3GPP TSG-RAN WG4 Meeting # 108bis R4-2317400

Xiamen, China, 9th – 13th October, 2023

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | 38.133 | **CR** |  | **rev** | **1** | **Current version:** | 16.17.0 |  |
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| *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:***  | On MRTD/MTTD requirement for inter-band non-collocated EN-DC/NE-DC (R16) |
|  |  |
| ***Source to WG:*** |  |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | TEI16 |  | ***Date:*** | 2023-09-24 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | Per discussion in R4-2315490,* MTTD requirement is missing for FDD-FDD EN-DC.
* MRTD/MTTD requriement for NE-DC is missing.
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|  |  |
| ***Summary of change:*** | * Adding MRTD/MTTD requirement for inter-band NE-DC with overlapping bands.
* Adding MRTD/MTTD requirements for FDD-FDD inter-band EN-DC with overlapping bands
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|  |  |
| ***Consequences if not approved:*** | The requirements is not complete. |
|  |  |
| ***Clauses affected:*** | 7.5; 7.6 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **x** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **x** |  |  Test specifications | TS 38.533 |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## 7.5 Maximum Transmission Timing Difference

### 7.5.1 Introduction

A UE shall be capable of handling a relative transmission timing difference between subframe timing boundary of E-UTRA PCell and the closest slot timing boundary of PSCell to be aggregated for EN-DC operation.

A UE shall be capable of handling a relative transmission timing difference among the closest slot timing boundaries of different carriers to be aggregated in NR carrier aggregation.

A UE shall be capable of handling a relative transmission timing difference between slot timing boundary of PCell and subframe timing boundary of E-UTRA PSCell to be aggregated for NE-DC operation.

A UE shall be capable of handling a relative transmission timing difference between slot timing boundaries of PCell and the closest slot timing boundary of PSCell to be aggregated in NR DC operation.

### 7.5.2 Minimum Requirements for inter-band EN-DC

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA PCell and PSCell as shown in Table 7.5.2-1.

Table 7.5.2-1 Maximum uplink transmission timing difference requirement for asynchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA PCell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 500 |
| 15 | 30 | 250 |
| 15 | 60 | 125 |
| 15 | 120Note1 | 62.5 |
| NOTE 1: For E-UTRA FDD-NR FDD intra-band EN-DC, for which the requirement is defined in clause 7.5.3 and this Table 7.5.2-1 is also applicable, the scenario with 120kHz PSCell does not exist. |

Table 7.5.2-2 Void

#### 7.5.2.1 Minimum Requirements for inter-band synchronous EN-DC

The requirements in this clause apply as a reference for inter-band synchronous EN-DC.

The UE shall be capable of handling a maximum uplink transmission timing difference (MTTD) between E-UTRA PCell and PSCell for inter-band synchronous EN-DC as shown in Table 7.5.2.1-1 1. The requirements for synchronous EN-DC are applicable for E-UTRA TDD-NR TDD, E-UTRA FDD-NR FDD, E-UTRA TDD-NR FDD and E-UTRA FDD-NR TDD inter-band EN-DC.

For E-UTRA TDD-NR TDD inter-band EN-DC with overlapping DL bands, only synchronized operation is assumed. The UE shall be capable of handling a maximum uplink transmission timing difference (MTTD) between E-UTRA Pcell and PSCell as shown in Table 7.5.2.1-1 provided that UE indicates that it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*, and in Table 7.5.3-1 provided that UE does not indicateit is capable of *interBandMRDC-WithOverlapDL-Bands-r16*.

For E-UTRA FDD-NR FDD inter-band EN-DC with overlapping DL bands, only synchronized operation is assumed if UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation. The UE shall be capable of handling a maximum uplink transmission timing difference (MTTD) between E-UTRA Pcell and PSCell as shown in Table 7.5.2.1-1 provided that UE indicates that it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*, and in Table 7.5.3-1 provided that UE does not indicateit it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*.

Table 7.5.2.1-1 Maximum uplink transmission timing difference requirement for inter-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA Pcell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 35.21 |
| 15 | 30 | 35.21 |
| 15 | 60 | 35.21 |
| 15 | 120 | 35.21 |

### 7.5.3 Minimum Requirements for intra-band EN-DC

For intra-band EN-DC, only co-located deployment is applied.

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA Pcell and PSCell as shown in Table 7.5.2-1 for E-UTRA FDD-NR FDD intra-band EN-DC provided the UE indicates that it is capable of asynchronous EN-DC operation [2].

