact on neighbour cell monitoring in RRC\_IDLE state
* If upon transition to RRC\_CONNECTED state, UE is not in relaxed neighbour cell monitoring state in RRC\_IDLE, then timer *TsearchDeltaP* restarted with the RRC\_CONNECTED state timer value.
* If upon transition to RRC\_CONNECTED state, UE is in relaxed neighbour cell monitoring state in RRC\_IDLE, then timer *TsearchDeltaP* is not started.
* In RRC\_CONNECTED state, when UE stops fulfilling the criteria ((*SrxlevRef* – *Srxlev*) < *SSearchDeltaP*) then timer *TsearchDeltaP* is started with the RRC\_CONNECTED timer value (FFS update variable names offline).
* Set the RRC\_CONNECTED state reference level to the last serving cell measurement, Srxlev, obtained before entering RRC\_CONNECTED state.
* No indication from UE to NW that indicates UE needs to perform inter-frequency measurements
* No dedicated signalling to enable/disable neighbour cell measurement for a UE in RRC\_CONNECTED.
* FFS whether support for connected mode measurements for RLF is indicated with or without FDD/TDD differentiation.
* Support for connected mode measurements for RLF is indicated without EPC/5GC differentiation.

RAN2#117-e agreements:* The 2 capabilities for connected mode intra-frequency and inter-frequency measurement are per UE without FDD/TDD differentiation.
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## 2.3 NB-IoT carrier selection based on the coverage level, and associated carrier specific configuration

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| 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

RAN2#112-e agreements: NoneRAN2#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#113bis-e agreements: NoneRAN2#114-e agreements:* Rel-17 paging carriers and the legacy paging carriers should be exclusive.
* RAN2 assumes S1AP/NGAP update is not needed.
* Carrier selection criteria does not include power boosting or service
* FFS: For option 1, whether DRX can be part of the carrier selection criteria
* Rel-17 paging carrier configuration is provided in broadcast signalling.
* Select between the following sub-options:
	+ - Option 1c: Network enables UE to select a Rel-17 paging carrier by providing the coverage information (CEL/Rmax) for the carrier selection to the UE in dedicated signalling
		- Option 2a: NW indicates the carrier to use explicitly via dedicated signalling based on information determined within the NW.
		- FFS for both options whether there is a report from the UE to suggest a carrier or provide a metric report
* Working assumption: UE metric for determining carrier suitability and selection is based on measured NRSRP. FFS whether to use a hysteresis/longer averaging/timer
* For option 1, upon cell change, FFS:
	+ - Alt 1: based on previously determined CEL and broadcasted paging carrier configuration in the new cell.
		- Alt 2: UE needs to perform fallback mechanism.
* For option 2, upon cell change, UE needs to perform fallback mechanism.
* Whenever the R17 coverage-based carrier criteria is met, UE uses the R17 coverage based carrier, otherwise UE should use the fallback mechanism
* For both options, fall back carrier is legacy paging carrier based on UE\_ID

RAN2#115-e agreements:* Support coverage or carrier specific DRX configurations, FFS details.
* UE capability for Rel-17 paging carrier selection should be introduced
* UE metric for determining carrier suitability and selection is based on NRSRP.
* Use a hysteresis/longer averaging/timer for UE metric based on NRSRP.
* FFS whether to introduce new UE report and/or whether to mandate support of existing Msg5 reporting.

RAN2#116-e agreements:* DRX is not used a criterion that needs to be explicitly considered for paging carrier selection.
* Option 1c with Alt2 (fallback when cell change) is supported

