**3GPP TSG-RAN WG4 Meeting # 104-e *R4-2213794***

**Electronic Meeting, Aug 15th – 26th, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-4** | **CR** | **-** | **rev** | **1** | **Current version:** | **17.5.0**  |  |
|  |
| *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 | **X** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | Introduction of PBCH performance requirements for RedCap |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_redcap-Perf |  | ***Date:*** | 2022-08-03  |
|  |  |  |  |  |
| ***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:*** | Based on the work plan R4-2210931, RAN4 should submit the draft CR for RedCap for review. |
|  |  |
| ***Summary of change:*** | Introduced the PBCH performance requirments for RedCap |
|  |  |
| ***Consequences if not approved:*** | The performance requirements will still be incomplete |
|  |  |
| ***Clauses affected:*** | 5.4, 7.4 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.521-4 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<The first Changes>

## 5.4 PBCH demodulation requirements

The receiver characteristics of PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$Pm-bch=1-\frac{A}{B}$$

Where A is the number of correctly decoded MIB PDUs and B is the number of transmitted MIB PDUs. The Pm-bch is derived with the assumption UE combines the PBCH symbols of the same SS/PBCH block index within the MIB TTI (80ms).

Table 5.4-1: Common test Parameters

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| Physical Cell ID |  | 0 |
| Cyclic prefix |  | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity |  | 1 |
| SS/PBCH block index Note1 |  | 0 |
| SS/PBCH block periodicity | ms | 20 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11] |

### 5.4.1 1RX requirements

#### 5.4.1.1 FDD

For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.1.1-1 in case SS/PBCH block index is not known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.1.1-1: Minimum performance PBCH in case SS/PBCH block index is not known for RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 1 Low | 1 | -2.5 |

#### 5.4.1.2 TDD

Table 5.4.1.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| TDD UL-DL pattern |  | FR1.30-1 |

For the parameters specified in Table 5.4-1 and Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.1.2-2 in case SS/PBCH block index is not known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.1.2-2: Minimum performance PBCH in case SS/BPCH block index is not known for RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)**  | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 1 Low | 1 | -1.0 |

### 5.4.2 2RX requirements

#### 5.4.2.1 FDD

Table 5.4.2.1-1: Void

|  |  |  |
| --- | --- | --- |
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|  |  |  |
|  |  |  |
|  |

For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.1-2 in case SS/PBCH block index is not known and below the specifies values in Table.5.4.2.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNR (dB)** |
| 1Note1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -6.7 |

Table 5.4.2.1-3 Minimum performance PBCH in case SS/PBCH block index is known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1Note1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 2 Low | 1 | -8.3 |

#### 5.4.2.2 TDD

Table 5.4.2.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| TDD UL-DL pattern |  | FR1.30-1 |
|  |

For the parameters specified in Table 5.4-1 and Table 5.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.2.2-2 and Table 5.4.2.2-4 in case SS/PBCH block index is not known and below the specified values in Table.5.4.2.2-3 and Table 5.4.2.2-5 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.2.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)**  | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -5.3 |

Table 5.4.2.2-3 Minimum performance PBCH in case SS/BPCH block index is known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -6.5 |

Table 5.4.2.2-4: Minimum performance PBCH in case SS/BPCH block index is not known for RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)**  | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNR (dB)** |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -5.3 |

Table 5.4.2.2-5 Minimum performance PBCH in case SS/BPCH block index is known for RedCap

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 20 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 2 Low | 1 | -6.5 |

### 5.4.3 4RX requirements

#### 5.4.3.1 FDD

Table 5.4.3.1-1: Void

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |

For the parameters specified in Table 5.4-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.1-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.1-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.1-2: Minimum performance PBCH in case SS/PBCH block index is not known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -8.9 |

Table 5.4.3.1-3: Minimum performance PBCH in case SS/PBCH block index is known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 10 / 15 | R.PBCH.1 | TDLC300-100 | 1 x 4 Low | 1 | -10.9 |

#### 5.4.3.2 TDD

Table 5.4.3.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Single antenna port |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| TDD UL-DL pattern |  | FR1.30-1 |
|  |

For the parameters specified in Table 5.4-1 and Table 5.4.3.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 5.4.3.2-2 in case SS/PBCH block index is not known and below the specified values in Table.5.4.3.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.3.1.

Table 5.4.3.2-2: Minimum performance PBCH in case SS/BPCH block index is not known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -8.6 |

Table 5.4.3.2-3: Minimum performance PBCH in case SS/BPCH block index is known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | SNR (dB) |
| 1 | 40 / 30 | R.PBCH.2 | TDLA30-10 | 1 x 4 Low | 1 | -9.6 |

<Unchanged Sections Skipped>

<The second Changes>

## 7.4 PBCH demodulation requirements

The receiver characteristics of PBCH are determined by the probability of miss-detection of the PBCH (Pm-bch), which is defined as

$$Pm-bch=1-\frac{A}{B}$$

Where A is the number of correctly decoded MIB PDUs and B is the number of transmitted MIB PDUs. The Pm-bch is derived with the assumption UE combines the PBCH symbols of the same SS/PBCH block index within the MIB TTI (80ms).

### 7.4.1 1RX requirements

(Void)

### 7.4.2 2RX requirements

#### 7.4.2.1 FDD

(Void)

#### 7.4.2.2 TDD

Table 7.4.2.2-1: Test parameters for PBCH

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Unit** | **Single antenna port** |
| Physical Cell ID |  | 0 |
| Cyclic prefix |  | Normal |
| Number of SS/PBCH blocks within an SS burst set periodicity |  | 1 |
| SS/PBCH block index Note1 |  | 0 |
| SS/PBCH block periodicity | ms | 20 |
| TDD UL-DL pattern |  | FR2.120-1 |
| Note 1: as specified in clause 4.1 of TS 38.213 [11]Note 2: as specified in clause 11.1 of TS 38.213 [11] |

For the parameters specified in Table 7.4.2.2-1 the average probability of a miss-detected PBCH (Pm-bch) shall be below the specified values in Table 7.4.2.2-2 in case SS/PBCH block index is not known and below the specified values in Table.7.4.2.2-3 in case SS/PBCH block index is known. The downlink physical setup is in accordance with Annex C.5.1.

Table 7.4.2.2-2: Minimum performance PBCH in case SS/PBCH block index is not known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Test number** | **Bandwidth (MHz) / Subcarrier spacing (kHz)** | **Reference channel** | **Propagation condition** | **Antenna configuration and correlation matrix** | **Reference value** |
| **Pm-bch (%)** | **SNRBB (dB)** |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -6.3 |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -6.1 |
| Note 1: The test case is also applicable for RedCap |

Table 7.4.2.2-3: Minimum performance PBCH in case SS/PBCH block index is known

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Test number | Bandwidth (MHz) / Subcarrier spacing (kHz) | Reference channel | Propagation condition | Antenna configuration and correlation matrix | Reference value |
| Pm-bch (%) | PBCH SNR (dB) |
| 1 | 100 / 120 | R.PBCH.5 | TDLA30-300 | 1 x 2 Low | 1 | -7.9 |
| 2 | 100 / 240 | R.PBCH.6 | TDLA30-75 | 1 x 2 Low | 1 | -7.6 |
| Note 1: The test case is also applicable for RedCap |

<End of Changes>