The UE shall be capable of handling a maximum uplink transmission timing difference between E-UTRA Pcell and PSCell as shown in Table 7.5.3-1 for E-UTRA TDD-NR TDD and E-UTRA FDD-NR FDD intra-band EN-DC provided the UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation [16].

Table 7.5.3-1: Maximum uplink transmission timing difference requirement for intra-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in E-UTRA Pcell (kHz) | UL Sub-carrier spacing for data in PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 5.21Note1,Note 2 |
| 15 | 30 | 5.21Note 2 |
| 15 | 60 | 5.21 Note 2 |
| NOTE 1: This is not applicable for a UE which indicates the capability of only supporting single UL timing (*ul-TimingAlignmentEUTRA-NR* is signalled). Single UL timing for E-UTRA and NR cell is assumed for this UE.NOTE 2: If the transmission timing difference exceeds the cyclic prefix length of the UL Sub-carrier spacing for data in PSCell, NR UE Tx EVM degradation is expected for the symbol that is overlapping the LTE subframe boundary |

### 7.5.4 Minimum Requirements for NR Carrier Aggregation

The UE shall be capable of handling at least a relative transmission timing difference between slot timing of all pairs of TAGs as shown in Table 7.5.4-1, provided that the UE is:

- configured with the pTAG and the sTAG for inter-band NR carrier aggregation in SA or NR-DC mode, or

- configured with more than one sTAG for inter-band NR carrier aggregation in EN-DC or NE-DC mode.

Table 7.5.4-1: Maximum uplink transmission timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of TAGs | Maximum uplink transmission timing difference (µs)  |
| FR1 | 34.6 |
| FR2 | 8.5 Note1 |
| Between FR1 and FR2 | 26.1  |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

### 7.5.5 Minimum Requirements for inter-band NE-DC

The UE shall be capable of handling a maximum uplink transmission timing difference between Pcell and E-UTRA PSCell as shown in Table 7.5.5-1 for inter-band asynchronous NE-DC.

Table 7.5.5-1: Maximum uplink transmission timing difference requirement for inter-band asynchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in Pcell (kHz) | UL Sub-carrier spacing for data in E-UTRA PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 500 |
| 30 | 15 | 250 |
| 60 | 15 | 125 |
| 120 | 15 | 62.5 |
| NOTE 1: Void |

Table 7.5.5-2 Void

#### 7.5.5.1 Minimum Requirements for inter-band synchronous NE-DC

The requirements in this clause apply as a reference for inter-band synchronous NE-DC.

The UE shall be capable of handling a maximum uplink transmission timing difference between Pcell and E-UTRA PSCell for inter-band synchronous NE-DC as shown in Table 7.5.5.1-1. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

For NR FDD-E-UTRA FDD inter-band NE-DC with overlapping DL bands, only synchronized operation is assumed if UE does not indicate that it is capable of asynchronous FDD-FDD NE-DC operation. The UE shall be capable of handling a maximum uplink transmission timing difference (MTTD)between NR PCell and PSCell as shown in Table 7.5.5.1-1 provided that the UE indicates that it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*, and the same requirement as in Table 7.5.3-1 provided that UE does not indicate it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*.

Table 7.5.5.1-1: Maximum uplink transmission timing difference requirement for inter-band synchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing in PCell (kHz) | UL Sub-carrier spacing for data in E-UTRA PSCell (kHz) | Maximum uplink transmission timing difference (µs) |
| 15 | 15 | 35.21 |
| 30 | 15 | 35.21 |
| 60 | 15 | 35.21 |
| 120 | 15 | 35.21 |

### 7.5.6 Minimum Requirements for inter-band NR DC

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and PSCell as shown in Table 7.5.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [14].

Table 7.5.6-1: Maximum uplink transmission timing difference requirement for inter-band synchronous NR DC

|  |  |
| --- | --- |
| Frequency Range | Maximum uplink transmission timing difference (µs) |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 34.6 |
| FR2 | FR2 | 8.5 |
| FR1 | FR2 | 34.1 |

The UE shall be capable of handling a maximum uplink transmission timing difference between PCell and PSCell as shown in Table 7.5.6-2 provided that the UE indicates that it is capable of asynchronous NR DC [14].

Table 7.5.6-2 Maximum uplink transmission timing difference requirement for inter-band asynchronous NR DC

|  |  |
| --- | --- |
| Max {Sub-carrier spacing in PCell (kHz), Sub-carrier spacing in PSCell (kHz)}  | Maximum uplink transmission timing difference (µs) |
| 15 | 500 |
| 30 | 250 |
| 60 | 125 |
| 120 | 62.5 |

## 7.6 Maximum Receive Timing Difference

### 7.6.1 Introduction

A UE shall be capable of handling a relative receive timing difference between subframe timing boundary of an E-UTRA cell belonging to the MCG and the closest slot timing boundary of a cell belonging to SCG to be aggregated for EN-DC operation.

