**3GPP TSG RAN WG1 Meeting #100b-e                     R1-200xxxx**

**eMeeting, April 20 - 30, 2020**

**Agenda Item: 7.2.2.2.2**

**Source: Moderator (Charter Communications)**

**Title: Draft-100b-e-NR-unlic-NRU-InitAccessProc-03 [RRM/RLM]**

**Document for: Discussion and Decision**

# Introduction

Three email discussions have been sanctioned in RAN1#100b-e on initial access procedures for NR-U. This third discussion that aims to converge by 4/24 has the following scope:

[100b-e-NR-unlic-NRU-InitAccessProc-03] Email discussion/approval on following issues related to RRM/RLM by 4/23; if necessary, followed by endorsing the corresponding TPs by 4/28 – Amitav (Charter)

* TP to 38.215 for RSSI definition
* Finalize the number of OFDM symbols for RSSI measurement duration configuration

These issues have been selected based on the preparatory discussion summarized in [14].

# Company views

## TP to 38.215 for RSSI definition

Choose between the following:

TP1 [7]:

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| **Definition** | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) measured by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc. The UE measures ~~observed~~ only in configured OFDM symbols and in the ~~configured~~ measurement bandwidth ~~over~~ *~~N~~* ~~number of resource blocks~~ corresponding to the ~~LBT~~ channel bandwidth [TS 37.213 §4.0] where the channel has center frequency ~~of~~ configured by *ARFCN-ValueNR*~~, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.~~  Higher layers configure the ~~measurement bandwidth,~~ *ARFCN-ValueNR,* reference subcarrier spacing and the measurement duration ~~and~~, i.e. which OFDM symbol(s) should be measured by the UE.  For frequency range 1, the reference point for the RSSI shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported RSSI value shall not be lower than the corresponding RSSI of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED intra-frequency,  RRC\_CONNECTED inter-frequency |

TP2 [3][6]:

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| **Definition** | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in the configured OFDM symbol~~s~~ and in the configured measurement bandwidth over *N* number of resource blocks corresponding to LBT bandwidth with the center frequency of configured ARFCN, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.  Higher layers configure the reference numerology, measurement bandwidth, measurement duration and which OFDM symbol(s) should be measured by the UE.  For frequency range 1, the reference point for the RSSI shall be the antenna connector of the UE. If receiver diversity is in use by the UE, the reported RSSI value shall not be lower than the corresponding RSSI of any of the individual receiver branches. |
| **Applicable for** | RRC\_CONNECTED intra-frequency,  RRC\_CONNECTED inter-frequency |

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| **Company** | **Views** |
| Samsung | We are in general with both TPs, and both have valid points to be merged. For example, we should not use “LBT bandwidth” as indicated in TP1, and use “reference numerology” instead of “reference subcarrier spacing” as in TP2. We would FL provide a merged TP for this issue. |
| LG Electronics | Agree with Samsung. To merge two TPs and minimize spec impact, the following TP can be considered.   |  | | --- | | Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) observed only in the configured OFDM symbol and in the measurement bandwidth corresponding to the channelbandwidth [TS 37.213 §4.0] where the channel has the center frequency configured by *ARFCN-valueNR*, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc.  Higher layers configure the *ARFCN-valueNR*, the reference numerology, and the measurement duration i.e., which OFDM symbol(s) should be measured by the UE. | |
| ZTE | We basiclly agree with LG’s TP.  Our understanding is that, the only difference of RSSI measurement between Rel-16 NRU and Rel-13 LAA is the newly introduced reference numerology and LBT bandwidth with the center frequency.  We agree to replace ‘LBT bandwidth’ with ‘channel bandwidth’ in TP1. As for the statement of ‘the configured OFDM symbol’, it absolutely follows the definition in Rel-13 which doesn’t need to change. |
| Nokia, NSB | We are fine with the “merged TP” as provided by LGE.  In particular and in our view the reference to TS 37.213 is mandatory to avoid any confusion related to the “channel” wording. |
| Ericsson | We made the following agreement in the last meeting:  Agreement:  The L1 averaging duration of RSSI measurements (within a configured measurement duration) is limited to 1 OFDM symbol of a configured reference subcarrier spacing.  This agreement says that the UE does not do averaging over symbols at L1, so if the UE is configured with a multi-symbol measurement duration, then L1 feeds multiple (per-symbol) measurements up to higher layers (in the UE). Higher layers will then process these multiple measurements before providing a single RSSI report over L3 to the gNB.  The merged proposal above as well as the proposal in [3] and [6] seem to have the same a flaw, because they say “…observed only in the configured OFDM symbol…” however, multiple symbols are configured (the measurement duration). So the wording is not accurate. I suggest that we capture that the linear average is computed on a per symbol basis within the configured measurement duration to solve this.  Furthermore, the text is very hard to parse, which is why we suggested moving the “…by the UE from all sources …” phrase up to the front.  How about the following merged/corrected TP?  Received Signal Strength Indicator (RSSI), comprises the linear average of the total received power (in [W]) measured by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc. The linear average is determined ~~observed only in configured OFDM symbols and in the configured~~ over the measurement bandwidth ~~over~~ *~~N~~* ~~number of resource blocks~~ for each symbol separately within the configured measurement duration. The measurement bandwidth corresponds~~ing~~ to the ~~LBT~~ channel bandwidth [TS 37.213 §4.0] ~~with~~ where the channel has center frequency ~~of~~ configured by ~~ARFCN~~ *ARFCN-ValueNR*~~, by the UE from all sources, including co-channel serving and non-serving cells, adjacent channel interference, thermal noise etc~~.  Higher layers configure ~~the measurement bandwidth,~~ *ARFCN-ValueNR,* the reference numerology, and the measurement duration ~~and~~, i.e. which OFDM symbol(s) should be measured by the UE. |
| Huawei, HiSilicon | Agree with ZTE. No need to change other part except for the LBT bandwidth -> channel bandwidth and reference numerology.  UE can measurement RSSI on multiple OFDM symbols. If change to “in the configured OFDM symbol”, it restricts the measurement only on one symbol. To our understanding, how UE measurement RSSI in L1 is an implementation issue. UE will only report one RSSI over the whole measurement duration. |
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## Finalize the number of OFDM symbols for RSSI measurement duration configuration

