**3GPP TSG RAN meeting #92e RP-21xxxx**

**Electronic Meeting, June 16 – 21, 2021**

## Status Report to TSG

**Agenda item:** 9.2.1

|  |  |
| --- | --- |
| **WI / SI Name** | NR-based Access to Unlicensed Spectrum |
| included in this status report | Study Item: No | Core part: Yes | Performance part:Yes | Testing part:No |
| **Acronym** | NR\_unlic |
| **Unique ID** | 820067 |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-192926 |
| **Target Completion Date****(indicate if changed)** | Study Item: N/A | Core part: 12/2020 | Performance part: 06/2021 | Testing part: N/A |
| **Overall Completion level** | Study Item: N/A | Core part: 100% | Performance Part: 100% | Testing part: N/A |

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** | TSG RAN1 |
| **Rapporteur** | **Name** | Jing Sun |
| **Company** | Qualcomm |
| **Email** | jingsun@qti.qualcomm.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:**

Additional TUs for core Q3-2020 and performance Q4-2020 and Q1-2021.

## 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

#### 2.1.2 Remaining Open issues

No remaining open issues in RAN1. RAN1 completion rate is 100%.

## 2.2 RAN2

#### 2.2.1 Agreements

#### 2.2.2 Remaining Open issues

No open issues. RAN2 100% complete.

## 2.3 RAN3

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

## 2.4 RAN4

#### 2.4.1 Agreements

##### RF:

##### RRM:

**From RAN4#98-bis-e:**

* Email discussion summary for performance requirements was approved in R4-2105804.
* Two WFs were approved for performance requirements
	+ WF on general test configurations in R4-2105709
	+ WF on LBT models in R4-2105710
* Updated test case list for NR-U performance work was approved in R4-2105711
* Agreed CRs/Draft CRs:

|  |  |
| --- | --- |
| **Tdoc number** | **Title** |
| R4-2105712  | Draft Big CR: Introduction of Rel-16 NR-U RRM performance requirements  |
| [R4-2106847](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106847.zip)  | NR-U accuracy requirements  |
| [R4-2106879](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106879.zip)  | DraftCR 36.133 Correction of accuracy requirements for NR-U bands  |
| [R4-2106975](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106975.zip)   | Draft CR on inter-RAT NR measurement accuracy requirements  |
| R4-2105713  | Draft CR on DL CCA model for NR-U  |
| [R4-2106873](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106873.zip)  | Draft CR: Update of RMC for NR-U test cases  |
| [R4-2106977](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106977.zip)  | Draft CR of test case configurations for NR-U  |
| R4-2105714  | Applicability rules for legacy NR tests for NR-U in 38.133  |
| R4-2105715  | Introduction of NR-U cell reselection tests  |
| R4-2105716  | Draft TC NR-U handover test cases  |
| R4-2105717  | Introduction of NR-U handover tests  |
| R4-2105718  | Draft CR of test cases for HO delay and interruption for NR-U  |
| R4-2106577  | Draft TC RRC re-establishment with CCA  |
| R4-2105719  | Draft CR on test cases for RRC release with redirection for NR-U  |
| R4-2105720  | RRC connection release with re-direction from NR to NR-U test in 38.133  |
| R4-2105721  | Draft CR: Random access procedure test cases for NR-U  |
| R4-2105722  | Test cases on BWP switching for NR-U SA in TS 38.133  |
| R4-2105723  | Draft CR of test cases for PSCell addition and release for NR-U  |
| R4-2105724  | Draft CR: Update of beam management test cases for NR-U  |
| R4-2106578  | Draft TC NR-U inter-frequency measurements  |
| R4-2105725  | Draft CR on test cases for inter-RAT measurement for NR-U  |
| R4-2105726  | Introduction of test cases for L1-RSRP measurement accuracy with CCA serving cell  |
| R4-2105727  | Draft CR on test cases for intra-frequency measurement accuracy for NR-U  |
| R4-2105728  | Test cases for RSSI and CO measurement accuracy in NR-U R16  |