RAN2#116bis-e agreements:* UE can be enabled/disabled coverage-based paging carrier selection via dedicated signalling. Presence or absence of the coverage information can be implicit enable/disable indication.
* In SIB, the value range for Rmax (*npdcch-NumRepetitionPaging*) in R17 paging carrier (list) configuration can be ENUMERATED {r1, r2, r4, r8, r16, r32, r64, r128}.
* In SIB, coverage specific nB is supported, e.g., a common nB value is configured for the R17 paging carrier(s) with same Rmax (npdcch-NumRepetitionPaging).
* Coverage-specific default DRX cycle is not supported.
* Working assumption: In SIB, coverage specific ue-SpecificDRX-CycleMin is supported, e.g., a common *ue-SpecificDRX-CycleMin* value is configured for the R17 paging carrier(s) with same Rmax (npdcch-NumRepetitionPaging).
	+ - (FFS check whether there are any issues with the UE specific minimum DRX cycle per coverage level, can confirm WA if no issues.)
* Paging weight can still be used in coverage-based paging carrier selection.
* In SIB, both non-mixed operation mode and mixed operation mode can be supported in R17 paging carrier list configuration. They can be configured separately (as legacy).
* The extension in SIB22-NB can be used for providing R17 paging carrier list configuration.
* No “offset” (headroom) would be introduced for the configured NRSRP threshold.
* A configurable cell specific timer period can be applied when UE compares its serving cell NRSRP with the NRSRP threshold. FFS how to signal and value range.
* It’s specified that UE does not switch paging carrier if it has stayed less than [xx] seconds on the carrier or within a PTW. FFS value of [xx] seconds
* Coverage based paging carrier selection is enabled implicitly, i.e., when relevant parameters are provided to the UE during release.
* The Rel-17 paging carriers can also be used as the DL carriers for random access.
* No need to introduce a subgroup of paging carriers for the more easily changed CE level.
* In SIB, at most 2 coverage levels can be configured in R17 paging carrier list, each coverage level has one NRSRP threshold
* Rmax may be configured per carrier or per carrier group (coverage level).
* A paging carrier group index, e.g., the index to one of the two lists which correspond to the 2 coverage levels in SIB, is provided to the UE in dedicated signalling (when UE is released to idle).
* UE measured NRSRP can be reported to network for assisting the network to provide suitable coverage level related information. FFS how.
* FFS whether to introduce a new paging carrier list, e.g., *DL-ConfigCommon-NB-r17*, or just to extend *PCCH-ConfigList-NB*.
* Support for coverage based paging carrier selection is indicated without FDD/TDD differentiation.
* Support for coverage based paging carrier selection is indicated without EPC/5GC differentiation.

RAN2#117-e agreements:* RAN2 introduces a new *ue-SpecificDRX-CycleMin* parameter which is configured per coverage level.
* Same rules, e.g., to wait a certain period of time or avoid paging carrier switching in PTW would be applied no matter UE selects legacy paging carrier or coverage-based paging carrier.
* RAN2 use the way of extending *PCCH-Config-NB* to provide the R17 paging carrier list configuration in SIB.
* It’s RAN2 assumption that the assigned information to UE in dedicated signaling also need to be delivered to core network and sent back to eNB in next paging.
* *UEPagingCoverageInformation* RRC container is used to deliver the assigned information to UE in dedicated signalling to core network and sent back to eNB. A response LS to RAN3 would be sent as early as possible.
* Only one timer is specified to reduce paging carrier switching, regardless of whether UE is in PTW and regardless of the currently selected carrier.
* The timer is started after UE selects/switches between coverage based/non-coverage based carrier. When the timer is running, UE does not switch its current paging carrier. When timer expires, UE is allowed to switch its paging carrier based on its coverage status with respect to what was configured by the network.
* The timer is configured in SIB with a cell-specific value.
* The unit of the timer is second, from 2.56s up to 40.96s (maximum 8 values).
* Previous agreement can be refined as below:
* In SIB, coverage specific nB is supported, e.g., a common nB value is configured for the R17 paging carrier(s) with same ~~Rmax (~~*~~npdcch-NumRepetitionPaging~~*~~)~~ coverage level.

[R2-2203582](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203582.zip%22%20%5Co%20%22https%3A//www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203582.zip) Reply LS to RAN3 on coverage-based carrier selection RAN2 LS out Rel-17 To:RAN3 |

## 2.4 Other

### NB-IoT 16-QAM for unicast in UL and DL

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| RAN2#113bis-e agreements:* Working assumption: For the UE supporting 16-QAM, the L2 buffer size is 12000 bytes.
* Working assumption: Support of 16-QAM has separate UE capabilities for DL and UL

RAN2#114-e agreements: NoneRAN2#115-e agreements:* Confirm the working assumption: The support of 16-QAM uses separate UE capabilities for DL and UL.
* 16QAM is configured via dedicated signalling separately for UL and DL.
* A NPUSCH 16QAM activation indication is needed in PUR configuration.

RAN2#116-e agreements:* Confirm the working assumption of 12000 bytes for DL 16QAM for NB-IoT

RAN2#116bis-e agreements:* For 16-QAM for unicast NPDSCH and 16-QAM for unicast NPUSCH, wait for RAN1 to conclude on the scope of the capability before discussion FDD/TDD differentiation.
* Support for 16-QAM for unicast NPDSCH & 16-QAM for unicast NPUSCH are indicated without EPC/5GC differentiation.
* Wait for RAN1 to conclude on whether and when the legacy table can also be used when 16QAM DL is configured.

