**3GPP TSG-RAN WG2 Meeting #124 *R2-231xxxx***

**Chicago, USA, November 13th – 17th, 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **37.355** | **CR** | **0480** | **rev** | **1** | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network | **x** |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Bluetooth AoA/AoD support [BT-AoA-AoD] | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | TEI18 | | | | |  | ***Date:*** | | | 2023-11-28 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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:*** | | Extension of the Bluetooth positioning method with support for AoA/AoD | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Enable Bluetooth AoA/AoD based on the agreement in RAN2  RAN1#123bis  Agreements:  Support Bluetooth AoA/AoD positioning in the LPP Bluetooth positioning method.  Introduce BT AoA/AoD measurements in LPP.  FFS if further BT control information can be captured in our specs.  and outcome of email discussion  [Post123bis][403][POS] BT AoA/AoD (Ericsson)  Scope: Draft and review a CR implementing the agreements from RAN2#123bis on Bluetooth AoA/AoD positioning.  Intended outcome: Report and CR to next meeting  Deadline: Long  And corrections due to issues detected post meeting, further discussed in post meeting email discussion  [Post124][421[POS] Updated CR on BT AoA/AoD (Ericsson)  Scope: Address issues in previously agreed CR R2-2312946 and confirm agreement on an updated CR.  Intended outcome: Agreed CR  Deadline: Short (for RP) | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Bluetooth AoA/AoD is not supported in LPP. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 6.3, 6.5.7.1, 6.5.7.2, 6.5.7.3, 6.5.7.4, 6.5.7.5, 6.5.7.6, 6.5.7.7, 6.5.7.8, 6.5.7.9, 6.6 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS/TR 38.305 CR 0153 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR 36.305 CR 0119 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*START OF CHANGE*

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 36.305: "Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN".

[3] 3GPP TS 23.271: "Functional stage 2 description of Location Services (LCS)".

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

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

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

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

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

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

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

[11] RTCM-SC104, RTCM Recommended Standards for Differential GNSS Service (v.2.3), August 20, 2001.

[12] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); "Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol Specification".

[14] 3GPP TS 44.031: "Location Services (LCS); Mobile Station (MS) - Serving Mobile Location Centre (SMLC) Radio Resource LCS Protocol (RRLP)".

[15] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

[16] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[17] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer – Measurements".

[18] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[19] 3GPP TS 23.003: "Numbering, addressing and identification".

[20] OMA-TS-LPPe-V1\_0, LPP Extensions Specification, Open Mobile Alliance.

[21] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[22] ITU-T Recommendation X.691 (07/2002) "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).

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

[24] ATIS-0500027: "Recommendations for Establishing Wide Scale Indoor Location Performance", May 2015.

[25] Bluetooth Special Interest Group: "Bluetooth Core Specification v4.2", December 2014.

[26] IEEE 802.11, Part 11: "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[27] IETF RFC 6225, "Dynamic Host Configuration Protocol Options for Coordinate-Based Location Configuration Information", July 2011.

[28] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

[29] "Earth Gravitational Model 96 (EGM96)", National Geospatial-Intelligence Agency, NASA.

[30] RTCM Standard 10403.3: "Differential GNSS (Global Navigation Satellite Systems) Services" – Version 3, October 7, 2016.

[31] IGS ANTEX: "The Antenna Exchanged Format" – version 1.4, September 15, 2010.

[32] Federal Information Processing Standards Publication 197, "Specification for the ADVANCED ENCRYPTION STANDARD (AES)", November 26, 2001.

[33] NIST Special Publication 800-38A, "Recommendation for Block Cipher Modes of Operation Methods and Techniques", 2001.

[34] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[35] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[36] 3GPP TS 38.215: "NR; Physical layer measurements".

[37] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[38] IRNSS Signal-In-Space (SPS) Interface Control Document (ICD) for standard positioning service version 1.1, Aug 2017.

[39] 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.

[40] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[41] 3GPP TS 38.211: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Physical channels and modulation".

[42] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[43] IS-QZSS-L6-001, Quasi-Zenith Satellite System Interface Specification – Centimetre Level Augmentation Service, Cabinet Office, November 5, 2018.

[44] 3GPP TR 38.901: "Technical Specification Group Radio Access Network; Study on channel model for frequencies from 0.5 to 100 GHz".

[45] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[46] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[47] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

[48] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[49] 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.

[50] 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.

[51] NMEA standard 0183, Version 4.11, November 2018.

[xx] Bluetooth Special Interest Group: "Bluetooth Core Specification v5.4", February 2023.

*NEXT CHANGE*

6.3 Message Body IEs

*[…]*

*– RequestAssistanceData*

The *RequestAssistanceData* message body in a LPP message is used by the target device to request assistance data from the location server.