**Key Agreements**

* **FBE and LBE applicability**
	+ For a UE that supports both LBE and FBE, all test cases are run with LBE, and additionally some specific test cases are also run with FBE.
		- The set of test cases is FFS
	+ A UE that signals FBE only capability is subject to tests only with FBE configuration.
	+ A UE that signals LBE only capability is subject to tests only with LBE configuration.
* **FBE and LBE test cases**
	+ For a UE that supports both LBE and FBE, the following test cases should be run for LBE and FBE:
		- RRC\_Idle, cell-reselection intra-frequency, NR-U -> NR-U
		- Random Access to NR-U PCell
* **UL/DL pattern configuration**
	+ For LBE, the default UL/DL pattern shall be the same as that in existing configurations TDDConf.2.1, i.e., DDDSUUUUDD, where the actual DL/UL configurations are indicated by DCI, according to which TE shall schedule the UE in each slot.
	+ For FBE, the default UL/DL pattern shall be the same as that in existing configurations TDDConf.2.1, i.e., DDDSUUUUDD, where the actual DL/UL configurations are indicated by DCI, according to which TE shall schedule the UE in each slot.
* **SSB configuration for NR-U test cases**
	+ Regarding SSB candidate positions:
		- One SSB candidate position is used for semi-static channel access configurations, and 2 SSB candidate positions are used for dynamic channel access configurations
	+ Regarding SSB indexes:
		- The number of SSB indexes to be used in each test case is configured to be the same as in the existing NR test case.
* **Test case specific configurations**
	+ Test configurations and parameters for various test cases were agreed
	+ Reselection test shall verify that maximum allowed CCA failures for Md, Mm and Me.
	+ Handover delay verified in test requirements is expressed using a formula containing L1, L1’ and L2 depending on the type of test case, and the total delay is limited by T304 timer.
		- FFS: Parameter L3
	+ In NR to NR-U RRC connection release with redirection test ensure that number of DL LBT failures (L1) in target cell does not exceed L1,max ; L1,max is defined in Table 6.2.3.2.3-1, TS 38.133
	+ For the non-contention random access procedure in NR-U, define only the SSB-based random access procedure test cases.
	+ Not to configure lbt-FailureRecoveryConfig for the random access procedure test cases
	+ Periodic SRS shall be configured in the SpCell to enable the UE to detect consistent UL LBT failure in the SpCell.
	+ In the NR-U RSSI/CO measurement TCs the parameter configuration shall guarantee the Io difference between inside RMTC and outside RMTC within a range of [14dB, 15dB].
* **CCA models**
	+ Test environment should not have test runs that are rendered useless due to exceeded LBT failures
	+ Test equipment should make sure that Lmax is not exceeded during a test by monitoring the number of CCA failures and preventing additional CCA failures from happening after Lmax is reached.
	+ Adopt a baseline UL CCA model as below:
		- TCCA ms prior to each UL transmission burst in the test:
			* The test equipment (TE) generates a uniform random variable p from the range [0, 1].
			* If p<PCCA\_UL, the TE transmits an [OCNG noise pattern] with an energy level X within the UE BW scheduled/configured for the UL transmission for at-least TCCA ms.
				+ TCCA is the channel sensing period depending on LBT category being used by the UE
				+ PCCA\_UL is the probability of a successful UL CCA
				+ Energy level X is FFS and is higher than the LBT detection threshold
		- The TE keeps a count of the number of UL CCA failures it causes.
		- The TE monitors the UL resource for the desired UL signal.
		- Based on when and/or whether the TE receives the desired UL signal, it deems the test case to pass/fail
		- Note 1: applicability of OCNG noise pattern is FFS
	+ Configure UL CCA failure recovery only as part of the following RRM test case:
		- NR-U – NR-U PCell UL active BWP switch based on persistent UL LBT failure
	+ RAN4 to test additional delay in acquiring PRACH resource due to UL LBT failures in the following requirement:
		- Handover to a target cell using CCA
	+ Include UL CCA failure in Random Access test cases

**From RAN4#99-e:**

* Email discussion summary for performance requirements was approved in R4-2108382.
* Three WFs were approved for performance requirements
	+ WF on general test configurations in R4-2108259
	+ WF on LBT models in R4-2108260
* Updated test case list for NR-U performance work was approved in R4-2108261
* LS to RAN5 on NR-U Test Cases subject to statistical testing in R4-2108262
* Agreed CRs/Draft CRs:

|  |  |
| --- | --- |
| **Tdoc number** | **Title** |
| R4-2108289  | Big CR: Introduction of Rel-16 NR-U RRM performance (Cat B, Rel 16) |
| R4-2108177  | Big CR: Introduction of Rel-16 NR-U RRM performance (Cat A, Rel 16) |
| R4-2110962  | DraftCR 38.133 NR-U conditions  |
| R4-2110968  | CR 36.133 Correction of accuracy requirements for NR-U bands  |
| R4-2110326  | CR on inter-RAT measurement accuracy for NR-U R16  |
| R4-2108263  | Draft CR: Update of RMC for NR-U test cases  |
| [R4-2109278](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2109278.zip)   | Requirement classification for statistical testing for TCs with CCA  |
| R4-2108264  | Draft CR on CCA model for NR-U   |
| R4-2108265  | Correction to cell reselection test cases for NR-U  |
| R4-2109279  | Draft TC NR-U Handover test cases  |
| R4-2108266  | Draft CR on HO test cases for NR-U  |
| R4-2108267  | Correction to handover test cases for NR-U  |
| R4-2108268  | Draft TC RRC re-establishment with CCA  |
| R4-2108270  | Draft CR on TC of RRC connection release with redirection for NR-U  |
| R4-2108271  | RRC re-establishment tests from NR to NR-U in 38.133  |
| R4-2108272  | Random Access test cases with CCA  |
| R4-2108273  | Draft CR: Random access procedure test cases for NR-U  |
| R4-2108274  | Correction to UE transmit timing tests  |
| R4-2108275  | Correction to BWP switching with consistent UL LBT failures  |
| R4-2108276  | Draft CR on PSCell addtion for NR-U  |
| R4-2108277  | NR-U SCell activation TC  |
| R4-2108278  | NR-U Other interruption TC  |
| R4-2108279  | Draft CR: Update of beam management test cases for NR-U  |
| R4-2109277  | Draft TC NR-U inter-frequency measurements  |
| R4-2108280  | Draft CR of test cases for Inter-RAT measurement for NR-U  |
| R4-2108281  | NR-U SFTD procedure TC  |
| R4-2108282  | RSRP/RSRQ  measurement accuracy test for NR-U in EN-DC  |
| R4-2108283  | TCs for RSSI and CO measurement accuracy in NR-U R16  |
| R4-2108284  | NR-U SFTD accuracy TC  |

**Key Agreements**

* **Applicability rules**
	+ Add a note in each NR-U test case for verifying the legacy requirements as follows:
		- In EN-DC test: The UE supporting EN-DC only on NR band(s) with shared spectrum access is required to be tested.
		- In SA test: The UE supporting SA operation only on NR band(s) with shared spectrum access is required to be tested.
	+ Above the NR-U tests include:
		- Handover
			* NR-U - > E-UTRAN (FDD,TDD)
		- Legacy DCI/timer/RRC-based BWP switching on NR-U SCell
		- Interruption
			* Due to inter-RAT SFTD measurements
			* Due to NR-U PSCell addition/release
		- Timing advance
* **SI decoding time**
	+ SI decoding time, TSI,CCA, is kept at 1280ms during RRC re-establishment and RRC release with re-direction in NR-U networks
* **Test case specific**
	+ Configure LCCA\_DL and LCCA\_UL such that T304 is not expired due to CCA failures in the HO test case.
	+ Configure LCCA\_DL = LCCA\_UL = 5, WCCA =T304, and T304=500ms in the HO test case with CCA
	+ Define configuration of random access test cases that help differentiating the UE behaviour when configured with semi-static and dynamic channel access modes.
	+ Define random access test cases that limit the number of CCA failures in UL and DL to prevent reaching preambleTransMax for both LBE and FBE configurations.
	+ Define *preambleTransMax*, LCCA\_DL and LCCA\_UL in random access test cases with CCA such that *preambleTransMax* > 5 + LCCA\_DL + LCCA\_UL for both LBE and FBE configurations
		- Define *preambleTransMax* = n20, LCCA\_DL =4 and LCCA\_UL =5 in random access test cases with CCA for both LBE and FBE configurations.
		- NOTE: LCCA\_DL is only configured if PCCA\_DL≠1
	+ Configure DL CCA failures for the random-access test cases for semi-static channel access configuration
	+ Test equipment to increase by 6dB NR configurations for *preambleReceivedTargetPower* for msg1 and *msgA-PreambleReceivedTargetPower* for msgA for RA test cases with UL CCA failures
	+ UE timing advance adjustment accuracy tests are defined for the following LBT configuration/setting in SpCell: PCCA\_UL=1 and PCCA\_DL =1 in all test times.
* **CCA models**
	+ CCA DL success probabilities are applicable to any value of *Es/Iot*
	+ CCA UL success probabilities are applicable to any value of *Es/Iot*
	+ Determine that TCs under CCA with 0 < PCCA <1 are subject to statistical testing.
		- Send LS to inform RAN5 about the RAN4 decision
	+ CCA success probabilities
		- DL
			* For LBE: P1 = 0.75, P2 = 0.75
			* For FBE: P = 0.9375
		- UL
			* For LBE: P = 0.75
			* For FBE: P = 0.87
	+ The existing DL CCA model in non-DRX shall also apply when DRX is used.
		- Regardless of whether DRX is used or not, prior to each DBT window, the test equipment shall determine whether the CCA attempt is successful.
	+ Include limitation of the UL CCA failures LCCA\_UL on the UL CCA model.
	+ OCNG pattern is used for noise generation during the UL CCA detection time (TCCA) within the UL resources where the UE needs to assess the UL CCA.
		- During the UL CCA detection time the test equipment should generate energy level 3 dB above the energy detection threshold defined in TS 37.106.

