**3GPP TSG-RAN4 Meeting #98-bis-e *R4-2104555***

 **Electronic Meeting, 12th – 20th April 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.141-1** | **CR** | **-** | **rev** | **1** | **Current version:** | **16.7.0** |  |
|  |
| *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 for TS38.141-1 Introduction of interlaced PUCCH format 0 and format 1 demodulation requirements |
|  |  |
| ***Source to WG:*** | Ericsson |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_unlic-Perf |  | ***Date:*** | 2021-03-26 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-16 |
|  | *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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | The requirement discussion of NR-U PUCCH with interlacing structure is completed and corresponding specification should be added. |
|  |  |
| ***Summary of change:*** | Requirement introduction of interlaced PUCCH PF0 and PF1* Adding chapter 8.3.7 for interlaced PUCCH format 0 conducted requirement
* Adding chapter 8.3.8 for interlaced PUCCH format 1 conducted requirement
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|  |  |
| ***Consequences if not approved:*** | There will be no requirement for interlaced PUCCH PF0 and PF1. |
|  |  |
| ***Clauses affected:*** | 8.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **x** |  |  Other core specifications  | TS/TR … CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS/TR 38.141-2 ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

######################### Start of change#1 ############################

### 8.3.7 Performance requirements for interlaced PUCCH format 0

#### 8.3.7.1 Definition and applicability

The performance requirement of single user interlaced PUCCH format 0 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The ACK missed deection requirement only applies to the PUCCH format 0 with 1 UCI bits. The UCI information only contrains ACK/NACK information

The 1bit UCI information is further defined with bitmap as [0].

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.x.x.

#### 8.3.7.2 Minimum Requirement

The minimum requirements are in TS 38.104 [2] clause 8.3.8.

#### 8.3.7.3 Test purpose

The test shall verify the receiver's ability to detect ACK under multipath fading propagation conditions for a given SNR.

#### 8.3.7.4 Method of test

##### 8.3.7.4.1 Initial conditions

Test environment: Normal, see annex B.2.

RF channels to be tested: single carrier M; see clause 4.9.1.

##### 8.3.7.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the channel bandwidth and sub-carrier spacing defined in table 8.3.7.4.2-1.

Table 8.3.7.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Subcarrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 | 20 | -77.2 dBm / 19.08 MHz |
| 30 | 20 | -77.4 dBm / 18.36 MHz |

3) The characteristics of the wanted signal shall be configured according to TS 38.211 [17] and the specific test parameters are configured as mentioned in table 8.3.7.4.2-2:

Table 8.3.7.4.2-2: Test Parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Number of UCI information bits | 1 |
| Number of symbols | 1 |
| Intra-slot frequency hopping | N/A  |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 13 |
| Number of interlaces | 1 |
| Interlace index | 0Note1 |
| Note 1: RBs 0, 10, 20, …, 100 are allocated for 15kHz SCS and RBs 0, 5, 10, …, 50 are allocated for 30kHz SCS. |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex B.

5) Adjust the equipment so that the SNR specified in table 8.3.7.5-1 or table 8.3.7.5-2 is achieved at the BS input during the ACK transmissions.

6) The signal generator sends a test pattern with the pattern outlined in figure 8.3.7.4.2-1. The following statistics are kept: the number of ACKs detected in the idle periods and the number of missed ACKs.



Figure 8.3.7.4.2-1: Test signal pattern for single user interlaced PUCCH format 0 demodulation tests

#### 8.3.7.5 Test Requirement

The fraction of falsely detected ACKs shall be less than 1% and the fraction of correctly detected ACKs shall be larger than 99% for the SNR listed in table 8.3.7.5-1.

