**3GPP TSG-RAN4 Meeting #104b-e *R4-2216692***

**Location meeting, 10th Oct – 19th Oct, 2022**

|  |
| --- |
| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.104** | **CR** | **-** | **rev** | **1** | **Current version:** | **17.7.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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| --- |
|  |
| ***Title:***  | Draft CR on annex for PRACH requirement for TS 38.104 |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_ext\_to\_71GHz-Perf |  | ***Date:*** | 2022-09-30 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | PPACH requirement has been introuduced in Rel-17 NR extend to 71GHz WI. The test preamble and test propagation conditions are ageed |
|  |  |
| ***Summary of change:*** | Add the test PRACH premable and propagation condition |
|  |  |
| ***Consequences if not approved:*** | The requirement can be not verfied properly  |
|  |  |
| ***Clauses affected:*** | A.6, G.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.141-2 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Revision of R4-2216692 |

<Start of Change1>

# A.6 PRACH Test preambles

Table A.6-1: Test preambles for Normal Mode in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 13 | 22 | 32 |
| A1, A2, A3, | 15 | 23 | 0 | 0 |
| B4, C0, C2 | 30 | 46 | 0 | 0 |

Table A.6-2: Test preambles for Normal Mode in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A1, A2, A3, | 60 | 69 | 0 | 0 |
| B4, C0, C2 | 120 | 69 | 0 | 0 |

Table A.6-6: Test preambles for PRACH with LRA=1151 and LRA=571

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A2, B4, C2 | 15 | 164 | 0 | 0 |
|  | 30 | 190 | 0 | 0 |

Table A.6-7: Test preambles for high speed train short formats in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| C2 | 120 | 0 | 0 | 0 |

Table A.6-8: Test preambles for PRACH with LRA=139, LRA=571 and LRA=1151 for 120 kHZ and 480 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | LRA | Ncs | Logical sequence index | v |
| A2B4, C2 | 120 | 571 | 285 | 0 | 0 |
| 120 | 1151 | 575 | 0 | 0 |
| 480 | 139 | 69 | 0 | 0 |
| 480 | 571 | 285 | 0 | 0 |

<End of Change1>

<Start of Change 2>

# G.2 Multi-path fading propagation conditions

The multipath propagation conditions consist of several parts:

- A delay profile in the form of a "tapped delay-line", characterized by a number of taps at fixed positions on a sampling grid. The profile can be further characterized by the r.m.s. delay spread and the maximum delay spanned by the taps.

- A combination of channel model parameters that include the Delay profile and the Doppler spectrum that is characterized by a classical spectrum shape and a maximum Doppler frequency.

- Different models are used for FR1, FR2(24.25 GHz – 71 GHz).

## G.2.1 Delay profiles

The delay profiles are simplified from the TR 38.901 [16] TDL models. The simplification steps are shown below for information. These steps are only used when new delay profiles are created. Otherwise, the delay profiles specified in G.2.1.1, G.2.1.2 and G.2.1.3 can be used as such.

 Step 1: Use the original TDL model from TR 38.901 [16].

 Step 2: Re-order the taps in ascending delays.

 Step 3: Perform delay scaling according to the procedure described in clause 7.7.3 in TR 38.901 [16].

 Step 4: Apply the quantization to the delay resolution 5 ns. This is done simply by rounding the tap delays to the nearest multiple of the delay resolution.

 Step 5: If multiple taps are rounded to the same delay bin, merge them by calculating their linear power sum.

 Step 6: If there are more than 12 taps in the quantized model, merge the taps as follows

- Find the weakest tap from all taps (both merged and unmerged taps are considered)

• If there are two or more taps having the same value and are the weakest, select the tap with the smallest delay as the weakest tap.

- When the weakest tap is the first delay tap, merge taps as follows

• Update the power of the first delay tap as the linear power sum of the weakest tap and the second delay tap.

• Remove the second delay tap.

- When the weakest tap is the last delay tap, merge taps as follows

• Update the power of the last delay tap as the linear power sum of the second-to-last tap and the last tap.

• Remove the second-to-last tap.

- Otherwise

• For each side of the weakest tap, identify the neighbour tap that has the smaller delay difference to the weakest tap.

o When the delay difference between the weakest tap and the identified neighbour tap on one side equals the delay difference between the weakest tap and the identified neighbour tap on the other side.

▪ Select the neighbour tap that is weaker in power for merging.

o Otherwise, select the neighbour tap that has smaller delay difference for merging.