##### Demod:

**RAN4 #98-bis-e:**

**UE Demod:** The discussion continued regarding the remaining details on the downlink transmission model and the test setup was agreed for PDSCH and CQI. A first set of PDSCH alignment results were collected, and the baseline simulation assumptions for CQI reporting were agreed.

Some of the agreements, extracted from the WF in R4-2106173, can be highlighted:

* For PDSCH and CQI requirements, no applicable test is defined for UE that do not support the optional capability ‘csi-RS-ValidationWith-DCI’;
* For PDSCH and CQI, define a single Downlink Transmission/LBT model for NR-U Demod tests, with LBT Failure Probability = 0.25;
* Define a single set of PDSCH Requirements for the unlicensed cell for scenario A and C;
* For NR + NR-U CA, NR PCell configuration will be specified and during test only PDSCH performances on the NR-U SCell CC will be verified;

Also agreed in this meeting:

* Baseline detailed simulation assumptions for CQI;

**BS Demod:** The discussion continued on PUSCH , PUCCH and PRACH Requirements.

Some of the agreements reached (see R4-2106134, R4-2106010):

* PUSCH requirements baseline applicability rules for BS supporting different bandwidth were agreed;
* Baseline simulation assumptions for CG-UCI tests were agreed;
* PF3 test metric and information bits pattern for PUCCH tests;
* BS declaration for extended PRACH;
* Big CRs :
	+ R4-2106166, Big CR for NR-U BS demodulation requirements in TS 38.104;
	+ R4-2106167, Big CR for NR-U BS conducted conformance testing in TS 38.141-1;
	+ R4-2106168, Big CR for NR-U BS radiated conformance testing in TS 38.141-2;

**RAN4 #99-e:**

**UE Demod**: The discussion continued with the definition of requirements based on the collected impairment simulation results and the agreements on the last details of the CQI test setup and NR PCell bandwidth configuration;

Some of the agreements (see email summary in R4-2108676), can be highlighted:

* For PDSCH requirements, define requirements for NR-U CC with {20, 40, 60, 80} MHz and test the largest supported unlicensed CBW only;
* For CQI requirements, define requirements for the NR-U CC with 20 MHz only;
* For the NR + NR-U CA scenario, configure the NR PCell with CBW 20MHz (TDD);
* For PDSCH and CQI, test UEs only for the largest number of supported RX;
* For CQI reporting test, configure Aperiodic CSI-RS resource and Aperiodic CQI Reporting and reuse Rel.15 setup with no PDSCH scheduling in slots that are not fully allocated to DL or that contain CSI-RS;
* CQI Detailed test setup assumptions and SNR points to be tested were agreed;
* PDSCH Requirements based on collected impairment results;
* Big CRs :
	+ R4-2108513, Big CR for the Introduction of NR-U UE Demodulation Requirements (PDSCH and CQI) – Cat B – Rel.16;

**BS Demod**: The discussion continued on PUSCH , PUCCH and PRACH Requirements.

Some of the agreements reached (see R4-2108677, R4-2108515):

* Simulation results alignment for interlaced PUSCH and CG-UCI multiplexed on PUSCH;
* Simulation results alignment for PUCCH requirements;
* Simulation results alignment for PRACH requirements;
* Big CRs:
	+ R4-2110504, Big CR for NR-U BS demodulation requirements in TS 38.104 (Rel-16);
	+ R4-2109598, Big CR for NR-U BS conducted conformance testing in TS38.141-1 (catB);
	+ R4-2109283, Big CR for NR-U BS radiated conformance testing in TS 38.141-2;

#### 2.4.2 Remaining Open issues

##### RF:

 None

##### RRM:

* Core part
	+ Complete, only maintenance work is needed.
* Performance part:
	+ Complete, only maintenance work is needed for some of the test cases

##### Demod

**UE Demod**:

* Update requirements in [] in the next meeting to reflect the complete impairment simulation results collected;

**BS Demod:**

* Further check SNR requirements and if needed, update the results in the next meeting;

RAN4 core completion is at 100% and performance completion is at 100%.

## 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.

v04.81 31.07.2018 simplification of template and addition of cross-TSG aspects

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