**3GPP TSG-RAN4 Meeting #104-e *R4-22XXXX***

**Electronic meeting, August 15 – August 26, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.171** | **CR** | **TBD** | **rev** | **-** | **Current version:** | **17.1.0** |  |
|  | | | | | | | | |
| *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:*** | Big CR for 38.171 (Rel-17) | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | MCC, CATT | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh-Perf | | | | |  | ***Date:*** | | | 2022-08-30 |
|  |  | | | |  | |  | | |  |
| ***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 can be 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:*** | | **This big CR includes the endorsed draft CR R4-2211730 in RAN4#104e meeting.**  B2a and B3I signals has been introduced in the network-assisted BDS System, as part of A-GNSS positioning methods in LTE and NR in RAN2. The corresponding performance requirements need to be specified. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Introduce the performance requirements for B2a and B3I signals in TS 38.171.   1. Add “BDS-SIS-ICD-B2a-1.0” and “BDS-SIS-ICD-B3I-1.0” for reference. 2. Add symbol introduction for B2a and B3I signals. 3. Table 4.1: Set the relative signal power level for B2a and B3I signals. 4. Table C.2: Ref. BDS ICD, introduce the values in the BDS entry as: Signal = B2a, X [m] = 0.5 \* c / 10.23 Mcps = 15 m; Signal = B3I, X [m] = 0.5 \* c / 10.23 Mcps = 15 m; Y [dB] = -4.5 5. Table C.3: Ref. BDS ICD, introduce the value in BDS entry in this table as: Signal = B2a, Ratio N = 1176.450 MHz (Carrier Freq) / 10.23 Mcps (Chipping rate) = 115; Signal = B1I, Ratio N = 1268.520 MHz (Carrier Freq) / 10.23 Mcps (Chipping rate) = 124. 6. Add the GNSS assistance data for B2a and B3I in Annex E.1 and E.2. 7. Update Y[dB] in Table C.2 to -6dB. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The performance requirements for B2a and B3I signals are missing in TS 38.171. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.2, 4.8, C.2, E.1, E.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# <Start of Change 1>

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

 References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

 For a specific reference, subsequent revisions do not apply.

 For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

[3] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[4] 3GPP TS 38.215: "NR; Physical layer; Measurements".

[5] ETSI TR 102 273-1-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 1: Uncertainties in the measurement of mobile radio equipment characteristics; Sub-part 2: Examples and annexes".

[6] IS-GPS-200, Revision D, Navstar GPS Space Segment/Navigation User Interfaces, March 7th, 2006.

[7] P. Axelrad, R.G. Brown, "GPS Navigation Algorithms", in Chapter 9 of "Global Positioning System: Theory and Applications", Volume 1, B.W. Parkinson, J.J. Spilker (Ed.), Am. Inst. of Aeronautics and Astronautics Inc., 1996.

[8] S.K. Gupta, "Test and Evaluation Procedures for the GPS User Equipment", ION-GPS Red Book, Volume 1, p. 119.

[9] 3GPP TS 38.509: "5GS; Special conformance testing functions for User Equipment (UE)".

[10] IS-GPS-705, Navstar GPS Space Segment/User Segment L5 Interfaces, September 22, 2005.

[11] IS-GPS-800, Navstar GPS Space Segment/User Segment L1C Interfaces, September 4, 2008.

[12] IS-QZSS, Quasi Zenith Satellite System Navigation Service Interface Specifications for QZSS, Ver.1.1, July 31, 2009.

[13] Galileo OS Signal in Space ICD (OS SIS ICD), Issue 1.2, February 2014, European Union.

[14] Global Navigation Satellite System GLONASS Interface Control Document, Version 5.1, 2008.

[15] Specification for the Wide Area Augmentation System (WAAS), US Department of Transportation, Federal Aviation Administration, DTFA01-96-C-00025, 2001.

[16] BDS-SIS-ICD-B1I-3.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B1I (Version 3.0)", China Satellite Navigation Office, February 2019.

[17] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[18] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[19] 3GPP TS 37.571-1: " User Equipment (UE) conformance specification for UE positioning; Part 1: Terminal conformance".

[20] 3GPP TS 38.508-1: "5GS; User Equipment (UE) conformance specification; Part 1: Common test environment".

[21] BDS-SIS-ICD-B1C-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B1C (Version 1.0)", December, 2017.

[22] BDS-SIS-ICD-B2a-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B2a (Version 1.0)", December, 2017.

[23] BDS-SIS-ICD-B3I-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B3I (Version 1.0)", February, 2018.