A UE shall be capable of handling a relative receive timing difference between subframe timing boundary of an E-UTRA cell belonging to the SCG to be aggregated for NE-DC operation and the closest slot timing boundary of a cell belonging to MCG.

A UE shall be capable of handling a relative receive timing difference between slot timing boundary of a cell belonging to MCG and the closest slot timing boundary of a cell belonging to the SCG to be aggregated for NR DC operation.

A UE shall be capable of handling a relative receive timing difference among the closest slot timing boundaries of different carriers to be aggregated in NR carrier aggregation.

The requirements defined in clause 7.6 are also applicable when UE is configured to receive multiple PDSCH transmission occasions from one or more QCL sources on any one of the aggregated NR carriers.

### 7.6.2 Minimum Requirements for inter-band EN-DC

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to SCG at the UE receiver as shown in Table 7.6.2-1.

Table 7.6.2-1: Maximum receive timing difference requirement for asynchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) (Note 1) | Maximum receive timing difference (µs) |
| 15 | 15 | 500 |
| 15 | 30 | 250 |
| 15 | 60 | 125 |
| 15 | 120Note2 | 62.5 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}.NOTE 2: For E-UTRA FDD-NR FDD intra-band EN-DC, for which the requirement is defined in clause 7.6.3 and this Table 7.6.2-1 is also applicable, the scenario with 120 kHz does not exit. |

Table 7.6.2-2 Void

Table 7.6.2-3 Void

#### 7.6.2.1 Minimum Requirements for inter-band synchronous EN-DC

The requirements in this clause apply as a reference for inter-band synchronous EN-DC.

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from an E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to SCG at the UE receiver for inter-band synchronous EN-DC as shown in Table 7.6.2.1-1. The requirements for synchronous EN-DC are applicable for E-UTRA TDD-NR TDD, E-UTRA FDD-NR FDD, E-UTRA TDD-NR FDD and E-UTRA FDD-NR TDD inter-band EN-DC.

For E-UTRA TDD-NR TDD inter-band EN-DC with overlapping DL bands, only synchronized operation is assumed. The UE shall be capable of handling at least a relative receive timing difference (MRTD)between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.2.1-1 provided that UE indicates that it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*, and in Table 7.6.3-1 provided that UE does not indicateit is capable of *interBandMRDC-WithOverlapDL-Bands-r16*.

For E-UTRA FDD-NR FDD inter-band EN-DC with overlapping DL bands, only synchronized operation is assumed if UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation. The UE shall be capable of handling at least a relative receive timing difference (MRTD) between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.2.1-1 provided that UE indicates that it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*, and in Table 7.6.3-1 provided that UE does not indicate it is capable of *interBandMRDC-WithOverlapDL-Bands-r16*.

Table 7.6.2.1-1: Maximum receive timing difference requirement for inter-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) (Note1) | Maximum receive timing difference (µs) |
| 15 | 15 | 33 |
| 15 | 30 |  |
| 15 | 60 |  |
| 15 | 120 |  |
| Note 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}. |

### 7.6.3 Minimum Requirements for intra-band EN-DC

For intra-band EN-DC, only co-located deployment is applied.

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG as shown in Table 7.6.2-1 for E-UTRA FDD-NR FDD intra-band EN-DC provided the UE indicates that it is capable of asynchronous EN-DC operation [2].

The UE shall be capable of handling at least a relative receive timing difference between subframe timing of signal from a E-UTRA cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG as shown in Table 7.6.3-1 for E-UTRA FDD-NR FDD and E-UTRA TDD-NR TDD intra-band EN-DC provided the UE does not indicate that it is capable of asynchronous FDD-FDD EN-DC operation [16].

Table 7.6.3-1 Maximum receive timing difference requirement for intra-band synchronous EN-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of E-UTRA cell in MCG (kHz) | DL Sub-carrier spacing of cell in SCG (kHz) Note1 | Maximum receive timing difference (µs) |
| 15 | 15 | 3 |
| 15 | 30 | 3 |
| 15 | 60 | 3 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}. |

Table 7.6.3-2 Void

### 7.6.4 Minimum Requirements for NR Carrier Aggregation

For intra-band CA, only co-located deployment is applied. For intra-band non-contiguous NR carrier aggregation, the UE shall be capable of handling at least a relative receive timing difference between slot timing of different carriers to be aggregated at the UE receiver as shown in Table 7.6.4-1 below.