-- ASN1START

RequestAssistanceData ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE {

requestAssistanceData-r9 RequestAssistanceData-r9-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

RequestAssistanceData-r9-IEs ::= SEQUENCE {

commonIEsRequestAssistanceData CommonIEsRequestAssistanceData OPTIONAL,

a-gnss-RequestAssistanceData A-GNSS-RequestAssistanceData OPTIONAL,

otdoa-RequestAssistanceData OTDOA-RequestAssistanceData OPTIONAL,

epdu-RequestAssistanceData EPDU-Sequence OPTIONAL,

...,

[[ sensor-RequestAssistanceData-r14

Sensor-RequestAssistanceData-r14 OPTIONAL,

tbs-RequestAssistanceData-r14 TBS-RequestAssistanceData-r14 OPTIONAL,

wlan-RequestAssistanceData-r14 WLAN-RequestAssistanceData-r14 OPTIONAL

]],

[[ nr-Multi-RTT-RequestAssistanceData-r16 NR-Multi-RTT-RequestAssistanceData-r16 OPTIONAL,

nr-DL-AoD-RequestAssistanceData-r16 NR-DL-AoD-RequestAssistanceData-r16 OPTIONAL,

nr-DL-TDOA-RequestAssistanceData-r16 NR-DL-TDOA-RequestAssistanceData-r16 OPTIONAL

]],

[[

bt-RequestAssistanceData-r18 BT-RequestAssistanceData-r18 OPTIONAL

]]

}

-- ASN1STOP

*– ProvideAssistanceData*

The *ProvideAssistanceData* message body in a LPP message is used by the location server to provide assistance data to the target device either in response to a request from the target device or in an unsolicited manner.

-- ASN1START

ProvideAssistanceData ::= SEQUENCE {

criticalExtensions CHOICE {

c1 CHOICE {

provideAssistanceData-r9 ProvideAssistanceData-r9-IEs,

spare3 NULL, spare2 NULL, spare1 NULL

},

criticalExtensionsFuture SEQUENCE {}

}

}

ProvideAssistanceData-r9-IEs ::= SEQUENCE {

commonIEsProvideAssistanceData CommonIEsProvideAssistanceData OPTIONAL, -- Need ON

a-gnss-ProvideAssistanceData A-GNSS-ProvideAssistanceData OPTIONAL, -- Need ON

otdoa-ProvideAssistanceData OTDOA-ProvideAssistanceData OPTIONAL, -- Need ON

epdu-Provide-Assistance-Data EPDU-Sequence OPTIONAL, -- Need ON

...,

[[

sensor-ProvideAssistanceData-r14 Sensor-ProvideAssistanceData-r14 OPTIONAL, -- Need ON

tbs-ProvideAssistanceData-r14 TBS-ProvideAssistanceData-r14 OPTIONAL, -- Need ON

wlan-ProvideAssistanceData-r14 WLAN-ProvideAssistanceData-r14 OPTIONAL -- Need ON

]],

[[ nr-Multi-RTT-ProvideAssistanceData-r16

NR-Multi-RTT-ProvideAssistanceData-r16

OPTIONAL, -- Need ON

nr-DL-AoD-ProvideAssistanceData-r16

NR-DL-AoD-ProvideAssistanceData-r16 OPTIONAL, -- Need ON

nr-DL-TDOA-ProvideAssistanceData-r16

NR-DL-TDOA-ProvideAssistanceData-r16

OPTIONAL -- Need ON

]],

[[

bt-ProvideAssistanceData-r18 BT-ProvideAssistanceData-r18 OPTIONAL -- Need ON

]]

}

-- ASN1STOP

*[…]*

6.5.7.1 Bluetooth Location Information

*–* *BT-ProvideLocationInformation*

The IE *BT-ProvideLocationInformation* is used by the target device to provide measurements for one or more Bluetooth beacons to the location server. It may also be used to provide Bluetooth positioning specific error reason or to provide Bluetooth AoA configuration of the target device.

-- ASN1START

BT-ProvideLocationInformation-r13 ::= SEQUENCE {

bt-MeasurementInformation-r13 BT-MeasurementInformation-r13 OPTIONAL,

bt-Error-r13 BT-Error-r13 OPTIONAL,

...,

[[

bt-AoA-Config-r18 BT-AoA-Config-r18 OPTIONAL

]]

}

BT-AoA-Config-r18 ::= SEQUENCE {

btAddr-r18 BIT STRING (SIZE (48)),

cteStatus-r18 ENUMERATED {enabled, disabled} OPTIONAL,

primaryAdvInterval-r18 INTEGER (32..16777) OPTIONAL,

secondAdvInterval-r18 INTEGER (6..65535) OPTIONAL,

txPower-r18 INTEGER (-127..20) OPTIONAL,

cteLength-r18 INTEGER (2..20) OPTIONAL,

cteCount-r18 INTEGER (1..16) OPTIONAL,

tx-PHY-M2-r18 NULL OPTIONAL,

...

