**3GPP TSG-RAN WG4 Meeting #100-e R4-20xxxxx**

**Electronic Meeting, 17-28 August 2021 Revision of R4-2014237**

**Source:** T-Mobile USA

**Title:** [Draft] LS on NB-IoT testing issues

**Agenda item:** 12.2

**Document for:** Approval

1 Introduction

In August of 2020 RAN4 sent an LS to the FCC asking for guidance on NB-IoT testing issues near the edges of bands [1]. RAN4 received indirect feedback from the FCC on NB-IoT testing in [2]. RAN4 subsequently agreed CRs to solve the NB-IoT testing issue in Rel-14 [3], Rel-15 [4], Rel-16 [15] and Rel-17 [16].

Recently it has come to our attention that PTCRB and CTIA CPWG have adopted some changes to the NB-IoT testing that are mostly in line with the RAN4 spec changes, but there are a couple of differences that should be aligned with the new RAN4 specifications in 36.101.

2 Discussion

In response to feedback from the FCC on NB-IoT testing, RAN4 adopted changes to the band edge for several bands to exclude 100 kHz at the edge of the band from NB-IoT operation, However, the FCC made it clear that the emissions requirements apply at the edge of the FCC license, not the edge of the FCC band if the band edge and the license edge are not aligned [2] as is the case with Band 12 and Band 13.

It has come to our attention that the changes to PTCRB and CPWG testing have excluded 100 kHz at the edge of band 12, Band 13 and Band 71.

Table O-6 LTE Category NB1 TRP Alternative channel Measurements Table for Stand-Alone (SA) Operation Using QPSK (15 kHz Sub-Carrier Spacing) in the Primary Mechanical Mode1

|   **Band** |   **Range** |  **NB1 UL EARFCN** | **UL Offset to NB1 EARFCN** | **Frequency of NB1 UL EARFCN** |  **Uplink Configuration** |  **Downlink Configuration** |
| --- | --- | --- | --- | --- | --- | --- |
| ***NUL*** | ***MUL*** | ***FUL* (MHz)** | **Modulation** | ***Ntones*** | **Modulation** | **Subcarriers** |
| 122 | Low | 23012 | 0 | 699.20 | π/4 QPSK | 1@0 | N/A3 |
| 122 | High | 23178 | 0 | 715.80 | π/4 QPSK | 1@11 | N/A3 |
| 13 | Low | 23182 | 0 | 777.20 | π/4 QPSK | 1@0 | N/A3 |
| 13 | High | 23278 | 0 | 786.80 | π/4 QPSK | 1@11 | N/A3 |
| 71 | Low | 133124 | 0 | 663.20 | π/4 QPSK | 1@0 | N/A3 |
| 71 | High | 133470 | 0 | 697.80 | π/4 QPSK | 1@11 | N/A3 |
| Note 1: Primary Mechanical Mode refers to device configured in preferred mode per manufacturer instructions (typically means antenna extended, fold or portrait slide open, but depends on form factor).Note 2: If the device supports Band 12 and Band 17, then testing is only required to be completed in Band 12.Note 3: As per 3GPP TS 36.521-1, Section 6.2.2F (UE Maximum Output Power for category NB1 and NB2). |

Table O-7 LTE Category NB1 TIS/C-TIS Alternative channel Measurements Table for Stand-Alone (SA) Operation Using QPSK (15 kHz Sub-Carrier Spacing) in the Primary Mechanical Mode1

| **Band** | **Range** | **NB1 DL EARFCN** | **DL Offset to NB1 EARFCN** | **Frequency of NB1 DL EARFCN** | **Uplink Configuration** | **Downlink Configuration** |
| --- | --- | --- | --- | --- | --- | --- |
| ***NDL*** | ***MDL*** | ***FDL* (MHz)** | **Modulation** | ***Ntones*** | **Modulation** | **Subcarriers** |
| 122 | Low | 5012 | -0.5 | 729.20 | p/2 BPSK | 1@0 | QPSK | 12 |
| 122 | Mid | 5095 | -0.5 | 737.50 | p/2 BPSK | 1@0 | QPSK | 12 |
| 122 | High | 5178 | -0.5 | 745.80 | p/2 BPSK | 1@0 | QPSK | 12 |
| 13 | Low | 5182 | -0.5 | 746.20 | p/2 BPSK | 1@0 | QPSK | 12 |
| 13 | Mid | 5230 | -0.5 | 751.00 | p/2 BPSK | 1@0 | QPSK | 12 |

While this is in line with guidance from the FCC for Band 71 and the upper edges of Band 12 and Band 13, it is not in line with the guidance from the FCC on the lower edge of Band 12 and Band 13 as reflected in versions 14.19.0, 15.15.0, 16.10.0, 17.2.0 of TS 36.101. Since the lower edge of the lower 700 MHz A block uplink license is at 698 MHz and not 699 MHz, it is not necessary to exclude the lowest 100 kHz of Band 12 from NB-IoT operation. Also, since the lower edge of the upper 700 MHz C block uplink license is 776 MHz and not 777 MHz, it is not necessary to exclude the lowest 100 kHz of Band 13 from NB-IoT operation. The following table is from 36.101 v16.10.0 shows that the lower edge of B12 and B13 are not moved by 100 kHz for operation in the USA:

**Table 5.5F-1 E-UTRA operating bands for NB-IoT in the USA**

|  |  |  |  |
| --- | --- | --- | --- |
| **E‑UTRA Operating Band** | **Uplink (UL) operating bandBS receiveUE transmit** | **Downlink (DL) operating bandBS transmit UE receive** | **Duplex Mode** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |
| 2 | 1850.1 MHz | – | 1909.9 MHz | 1930.1 MHz | – | 1989.9 MHz | FDD |
| 4 | 1710.1 MHz | – | 1754.9 MHz  | 2110.1 MHz | – | 2154.9 MHz | FDD |
| 5 | 824.1 MHz | – | 848.9 MHz | 869.1 MHz | – | 893.9MHz | FDD |
| 12 | 699 MHz | – | 715.9 MHz | 729 MHz | – | 745.9 MHz | FDD |
| 13 | 777 MHz | – | 786.9 MHz | 746 MHz | – | 755.9 MHz | FDD |
| 17 | 704.1 MHz | – | 715.9 MHz | 734.1 MHz | – | 745.9 MHz | FDD |
| 25 | 1850.1 MHz | – | 1914.9 MHz | 1930.1 MHz | – | 1994.9 MHz | FDD |
| 26 | 814.1 MHz | – | 848.9 MHz | 859.1 MHz | – | 893.9 MHz | FDD |
| 66 | 1710.1 MHz | – | 1779.9 MHz  | 2110.1 MHz | – | 2199.0 MHz | FDD4 |
| 71 | 663.1 MHz | – | 697.9 MHz  | 617.1 MHz | – | 651.9 MHz | FDD |
| 85 | 698.1 MHz | – | 715.9 MHz | 728.1 MHz | – | 745.9 MHz | FDD |

Note that 2199.0 MHz for B66 is an error. It should be 2179.9 MHz. This is being corrected.

In 36.101 the NB-IoT restriction for operation in the USA is tied to NS\_04 signalling, but our understanding is that FCC certification does not use NS signalling. Therefore NB-IoT UEs shall not operate in the 100 kHz at the edge of the band when operating in the USA even when NS\_04 is not signalled.

We believe the tables above should be modified as follows:

Table O-6 LTE Category NB1 TRP Alternative channel Measurements Table for Stand-Alone (SA) Operation Using QPSK (15 kHz Sub-Carrier Spacing) in the Primary Mechanical Mode1

|   **Band** |   **Range** |  **NB1 UL EARFCN** | **UL Offset to NB1 EARFCN** | **Frequency of NB1 UL EARFCN** |  **Uplink Configuration** |  **Downlink Configuration** |
| --- | --- | --- | --- | --- | --- | --- |
| ***NUL*** | ***MUL*** | ***FUL* (MHz)** | **Modulation** | ***Ntones*** | **Modulation** | **Subcarriers** |
| 122 | Low | 23011 | 0 | 699.10 | π/4 QPSK | 1@0 | N/A3 |
| 122 | High | 23178 | 0 | 715.80 | π/4 QPSK | 1@11 | N/A3 |
| 13 | Low | 23181 | 0 | 777.10 | π/4 QPSK | 1@0 | N/A3 |
| 13 | High | 23278 | 0 | 786.80 | π/4 QPSK | 1@11 | N/A3 |
| 71 | Low | 133124 | 0 | 663.20 | π/4 QPSK | 1@0 | N/A3 |
| 71 | High | 133470 | 0 | 697.80 | π/4 QPSK | 1@11 | N/A3 |
| Note 1: Primary Mechanical Mode refers to device configured in preferred mode per manufacturer instructions (typically means antenna extended, fold or portrait slide open, but depends on form factor).Note 2: If the device supports Band 12 and Band 17, then testing is only required to be completed in Band 12.Note 3: As per 3GPP TS 36.521-1, Section 6.2.2F (UE Maximum Output Power for category NB1 and NB2). |

Table O-7 LTE Category NB1 TIS/C-TIS Alternative channel Measurements Table for Stand-Alone (SA) Operation Using QPSK (15 kHz Sub-Carrier Spacing) in the Primary Mechanical Mode1

| **Band** | **Range** | **NB1 DL EARFCN** | **DL Offset to NB1 EARFCN** | **Frequency of NB1 DL EARFCN** | **Uplink Configuration** | **Downlink Configuration** |
| --- | --- | --- | --- | --- | --- | --- |
| ***NDL*** | ***MDL*** | ***FDL* (MHz)** | **Modulation** | ***Ntones*** | **Modulation** | **Subcarriers** |
| 122 | Low | 5011 | -0.5 | 729.10 | p/2 BPSK | 1@0 | QPSK | 12 |
| 122 | Mid | 5095 | -0.5 | 737.50 | p/2 BPSK | 1@0 | QPSK | 12 |
| 122 | High | 5178 | -0.5 | 745.80 | p/2 BPSK | 1@0 | QPSK | 12 |
| 13 | Low | 5181 | -0.5 | 746.10 | p/2 BPSK | 1@0 | QPSK | 12 |
| 13 | Mid | 5230 | -0.5 | 751.00 | p/2 BPSK | 1@0 | QPSK | 12 |

