CCSDS SLS RF and Modulation Working Group

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Ranging Transponder Bandwidth for Residual Carrier Systems, Category A and B (Rec. 2.5.4A and 2.5.4B)

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1. Introduction

Several requirements on the transponder frequency response and on the ranging channel linear phase-frequency relationship are specified in CCSDS Recommendation 2.5.4A and 2.5.4B, both from September 1989.

The requirements of 2.5.4A for Category A missions are based on the use of a tone ranging system with major tone at 100 kHz and minor tones starting at 4 kHz. In Europe a new ranging standard is being specified at ECSS level, which is based on a sinewave tone phase modulated by a square wave code in line with the current ESA standard. Transponders designed to meet such ranging standard are not compatible with 2.5.4A. However, it is reasonable to assume that the ECSS ranging signal for a 100 kHz tone can be used for cross-support.

The requirements of 2.5.4B for Category B missions cannot be met by the ECSS standard ranging system when a tone frequency of 1 MHz is selected as in 2.5.4B. The major problem here is the low frequency response. It is believed that such requirement may be due to the NASA/JPL ranging system with square-wave modulation and no chopping of the lower frequency components. Given that now also NASA/JPL ranging can support sinewave tones and that chopping is possible, it may be feasible to relax recommends 2 and 3 and check for recommends 5. With sinewave tone and chopping, in fact, the NASA/JPL system is expected to behave similarly to the ECSS ranging system.

2. Proposal for change

ESA's proposal is to change 2.5.4A drastically to remove the dependence from the old legacy of tone ranging systems and settle for a 100 kHz sinewave tone modulated by a code.
As far as 2.5.4B is concerned, ESA proposes to remove the low frequency requirements. A 1 MHz sinewave tone could remain as the baseline for cross-support.