See [1][8].

Alt. 1: The number of OFDM symbols for RSSI measurement duration should be scale with configured reference SCS. i.e.

· For 15 kHz: {sym1, sym14, sym28, sym42, sym70}

· For 30 kHz: {sym2, sym28, sym54, sym84, sym140}

· For 60 kHz+NCP: {sym4, sym56, sym108, sym168, sym280}

· For 60 kHz+ECP: {sym4, sym48, sym96, sym144, sym240}

Alt. 2: Add extra symbols or modify supported symbols of baseline set {sym1, sym14, sym28, sym42, sym70} to account for ECP.

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| **Company** | **Views** |
| Samsung | Alt 1 is a particular example of Alt 2, and we don’t strong preference on the exact value of the symbols as long as it makes sense. The key point is we should consider ECP when setting the number of symbols. One further comment on Alt 1 is, the number of symbols may not exactly follow the scaling of SCS, for example, 1 symbol RSSI measurement should be always useful to keep. |
| LG Electronics | Alt 1 is acceptable with the understanding that the set of {sym1, sym14, sym28, sym42, sym70} is already implemented in running 331 specification. |
| ZTE | We prefer Alt. 2. For Alt. 1, We don’t think we should limit the RSSI measurement duration to a certain time for each SCS. It’s better to keep the current symbol set and change the configurable reference SCS to achieve different time duration for different SCS. Besides, it’s reasonable to add some values for ECP. |
| Nokia, NSB | We prefer Alt 1, bearing in mind the constraint that the measurement duration should not exceed 5ms.  Related to TS 38.331, one possible implementation could be as follows: *{sym1o2o4o4, sym14o28o56o48, sym28o54o108o96, sym42o84o168o144, sym70o140o280o240}* with “sym1o2o4o4” meaning “1 symbol for 15 kHz, 2 symbols for 30 kHz, 4 symbols for both 60 kHz/NCP and 60 kHz/ECP, and so on .... |
| Ericsson | We strongly disagree with Alt-1. It is important to maintain the ability to measure, for example, a single symbol in whatever is the configured reference numerology. Hence, we prefer to keep {sym1, sym14, sym28, sym42, sym70} as they are currently in 38.331. It can be further discussed if additional values can be added, since 3 bits are needed to signal the 5 current values. So adding 3 more values would not increase the RRC overhead.  We are not quite sure what extra values are being proposed in Alt-2. However, sym2, sym4 and sym56 are useful values. |
| Huawei, HiSilicon | We prefer Alt 1 which allows UE to have similar measurement accuracy as LTE-LAA for all newly introduced numerology. The accuracy depends on the duration of measurement.  As for adapting the duration of measurement by change reference numerology, it may introduce additional switching delay due to numerology change from that of active BWP. |
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# References

1. R1-2001535 Maintainance on the initial access procedures Huawei, HiSilicon
2. R1-2001653 Remaining issues on initial access procedure for NR-U vivo
3. R1-2001706 Remaining issues on the initial access procedure for NR-U ZTE, Sanechips
4. R1-2001760 Discussion on the remaining issues of enhancements to initial access procedure OPPO
5. R1-2001936 Remaining issues of initial access and mobility for NR-U LG Electronics
6. R1-2001988 Enhancements to initial access and mobility for NR-unlicensed Intel Corporation
7. R1-2002032 Enhancements to initial access procedures Ericsson
8. R1-2002118 Initial access procedures for NR-U Samsung
9. R1-2002248 Remaining issues on initial access procedure for NR-U ETRI
10. R1-2002263 Remaining issues on initial access procedure Spreadtrum Communications
11. R1-2002278 On Enhancements to Initial Access Procedures for NR-U Nokia, Nokia Shanghai Bell
12. R1-2002407 Remaining issues on initial access procedure for NR-U operation MediaTek Inc.
13. R1-2002531 TP for Initial access and mobility procedures for NR-U Qualcomm Incorporated
14. R1-2001701 FL summary 72222 NRU Charter Communications