}

-- ASN1STOP

| ***BT-*** ***ProvideLocationInformation* field descriptions** |
| --- |
| ***btAddr***  This field specifies the Bluetooth address of the device [xx]. In case the device updates its address during an established LPP session, the device shall provide the new address as unsolicited location information to the server |
| ***cteStatus***  This field provides the Bluetooth AoA transmission status of the device  enabled: Bluetooth AoA transmission is enabled  disabled: Bluetooth AoA transmission is disabled |
| ***primaryAdvInterval***  This field specifies the Bluetooth primary advertisement channel periodicity that the device will use, scaling factor 0.625 ms [xx]. |
| ***secondAdvInterval***  This field specifies the Bluetooth periodic advertising interval on secondary advertisement channels that the device will use, scaling factor 0.625 ms [xx]. |
| ***txPower***  This field specifies the Bluetooth advertising TX power in dBm that the device will use. |
| ***cteLength***  This field specifies the configured CTE length to be used by the device in number of 8us segments. |
| ***cteCount***  This field specifies the number of Bluetooth packets that include a CTE that the device will transmit each periodic advertising. |
| ***tx-PHY-M2***  This field, if present, indicates that Bluetooth TX PHY 2 Megasymbols/s will be used for AoA, otherwise Bluetooth TX PHY 1 Megasymbols/s will be used, |

6.5.7.2 Bluetooth Location Information Elements

*– BT-MeasurementInformation*

-- ASN1START

BT-MeasurementInformation-r13 ::= SEQUENCE {

measurementReferenceTime-r13 UTCTime OPTIONAL,

bt-MeasurementList-r13 BT-MeasurementList-r13 OPTIONAL,

...,

[[

bt-MeasurementList-r18 BT-MeasurementList-r18 OPTIONAL ]]

}

BT-MeasurementList-r13 ::= SEQUENCE (SIZE(1..maxBT-Beacon-r13)) OF BT-MeasurementElement-r13

BT-MeasurementElement-r13 ::= SEQUENCE {

btAddr-r13 BIT STRING (SIZE (48)),

rssi-r13 INTEGER (-128..127) OPTIONAL,

...

}

BT-MeasurementList-r18 ::= SEQUENCE (SIZE(1..maxBT-Beacon-r13)) OF BT-MeasurementElement-r18

BT-MeasurementElement-r18 ::= SEQUENCE {

btAddr-r18 BIT STRING (SIZE (48)),

bt-azimuth-r18 INTEGER (0..359),

bt-elevation-r18 INTEGER (0..180) OPTIONAL,

rssi-r18 INTEGER (-128..127) OPTIONAL,

...

}

-- ASN1STOP

| ***BT-MeasurementInformation* field descriptions** |
| --- |
| ***measurementReferenceTime***  This field provides the UTC time when the Bluetooth measurements are performed and should take the form of *YYMMDDhhmmssZ*. |
| ***bt-MeasurementList***  This field provides the Bluetooth measurements for up to 32 Bluetooth beacons. |
| ***btAddr***  This field specifies the Bluetooth public address of the Bluetooth beacon [25]. |
| ***rssi***  This field provides the beacon received signal strength indicator (RSSI) in dBm. |
| ***bt-azimuth***  This field represents the estimated AoD azimuth in GCD relative the Bluetooth beacon reference position. |
| ***bt-elevation***  This field represents the estimated AoD elevation in GCD relative the Bluetooth beacon reference position. |

6.5.7.3 Bluetooth Location Information Request

*–* *BT-RequestLocationInformation*

The IE *BT-RequestLocationInformation* is used by the location server to request Bluetooth measurements or request/ suggest AoA configuration from/to a target device.

-- ASN1START

BT-RequestLocationInformation-r13 ::= SEQUENCE {

requestedMeasurements-r13 BIT STRING {

rssi (0),

aod-v1800 (1)} (SIZE(1..8)),

...,

[[

bt-requestedAoA-Config-r18 BIT STRING {

aoa-advConfig (0),

aoa-cteConfig (1)} (SIZE(1..8)) OPTIONAL, -- Need ON

bt-suggestedAoA-Config-r18 BT-SuggestedAoA-Config-r18 OPTIONAL -- Need ON

]]

