**Input paper: [[1]](#footnote-1)** EM1-5.1.3.6

**Input paper for the following Committee(s):** **Purpose of paper:**

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**Agenda item** [[2]](#footnote-2) n.n

**Technical domain/ Task number** 2 …………………………………

**Author(s)/Submitter(s)** China MSA

PROPOSAL ON THE REVISION OF G1117 b1.1[[3]](#footnote-3)

# Summary

The transmission and prediction of orbit parameters of low orbit satellites have been widely used in satellite-based Internet of Things(IoT) system. Although the existing VDES constellation orbit parameter messages in G1117 B1.1 VDE-SAT Network Orbit Data can provide complete satellite orbit parameter broadcasting of satellite constellation, the TLE (Two-line elements)of orbit parameters would occupy more data space. The six Keplerian elements can meet the needs of VDES terminals for orbit calculation and prediction.

## Purpose of the document

This paper introduces some technical solutions and revision proposals on G1117 B1.1 VDE-SAT Network Orbit Data.

## related document

1. ITU-R Recommendation M.2092, Technical characteristics for a VHF data exchange system

in the VHF maritime band

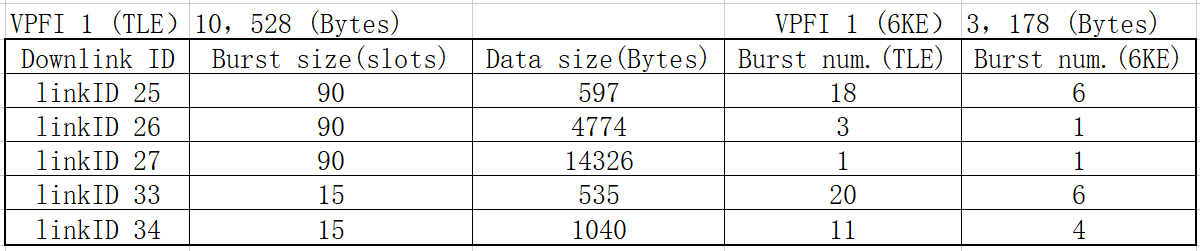
# Background

TLE is used in the present document as the VDES constellation network orbit data parameter which takes more bits and could be further optimized by replacing it with the six Keplerian elements.

# discussion

Each TLE parameter consumes 828bits. Judging from the present G1117 B.1.1 information, VPFI 1 packet would consume 84,192bits /10,543 Bytes(including 4Byte CRC+15byteVDE packet overhead)if it is for a 100-sat VDES constellation.

