

RECOMMENDATION ITU-R M.823-3*

Technical characteristics of differential transmissions for global navigation satellite systems from maritime radio beacons in the frequency band 283.5-315 kHz in Region 1 and 285-325 kHz in Regions 2 and 3

(1992-1995-1997-2006)

Scope

Many Administrations have implemented transmissions from radio beacon stations of differential corrections for global navigation satellite systems (GNSS). This Recommendation contains the technical characteristics to which such transmissions should conform for corrections to the GPS and GLONASS Navigation Satellite Systems. The Recommendation also describes the various types of differential correction messages used for those navigation satellite systems and the message format. In addition, it contains details of message transmission schedules.

The ITU Radiocommunication Assembly,

considering

- a) Resolution No. 602 of the World Administrative Radio Conference for the Mobile Services (Geneva, 1987) (WARC Mob-87);
- b) that according to No. 5.73 of the Radio Regulations (RR), in the band 285-325 kHz (283.5-325 kHz in Region 1) in the maritime radionavigation service, radio beacon stations may also transmit supplementary navigational information using narrow-band techniques, on condition that the prime function of the beacon is not significantly degraded;
- c) Recommendation ITU-R M.631 on the use of hyperbolic maritime radionavigation systems in the band 283.5-315 kHz;
- d) the technical characteristics set out in the Final Acts of the Regional Administrative Conference for the Planning of the Maritime Radionavigation Service (radio beacons) in the European Maritime Area (Geneva, 1985);
- e) that the navigational accuracy expected to be available from global navigation satellite systems (GNSS) will be 13-36 m (with 95% probability) for general use;
- f) that this accuracy, whilst adequate for most general navigation requirements, will not be enough for some specialized navigation, such as in confined waterways and harbour approaches or for the position sensor in electronic chart systems;
- g) that other specialized maritime applications, such as fishing, navigational surveying, dredging, cable and pipe laying, positioning of buoys and other offshore structures may require higher accuracy than that available from GNSS for general use;

* This Recommendation should be brought to the attention of the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO), the International Association of Lighthouse Authorities (IALA) and the International Maritime Radio Association (CIRM).

- h) that the navigational accuracy and integrity of GNSS can be improved considerably by the transmission of differential corrections from suitably located reference stations;
- j) that technical, economic and administrative factors indicate that the use of maritime radio beacons would be one feasible solution for the transmission of differential corrections;
- k) that propagation of transmissions from maritime radio beacons is predominantly by ground wave with a usable range that does not exceed the range of applicability of the reference station corrections;
- l) that maritime radio beacons currently provide coverage of coastal waters in many parts of the world, enabling a worldwide standard for these differential transmissions to be introduced efficiently and economically;
- m) that, although present studies have specifically addressed transmission of corrections for GPS/GLONASS, the same principles apply to terrestrial radionavigation systems, such as Loran-C/Chayka,

recommends

- 1 that the technical characteristics of a differential correction service for GNSS using maritime radio beacons, in the frequency band 283.5-315 kHz in Region 1 and 285-325 kHz in Regions 2 and 3, and for associated receivers, should be in accordance with the characteristics given in Annex 1.