}

BT-SuggestedAoA-Config-r18 ::= SEQUENCE {

cteStatus-r18 ENUMERATED {enabled, disabled} OPTIONAL, -- Need ON

primaryAdvInterval-r18 INTEGER (32..16777) OPTIONAL, -- Need ON

secondAdvInterval-r18 INTEGER (6..65535) OPTIONAL, -- Need ON

txPower-r18 INTEGER (-127..20) OPTIONAL, -- Need ON

cteLength-r18 INTEGER (2..20) OPTIONAL, -- Need ON

cteCount-r18 INTEGER (1..16) OPTIONAL, -- Need ON

tx-PHY-M2-r18 NULL OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| ***BT-RequestLocationInformation* field descriptions** |
| --- |
| ***requestedMeasurements***  This field specifies the Bluetooth measurements requested. This is represented by a bit string, with a one‑value at the bit position means the particular measurement is requested; a zero‑value means not requested. The following measurement requests can be included.  rssi: Bluetooth beacon signal strength at the target  aod: Estimated AoD per Bluetooth beacon |
| ***bt-requestedAoA-Config***  This field specifies the Bluetooth AoA configuration parameters requested. This is represented by a bit string, with a one‑value at the bit position means the particular measurement is requested; a zero‑value means not requested. The following information requests can be included.  aoa-advConfig: The Bluetooth advertisement address and periodic intervals of the device  aoa-cteConfig: The configured CTE status, length, count and PHY |
| ***cteStatus***  This field suggests the Bluetooth AoA transmission status of the device, and is used by the location server to suggest BLE AoA transmission of the device to be enabled or disabled.  enabled: Bluetooth AoA transmission is suggested enabled  disabled: Bluetooth AoA transmission is suggested disabled |
| ***primaryAdvInterval***  This field suggests the Bluetooth primary advertisement channel periodicity of the device, scaling factor 0.625 ms [xx]. |
| ***secondAdvInterval***  This field suggests the Bluetooth periodic advertising interval on secondary advertisement channels of the device, scaling factor 0.625 ms [xx]. |
| ***txPower***  This field suggests the Bluetooth advertising TX power in dBm of the device [xx]. |
| ***cteLength***  This field suggests the CTE length ofthe device in number of 8us segments. |
| ***cteCount***  This field suggests the number of Bluetooth packets that include a CTE of the device each periodic advertising event |
| ***tx-PHY-M2***  This field, if present, suggests that Bluetooth TX PHY 2 Megasymbols/s is used for AoA, otherwise Bluetooth TX PHY 1 Megasymbols/s is suggested to be used by the device, |

6.5.7.4 Bluetooth Capability Information

*–* *BT-ProvideCapabilities*

The IE *BT-ProvideCapabilites* is used by the target device to provide its capabilities for Bluetooth positioning to the location server.

-- ASN1START

BT-ProvideCapabilities-r13 ::= SEQUENCE {

bt-Modes-r13 BIT STRING { standalone (0),

ue-assisted (1),

ue-based-v1800 (2)} (SIZE (1..8)),

bt-MeasSupported-r13 BIT STRING { rssi-r13 (0),

aod-v1800 (1) } (SIZE (1..8)),

...,

[[

idleStateForMeasurements-r14

ENUMERATED { required } OPTIONAL,

periodicalReportingSupported-r14

PositioningModes OPTIONAL

]],

[[ scheduledLocationRequestSupported-r17 ScheduledLocationTimeSupportPerMode-r17 OPTIONAL

]],

[[

bt-AoA-r18 ENUMERATED { request-only, suggestion } OPTIONAL

]]

}

-- ASN1STOP

| ***BT-ProvideCapabilities* field descriptions** |
| --- |
| ***bt-Modes***  This field specifies the Bluetooth mode(s) supported by the target device. This is represented by a bit string, with a one value at the bit position means the Bluetooth mode is supported; a zero value means not supported. NOTE: ue-based is only supported for AoD with assistance data in this release. |
| ***bt-MeasSupported***  This field specifies the Bluetooth measurements supported by the target device. This is represented by a bit string, with a one‑value at the bit position means the particular measurement is supported; a zero‑value means not supported. A zero-value in all bit positions in the bit string means only the basic Bluetooth positioning method is supported by the target device which is reporting of the Bluetooth beacon identity. The following bits are assigned for the indicated measurements.  rssi: Bluetooth beacon signal strength at the target device  aod: Bluetooth beacon AoD at the target device |
| ***idleStateForMeasurements***  This field, if present, indicates that the target device requires idle state to perform BT measurements. |
| ***periodicalReportingSupported***  This field, if present, specifies the positioning modes for which the target device supports *periodicalReporting*. This is represented by a bit string, with a one value at the bit position means *periodicalReporting* for the positioning mode is supported; a zero value means not supported. If this field is absent, the location server may assume that the target device does not support *periodicalReporting* in *CommonIEsRequestLocationInformation*. |
| ***scheduledLocationRequestSupported***  This field, if present, specifies the positioning modes for which the target device supports scheduled location requests – i.e., supports the IE *ScheduledLocationTime* in IE *CommonIEsRequestLocationInformation* – and the time base(s) supported for the scheduled location time for each positioning mode. If this field is absent, the target device does not support scheduled location requests. |
| ***bt-AoA***  This field, if present, indicates that the target device supports Bluetooth AoA, where  *request-only*: Target device supports to provide its Bluetooth AoA transmission configuration to LMF upon request  *suggestion*: Target device supports obtaining a suggestion from LMF about device Bluetooth AoA transmission configuration and device supports to provide its Bluetooth AoA transmission configuration based on the suggestion back to LMF |
| ***bt-AoD***  This field, if present, indicates that the target device supports Bluetooth AoD |

6.5.7.5 Bluetooth Capability Information Request

*–* *BT-RequestCapabilities*

The IE *BT-RequestCapabilities* is used by the location server to request Bluetooth positioning capabilities from a target device.

-- ASN1START

BT-RequestCapabilities-r13 ::= SEQUENCE {

...

}

-- ASN1STOP

6.5.7.6 BT Error Elements

*–* *BT-Error*

The IE *BT-Error* is used by the location server or target device to provide error reasons for Bluetooth positioning to the target device or location server, respectively.

-- ASN1START

BT-Error-r13 ::= CHOICE {

locationServerErrorCauses-r13 BT-LocationServerErrorCauses-r13,

targetDeviceErrorCauses-r13 BT-TargetDeviceErrorCauses-r13,

...

}

-- ASN1STOP

*–* *BT-LocationServerErrorCauses*

The IE *BT-LocationServerErrorCauses* is used by the location server to provide error reasons for Bluetooth positioning to the target device.