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply:

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in TS 37.340 [2].

**en-gNB**: as defined in TS 37.340 [2].

**gNB**: as defined in in TS 38.300 [17].

**Horizontal Dilution Of Precision (HDOP):** measure of position determination accuracy that is a function of the geometrical layout of the satellites used for the fix, relative to the receiver antenna

**NE-DC**: NR-E-UTRA Dual Connectivity as defined in TS 37.340 [2].

**ng-eNB**: as defined in TS 38.300 [17].

**NR-DC**: NR-NR Dual Connectivity as defined in TS 37.340 [2].

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

B1I BeiDou B1I navigation signal with carrier frequency of 1561.098 MHz.

B1C BeiDou B1C navigation signal with carrier frequency of 1575.420 MHz.

B2a BeiDou B2a navigation signal with carrier frequency of 1176.450 MHz.

B3I BeiDou B3I navigation signal with carrier frequency of 1268.520 MHz.

E1 Galileo E1 navigation signal with carrier frequency of 1575.420 MHz.

E5 Galileo E5 navigation signal with carrier frequency of 1191.795 MHz.

E6 Galileo E6 navigation signal with carrier frequency of 1278.750 MHz.

G1 GLONASS navigation signal in the L1 sub-bands with carrier frequencies 1602 MHz ± k × 562.5 kHz.

G2 GLONASS navigation signal in the L2 sub-bands with carrier frequencies 1246 MHz ± k × 437.5 kHz.

k GLONASS channel number, k = -7…13.

L1 C/A GPS or QZSS L1 navigation signal carrying the Coarse/Acquisition code with carrier frequency of 1575.420 MHz.

L1C GPS or QZSS L1 Civil navigation signal with carrier frequency of 1575.420 MHz.

L2C GPS or QZSS L2 Civil navigation signal with carrier frequency of 1227.600 MHz.

L5 GPS or QZSS L5 navigation signal with carrier frequency of 1176.450 MHz.

**G** Geometry Matrix.

 Measured pseudo-range of satellite *i* of GNSSm.

**W** Weighting Matrix.

 Line of sight unit vector from the user to the satellite *i* of GNSSm.

 State vector of user position and clock bias.

# <End of Change 1>

# <Start of Change 2>

4.8 UEs supporting multiple signals

For UEs supporting multiple signals, different minimum performance requirements may be associated with different signals. The satellite simulator shall generate all signals supported by the UE. Signals not supported by the UE do not need to be simulated. The relative power levels of each signal type for each GNSS are defined in Table 4.1. The individual test scenarios in clause 6 define the reference signal power level for each satellite. The power level of each simulated satellite signal type shall be set to the reference signal power level defined in each test scenario in clause 6 plus the relative power level defined in Table 4.1.

Table 4.1: Relative signal power levels for each signal type for each GNSS

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BDS | | | Galileo | | GLONASS | | GPS/Modernized GPS | | QZSS | | SBAS | |
| Signal power levels relative to reference power levels | B1I | D1 | 0 dB | E1 | 0 dB | G1 | 0 dB | L1 C/A | 0 dB | L1 C/A | 0 dB | L1 | 0 dB |
| D2 | +5 dB |
| B1C | D1 | 0 dB | E6 | +2 dB | G2 | -6 dB | L1C | +1.5 dB | L1C | +1.5 dB |  |  |
| B2a | D1 | 0 dB | E5 | +2 dB |  |  | L2C | -1.5 dB | L2C | -1.5 dB |  |  |
| B3I | D1 | 0 dB |  |  |  |  | L5 | +3.6 dB | L5 | +3.6 dB |  |  |
| D2 | +5 dB |

NOTE 1: For test cases which involve “Modernized GPS”, the satellite simulator shall also generate the GPS L1 C/A signal if the UE supports “GPS” in addition to “Modernized GPS”.

NOTE 2: The signal power levels in the Test Parameter Tables represent the total signal power of the satellite per channel not e.g. pilot and data channels separately.

NOTE 3: For test cases which involve "BDS", D1 represents MEO/IGSO satellites for B1I/B3I and B1C/B2a signal types and D2 represents GEO satellites for B1I/B3I signal type.

# <End of Change 2>

# <Start of Change 3>

# C.1 Static propagation conditions

The propagation for the static performance measurement is an Additive White Gaussian Noise (AWGN) environment. No fading and multi-paths exist for this propagation model.

# C.2 Multi-path case

Doppler frequency difference between direct and reflected signal paths is applied to the carrier and code frequencies. The Carrier and Code Doppler frequencies of LOS and multi-path for GNSS signal are defined in table C.1.

