3GPP TSG-RAN WG4 Meeting #100-e R4-2115423

 Electronic Meeting, August 16-27, 2021

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **36.171** | **CR** | Draft | **rev** | **-** | **Current version:** | **15.1.0** |  |
|  |
| *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:***  | CR on satellite allocation |
|  |  |
| ***Source to WG:*** | MediaTek Inc., Rohde & Schwarz |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | TEI15 |  | ***Date:*** | 2021-8-16 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-15 |
|  | *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 way the GNSS scenarios are defined, the complexity of the test case increases with the number of constellations used. This complexity increase is not consistent with the real field behavior: UEs supporting multiple constellations will generally see many more satellites. |
|  |  |
| ***Summary of change:*** | Increase the number of satellites to maintain always an overdetermined system with 1 equation more than unknowns for Table 6.2, Table 6.5, Table 6.8, Table 6.11, Table 6.14, and Table 6.18. |
|  |  |
| ***Consequences if not approved:*** | Not consistent UE behavior  |
|  |  |
| ***Clauses affected:*** | 6.1.1, 6.1.2, 6.2, 6.3, 6.4, 6.5, B.1.5.2 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS37.571-1 |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<Start of Change 1>

### 6.1.1 Coarse time assistance

In this test case 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. AWGN channel model is used.

Table 6.1: Test parameters

| System | Parameters | Unit | Value |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.2 |
| Total number of generated satellites  | - | 6 or 7(2) |
| HDOP range |  | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| Galileo | Reference high signal power level  | dBm | -142 |
| Reference low signal power level | dBm | -147 |
| GPS(1) | Reference high signal power level | dBm | -142 |
| Reference low signal power level | dBm | -147 |
| GLONASS | Reference high signal power level | dBm | -142 |
| Reference low signal power level | dBm | -147 |
| BDS | Reference high signal power level | dBm | -136 |
| Reference low signal power level | dBm | -145 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities.NOTE 2: 7 satellites apply only for case of triple constellation. |

Table 6.2: Power level and satellite allocation

|  |  |
| --- | --- |
|  | Satellite allocation for each constellation |
| GNSS-1(1) | GNSS-2 | GNSS-3 |
| Single constellation | High signal level | 1 | - | - |
| Low signal level | 5 | - | - |
| Dual constellation | High signal level | 1 | - | - |
| Low signal level | 2 | 3 | - |
| Triple constellation | High signal level | 1 | - | - |
| Low signal level | 2 | 2 | 2 |
| Note 1:GNSS-1, i.e. the system having the satellite with high signal level, shall be selected by the device manufacturer. |

<End of Change 1>

<Start of Change 2>

### 6.1.2 Fine time assistance

This requirement is only valid for fine time assistance capable UEs. In this requirement 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. AWGN channel model is used.

Table 6.4: Test parameters

| **System** | **Parameters** | **Unit** | **Value** |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.5 |
| Total number of generated satellites  | - | 6 or 7(2) |
| HDOP range |  | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| GNSS fine time assistance error range | s | ±10 |
| Galileo | Reference signal power level  | dBm | -147 |
| GPS(1) | Reference signal power level | dBm | -147 |
| GLONASS | Reference signal power level | dBm | -147 |
| BDS | Reference signal power level | dBm | -147 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities.NOTE 2: 7 satellites apply only for case of triple constellation. |

Table 6.5: Satellite allocation

|  |  |
| --- | --- |
|  | Satellite allocation for each constellation |
| GNSS-1 | GNSS-2 | GNSS-3 |
| Single constellation | 6 | - | - |
| Dual constellation | 3 | 3 | - |
| Triple constellation | 3 | 2 | 2 |

<End of Change 2>

<Start of Change 3>

## 6.2 Nominal Accuracy

Nominal accuracy requirement verifies the accuracy of A-GNSS position estimate in ideal conditions. The primarily aim of the test is to ensure good accuracy for a position estimate when satellite signal conditions allow it.This test case verifies the performance of the first position estimate.

In this requirement 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. If SBAS is to be tested one additional satellite shall be generated. AWGN channel model is used. The number of simulated satellites for each constellation is as defined in Table 6.8.