-- ASN1START

BT-LocationServerErrorCauses-r13 ::= SEQUENCE {

cause-r13 ENUMERATED {undefined, ...,

assistanceDataNotSupportedByServer-v1800,

assistanceDataSupportedButCurrentlyNotAvailableByServer-v1800,

notProvidedAssistanceDataNotSupportedByServer-v1800

},

...

}

-- ASN1STOP

– *BT-TargetDeviceErrorCauses*

The IE *BT-TargetDeviceErrorCauses* is used by the target device to provide error reasons for Bluetooth positioning to the location server.

-- ASN1START

BT-TargetDeviceErrorCauses-r13 ::= SEQUENCE {

cause-r13 ENUMERATED {undefined,

requestedMeasurementsNotAvailable,

notAllrequestedMeasurementsPossible,

...,

assistanceDataMissing-v1800,

unableToMeasureAnyBT-Beacons-v1800,

thereWereNotEnoughBeaconsReceivedForUeBasedAoD-v1800,

unableToTransmitCTE-v1800

},

bt-Beacon-rssiMeasurementNotPossible-r13 NULL OPTIONAL,

...

}

-- ASN1STOP

| ***BT-TargetDeviceErrorCauses* field descriptions** |
| --- |
| ***cause***  This field provides a Bluetooth specific error cause. If the cause value is 'notAllRequestedMeasurementsPossible', the target device was not able to provide all requested Bluetooth measurements (but may be able to provide some measurements). In this case, the target device should include *bt-Beacon-rssiMeasurementNotPossible* field. |

6.5.7.7 Bluetooth Assistance Data

*–* *BT-ProvideAssistanceData*

The IE *BT-ProvideAssistanceData* is used by the location server to provide assistance data to enable UE‑based and UE-assisted AoD positioning. It may also be used to provide Bluetooth positioning specific error reasons.

-- ASN1START

BT-ProvideAssistanceData-r18 ::= SEQUENCE {

bt-BeaconInfo-r18 BT-BeaconInfo-r18,

bt-Error-r18 BT-Error-r13 OPTIONAL, -- Need ON

...

}

-- ASN1STOP

| ***BT-ProvideAssistanceData* field descriptions** |
| --- |
| ***bt-BeaconInfo*** This field provides data for aset of Bluetooth beacons. |
| ***bt-Error*** This field provides error information and may be included when a Provide Assistance Data is sent in response to a Request Assistance Data. |

6.5.7.8 Bluetooth Assistance Data Elements

– *BT-BeaconInfo*

The IE *BT-BeaconInfo* is used by the location server to provide Bluetooth beacon information for one set of Bluetooth beacons.

-- ASN1START

BT-BeaconInfo-r18 ::= SEQUENCE {

referencePoint-r18 ReferencePoint-r16,

bt-BeaconInfoList-r18 SEQUENCE (SIZE (1..maxBT-BeaconAD-r18)) OF BT-BeaconInfoElement-r18,

...

}

BT-BeaconInfoElement-r18 ::= SEQUENCE {

btAddr-r18 BIT STRING (SIZE (48)),

bt-BeaconLocation-r18 RelativeLocation-r16 OPTIONAL, -- Need OP

bt-LCS-GCS-TranslationParameter-r18 LCS-GCS-TranslationParameter-r16

OPTIONAL, -- Cond NotSameAsPrev1

bt-antArrayConfig-r18 BT-AntArrayConfig-r18 OPTIONAL, -- Cond NotSameAsPrev2

bt-antElementList-r18 SEQUENCE (SIZE (2..maxBT-BeaconAntElt-r18)) OF

BT-AntElement-r18 OPTIONAL, -- Cond NotSameAsPrev3 bt-antSwitchingPattern-r18 SEQUENCE (SIZE (2..maxBT-BeaconAntElt-r18)) OF

BT-AntSwitchElement-r18 OPTIONAL, -- Cond NotSameAsPrev4

bt-AoDTransmConfig-r18 BT-AoDTransmConfig-r18 OPTIONAL, -- Cond NotSameAsPrev5

...

}

BT-AntArrayConfig-r18 ::= CHOICE {

bt-UniformLinearArray-r18 BT-UniformLinearArray-r18,

bt-UniformRectangularArray-r18 BT-UniformRectangularArray-r18,

bt-UniformCircularArray-r18 BT-UniformCircularArray-r18,

bt-GenericArray-r18 BT-GenericArray-r18

}

BT-AntElement-r18 ::= SEQUENCE {

polarization-r18 ENUMERATED {m45, zero, p45, p90, circ},

...

}

BT-AntSwitchElement-r18 ::= SEQUENCE {

antElementIndexShort-r18 INTEGER (1..16),

antElementIndexOffset-r18 ENUMERATED {o16, o32, o48, o64} OPTIONAL, -- Need OP

...

}

BT-AoDTransmConfig-r18 ::= SEQUENCE {

primaryAdvInterval-r18 INTEGER (32..16777),

secondAdvInterval-r18 INTEGER (6..65535),

cteLength-r18 INTEGER (2..20),

cteCount-r18 INTEGER (1..16),

cteType2us-r18 NULL OPTIONAL, -- Need OP

tx-PHY-M2-r18 NULL OPTIONAL, -- Need OP

...