RAN2#117-e agreements:* UE does not provide CQI report for 16QAM in MSG3.
* 16QAM feature is not supported for MT-EDT.
* Legacy Downlink Channel Quality Report Command MAC CE is reused to trigger the channel quality report for 16QAM. (revisit only if RAN1 revise their agreements)
* When UE is configured with 16 QAM then the new table is used. (revisit only if RAN1 revise their agreements)
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### LTE-MTC 14 HARQ processes in DL for HD-FDD Cat M1 UEs

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| RAN2#113bis-e agreements:* 14 HARQ activation is configured by dedicated RRC signalling.
* Working assumption: No change to current L2 buffer size requirement

RAN2#114-e agreements: NoneRAN2#115-e agreements:* Confirm the working assumption: No change to current L2 buffer size requirement for HD-FDD Cat M1 UEs supporting 14 HARQ processes in DL.

RAN2#116bis-e agreements:* Introduce a new UE capability ce-14HARQProcesses-r17, conditional to support of ce-ModeA-r13. Signalling of the capability implies support of HARQ-ACK delay solution with Alt-1.
* Introduce a new UE capability ce-14HARQProcesses-Alt2-r17, conditional to support of ce-14HARQProcesses-r17, for additional support of HARQ-ACK delay solution with Alt-2e.
* Support for 14 HARQ processes for PDSCH is indicated without EPC/5GC differentiation.

RAN2#117-e agreements: None |

### LTE-MTC Max DL TBS of 1736 bits for HD-FDD Cat. M1 UEs in CE mode A only

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| RAN2#113bis-e agreements:* DL TBS of 1736 bits is configured by dedicated RRC signalling.
* FFS: Whether to update L2 buffer size requirement

RAN2#114-e agreements: NoneRAN2#115-e agreements:* The table 4.1A-1 in TS 36.306 for DL Category M1 needs to be updated to indicate 1736 bits TBS and 43008 soft channel bits.
* Max DL TBS of 1736 bits can be supported for PUR.
* FFS EDT support.

RAN2#116-e agreements:* No change to existing L2 buffer requirements for supporting 1736bits TBS for eMTC.

RAN2#116bis-e agreements:* Support for maximum DL TBS of 1736 bits is indicated without EPC/5GC differentiation.

RAN2#117-e agreements:* RAN2 confirm that DL TBS of 1736 bits can be supported in multi-TB scheduling.
* DL TBS of 1736 bits is not supported in SC-PTM.
* DL TBS of 1736 bits is not supported in EDT.
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### Power reduction for PRACH, PUCCH, and full-PRB PUSCH

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| RAN2#116bis-e agreements:* Wait for RAN4 to decide which capability is needed for power reduction for PRACH, PUCCH, and full-PRB PUSCH.

RAN2#117-e agreements: None |

# 3 References: List of approved outgoing Rel-17 LSs

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| **Tdoc** | **Meeting** | **Title** | **WI** | **To** | **Cc** |
| R2-2102165 | RAN2#113-e | LS on neighbour cell measurement in NB-IoT RRC\_CONNECTED state | NB\_IOTenh4\_LTE\_eMTC6-Core | RAN4 |  |
| R2-2203582 | RAN2#117-e | Reply LS to RAN3 on coverage-based carrier selection | NB\_IOTenh4\_LTE\_eMTC6-Core | RAN3 |  |
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# 4 References: Reports from the breakout session

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| **Meeting** | **Date** | **Title** | **Tdoc** |
| RAN2#111-e, Online | 17-28 August 2020 | Report NB-IoT breakout session | R2-2008127 |
| RAN2#112-e, Online | 2-13 November 2020 | Report NB-IoT breakout session | R2-2010707 |
| RAN2#113-e, Online | Jan 25 - Feb 5 2021 | Report NB-IoT breakout session | R2-2101957 |
| RAN2#113bis-e, Online | 12 - 20 April 2021 | Report NB-IoT breakout session | R2-2104307 |
| RAN2#114-e, Online | 19 – 27 May 2021 | Report NB-IoT breakout session | R2-2106477 |
| RAN2#115-e, Online | 9 - 27 August 2021 | Report NB-IoT breakout session | R2-2108837 |
| RAN2#116-e, Online | 1 – 12 November 2021 | Report NB-IoT breakout session | R2-2111297 |
| RAN2#116bis-e, Online | 17 – 25 January 2022 | Report NB-IoT breakout session | R2-2201667 |
| RAN2#117-e, Online | Feb 21 – Mar 3 2022 | Report NB-IoT breakout session | R2-2203517 |

# 5 Change history

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| **Tdoc** | **Title** | **Comment** |
| R2-2008309 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#111-e  |
| R2-2010911 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#112-e |
| R2-2102164 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#113-e |
| R2-2104451 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#113bis-e |
| R2-2106602 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#114-e |
| R2-2108974 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#115-e |
| R2-2111396 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#116-e |
| R2-2201788 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#116bis-e |
| R2-2203587 | RAN2 agreements for Rel-17 additional enhancements for NB-IoT & LTE-MTC | Post RAN2#117-e |