3GPP TSG-RAN WG2 Meeting #123bis R2-230xxxx

Xiamen, China, 9-13 October 2023

**Agenda item: 6.4.1**

**Source: CATT**

**Title:** **[Post123bis][402][POS] BDS B1C corrections (CATT)**

**WID/SID: NR\_pos\_enh2-Core**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

* [Post123bis][402][POS] BDS B1C corrections (CATT)

      Scope: Discuss the proposal in R2-2311372 and develop a CR for next meeting, considering also the broadcast case.

      Intended outcome: Agreeable CR

      Deadline: Long

In this email discussion the following contribution related with BDS B1C corrections, i.e., including correction of existing SSR IEs for BDS B1C signal to decide if these contributions or proposals in the contributions can be agreed.

1. [R2-2311372](https://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Inbox/R2-2311372.zip) Report of [AT123bis][415][POS] BDS B1C corrections (CATT) CATT discussion Rel-17
2. [R2-2311572](file:///C:\Users\mtk16923\Documents\3GPP%20Meetings\202310%20-%20RAN2_123bis,%20Xiamen\Extracts\R2-2311572_37355_CR0466r2_(Rel-17).docx) Correction of existing SSR IEs in A-GNSS for BDS system CATT, CAICT, CMCC, China Telecom, China Unicom, Huawei, ZTE Corporation, MediaTek Inc., OPPO, xiaomi, vivo, Spreadtrum CR Rel-17 37.355 17.6.0 0466 2 F NR\_pos\_enh-Core

# 2 Contact Information

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Swift Navigation | Grant Hausler: grant@swiftnav.com |
| vivo | Xiang Pan (panxiang@vivo.com) |
| Ericsson | Fredrik Gunnarsson (fredrik.gunnarsson@ericsson.com) |
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# 3 Discussion

[R2-2311372](https://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Inbox/R2-2311372.zip) Report of [AT123bis][415][POS] BDS B1C corrections (CATT) has discussion and reach the agreeable way forward:

Introduce a new field to distinguish the reference signal for all potential GNSS and a UE capability to solve the backward compatibility in unicast LPP.

Companies will further discuss how to solve the backward compatibility in broadcast for the next meeting.

1. Proposal 1: Agree the revised CR in R2-2311572.
2. Proposal 2: Further discuss how to solve the backward compatibility in broadcast.

## 3.1 Impacts of correction for BDS B1C signal in TS 37.355

[R2-2311572](file:///C:\Users\mtk16923\Documents\3GPP%20Meetings\202310%20-%20RAN2_123bis,%20Xiamen\Extracts\R2-2311572_37355_CR0466r2_(Rel-17).docx) proposed the following correction to enable the SSR service applie to B1C-only devices in unicast:

### 3.1.1 correction #1

2 References: ICD specification of BDS PPP-B2b is added in section 2 as reference for B1C.

[XX] BDS-SIS-ICD-PPP-B2b-1.0: "BeiDou Navigation Satellite System Signal In Space Interface Control Document Precise Point Positioning Service Signal PPP-B2b (Version 1.0)", July, 2020.

### 3.1.2 correction #2

GNSS-SSR-OrbitCorrections

1. A new field *refEmph* for identifying the reference signal of B1C is included in *GNSS-SSR-OrbitCorrections* which also allows future extension.

2. The condition of the new field is added.

3. The field description of the new field is added to clarify which signal is the reference signal that the iod field refers.

4. Note 4 is added to clarify when that gnss-ID indicates 'bds' and if *refEmph* is present, the iod refers to the indicated broadcast ephemeris.