}

-- ASN1STOP

| Conditional presence | Explanation |
| --- | --- |
| *NotSameAsPrev1* | The field is mandatory present in the first element of the *bt-BeaconInfoList* list; otherwise if not present, the *bt-LCS-GCS-TranslationParameter* of this element is the same as the *bt-LCS-GCS-TranslationParameter* of theprevious element in the *bt-BeaconInfoList* list |
| *NotSameAsPrev2* | The field is mandatory present in the first element of the *bt-BeaconInfoList* list; otherwise if not present, the *bt-antArrayConfig* of this element is the same as the *bt-antArrayConfig* of theprevious element in the *bt-BeaconInfoList* list |
| *NotSameAsPrev3* | The field is mandatory present in the first element of the *bt-BeaconInfoList* list; otherwise if not present, the *bt-antElementList* of this element is the same as the *bt-antElementList* of theprevious element in the *bt-BeaconInfoList* list |
| *NotSameAsPrev4* | The field is mandatory present in the first element of the *bt-BeaconInfoList* list; otherwise if not present, the *bt-antSwitchingPattern* of this element is the same as the *bt-antSwitchingPattern* of theprevious element in the *bt-BeaconInfoList* list |
| *NotSameAsPrev5* | The field is mandatory present in the first element of the *bt-BeaconInfoList* list; otherwise if not present, the *bt-AoDTransmConfig* of this element is the same as the *bt-AoDTransmConfig* of theprevious element in the *bt-BeaconInfoList* list |

| ***BT-BeaconInfo* field descriptions** |
| --- |
| ***btAddr***  This field specifies the Bluetooth public address of the Bluetooth beacon [xx]. |
| ***referencePoint***  This field specifies the reference point used to define the locations of the set of Bluetooth beacons. |
| ***bt-BeaconLocation***  This field provides the location of the Bluetooth beacon relative to the *referencePoint* location. If this field is absent the Bluetooth beacon location coincides with the *referencePoint* location |
| ***bt-LCS-GCS-TranslationParameter***  This field provides the angles α (bearing angle), β (downtilt angle) and γ (slant angle) for the translation of a Local Coordinate System (LCS) to a Global Coordinate System (GCS) as defined in TR 38.901 [44]. |
| ***polarization***  This field specifies the antenna element polarization in degrees relative the positive y-axis, where *m45*, *zero*, *p45*, *p90* represents -45, zero, 45 and 90 degrees respectively towards the z-axis, and *circ* represents circular polarization. |
| ***bt-AoDTransmConfig***  This field specifies Bluetooth beacon AoD transmission configuration in terms of advertising periodicities and CTE configuration to support the device to configure its scan windows and intervals. |
| ***primaryAdvInterval***  This field specifies the Bluetooth primary advertisement channel periodicity used by the Bluetooth beacon, scaling factor 0.625 ms [xx]. |
| ***secondAdvInterval***  This field specifies the Bluetooth periodic advertising interval on secondary advertisement channels used by the Bluetooth beacon, scaling factor 0.625 ms [xx]. |
| ***cteLength***  This field specifies the configured CTE length to be used by the beacon in number of 8us segments. |
| ***cteCount***  This field specifies the number of Bluetooth packets that include a CTE that are transmitted each periodic advertising event |
| ***cteType2us***  This field, if present, indicates that 2us antenna switching slot duration is used by the beacon, otherwise 1us antenna switching slot duration is used, |
| ***tx-PHY-M2***  This field, if present, indicates that Bluetooth TX PHY 2 Megasymbols/s is used by the beacon, otherwise Bluetooth TX PHY 1 Megasymbols/s is used, |
| ***bt-antSwitchingPattern***  This field specifies the Bluetooth antenna switching pattern as a list of indices, where each index is the order value of a specific antenna element in the *bt-antElementList-r18* attribute of the IE *BT-BeaconInfoElement-r18* – first element in the list corresponds to index 1 and so on. If the antenna switching pattern is shorter than the number of available sample slots, then the antenna switching patterns continues from the beginning of the *bt-antSwitchingPattern-r18*. If antenna switching pattern is longer than the number of available sample slots, then the elements in *bt-antSwitchingPattern-r18* are discarded. If this field is not present, the target device can assume an antenna switching pattern with the configured antenna element in the same order as in the *bt-antElementList-r18.* |
| ***antElementIndexShort***  This field specifies short part of the antenna element index |
| ***antElementIndexOffset***  This field specifies offset of the antenna element index, where o16, o32, o48 and o64 respresents 16, 32, 48 and 64 respectively to offset the short part of the antenna element index. If not present, the offset is zero. |

– *BT-UniformLinearArray*

The IE *BT-UniformLinearArray* is used by the location server to define a linear antenna array as a formula based on the antenna element index.