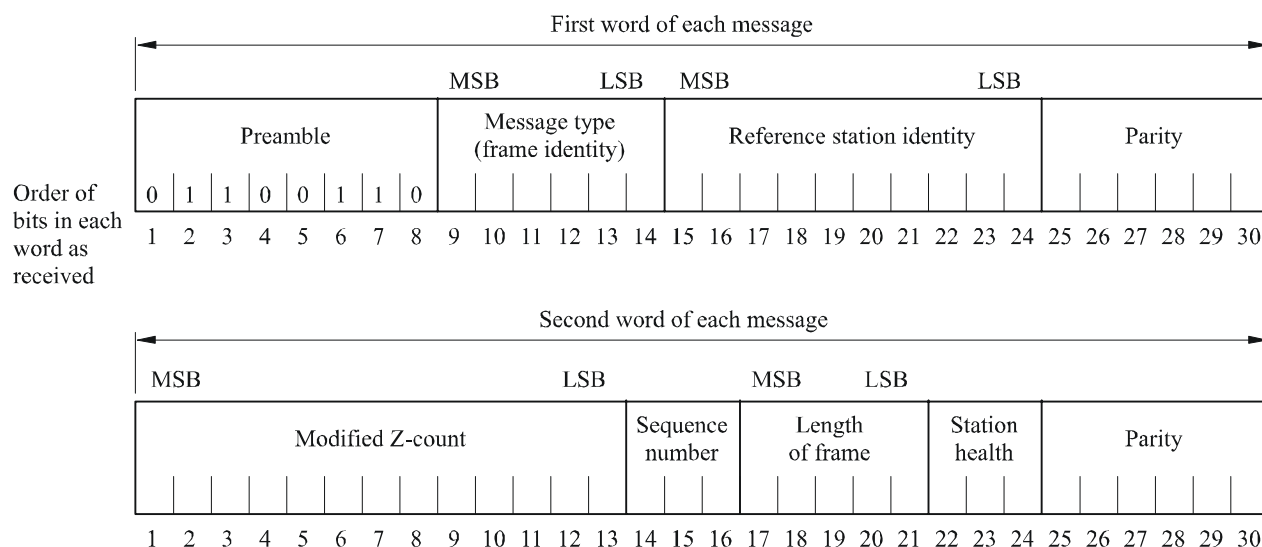
Annex 1

System characteristics for differential GNSS

1 Technical characteristics

- 1.1 The carrier frequency of the differential correction signal of a radio-beacon station is an integer multiple of 500 Hz.
- 1.2 Frequency tolerance of the carrier is ± 2 Hz.
- 1.3 The general message format is as shown in Fig. 1 which details the first two 30 bit words of each frame or message type. Each frame is $N + 2$ words long, N words containing the data of the message. The minimum message types available for transmission are as shown in Table 1. Details of these message type contents and formats are as shown in Figs. 2 to 7 for GPS and Figs. 8 to 12 for GLONASS. The parity algorithm used links 30 bit words within and across sub-frames of 10 words, using the (32,26) Hamming Code. Type 6 or 34 ($N = 0$ or $N = 1$) messages should be used if no other message type is available.

FIGURE 1

Two-word header for all messages

MSB: most significant bit

LSB: least significant bit

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Station health bits:

111 Shall cause the user equipment to indicate that the reference station is not working properly.

110 Shall cause the user equipment to indicate that the transmission is unmonitored.

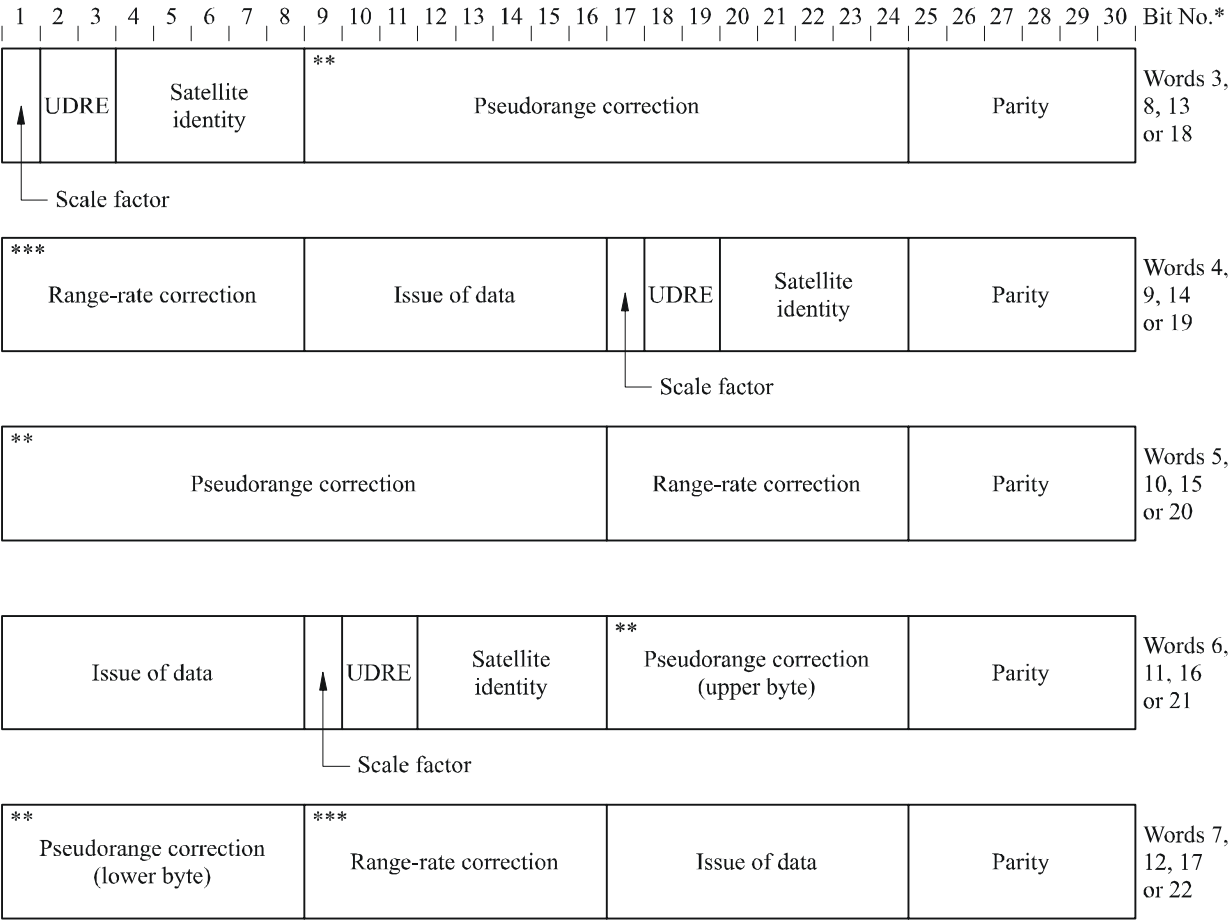
Other codes can be used by the service provider for healthy broadcasts.

TABLE 1

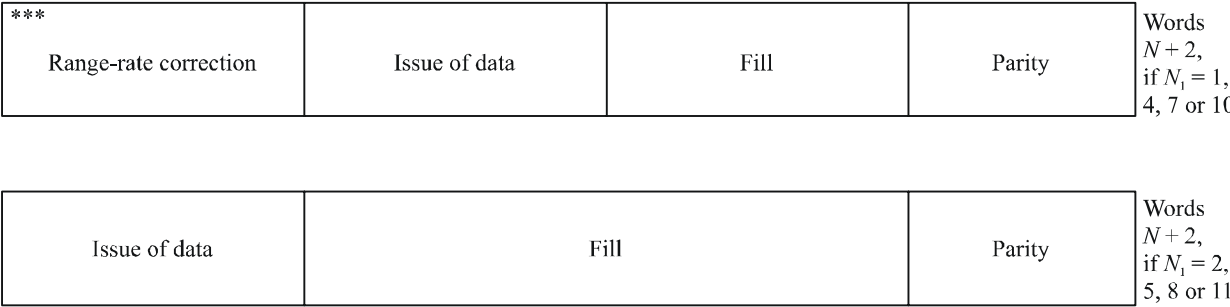
Message types

GPS message type number	Title	GLONASS message type number
1	Differential GNSS corrections (full set of satellites)	31
3	Reference station parameters	32
4	Reference Station Datum	4
5	Constellation health	33
6	Null frame	34 ($N = 0$ or $N = 1$)
7	Radio beacon almanacs	35
9	Subset differential GNSS corrections (this may replace Types 1 or 31)	34 ($N > 1$)
16	Special message	36
27	Extended radio beacon almanac	27

FIGURE 2
Type 1 and Type 9 message formats
Differential GPS corrections



If the number of satellite corrections, N_1 , is not divisible by 3 then one of the two following words is substituted for the last word of this message to complete the data



UDRE: user differential range error.