SSR-OrbitCorrectionSatelliteElement-r15 ::= SEQUENCE {

svID-r15 SV-ID,

iod-r15 BIT STRING (SIZE(11)),

delta-radial-r15 INTEGER (-2097152..2097151),

delta-AlongTrack-r15 INTEGER (-524288..524287),

delta-CrossTrack-r15 INTEGER (-524288..524287),

dot-delta-radial-r15 INTEGER (-1048576..1048575) OPTIONAL, -- Need ON

dot-delta-AlongTrack-r15 INTEGER (-262144..262143) OPTIONAL, -- Need ON

dot-delta-CrossTrack-r15 INTEGER (-262144..262143) OPTIONAL, -- Need ON

...,

[[

ssr-IntegrityOrbitBounds-r17 SSR-IntegrityOrbitBounds-r17 OPTIONAL -- Cond Integrity1

]],

[[

refEmph-r17 ENUMERATED { b1c, ... } OPTIONAL -- Cond REF

]]

}

| Conditional presence | Explanation |
| --- | --- |
| *Integrity1* | The field is mandatory present if *ORBIT-IntegrityParameters* is present*;* otherwise it is not present. |
| *Integrity2* | The field is mandatory present if *orbitRangeErrorCorrelationTime* is present*;* otherwise it is not present. |
| *REF* | The field is optionally present, Need ON, for none default reference signal (e.g. B1C in [XX]); otherwise it is not present. |

|  |
| --- |
| ***GNSS-SSR-OrbitCorrections field descriptions*** |
| ***iod***  This field specifies the IOD value of the broadcast ephemeris for which the orbit corrections are valid (see IE *GNSS‑NavigationModel*). NOTE 2, NOTE4. |
| ***refEmph***  This field specifies which signal is the reference signal that the iod field refers to (see the IE *GNSS‑NavigationModel*) if present. |

NOTE 1: The update intervals are aligned to the GPS time scale for all GNSSs in order to allow synchronous operation for multiple GNSS services. This means that the update intervals may not be aligned to the beginning of the day for another GNSS. Due to the leap seconds, this is generally the case for GLONASS.

NOTE 2: In the cases that *gnss-ID* indicates 'gps', 'qzss' or 'bds', the *iod* refers to the NAV broadcast ephemeris (GPS L1 C/A, QZSS QZS-L1 or BDS B1I/B3I, respectively, in table GNSS to iod Bit String(11) relation in IE *GNSS‑NavigationModel*).

NOTE 3: The reference time *t0* is *epochTime* + ½ × *ssrUpdateInterval*. The reference time *t0* for *ssrUpdateInterval* '0' is *epochTime*.

NOTE 4: In the cases that *gnss-ID* indicates 'bds' and if *refEmph* is present, the *iod* refers to the indicated broadcast ephemeris (e.g. *b1c* for B-CNAV1 broadcast ephemeris (BDS B1C/B2a in table GNSS to iod Bit String(11) relation in IE *GNSS‑NavigationModel*).

### 3.1.3 correction #3

GNSS-SSR-OrbitCorrectionsSupport (Capability):

The capability to support reference signal of B1C or not is included in *GNSS-SSR-OrbitCorrectionsSupport*

#### – *GNSS-SSR-OrbitCorrectionsSupport*

-- ASN1START

GNSS-SSR-OrbitCorrectionsSupport-r15 ::= SEQUENCE {

...,

[[

orbit-IntegritySup-r17 BIT STRING { correlationTimeSup (0)

} (SIZE(1..8)) OPTIONAL

]],

[[

bds-B1C-SSR-OrbitCorrectionsSupport-r17 ENUMERATED { supported } OPTIONAL

]]

}

-- ASN1STOP

| *GNSS-SSR-OrbitCorrectionsSupport* field descriptions |
| --- |
| ***orbit-IntegritySup***  This field, if present, indicates that the target device supports the IEs *ORBIT-IntegrityParameters* and *SSR-IntegrityOrbitBounds*.  A one‑value at the bit position '0' means that the target device supports the fields *orbitRangeErrorCorrelationTime* and *orbitRangeRateErrorCorrelationTime* in IE *ORBIT-IntegrityParameters*. |
| ***bds-B1C-SSR-OrbitCorrectionsSupport***  This field, if present, indicates that the target device supports the SSR oribit correction for B1C. |