-- ASN1START

BT-UniformLinearArray-r18 ::= SEQUENCE {

bt-NoElements-r18 INTEGER (2..maxBT-BeaconAntElt-r18),

bt-InterElementDist-r18 INTEGER (30..130)

}

-- ASN1STOP

| ***BT-UniformLinearArray* field descriptions** |
| --- |
| ***bt-NoElements***  This field specifies the number of antenna elements in the linear antenna array. It is the same as the number of antenna elements in the *bt-antElementList-r18* of the IE *BT-BeaconInfoElement-r18*. |
| ***bt-InterElementDist***  This field specifies the distance between to adjacent elements in the uniform linear antenna array between ¼ and just above 1 wavelength. Scale factor 1mm. |

The antenna element locations of the antenna array are defined along the y-axis from the reference point. The coordinates of the elements are *x=0, z=0* and *y = (index-1)\*bt-InterElementDist-r18*, where *index* is the order value of a specific antenna element in the *bt-antElementList-r18* attribute of the IE *BT-BeaconInfoElement-r18* – first element in the list corresponds to index 1 and so on.

– *BT-UniformRectangularArray*

The IE *BT-UniformRectangularArray* is used by the location server to define a rectangular antenna array as a formula based on the antenna element index.

-- ASN1START

BT-UniformRectangularArray-r18 ::= SEQUENCE {

bt-NoElementsY-r18 INTEGER (1..maxBT-BeaconAntElt-r18),

bt-NoElementsZ-r18 INTEGER (1..maxBT-BeaconAntElt-r18),

bt-InterElementDistY-r18 INTEGER (30..135),

bt-InterElementDistZ-r18 INTEGER (30..135)

}

-- ASN1STOP

| ***BT-UniformRectangular* field descriptions** |
| --- |
| ***bt-NoElementsY***  This field specifies the number of antenna elements in the L-shaped antenna array along the y-axis. The product *bt-ElementDeltaY\** *bt-ElementDeltaZ* is the same as the number of antenna elements in the *bt-antElementList-r18* of the IE *BT-BeaconInfoElement-r18*. |
| ***bt-NoElementsZ***  This field specifies the number of antenna elements in the linear antenna array along the z-axis. |
| ***bt-InterElementDistY***  This field specifies the distance between to adjacent elements in the uniform rectangular antenna array along the y-axis. |
| ***bt-InterElementDistZ***  This field specifies the distance between to adjacent elements in the uniform rectangular antenna array along the z-axis. |

The antenna element locations of the uniform rectangular antenna array are defined row by row along the y-axis with an increasing offset in the z-direction for each row from the reference point. The coordinates of the elements of the

* first row are *x=0, z=0* and *y = (index-1)\*bt-InterElementDistY-r18*, for index 1 to *bt-NoElementsY*
* second row are *x=0, z =* *bt-InterElementDistZ* and *y = (index-bt-NoElementsY-1)\*bt-InterElementDistY-r18*, for index (*bt-NoElementsY*+1) to 2\**bt-NoElementsY*
* row *N* are *x=0, z =* *(N-1)\*bt-InterElementDistZ* and *y = (index-(N-1)\*bt-NoElementsY-1)\*bt-InterElementDistY-r18*, for index (*(N-1)\*bt-NoElementsY*+1) to *N*\**bt-NoElementsY*, where *N = 1* to *bt-NoElementsZ.*

– *BT-UniformCircularArray*

The IE *BT-UniformCircularArray* is used by the location server to define a uniform circular antenna array as a formula based on the antenna element index.

-- ASN1START

BT-UniformCircularArray-r18 ::= SEQUENCE {

bt-NoElements-r18 INTEGER (2..maxBT-BeaconAntElt-r18),

bt-InterElementDist-r18 INTEGER (30..130)

}

-- ASN1STOP

| ***BT-UniformCircularArray* field descriptions** |
| --- |
| ***bt-NoElements***  This field specifies the number of antenna elements in the circular antenna array. It is the same as the number of antenna elements in the *bt-antElementList-r18* of the IE *BT-BeaconInfoElement-r18* |
| ***bt-InterElementDist***  This field specifies the distance between to adjacent elements in the uniform circular antenna array between ¼ and just above 1 wavelengths. Scale factor 1mm. |

The antenna element locations of the antenna array are defined along a circle with the reference point as center. The coordinates of the elements are:

* *x=0*
* *y = bt-Radius\** cos*(2\*p\*(index-1)/ bt-NoElements-r18)*
* *z = bt-Radius\** sin*(2\*p\*(index-1)/ bt-NoElements-r18)*

where *index* is the order value of a specific antenna element in the *bt-antElementList-r18* attribute of the IE *BT-BeaconInfoElement-r18* – first element in the list corresponds to index 1 and so on, and

*bt-Radius* = *bt-InterElementDist-r18*/(2\*sin(*p / bt-NoElements-r18*))

– *BT-GenericArray*

The IE *BT-GenericArray* is used by the location server to define a generic antenna array as a list of offset locations for each antenna element, where each ordered entry in *BT-GenericArray-r18* is associated to the same ordered entry in the *bt-antElementList-r18* attribute of the IE *BT-BeaconInfoElement-r18.*

-- ASN1START

BT-GenericArray-r18 ::= SEQUENCE (SIZE (2..maxBT-BeaconAntElt-r18)) OF BT-ULA-GenericAntElement-r18

BT-ULA-GenericAntElement-r18 ::= SEQUENCE {

deltaY-r18 INTEGER (-135..135) OPTIONAL, -- Need OP

deltaX-r18 INTEGER (-135..135) OPTIONAL, -- Need OP

deltaZ-r18 INTEGER (-135..135) OPTIONAL -- Need OP

}

-- ASN1STOP

| ***BT-GenericArray* field descriptions** |
| --- |
| ***deltaX, deltaY, deltaZ***  This field specifies the antenna element location offset in X, Y, Z directions respectively. If not present, the delta is zero. Scale factor 1mm. |

6.5.7.9 Bluetooth Assistance Data Request

*–* *BT-RequestAssistanceData*

The IE *BT-RequestAssistanceData* is used by the target device to request BT assistance data from a location server.