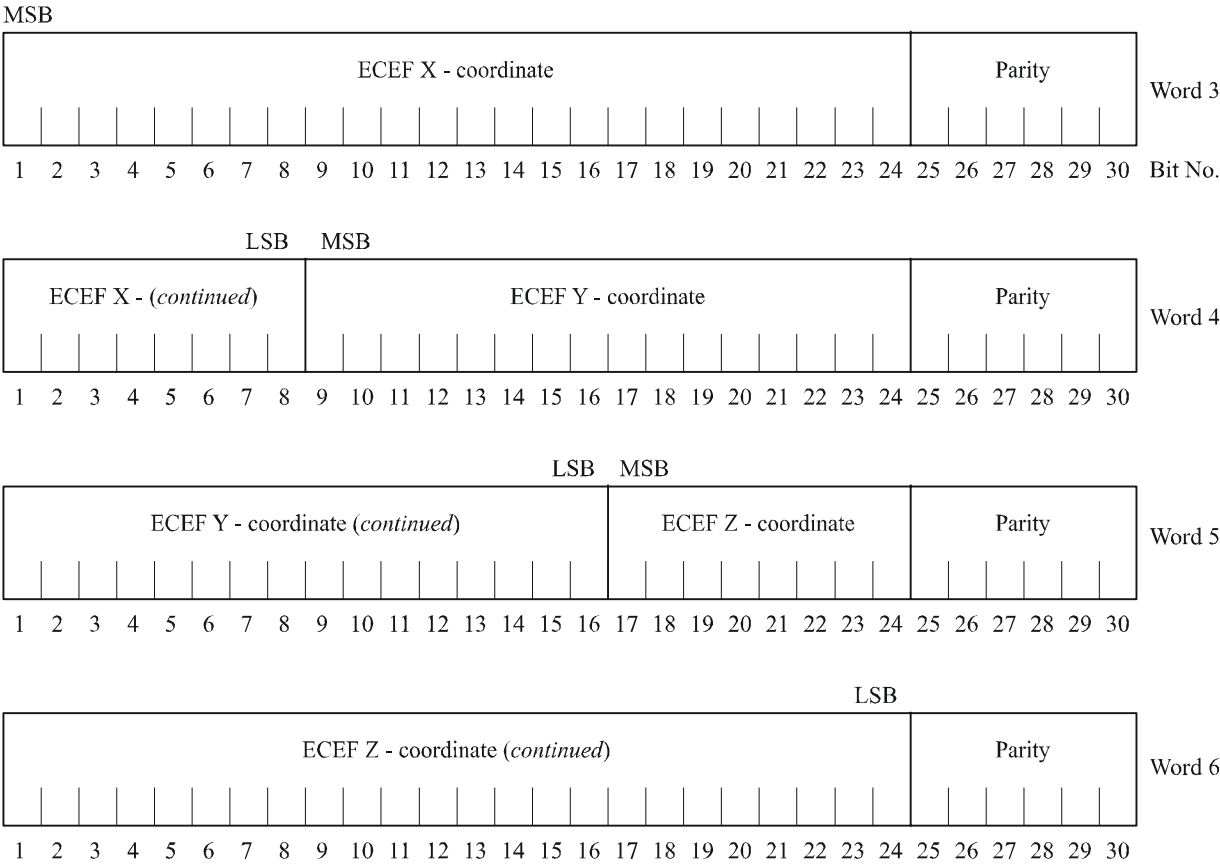
* As received.

** Binary 1000 0000 0000 0000 indicates a problem and user equipment should immediately stop using this satellite.

*** Binary 1000 0000 indicates a problem and user equipment should immediately stop using this satellite.

Note 1 - In Type 1 messages the data from all satellites in view are transmitted. In Type 9 messages only the data from a subset of satellites are transmitted.