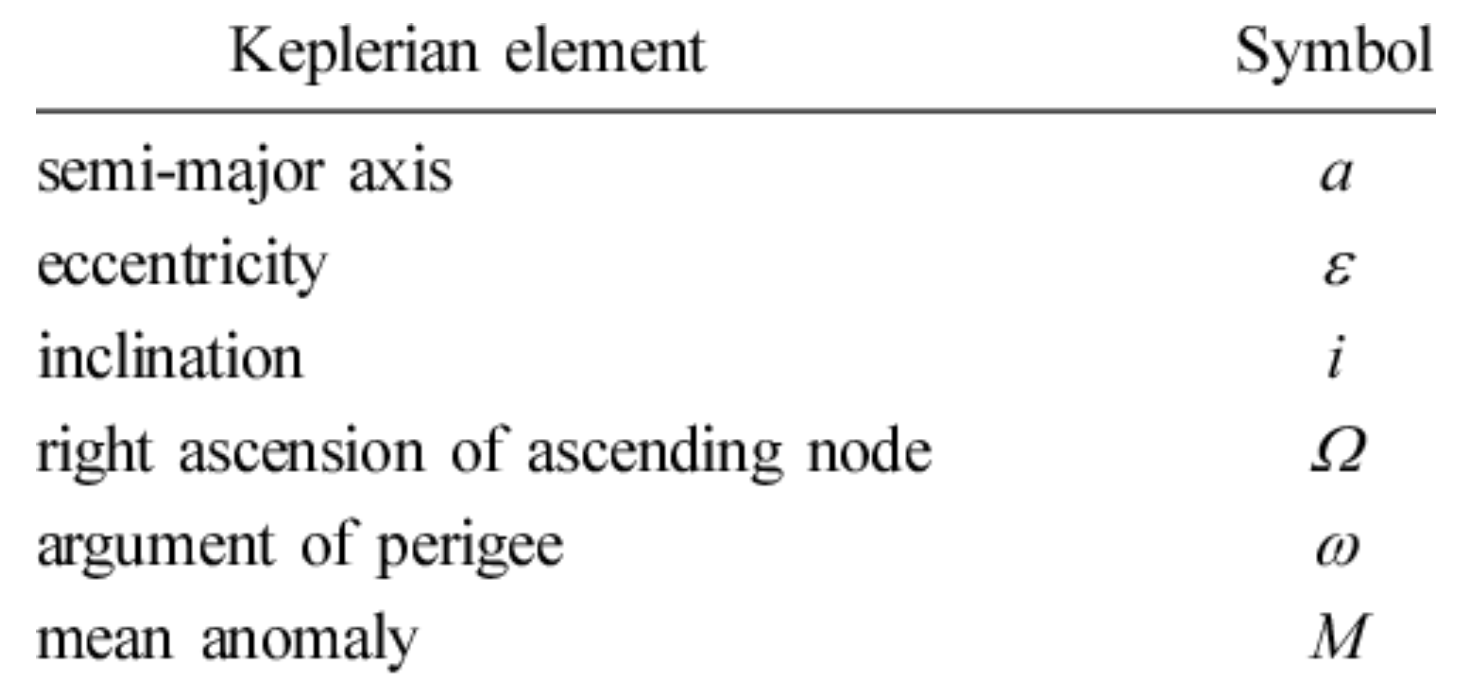
We propose to replace TLE parameter with the six Keplerian elements which occupy only 240bits, therefore the figure of VPFI 1 for the same constellation would occupy 25, 392bits /3, 193 Bytes(including 4Byte CRC+15byteVDE packet overhead). The following table lists the number of bursts required for downlink broadcast VPFI 1 packets with different Link ids.



If the six Keplerian elements are used to broadcast orbit data, VPFI 1 packets can be broadcast in one DC slot (90slots) using multiple Link ids (26,27,33,34) in a case of 100-sat constellation. Yet using TLE orbit parameters, multiple DC time slots or long DC time slots are required to complete transmission, which consumes more satellite downlink resources. It should be noted that Link id 27 is capable of broadcasting larger amounts of data, but requires a higher signal-to-noise ratio link as protection.

As orbit extrapolation calculation and prediction, the six Keplerian elements have been widely used in GPS system and other satellite IoT systems, which can meet the needs of VDES terminals for orbit calculation and prediction. The six number orbit parameters are described as follows:

Satellite orbit time: offset from 0h:00min:00s UTC 2018. (Reference time)



The orbit data are shown in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| NO. | Data definition | Type | Unit | Number of bytes | Contents scope |
| 1 | second | Integer |  | 4 | Relative time to 0:0:00 in 2018 |
| 2 | milisecond | Word |  | 2 |  |
| 3 | semi-major axis | float | rad | 4 |  |
| 4 | eccentricity | float | rad | 4 |  |
| 5 | inclination | float | rad | 4 |  |
| 6 | right ascension of ascending node | float | rad | 4 |  |
| 7 | argument of perigee | float | rad | 4 |  |
| 8 | mean anomaly | float | rad | 4 |  |

# references

[1] ITU-R Recommendation M.2092, Technical characteristics for a VHF data exchange system in the VHF maritime band

[2] IALA guideline G1117 “VHF Data Exchange System(VDES) Overview”.

# action requested of the committee

The committee is requested to consider the proposal in the revision of IALA guideline G1117 and take action as appropriate.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)
3. Footer will automatically populate [↑](#footnote-ref-3)