**Question 1**: Please provide comments below regarding the above corrections.

|  |  |
| --- | --- |
| Company | Comments |
| Swift Navigation | If we adopt the proposed changes to *gnss-id* in Section 3.2 below, we do not require correction#2 or correction #3 (i.e. we do not need to add *refEmph* or *bds-B1C-SSR-OrbitCorrectionsSupport*).  All we need to do is amend NOTE 2:  NOTE 2: In the cases that *gnss-ID* indicates 'gps', 'qzss', 'bds' or bds-v1770, the *iod* refers to the NAV broadcast ephemeris (GPS L1 C/A, QZSS QZS-L1, BDS B1I/B3I or BDS B1C/B2a, respectively, in table GNSS to iod Bit String(11) relation in IE *GNSS‑NavigationModel*).  GNSS-ID also needs updating: – *GNSS-ID* The IE *GNSS-ID* is used to indicate a specific GNSS.  -- ASN1START  GNSS-ID ::= SEQUENCE {  gnss-id ENUMERATED{ gps, sbas, qzss, galileo, glonass, ..., bds, navic-v1610, bds-v1770 },  ...  }  -- ASN1STOP  [CATT] for 37.355 CR, we don’t think GNSS-ID needs to be changed. It would introduce more issues which need more clarifications, e.g. which value should be used for B1C, B2a signal without SSR etc. So we prefer current CR. |
| vivo | OK with the changes suggested by Rapp.  For the alternative suggested by Swift, the GNSS-ID-Bitmap needs to be enhanced as well.  GNSS-ID-Bitmap ::= SEQUENCE {  gnss-ids BIT STRING { gps (0),  sbas (1),  qzss (2),  galileo (3),  glonass (4),  bds (5),  navic-v1610 (6),  bds-v1770 (7) } (SIZE (1..16)),  ...  }  [CATT] The same comments as above. |
| Qualcomm | Defining a new GNSS-ID for a signal will create confusion/ambiguity. E.g., what happens if we set the GNSS-ID to *bds-v1770* and any of the "legacy" Assistance Data are not provided for B1C:  GNSS-GenericAssistData ::= SEQUENCE (SIZE (1..16)) OF GNSS-GenericAssistDataElement  GNSS-GenericAssistDataElement ::= SEQUENCE {  gnss-ID GNSS-ID,  sbas-ID SBAS-ID OPTIONAL, -- Cond GNSS-ID-SBAS  gnss-TimeModels GNSS-TimeModelList OPTIONAL, -- Need ON  gnss-DifferentialCorrections GNSS-DifferentialCorrections OPTIONAL, -- Need ON  gnss-NavigationModel GNSS-NavigationModel OPTIONAL, -- Need ON  gnss-RealTimeIntegrity GNSS-RealTimeIntegrity OPTIONAL, -- Need ON  gnss-DataBitAssistance GNSS-DataBitAssistance OPTIONAL, -- Need ON  gnss-AcquisitionAssistance GNSS-AcquisitionAssistance OPTIONAL, -- Need ON  gnss-Almanac GNSS-Almanac OPTIONAL, -- Need ON  gnss-UTC-Model GNSS-UTC-Model OPTIONAL, -- Need ON  gnss-AuxiliaryInformation GNSS-AuxiliaryInformation OPTIONAL, -- Need ON  ...,  [[  Therefore, the CR as proposed seems cleaner/better and preferred. |
| Swift Navigation | It seems inconsistent and confusing having different approaches for unicast and broadcast. It creates additional complexity because the device now needs to interpret fields differently depending whether it is in broadcast or unicast mode.  We assumed that setting GNSS-ID to bds-v1770 would require treating B1C as an entirely independent constellation including treating it separately for how the Assistance Data is set for A-GNSS, i.e. to avoid any ambiguity/confusion. |
| Ericsson | Same view as Swift – this is not a consistent solution and it not inline with how constellations and signals are represented so far. |
| CATT | We agree with QC. And we don’t think the inconsistent is a big issue.  But if it is not acceptable, we can provide alternative CR set which not touch GNSS-ID, and a new posSibType would be defined to provide B1C SSR case. Please consider if the alternative solution is ok or not. The corresponding CRs are uploaded also with (solution 2).Companies are welcome to further check and comment offline. We can further discuss which CR set can be agreed during next meeting. |
| Ericsson | We thought about this more today. Often when new features are introduced that adds to existing functionality in previous releases, either totally new IEs are introduced or a delta to existing IEs is introduced. In order to support both legacy devices only supporting B1I/B3I as well as new devices that only supports B1C, then something similar needs to be considered here as well.  In consideration of payload size, it seems most attractive to opt for a delta with an identifier indicating that the delta is for B1C in Rel 17. Later, this could be extended to other constellations also. |