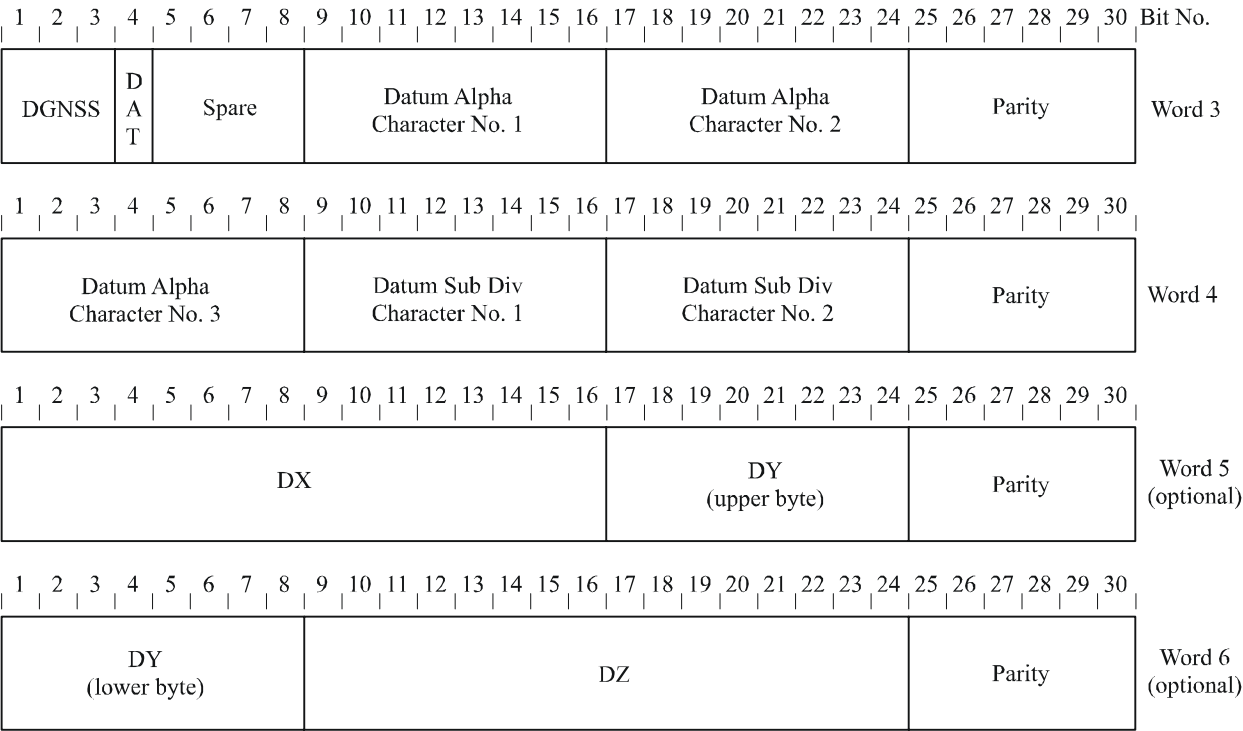
FIGURE 3
Type 3 message format
Reference station parameters (GPS)



MSB: most significant bit
LSB: least significant bit
ECEF: Earth-centred, Earth-fixed, WGS-84, unless otherwise specified by service provider

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FIGURE 4
Type 4 message format
Reference station datum
(see table 2)



Note 1 - The three Datum Alpha Code Characters are used to specify the datum used for the selected DGNSS broadcast using the three character alphabetic code for geodetic datum from the International Hydrographic Organization Publication S-60. Publication S-60 does not contain all the geodetic datums in use. If the datum alpha code is unknown, three null characters should be inserted. For a user defined datum, insert 999.

Note 2 - The parameters DX, DY and DZ specify the ECEF offset of the reference station coordinates. The sense of the shift is defined for DAT = 0 such that if DX, DY and DZ are added to the reference station position expressed in the local ECEF, then the position of the reference station is obtained in GNSS coordinates. The sense of the shift is defined for DAT = 1 such that if DX, DY and DZ are added to the reference station position expressed in WGS-84 (GPS)/PE-90 (GLONASS), then the position of the reference station is obtained in local datum coordinates (Parameters of the Earth-90, formerly called SGS-90). Note that since the differences between datums are not exactly represented by offsets (e.g. coordinate rotational differences are involved), the user positional accuracy may degrade throughout the coverage region of the station.

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