Table 8.3.7.5-1: Test requirements for interlaced PUCCH format 0 with 15 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex G) | Number ofOFDM symbols | SNR (dB) |
| 1 | 2 | TDLA30-10 Low | 1 | [TBD] |

Table 8.3.7.5-2: Test requirements for interlaced PUCCH format 0 with 30 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Propagation conditions and correlation matrix (Annex G) | Number ofOFDM symbols | SNR (dB) |
| 1 | 2 | TDLA30-10 Low | 1 | [TBD] |

### 8.3.8 Performance requirements for interlaced PUCCH format 1

#### 8.3.8.1 NACK to ACK detection

##### 8.3.8.1.1 Definition and applicability

The performance requirement of interlaced PUCCH format 1 for NACK to ACK detection is determined by the two parameters: probability of false detection of the ACK and the NACK to ACK detection probability. The performance is measured by the required SNR at probability of the NACK to ACK detection equal to 0.1% or less. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK at particular bit position when input is only noise. Each false bit detection is counted as one error.

The NACK to ACK detection probability is the probability of detecting an ACK bit when a NACK bit was sent on particular bit position. Each NACK bit erroneously detected as ACK bit is counted as one error. Erroneously detected NACK bits in the definition do not contain the NACK bits which are mapped from DTX, i.e. NACK bits received when DTX is sent should not be considered.

The NACK to ACK deection requirement only applies to the PUCCH format 1 with 2 UCI bits. The UCI information only contrains ACK/NACK information

The 2bits UCI information is further defined with bitmap as [0 1].

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.x.x.

##### 8.3.8.1.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.3.9.

##### 8.3.8.1.3 Test purpose

The test shall verify the receiver's ability not to falsely detect NACK bits as ACK bits under multipath fading propagation conditions for a given SNR.

##### 8.3.8.1.4 Method of test

###### 8.3.8.1.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

RF channels to be tested: for single carrier: M; see clause 4.9.1.

###### 8.3.8.1.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the combinations of SCS and channel bandwidth defined in table 8.3.8.1.4.2-1.

Table 8.3.8.1.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 | 20 | -77.2 dBm / 19.08 MHz |
| 30 | 20 | -77.4 dBm / 18.36 MHz |

3) The characteristics of the wanted signal shall be configured according to TS 38.211 [17], and the specific test parameters are configured as below:

Table 8.3.8.1.4.2-2: Test parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of symbols | 14 |
| Intra-slot frequency hopping | N/A |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of interlace | 1 |
| Interlace index | 0Note1 |
| Note 1: RBs 0, 10, 20, …, 100 are allocated for 15kHz SCS and RBs 0, 5, 10, …, 50 are allocated for 30kHz SCS. |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

5) Adjusting the equipment so that the SNR specified in table 8.3.8.1.5-1 and table 8.3.8.1.5-2 is achieved at the BS input during the transmissions.

6) The signal generator sends random codeword from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits detected in the idle periods and the number of NACK bits detected as ACK.

##### 8.3.8.1.5 Test Requirement

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of NACK bits falsely detected as ACK shall be less than 0.1% for the SNR listed in tables 8.3.8.1.5-1.

Table 8.3.8.1.5-1: Required SNR for interlaced PUCCH format 1 with 15 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Cyclic-Prefix | Propagation conditions and correlation matrix (Annex G) | SNR (dB) |
| 1 | 2 | Normal | TDLA30-10 Low | [TBD] |

Table 8.3.8.1.5-2: Required SNR for interlaced PUCCH format 1 with 30 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Cyclic-Prefix | Propagation conditions and correlation matrix (Annex G) | SNR (dB) |
| 1 | 2 | Normal | TDLA30-10 Low | [TBD] |

#### 8.3.8.2 ACK missed detection

##### 8.3.8.2.1 Definition and applicability

The performance requirement of interlaced PUCCH format 1 for ACK missed detection is determined by the two parameters: probability of false detection of the ACK and the probability of detection of ACK. The performance is measured by the required SNR at probability of detection equal to 0.99. The probability of false detection of the ACK shall be 0.01 or less.

The probability of false detection of the ACK is defined as a conditional probability of erroneous detection of the ACK when input is only noise.

The probability of detection of ACK is defined as conditional probability of detection of the ACK when the signal is present.