Table C.1: Multipath case

|  |  |  |  |
| --- | --- | --- | --- |
| Initial relative delay  [m] | Carrier Doppler frequency of tap [Hz] | Code Doppler frequency of tap [Hz] | Relative mean power [dB] |
| 0 | Fd | Fd / N | 0 |
| X | Fd - 0.1 | (Fd-0.1) /N | Y |
| NOTE: Discrete Doppler frequency is used for each tap. | | | |

Where the X and Y depends on the GNSS signal type and is shown in Table C.2, and N is the ratio between the transmitted carrier frequency of the signals and the transmitted chip rate as shown in Table C.3 (where k in Table C.3 is the GLONASS frequency channel number).

Table C.2: Parameter values

|  |  |  |  |
| --- | --- | --- | --- |
| System | Signals | X [m] | Y [dB] |
| BDS | B1I | 75 | -4.5 |
| B1C | 125 | -4.5 |
| B2a | 15 | -6 |
| B3I | 15 | -6 |
| Galileo | E1 | 125 | -4.5 |
| E5a | 15 | -6 |
| E5b | 15 | -6 |
| GLONASS | G1 | 275 | -12.5 |
| G2 | 275 | -12.5 |
| GPS/Modernized GPS | L1 C/A | 150 | -6 |
| L1C | 125 | -4.5 |
| L2C | 150 | -6 |
| L5 | 15 | -6 |

Table C.3: Ratio between carrier frequency and chip rate

|  |  |  |
| --- | --- | --- |
| System | Signals | N |
| BDS | B1I | 763 |
| B1C | 1540 |
| B2a | 115 |
| B3I | 124 |
| Galileo | E1 | 1540 |
| E5a | 115 |
| E5b | 118 |
| GLONASS | G1 | 3135.03 + k ⋅ 1.10 |
| G2 | 2438.36 + k ⋅ 0.86 |
| GPS/Modernized GPS | L1 C/A | 1540 |
| L1C | 1540 |
| L2C | 1200 |
| L5 | 115 |

The initial carrier phase difference between taps shall be randomly selected between 0 and 2. The initial value shall have uniform random distribution.

# <End of Change 3>

# <Start of Change 4>

# E.1 Introduction

This annex defines the assistance data IEs available at the SS in all test cases. The assistance data shall be given for satellites as defined in B.1.5.

The information elements are given with reference to TS 36.355 [3], where the details are defined.

Table E.1 defines the assistance data elements which shall be provided to the UE in the tests (steps (d) and (e) in the message sequence according to annexes D.2 and D.3). The assistance data provided depends on the mode being used in the test case, the assistance data supported by the UE (indicated in step (c) in the message sequence according to annexes D.2 and D.3) and the GNSSs supported by the UE. Assistance data IEs not supported by the UE shall not be sent. Assistance data IEs supported by the UE but not listed in Table E.1 shall not be sent.

Table E.1: Assistance data to be provided to the UE

|  |  |  |  |
| --- | --- | --- | --- |
| Assistance data IE supported by UE | Mode used in test case | | |
| UE-based | UE-assisted,  GNSS-AcquisitionAssistance supported by UE | UE-assisted,  GNSS-AcquisitionAssistance not supported by UE |
| GNSS-Reference Time | Yes | Yes | Yes |
| GNSS-ReferenceLocation | Yes | No | Yes |
| GNSS-IonosphericModel | Yes | No | No |
| GNSS-TimeModelList | Yes(1) | No | Yes(1) |
| GNSS-NavigationModel | Yes | No | Yes |
| GNSS-AcquisitionAssistance | No | Yes | No |
| GNSS-Almanac | No | No | Yes |
| GNSS-UTC-Model | Yes(3) | Yes(3) | Yes(3) |
| GNSS-AuxiliaryInformation | Yes(2) | Yes(2) | Yes(2) |
| NOTE 1: In case more than a single GNSS is supported by the UE.  NOTE 2: In case the UE supports GLONASS, and/or more than one GPS signal, and/or BDS B1C/B2a.  NOTE 3: In case more than a single GNSS is supported by the UE and the UE supports GLONASS. | | | |