## 3.2 Impacts of correction for BDS B1C signal in TS 38.331

The BDS SSR information for B1I is not the same as BDS SSR information for B1C, e.g. orbit correction. While to avoid miss-understanding, a note was introduced and clarified that B1I was the default reference signal which introduced in the last version of specification. But in some region, there are devices that only support BDS B1C, so the SSR information based on only B1C was provided. It is important to provide the high accuracy positioning service to the decives including B1I devices and single mode of B1C devices.

Considering legacy UE behaviour, a new value of GNSS ID is proposed to be added to indicate that BDS SSR information is for B1C.

### 

### 6.3.1a Positioning System information blocks

– *PosSI-SchedulingInfo*

-- ASN1START

-- TAG-POSSI-SCHEDULINGINFO-START

PosSI-SchedulingInfo-r16 ::= SEQUENCE {

posSchedulingInfoList-r16 SEQUENCE (SIZE (1..maxSI-Message)) OF PosSchedulingInfo-r16,

posSI-RequestConfig-r16 SI-RequestConfig OPTIONAL, -- Cond MSG-1

posSI-RequestConfigSUL-r16 SI-RequestConfig OPTIONAL, -- Cond SUL-MSG-1

...,

[[

posSI-RequestConfigRedCap-r17 SI-RequestConfig OPTIONAL -- Cond REDCAP-MSG-1

]]

}

PosSchedulingInfo-r16 ::= SEQUENCE {

offsetToSI-Used-r16 ENUMERATED {true} OPTIONAL, -- Need R

posSI-Periodicity-r16 ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},

posSI-BroadcastStatus-r16 ENUMERATED {broadcasting, notBroadcasting},

posSIB-MappingInfo-r16 PosSIB-MappingInfo-r16,

...

}

PosSIB-MappingInfo-r16 ::= SEQUENCE (SIZE (1..maxSIB)) OF PosSIB-Type-r16

PosSIB-Type-r16 ::= SEQUENCE {

encrypted-r16 ENUMERATED { true } OPTIONAL, -- Need R

gnss-id-r16 GNSS-ID-r16 OPTIONAL, -- Need R

sbas-id-r16 SBAS-ID-r16 OPTIONAL, -- Cond GNSS-ID-SBAS

posSibType-r16 ENUMERATED { posSibType1-1, posSibType1-2, posSibType1-3, posSibType1-4, posSibType1-5, posSibType1-6,

posSibType1-7, posSibType1-8, posSibType2-1, posSibType2-2, posSibType2-3, posSibType2-4,

posSibType2-5, posSibType2-6, posSibType2-7, posSibType2-8, posSibType2-9, posSibType2-10,

posSibType2-11, posSibType2-12, posSibType2-13, posSibType2-14, posSibType2-15,

posSibType2-16, posSibType2-17, posSibType2-18, posSibType2-19, posSibType2-20,

posSibType2-21, posSibType2-22, posSibType2-23, posSibType3-1, posSibType4-1,

posSibType5-1,posSibType6-1, posSibType6-2, posSibType6-3,... },

areaScope-r16 ENUMERATED {true} OPTIONAL -- Need S

}

GNSS-ID-r16 ::= SEQUENCE {

gnss-id-r16 ENUMERATED{gps, sbas, qzss, galileo, glonass, bds, ..., navic-v1760, bds-v1770},

...

}

SBAS-ID-r16 ::= SEQUENCE {

sbas-id-r16 ENUMERATED { waas, egnos, msas, gagan, ...},

...