Table 7.6.4-1: Maximum receive timing difference requirement for intra-band non-contiguous NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range | Maximum receive timing difference (µs)  |
| FR1 | 31 |
| FR2 | 0.26 |
| Note 1: In the case of different SCS on different CCs, if the receive time difference exceeds the cyclic prefix length of that SCS, demodulation performance degradation is expected for the first symbol of the slot. |

For inter-band NR carrier aggregation, the UE shall be capable of handling at least a relative receive timing difference between slot timing of all pairs of carriers to be aggregated at the UE receiver as shown in Table 7.6.4-2 below.

Table 7.6.4-2: Maximum receive timing difference requirement for inter-band NR carrier aggregation

|  |  |
| --- | --- |
| Frequency Range of the pair of carriers | Maximum receive timing difference (µs)  |
| FR1 | 33 |
| FR2 | 8 note1 |
| Between FR1 and FR2 | 25  |
| Note1: This requirement applies to the UE capable of independent beam management for FR2 inter-band CA. |

### 7.6.5 Minimum Requirements for inter-band NE-DC

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from an E-UTRA cell belonging to the SCG at the UE receiver for asynchronous NE-DC as shown in Table 7.6.5-1.

Table 7.6.5-1: Maximum receive timing difference requirement for asynchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of cell in MCG (kHz) | DL Sub-carrier spacing of EUTRA cell in SCG (kHz) (Note 1) | Maximum receive timing difference (µs) |
| 15 | 15 | 500 |
| 30 | 15 | 250 |
| 60 | 15 | 125 |
| 120 | 15 | 62.5 |
| NOTE 1: DL Sub-carrier spacing is min{SCSSS, SCSDATA}.NOTE 2: Void |

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from a E-UTRA cell belonging to the SCG at the UE receiver for inter-band synchronous NE-DC as shown in Table 7.6.5-2. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

Table 7.6.5-2: Void

#### 7.6.5.1 Minimum Requirements for inter-band synchronous NE-DC

The requirements in this clause apply as a reference for inter-band synchronous NE-DC.

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and subframe timing of signal from a E-UTRA cell belonging to the SCG at the UE receiver for inter-band synchronous NE-DC as shown in Table 7.6.5.1-1. The requirements for synchronous NE-DC are applicable for NR TDD- E-UTRA TDD, NR FDD- E-UTRA FDD, NR TDD- E-UTRA FDD and NR FDD- E-UTRA TDD inter-band NE-DC.

For NR FDD-E-UTRA FDD inter-band NE-DC with overlapping DL bands, only synchronized operation is assumed if UE does not indicate that it is capable of asynchronous FDD-FDD NE-DC operation. The UE shall be capable of handling at least a relative receive timing difference (MRTD)between subframe timing of signal from a cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.2.1-1 provided that UE indicates that it is capable of interBandMRDC-WithOverlapDL-Bands-r16, and the same requirement as in Table 7.6.3-1 apply provided that UE does not indicateit is capable of interBandMRDC-WithOverlapDL-Bands-r16.

Table 7.6.5.1-1: Maximum receive timing difference requirement for inter-band synchronous NE-DC

|  |  |  |
| --- | --- | --- |
| Sub-carrier spacing of cell in MCG (kHz) | DL Sub-carrier spacing of EUTRA cell in SCG (kHz) (Note1) | Maximum receive timing difference (µs) |
| 15 | 15 | 33 |
| 30 | 15 |  |
| 60 | 15 |  |
| 120 | 15 |  |

### 7.6.6 Minimum Requirements for inter-band NR DC

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.6-1 provided that the UE indicates that it is capable of synchronous NR DC only [16].

Table 7.6.6-1: Maximum receive timing difference requirement for inter-band synchronous NR DC

|  |  |
| --- | --- |
| Frequency Range | Maximum receive timing difference (µs)  |
| Cell in MCG | Cell in SCG |  |
| FR1 | FR1 | 33 |
| FR2 | FR2 | 8 |
| FR1 | FR2 | 33 |

The UE shall be capable of handling at least a relative receive timing difference between slot timing of signal from a cell belonging to the MCG and slot timing of signal from a cell belonging to the SCG at the UE receiver as shown in Table 7.6.6-2 provided that the UE indicates that it is capable of asynchronous NR DC [16].

Table 7.6.6-2 Maximum receive timing difference requirement for inter-band asynchronous NR DC

|  |  |
| --- | --- |
| Max {Sub-carrier spacing in PCell (kHz), Sub-carrier spacing in PSCell (kHz)}  | Maximum receive timing difference (µs) |
| 15 | 500 |
| 30 | 250 |
| 60 | 125 |
| 120 | 62.5 |