Table 6.7: Test parameters

| System | Parameters | Unit | Value |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.8 |
| Total number of generated satellites  | - | 6 or 7(2) or 8(3) |
| HDOP Range | - | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| GPS(1) | Reference signal power level for all satellites | dBm | -128.5 |
| Galileo | Reference signal power level for all satellites | dBm | -127 |
| GLONASS | Reference signal power level for all satellites | dBm | -131 |
| QZSS | Reference signal power level for all satellites | dBm | -128.5 |
| SBAS | Reference signal power level for all satellites | dBm | -131 |
| BDS | Reference signal power level for all satellites | dBm | -133 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities.NOTE 2: 7 satellites apply for case of single or dual constellation and SBAS is supported or case of triple constellation and SBAS is not supported.NOTE 3: 8 satellites apply only for case of triple constellation and SBAS is supported. |

If QZSS is supported, one of the GPS satellites will be replaced by a QZSS satellite with respective signal support. If SBAS is supported, the SBAS satellite with the highest elevation will be added to the scenario.

Table 6.8: Satellite allocation

|  |  |
| --- | --- |
|  | Satellite allocation for each constellation |
| GNSS 1(1) | GNSS 2(1) | GNSS 3(1) | SBAS |
| Single constellation | 6 | -- | -- | 1 |
| Dual constellation | 3 | 3 | -- | 1 |
| Triple constellation | 3 | 2 | 2 | 1 |
| NOTE 1: GNSS refers to global systems i.e., GPS, Galileo, GLONASS and BDS. |

<End of Change 3>

<Start of Change 4>

## 6.3 Dynamic Range

The aim of a dynamic range requirement is to ensure that a GNSS receiver performs well when visible satellites have rather different signal levels. Strong satellites are likely to degrade the acquisition of weaker satellites due to their cross‑correlation products. Hence, it is important in this test case to keep use AWGN in order to avoid loosening the requirements due to additional margin because of fading channels. This test case verifies the performance of the first position estimate.

In this requirement 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. Two different reference power levels, denoted as "high" and "low" are used for each GNSS. The allocation of "high" and "low" power level satellites depends on the number of supported GNSSs and it is defined in Table 6.11. AWGN channel model is used.

Table 6.10: Test parameters

| System | Parameters | Unit | Value |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.11 |
| Total number of generated satellites | - | 6 or 7(2) |
| HDOP Range | - | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| Galileo | Reference high signal power level | dBm | -127.5 |
| Reference low signal power level | dBm | -147 |
| GPS(1) | Reference high signal power level | dBm | -129 |
| Reference low signal power level | dBm | -147 |
| GLONASS | Reference high signal power level | dBm | -131.5 |
| Reference low signal power level | dBm | -147 |
| BDS | Reference high signal power level | dBm | -133.5 |
| Reference low signal power level | dBm | -145 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities. NOTE 2: 7 satellites apply only for case of triple constellation. |

Table 6.11: Power level and satellite allocation

|  |  |
| --- | --- |
|  | Satellite allocation for each constellation |
| GNSS 1(1) | GNSS 2(1) | GNSS 3(1) |
| Single constellation | High signal level | 2 | -- | -- |
| Low signal level | 4 | -- | -- |
| Dual constellation | High signal level | 1 | 1 | -- |
| Low signal level | 2 | 2 | -- |
| Triple constellation | High signal level | 1 | 1 | 1 |
| Low signal level | 2 | 1 | 1 |
| NOTE 1: GNSS refers to global systems i.e., GPS, Galileo, GLONASS and BDS. |

<End of Change 4>

<Start of Change 5>

## 6.4 Multi-Path scenario

The purpose of the test case is to verify the receiver's tolerance to multipath while keeping the test setup simple. This test case verifies the performance of the first position estimate.

In this requirement 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. Some of the satellites have a one tap channel representing the Line-Of-Sight (LOS) signal. The other satellites have a two-tap channel, where the first tap represents the LOS signal and the second represents a reflected and attenuated signal as specified in Annex C.2. The number of satellites generated for each GNSS as well as the channel model used depends on the number of systems supported by the UE and is defined in Table 6.14. The channel model as specified in Annex C.2 further depends on the generated signal.

Table 6.13: Test parameter

| System | Parameters | Unit | Value |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.14 |
| Total number of generated satellites  | - | 6 or 7(2) |
| HDOP range |  | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| Galileo | Reference signal power level  | dBm | -127 |
| GPS(1) | Reference signal power level | dBm | -128.5 |
| GLONASS | Reference signal power level | dBm | -131 |
| BDS | Reference signal power level | dBm | -133 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities.NOTE 2: 7 satellites apply only for case of triple constellation. |

Table 6.14: Channel model allocation

|  |  |
| --- | --- |
|  | Channel model allocation for each constellation |
| GNSS-1 | GNSS-2 | GNSS-3 |
| Single constellation | One-tap channel | 2 | -- | -- |
| Two-tap channel | 4 | -- | -- |
| Dual constellation | One-tap channel | 1 | 1 | -- |
| Two-tap channel | 2 | 2 | -- |
| Triple constellation | One-tap channel | 1 | 1 | 1 |
| Two-tap channel | 2 | 1 | 1 |

<End of Change 5>

<Start of Change 6>

## 6.5 Moving scenario and periodic update

The purpose of the test case is to verify the receiver's capability to produce GNSS measurements or location fixes on a regular basis, and to follow when it is located in a vehicle that slows down, turns or accelerates. A good tracking performance is essential for a certain location services. A moving scenario with periodic update is well suited for verifying the tracking capabilities of an A-GNSS receiver in changing UE speed and direction. In the requirement the UE moves on a rectangular trajectory, which imitates urban streets. AWGN channel model is used. This test is not performed as a Time to First Fix (TTFF) test.