• To merge, the power of the merged tap is the linear sum of the power of the weakest tap and the selected tap.

• When the selected tap is the first tap, the location of the merged tap is the location of the first tap. The weakest tap is removed.

• When the selected tap is the last tap, the location of the merged tap is the location of the last tap. The weakest tap is removed.

• Otherwise, the location of the merged tap is based on the average delay of the weakest tap and selected tap. If the average delay is on the sampling grid, the location of the merged tap is the average delay. Otherwise, the location of the merged tap is rounded towards the direction of the selected tap (e.g. 10 ns & 20 ns 🡪 15 ns, 10 ns & 25 ns 🡪 20 ns, if 25 ns had higher or equal power; 15 ns, if 10 ns had higher power) . The weakest tap and the selected tap are removed.

- Repeat step 6 until the final number of taps is 12.

 Step 7: Round the amplitudes of taps to one decimal (e.g. -8.78 dB 🡪 -8.8 dB)

 Step 8: If the delay spread has slightly changed due to the tap merge, adjust the final delay spread by increasing or decreasing the power of the last tap so that the delay spread is corrected.

 Step 9: Re-normalize the highest tap to 0 dB.

Note 1: Some values of the delay profile created by the simplification steps may differ from the values in tables G.2.1.1-2, G.2.1.1-3, G.2.1.1-4, G.2.1.2-2, G.2.1.2-3, G.2.1.2-4 and G.2.1.2-5 for the corresponding model.

Note 2: For Step 5 and Step 6, the power values are expressed in the linear domain using 6 digits of precision. The operations are in the linear domain.

### G.2.1.1 Delay profiles for FR1

The delay profiles for FR1 are selected to be representative of low, medium and high delay spread environment. The resulting model parameters are specified in table G.2.1.1-1 and the tapped delay line models are specified in tables G.2.1.1-2 ~ G.2.1.1-4.

Table G.2.1.1-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of channel taps | Delay spread(r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLB100 | 12 | 100 ns | 480 ns | 5 ns |
| TDLC300 | 12 | 300 ns | 2595 ns | 5 ns |

Table G.2.1.1-2: TDLA30 (DS = 30 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
|  8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table G.2.1.1-3: TDLB100 (DS = 100 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | 0 | Rayleigh |
| 2 | 10 | -2.2 | Rayleigh |
| 3 | 20 | -0.6 | Rayleigh |
| 4 | 30 | -0.6 | Rayleigh |
| 5 | 35 | -0.3 | Rayleigh |
| 6 | 45 | -1.2 | Rayleigh |
| 7 | 55 | -5.9 | Rayleigh |
| 8 | 120 | -2.2 | Rayleigh |
| 9 | 170 | -0.8 | Rayleigh |
| 10 | 245 | -6.3 | Rayleigh |
| 11 | 330 | -7.5 | Rayleigh |
| 12 | 480 | -7.1 | Rayleigh |

Table G.2.1.1-4: TDLC300 (DS = 300 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -6.9 | Rayleigh |
| 2 | 65 | 0 | Rayleigh |
| 3 | 70 | -7.7 | Rayleigh |
| 4 | 190 | -2.5 | Rayleigh |
| 5 | 195 | -2.4 | Rayleigh |
| 6 | 200 | -9.9 | Rayleigh |
| 7 | 240 | -8.0 | Rayleigh |
| 8 | 325 | -6.6 | Rayleigh |
| 9 | 520 | -7.1 | Rayleigh |
| 10 | 1045 | -13.0 | Rayleigh |
| 11 | 1510 | -14.2 | Rayleigh |
| 12 | 2595 | -16.0 | Rayleigh |

### G.2.1.2 Delay profiles for FR2

The delay profiles for FR2 are specified in table G.2.1.2-1 and the tapped delay line models are specified in table G.2.1.2-2- G.2.1.2-5.

Table G.2.1.2-1: Delay profiles for NR channel models

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Number of channel taps | Delay spread(r.m.s.) | Maximum excess tap delay (span) | Delay resolution |
| TDLA30 | 12 | 30 ns | 290 ns | 5 ns |
| TDLA10 | 16 | 10 ns | 96 ns | 2 ns |
| TDLD10 | 10 | 10 ns | 126 ns | 2 ns |
| TDLD30 | 10 | 30 ns | 375 ns | 5 ns |