# E.2 GNSS assistance data

a) **GNSS-ReferenceTime IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.2: GNSS-ReferenceTime IE

|  |  |  |
| --- | --- | --- |
| Information Element | All tests except Sensitivity Fine Time Assistance | Sensitivity Fine Time Assistance test |
| GNSS-ReferenceTime |  |  |
| > gnss-SystemTime |  |  |
| >> gnss-TimeID | Yes | Yes |
| >> gnss-DayNumber | Yes | Yes |
| >> gnss-TimeOfDay | Yes | Yes |
| >> gnss-TimeOfDayFrac-msec | Yes | Yes |
| >> notificationOfLeapSecond | Yes if  gnss-TimeID = ‘glonass’ | Yes if  gnss-TimeID = ‘glonass’ |
| >> gps-TOW-Assist | Yes if  gnss-TimeID = ‘gps’ | Yes if  gnss-TimeID = ‘gps’ |
| > referenceTimeUnc | Yes | No |
| > gnss-ReferenceTimeForOneCell | No | Yes |
| >> networkTime |  | Yes |
| >>> secondsFromFrameStructureStart |  | Yes |
| >>> fractionalSecondsFromFrameStructureStart |  | Yes |
| >>> frameDrift |  | Yes |
| >>> cellID |  | Yes |
| >>> CHOICE eUTRA |  |  |
| >>>> physCellId |  | Yes |
| >>>> cellGlobalIdEUTRA |  | Yes |
| >>>> earfcn/earfcn-v9a0 |  | Yes |
| >>> CHOICE nr-r15 |  |  |
| >>>> nrPhysCellId-r15 |  | Yes |
| >>>> nrCellGlobalID-r15 |  | Yes |
| >>>> nrARFCN-r15 |  | Yes |
| >> referenceTimeUnc |  | Yes |

b) **GNSS-ReferenceLocation IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.3: GNSS-ReferenceLocation IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-ReferenceLocation | threeDlocation |

c) **GNSS-IonosphericModel IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.4: GNSS-IonosphericModel IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-IonosphericModel | KlobucharModelParameter |
| NeQuickModelParameter(1) |
| KlobucharModel2Parameter(2) |
| NOTE 1: Only required if GNSSs supported include Galileo.  NOTE 2: Only required if GNSSs supported include BDS B1C/B2a. | |

d) **GNSS-TimeModelList IE.** This information element is only required for multi system tests, and is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.5: GNSS-TimeModelList IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-TimeModelList |  |
|  | gnssTOID  For each GNSS included in the test. |
|  | deltaT |

e) **GNSS-NavigationModel IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.6: GNSS-NavigationModel IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-NavigationModel |  |

Table E.7: GNSS Clock and Orbit Model choices

|  |  |
| --- | --- |
| GNSS | Clock and Orbit Model choice |
| BDS B1I/B3I | Model-6 |
| BDS B1C/B2a | Model-7 |
| Galileo | Model-1 |
| GLONASS | Model-4 |
| GPS L1 C/A | Model-2 |
| Modernized GPS | Model-3 |
| QZSS QZS-L1 C/A | Model-2 |
| QZSS QZS-L1C/L2C/L5 | Model-3 |
| SBAS | Model-5 |

f) **GNSS-AcquisitionAssistance IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.8: GNSS-AcquisitionAssistance IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-AcquisitionAssistance |  |

g) **GNSS-Almanac IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.9: GNSS-Almanac IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-Almanac |  |

Table E.10: GNSS Almanac choices

|  |  |
| --- | --- |
| GNSS | Almanac Model choice |
| BDS B1I/B3I | Model-7 |
| BDS B1C/B2a | Model-3, 4 |
| Galileo | Model-1 |
| GLONASS | Model-5 |
| GPS L1 C/A | Model-2 |
| Modernized GPS | Model-3, 4 |
| QZSS QZS-L1 C/A | Model-2 |
| QZSS QZS-L1C/L2C/L5 | Model-3, 4 |
| SBAS | Model-6 |

h) **GNSS-UTC-Model IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.11: GNSS-UTC-Model IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-UTC-Model |  |

Table E.12: GNSS UTC Model choices

|  |  |
| --- | --- |
| GNSS | UTC Model choice |
| BDS B1I/B3I | Model-5 |
| BDS B1C/B2a | Model-2 |
| Galileo | Model-1 |
| GLONASS | Model-3 |
| GPS L1 C/A | Model-1 |
| Modernized GPS | Model-2 |
| QZSS QZS-L1 C/A | Model-1 |
| QZSS QZS-L1C/L2C/L5 | Model-2 |
| SBAS | Model-4 |

i) **GNSS-AuxiliaryInformation IE.** This information element is defined in clause 6.5.2.2 of TS 36.355 [3].

Table E.13: GNSS-AuxiliaryInformation IE

|  |  |
| --- | --- |
| Name of the IE | Fields of the IE |
| GNSS-AuxiliaryInformation |  |

# <End of Change 4>