}

-- TAG-POSSI-SCHEDULINGINFO-STOP

-- ASN1STOP

|  |
| --- |
| ***PosSI-SchedulingInfo* field descriptions** |
| ***gnss-id***  The presence of this field indicates that the positioning SIB type is for a specific GNSS. Indicates a specific GNSS (see also TS 37.355 [49]).  This field is set to *bds-v1770*, if the reference signal ofSSR correction in *posSibType2-17* is BDS B1C as specified in TS 37.355 [49]. |

There are concerns on the back compatible on the broadcast functionality. Below please find the analysis:

If only the network is implemented according to the CR and the UE is not, the B1I device won't send the request based on B1C to network, the broadcast of SSR still is based on B1I. No interoperability problems are foreseen.

If only the UE is implemented according to the CR and the network is not, there is no *bds-v1770* in the *PosSchedulingInfo* no interoperability problems are foreseen.

**Question 2**: Please provide comments below regarding the addition of the new value of GNSS ID and the description change of the affected IE.

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| --- | --- |
| Company | Comments |
| Swift Navigation | Suggest using a more specific name for field value, e.g. *bds-cnav-v1770*.  If we take this approach, it means some NWs may want to support both ephemeris types: B1I/B3I and B1C/B2a. In this case, a NW will need to generate two different sets of SSR corrections for each ephemeris type (i.e. it is not the case that only the value of *GNSS-SSR-OrbitCorrections* will change depending which ephemeris type is used; if we reference a different ephemeris, the effects can propagate into all other SSR corrections, depending on the correction provider implementation).  So the NW must make an implementation choice whether to maximise backward compatibility with devices that use:   1. B1C/B2a as the reference ephemeris 2. B1I/B3I as the reference ephemeris, or 3. Trying to support both (which adds complexity and overhead generating multiple SSR corrections for different ephemeris types). |
| vivo | Generally fine with the changes. Suggest rephrase:  If this field is set to *bds-v1770*, the positioning SIB type is for BDS and the reference signal ofSSR correction in *posSibType2-17* is BDS B1C as specified in TS 37.355 [49]. |
| Qualcomm | I can't see how this solves the backwards compatibility problem. A Rel-16 UE in a Rel-17 NW will not understand the extension and will always assume the corrections are provided for B1I. |
| Qualcomm | I take back my comment above. A Rel-16 UE will not comprehend the GNSS-ID with value 'bds-v1770', and therefore, can not identify the GNSS for which the posSIB is provided.  However, defining a new GNSS ID for a signal is not "nice", but I think it can work if it is made clear that this entry is only valid for posSibType2-17. There are NRPPa impacts as well.  I'm O.K. with this solution. |
| Swift Navigation | It seems strange/inconsistent to introduce a new GNSS-ID field into broadcast but not unicast because the device now requires different logic to interpret the fields depending which mode it is in (unicast vs. broadcast) which adds complexity. |
| Ericsson | Same view as Swift – the solution with a new GNSS-ID is not consistent. |
| CATT | The proposed solution is the simplest solution, although GNSS-ID is not consistent with LPP spec. An alternative solution is to define a new posSibType which the content is the same as posSibType2-17. We also a CR set for the alternative solution which also uploaded with tag solution 2. We plan to submit two CR sets to the next RAN2 meeting and to see which set can be agreed. |
| Ericsson | A simple solution could have issues not only with BC but also potentially with forward compatibility (FC …). After some thoughts about this, a delta solution for B1C corrections ontop of B1I/B3I corrections seems to be simple and effective. Can try to provide an example. |
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## 3.3 Any other comments

**Question 3**: please provide any additional comment; e.g. any additional impacts foreseen

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| --- | --- |
| Company | Comments |
| Swift Navigation | We think this proposal is workable taking into account our suggested changes above, but we would like to hear opinions from the wider group on any additional impacts we may have missed on backward compatibility. |
| Ericsson | If we would opt for a solution that would not be consistent with how constellations and signals have been represented in previous releases, we believe the matter need to be thoroughly discussed before taking such a step. |
| Ericsson | Our suggestion is to investigate a delta solution for B1C over B1I/B3I corrections. |
|  |  |

**Summary:**

# 4 Conclusion