The ACK missed deection requirement only applies to the PUCCH format 1 with 2 UCI bits. The UCI information only contrains ACK/NACK information.

The 2bits UCI information is further defined with bitmap as [0 1].

Which specific test(s) are applicable to BS is based on the test applicability rules defined in clause 8.1.x.x.

##### 8.3.8.2.2 Minimum Requirement

The minimum requirement is in TS 38.104 [2] clause 8.3.9.

##### 8.3.8.2.3 Test purpose

The test shall verify the receiver's ability to detect ACK bits under multipath fading propagation conditions for a given SNR.

##### 8.3.8.2.4 Method of test

###### 8.3.8.2.4.1 Initial Conditions

Test environment: Normal; see annex B.2.

RF channels to be tested: for single carrier (SC): M; see clause 4.9.1.

###### 8.3.8.2.4.2 Procedure

1) Connect the BS tester generating the wanted signal, multipath fading simulators and AWGN generators to all BS antenna connectors for diversity reception via a combining network as shown in annex D.5 and D.6 for *BS type 1-C* and *type 1-H* respectively.

2) Adjust the AWGN generator, according to the combinations of SCS and channel bandwidth defined in table 8.3.8.2.4.2-1.

Table 8.3.8.2.4.2-1: AWGN power level at the BS input

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing (kHz) | Channel bandwidth (MHz) | AWGN power level |
| 15 | 20 | -77.2 dBm / 19.08 MHz |
| 30 | 20 | -77.4 dBm / 18.36 MHz |

3) The characteristics of the wanted signal shall be configured according to TS 38.211 [17], and the specific test parameters are configured as below:

Table 8.3.8.2.4.2-2: Test parameters

|  |  |
| --- | --- |
| Parameter | Test |
| Number of information bits | 2 |
| Number of symbols | 14 |
| Intra-slot frequency hopping | N/A |
| Group and sequence hopping | neither |
| Hopping ID | 0 |
| Initial cyclic shift | 0 |
| First symbol | 0 |
| Index of orthogonal cover code (*timeDomainOCC*) | 0 |
| Number of interlace | 1 |
| Interlace index | 0Note1 |
| Note 1: RBs 0, 10, 20, …, 100 are allocated for 15kHz SCS and RBs 0, 5, 10, …, 50 are allocated for 30kHz SCS. |

4) The multipath fading emulators shall be configured according to the corresponding channel model defined in annex G.

5) Adjusting the equipment so that the SNR specified in table 8.3.8.2.5-1 and table 8.3.8.2.5-2 is achieved at the BS input during the transmissions.

6) The signal generator sends random codewords from applicable codebook, in regular time periods. The following statistics are kept: the number of ACK bits falsely detected in the idle periods and the number of missed ACK bits. Each falsely detected ACK bit in the idle periods is accounted as one error for the statistics of false ACK detection, and each missed ACK bit is accounted as one error for the statistics of missed ACK detection.

Note that the procedure described in this clause for ACK missed detection has the same condition as that described in clause 8.3.8.1.4.2 for NACK to ACK detection. Both statistics are measured in the same testing.

##### 8.3.8.2.5 Test Requirement

The fraction of falsely detected ACK bits shall be less than 1% and the fraction of correctly detected ACK bits shall be larger than 99% for the SNR listed in tables 8.3.8.2.5-1.

Table 8.3.8.2.5-1 Required SNR for interlaced PUCCH format 1 with 15 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Cyclic-Prefix | Propagation conditions and correlation matrix (Annex G) | SNR (dB) |
| 1 | 2 | Normal | TDLA30-10 Low | [TBD] |

Table 8.3.8.2.5-2 Required SNR for interlaced PUCCH format 1 with 30 kHz SCS, 20MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Number of Tx antennas | Number of RX antennas | Cyclic-Prefix | Propagation conditions and correlation matrix (Annex G) | SNR (dB) |
| 1 | 2 | Normal | TDLA30-10 Low | [TBD] |

######################### End of change#1 ############################