-- ASN1START

BT-RequestAssistanceData-r18 ::= SEQUENCE {

requestedAD-r18 BIT STRING { beacon-location (0),

beacon-antConfig (1),

beacon-transmConfig (2) } (SIZE (1..8)),

...

}

-- ASN1STOP

| ***BT-RequestAssistanceData* field descriptions** |
| --- |
| ***requestedAD*** This field specifies the Bluetooth assistance data requested. This is represented by a bit string, with a one-value at the bit position means the particular assistance data is requested; a zero-value means not requested. The following assistance data types are included:   * *beacon-location*: Bluetooth beacon location information * *beacon-antConfig*: Bluetooth beacon antenna orientation, array configuration information and antenna switching pattern for AoD estimation * *beacon-transmConfig*: Bluetooth beacon advertisement and CTE configuration information |

*NEXT CHANGE*

6.6 Multiplicity and type constraint values

*– Multiplicity and type constraint definitions*

-- ASN1START

maxEARFCN INTEGER ::= 65535 -- Maximum value of EUTRA carrier frequency

maxEARFCN-Plus1 INTEGER ::= 65536 -- Lowest value extended EARFCN range

maxEARFCN2 INTEGER ::= 262143 -- Highest value extended EARFCN range

maxMBS-r14 INTEGER ::= 64

maxWLAN-AP-r13 INTEGER ::= 64

maxKnownAPs-r14 INTEGER ::= 2048

maxVisibleAPs-r14 INTEGER ::= 32

maxWLAN-AP-r14 INTEGER ::= 128

maxWLAN-DataSets-r14 INTEGER ::= 8

maxBT-Beacon-r13 INTEGER ::= 32

maxBT-BeaconAntElt-r18 INTEGER ::= 74

maxBT-BeaconAD-r18 INTEGER ::= 64

nrMaxBands-r16 INTEGER ::= 1024 -- Maximum number of supported bands in

-- UE capability.

nrMaxFreqLayers-r16 INTEGER ::= 4 -- Max freq layers

nrMaxFreqLayers-1-r16 INTEGER ::= 3

nrMaxNumDL-PRS-ResourcesPerSet-1-r16 INTEGER ::= 63

nrMaxNumDL-PRS-ResourceSetsPerTRP-1-r16 INTEGER ::= 7

nrMaxResourceIDs-r16 INTEGER ::= 64 -- Max Resource IDs

nrMaxResourceOffsetValue-1-r16 INTEGER ::= 511

nrMaxResourcesPerSet-r16 INTEGER ::= 64 -- Maximum resources for one set

nrMaxSetsPerTrpPerFreqLayer-r16 INTEGER ::= 2 -- Maximum resource sets for one TRP

nrMaxSetsPerTrpPerFreqLayer-1-r16 INTEGER ::= 1

nrMaxTRPs-r16 INTEGER ::= 256 -- Max TRPs per UE

nrMaxTRPsPerFreq-r16 INTEGER ::= 64 -- Max TRPs per freq layers

nrMaxTRPsPerFreq-1-r16 INTEGER ::= 63

maxSimultaneousBands-r16 INTEGER ::= 4 -- Maximum number of simultaneously

-- measured bands

maxBandComb-r16 INTEGER ::= 1024

nrMaxConfiguredBands-r16 INTEGER ::= 16

maxNumOfRxTEGs-r17 INTEGER ::= 32

maxNumOfRxTEGs-1-r17 INTEGER ::= 31

maxNumOfTxTEGs-1-r17 INTEGER ::= 7

maxTxTEG-Sets-r17 INTEGER ::= 256 -- Maximum applicable number is 64

maxNumOfRxTxTEGs-1-r17 INTEGER ::= 255

maxNumOfTRP-TxTEGs-1-r17 INTEGER ::= 7

maxNumOfSRS-PosResources-r17 INTEGER ::= 64

maxNumOfSRS-PosResources-1-r17 INTEGER ::= 63

maxNumResourcesPerAngle-r17 INTEGER ::= 24

maxNumPrioResources-r17 INTEGER ::= 24

maxAddMeasTDOA-r17 INTEGER ::= 31

maxAddMeasAoD-r17 INTEGER ::= 23

maxAddMeasRTT-r17 INTEGER ::= 31

maxOD-DL-PRS-Configs-r17 INTEGER ::= 8

maxCellIDsPerArea-r17 INTEGER ::= 256

maxNrOfAreas-r17 INTEGER ::= 16

maxMeasInstances-r17 INTEGER ::= 32

-- ASN1STOP