Table G.2.1.2-2: TDLA30 (DS = 30 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns) | Power (dB) | Fading distribution |
| 1 | 0 | -15.5 | Rayleigh |
| 2 | 10 | 0 | Rayleigh |
| 3 | 15 | -5.1 | Rayleigh |
| 4 | 20 | -5.1 | Rayleigh |
| 5 | 25 | -9.6 | Rayleigh |
| 6 | 50 | -8.2 | Rayleigh |
| 7 | 65 | -13.1 | Rayleigh |
|  8 | 75 | -11.5 | Rayleigh |
| 9 | 105 | -11.0 | Rayleigh |
| 10 | 135 | -16.2 | Rayleigh |
| 11 | 150 | -16.6 | Rayleigh |
| 12 | 290 | -26.2 | Rayleigh |

Table G.2.1.2-3: TDLA10 (DS = 10 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -16.1 | Rayleigh |
| 2 | 4 | 0 |  |
| 3 | 6 | -4 |  |
| 4 | 8 | -10.2 |  |
| 5 | 16 | -18.6 |  |
| 6 | 18 | -9.3 |  |
| 7 | 22 | -13.7 |  |
|  8 | 24 | -17.9 |  |
| 9 | 26 | -13.5 |  |
| 10 | 30 | -14 |  |
| 11 | 40 | -15.4 |  |
| 12 | 44 | -18.9 |  |
| 13 | 46 | -21.0 |  |
| 14 | 48 | -21.6 |  |
| 15 | 50 | -19.3 |  |
| 16 | 96 | -25.9 |  |

Table G.2.1.2-4: TDLD10 (DS = 10 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -15.5 | LOS |
| 0 | 0 | Rayleigh |
| 2 | 6 | -5.1 |  |
| 3 | 14 | -5.1 |  |
| 4 | 18 | -9.6 |  |
| 5 | 26 | -8.2 |  |
| 6 | 40 | -13.1 |  |
|  7 | 80 | -11.5 |  |
| 8 | 94 | -11.0 |  |
| 9 | 98 | -16.2 |  |
| 10 | 126 | -16.6 |  |
| Note 1: Tap #1 follows a Ricean distribution. |

Table G.2.1.2-5: TDLD30 (DS = 30 ns)

|  |  |  |  |
| --- | --- | --- | --- |
| Tap # | Delay (ns] | Power (dB) | Fading distribution |
| 1 | 0 | -0.2 | LOS |
| 0 | -12.4 | Rayleigh |
| 2 | 20 | -21 |  |
| 3 | 40 | -16.7 |  |
| 4 | 55 | -18.3 |  |
| 5 | 80 | -21.9 |  |
| 6 | 120 | -27.8 |  |
|  7 | 240 | -23.6 |  |
| 8 | 285 | -24.8 |  |
| 9 | 290 | -30.0 |  |
| 10 | 375 | -27.6 |  |
| Note 1: Tap #1 follows a Ricean distribution. |

## G.2.2 Combinations of channel model parameters

The propagation conditions used for the performance measurements in multi-path fading environment are indicated as a combination of a channel model name and a maximum Doppler frequency, i.e., TDLA<DS>-<Doppler>, TDLB<DS>-<Doppler> or TDLC<DS>-<Doppler> where '<DS>' indicates the desired delay spread and '<Doppler>' indicates the maximum Doppler frequency (Hz).

Table G.2.2-1 and G.2.2-2 show the propagation conditions that are used for the performance measurements in multi-path fading environment for low, medium and high Doppler frequencies for FR1 and FR2 (24.25 GHz – 71 GHz) , respectively.

Table G.2.2-1: Channel model parameters for FR1

|  |  |  |
| --- | --- | --- |
| Combination name | Tapped delay line model | Maximum Doppler frequency |
| TDLA30-5 | TDLA30 | 5 Hz |
| TDLA30-10 | TDLA30 | 10 Hz |
| TDLB100-400 | TDLB100 | 400 Hz |
| TDLC300-100 | TDLC300 | 100 Hz |
| TDLC300-600 | TDLC300 | 600 Hz |
| TDLC300-1200 | TDLC300 | 1200 Hz |

Table G.2.2-2: Channel model parameters for FR2

|  |  |  |
| --- | --- | --- |
| Combination name | Tapped delay line model | Maximum Doppler frequency |
| TDLA30-75 | TDLA30 | 75 Hz |
| TDLA30-300 | TDLA30 | 300 Hz |
| TDLA10-650 | TDLA10 | 650 Hz |
| TDLA30-650 | TDLA30 | 650 Hz |
| TDLD10-200 | TDLD10 | 200 Hz |
| TDLD30-200 | TDLD30 | 200 Hz |

<End of Change 2>