**Proposal 1: RAN4 to send an LS to RAN5, PTCRB and CTIA CPWG to inform them of the changes to NB-IoT testing.**

3 Conclusions

**Proposal 1: RAN4 to send an LS to RAN5, PTCRB and CTIA CPWG to inform them of the changes to NB-IoT testing.**

4 References

1. R4-2011913, “LS on NB-IoT testing issues,” RAN4
2. R4-2107330, “NB-IoT Testing,” T-Mobile USA, Qualcomm
3. R4-2108012, “CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
4. R4-2111484, “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
5. R4-2111485, “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
6. R4-2111486, “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm

5 Draft LS

**Title: [Draft] LS on NB-IoT testing issues**

**Reply To:**

**Release:** Rel-14

**Work Item:** TEI-14

**Source:** RAN WG4

**To:** RAN WG5, PTCRB, CTIA CPWG

**Cc:**

**Contact Person:**

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**Attachments:**

**1. Background information:**

In August of 2020 RAN4 sent an LS to the FCC asking for guidance on NB-IoT testing issues near the edges of bands [1]. RAN4 received indirect feedback from the FCC on NB-IoT testing in [2]. RAN4 subsequently agreed CRs to solve the NB-IoT testing issue in Rel-14 [3], Rel-15 [4], Rel-16 [15] and Rel-17 [16]. The changes are summarized in the following table for NB-IoT operation in the USA, and especially that the lowest 100 kHz of Band 12 and Band 13 are not excluded for NB-IoT operation in the USA:

**Table 5.5F-1 E-UTRA operating bands for NB-IoT in the USA**

|  |  |  |  |
| --- | --- | --- | --- |
| **E‑UTRA Operating Band** | **Uplink (UL) operating bandBS receiveUE transmit** | **Downlink (DL) operating bandBS transmit UE receive** | **Duplex Mode** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |
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| 4 | 1710.1 MHz | – | 1754.9 MHz  | 2110.1 MHz | – | 2154.9 MHz | FDD |
| 5 | 824.1 MHz | – | 848.9 MHz | 869.1 MHz | – | 893.9MHz | FDD |
| 12 | 699 MHz | – | 715.9 MHz | 729 MHz | – | 745.9 MHz | FDD |
| 13 | 777 MHz | – | 786.9 MHz | 746 MHz | – | 755.9 MHz | FDD |
| 17 | 704.1 MHz | – | 715.9 MHz | 734.1 MHz | – | 745.9 MHz | FDD |
| 25 | 1850.1 MHz | – | 1914.9 MHz | 1930.1 MHz | – | 1994.9 MHz | FDD |
| 26 | 814.1 MHz | – | 848.9 MHz | 859.1 MHz | – | 893.9 MHz | FDD |
| 66 | 1710.1 MHz | – | 1779.9 MHz  | 2110.1 MHz | – | 2199.0 MHz | FDD4 |
| 71 | 663.1 MHz | – | 697.9 MHz  | 617.1 MHz | – | 651.9 MHz | FDD |
| 85 | 698.1 MHz | – | 715.9 MHz | 728.1 MHz | – | 745.9 MHz | FDD |

Please note that 2199.0 MHz for B66 is an error. It should be 2179.9 MHz. This is being corrected.

In 36.101 the NB-IoT restriction for operation in the USA is tied to NS\_04 signalling, but our understanding is that FCC certification does not use NS signalling. Therefore NB-IoT UEs shall not operate in the 100 kHz at the edge of the band when operating in the USA even when NS\_04 is not signalled.

1. **Summary**

TS 36.101 has been updated to exclude 100 kHz at the edge of NB-IoT bands for operation in the USA, except for the lower edge of Band 12 and Band 13 which are not excluded.

1. **Actions:**

**To** **RAN5, PTCRB and CTIA CPWG,**

**ACTION:** RAN4 kindly asks RAN5, PTCRB and CPWG to take the above into consideration for NB-IoT testing.

1. **References:**
2. [R4-2011913](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011913.zip), “LS on NB-IoT testing issues,” RAN4
3. [R4-2107330](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107330.zip), “NB-IoT Testing,” T-Mobile USA, Qualcomm
4. [R4-2108012](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2108012.zip), “CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
5. [R4-2111484](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111484.zip), “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
6. [R4-2111485](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111485.zip), “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
7. [R4-2111486](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_99-e/Docs/R4-2111486.zip), “Mirror CR for 36.101: Introduction of NS Signalling for NB-IoT in the USA,” T-Mobile USA, Qualcomm
8. **Date of Next TSG-RAN WG4 Meetings:**

TSG-RAN4 #101-e 1-12 November 2021 Online

TSG-RAN4 #102 21-25 February 2022 Athens, Greece?