In this requirement 6 satellites are generated for the terminal for single constellation and dual constellation, and 7 satellites are generated for triple constellation. The UE is requested to use periodical reporting with a reporting interval of 2 seconds.

The UE moves on a rectangular trajectory of 940 m by 1 440 m with rounded corner defined in Figure 6.1. The initial reference is first defined followed by acceleration to final speed of 100 km/h in 250 m. The UE then maintains the speed for 400 m. This is followed by deceleration to final speed of 25 km/h in 250 m. The UE then turn 90 degrees with turning radius of 20 m at 25 km/h. This is followed by acceleration to final speed of 100 km/h in 250 m. The sequence is repeated to complete the rectangle.

Table 6.16: Trajectory Parameters

|  |  |  |
| --- | --- | --- |
| Parameter | Distance (m) | Speed (km/h) |
| l11, l15, l21, l25 | 20 | 25 |
| l12, l14, l22, l24 | 250 | 25 to 100 and 100 to 25 |
| l13 | 400 | 100 |
| l23 | 900 | 100 |



Figure 6.1: Rectangular trajectory of the moving scenario and periodic update test case

Table 6.17: Test Parameters

| **System** | **Parameters** | **Unit** | **Value** |
| --- | --- | --- | --- |
|  | Number of generated satellites per system | - | See Table 6.18 |
| Total number of generated satellites | - | 6 or 7(2) |
| HDOP Range per system | - | 1.4 to 2.1 |
| Propagation conditions  | - | AWGN |
| GNSS coarse time assistance error range | seconds | ±2 |
| Galileo | Reference signal power level for all satellites | dBm | -127 |
| GPS(1) | Reference signal power level for all satellites | dBm | -128.5 |
| GLONASS | Reference signal power level for all satellites | dBm | -131 |
| BDS | Reference signal power level for all satellites | dBm | -133 |
| NOTE 1: "GPS" here means GPS L1 C/A, Modernized GPS, or both, dependent on UE capabilities.NOTE 2: 7 satellites apply only for case of triple constellation. |

Table 6.18: Satellite allocation

|  |  |
| --- | --- |
|  | Satellite allocation for each constellation |
| GNSS 1(1) | GNSS 2(1) | GNSS 3(1) |
| Single constellation | 6 | -- | -- |
| Dual constellation | 3 | 3 | -- |
| Triple constellation | 3 | 2 | 2 |
| NOTE1: GNSS refers to global systems i.e., GPS, Galileo, GLONASS and BDS. |

<End of Change 6>

<Start of Change 7>

### B.1.5.2 UE supports other A-GNSSs

In the case of test cases in clause 6 (UE supports other GNSSs), the satellite constellation shall consist of 24 satellites for GLONASS; 27 satellites for GPS, Modernized GPS and Galileo; 3 satellites for QZSS; 2 satellites for SBAS and 35 satellites for BDS (5 GEO, 27 MEO, 3 IGSO). Almanac assistance data shall be available for all these satellites. At least 7 of the satellites per GPS, Modernized GPS, Galileo, GLONASS and BDS constellation shall be visible to the UE (that is, above 15 degrees elevation with respect to the UE). At least 1 of the satellites for QZSS shall be within 15 degrees of zenith; and at least 1 of the satellites for SBAS shall be visible to the UE. For BDS with reference location in Asia, at least 1 of the visible satellites shall be a GEO (above 15 degrees elevation with respect to the UE). All other satellite specific assistance data shall be available for all visible satellites. In each test, signals are generated for only 6 satellites for single constellation and dual constellation and 7 satellites for triple constellation (or one additional satellite if SBAS is included). The HDOP for the test shall be calculated using these satellites. The simulated satellites for GPS, Modernized GPS, Galileo, GLONASS and BDS shall be selected from the visible satellites for each constellation consistent with achieving the required HDOP for the test. For BDS with reference location in Asia, 1 of the simulated satellites shall be a GEO.

NOTE: Currently up to 30 BDS satellites (maximum 22 MEO) can be supported.

<End of Change 7>