

RTCA Special Committee 186, Working Group 3

ADS-B 1090 MOPS

Meeting #6

MOPS changes to accommodate enhanced DMTL techniques.

PRESENTED BY: William Harman

SUMMARY

In previous meetings, WG-3 noted several needed MOPS changes related to DMTL. One change is needed because we have identified two different ways of using DMTL. The MOPS should identify both and make it clear that both are allowed. This paper provides MOPS changes in Appendix I to do this.

Another change is needed because the existing DMTL requirements in section 2.2 would contradict the enhanced techniques. The paper also provides MOPS changes for section 2.2 to eliminate the contradiction.

This paper responds to Action Item 4-10.

Working Group 3 identified several needed MOPS changes relating to DMTL (Dynamic Minimum Triggering Level). One change is needed because we have identified two different ways of using DMTL, whereas the existing MOPS Appendix A only includes one of these.

Specifically, John Van Dongen showed that reference level generation can be done prior to preamble validation, and that this technique offers some performance improvements. Working Paper WP-4-14 (Harman) documents these considerations. WG-3 concluded that a change in Appendix I is needed to allow the use of this effective design. Action Item 4-10 was assigned to generate the MOPS changes.

I have drafted some changes to Appendix I to correct this inconsistency. The draft material follows.

WG-3 also noted that some MOPS changes are needed in section 2.2 for the DMTL requirements. Looking at the current organization of section 2.2.4, I have drafted a MOPS change to correct this problem. A key point is that the MOPS defines a choice between (1) the current reception techniques and (2) the enhanced reception techniques. Vince Orlando has already drafted new material for the enhanced techniques, calling the new section “Optional Enhanced Squitter Reception Techniques”. This title makes the point that the manufacturer has a choice. It remains to add a corresponding statement earlier where the current techniques are described. That’s what I have proposed, which would be inserted into the existing section 2.2.4.3.4.

The draft MOPS changes follow.

While working on these sections of the MOPS, I noticed several editorial changes that seem appropriate. I recommend some specific editorial changes, which are listed at the end of this working paper.

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Appendix I Changes:

- Section I.4.1.2.2.1, Overview. Third and fourth paragraph. Replace with:

The improved preamble detection algorithm includes three steps, that are described in the following sections of this appendix:

- a. Preamble detection (section I.4.1.2.2.2)
- b. Preamble validation (section I.4.1.2.2.3)
- c. Reference level generation (section I.4.1.2.2.4)

These steps can be performed in the order a-b-c, or alternatively in the order a-c-b. Both designs have been evaluated and found to perform effectively.

The preamble detection step is used to identify, by locating a 4-pulse preamble set, the potential starting point of a set of samples to be processed as an extended squitter. The preamble validation step prunes the list of preambles in an attempt to eliminate most false preamble detections caused by interference. The reference level generation step determines a “reference level” which is an estimate of the received signal power level, that is used (like DMTL) in subsequent message bit processing and decoding. If step c is done before step b, then the reference level can be used in the validation step.

- Section I.4.1.2.2.2, Preamble Detection. Third paragraph. Replace with:

Detection of a valid four pulse preamble is performed similarly to the current algorithm with certain exceptions. The exceptions are as follows:

1. The improved reception technique does not use a dynamic threshold in preamble detection.
2. The improved reception technique does not use inferred leading edges in preamble detection.
3. Pulse sample timing tolerance is limited to either one sample plus or one sample minus, but not both in the same preamble.
4. If two or more of the subsequent ... (continue with existing text).

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Section 2.2 change:

- Section 2.2.4.3.4, 1090 MHz ADS-B Message Reception Techniques

This section title currently has no text. Add the following text:

This section and its subparagraphs give requirements for ADS-B reception according to the techniques associated with current TCAS receivers. Optional enhanced reception techniques are addressed in section 2.2.4.4. That section gives requirements for the enhanced techniques.

- Section 2.2.4.4, Optional Enhanced Squitter Reception Techniques

This section has been drafted by Vince Orlando, and appears in WP-6-04. I propose replacing the section reference TBD in Vince's first paragraph, so that the first sentence reads as follows:

“The squitter reception techniques specified in subparagraphs 2.2.4.3.1.2 through 2.2.4.3.5 provide a high probability of correct reception when the desired squitter is overlapped with one ATCRBS interfering reply of equal or greater power.”

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PROPOSED EDITORIAL CHANGES

(1) Downlink. In Appendix I, there are several instances in which the received signal is called a “downlink message” or “reply.” For example, in I.4.1.2.2.4 in the first sentence, “the Mode S downlink message” would be better called “the Extended Squitter signal.” I propose making a consistent search for these and substituting “Extended Squitter”.

(2) Section reference. In section I.4.1.2, part 1, there are two section references. The second should be changed from I.4.1.2.2. to I.4.1.2.2.3.

(3) Existence. In I.4.1.2, last paragraph, first sentence, I recommend changing “existence” to “detection”.

(4) Receiver threshold. In section I.4.1.2.2.1, at the end of the first paragraph, it says, “A threshold is set for the receiver; samples below this level are deemed to be zero.” This is not correct. Samples below the threshold are used to calculate slope, which is needed in declaring leading edges. I propose rewording this sentence as follows. “A threshold is set for the receiver; pulses below threshold are not detected.”

(5) False preamble detections. In I.4.1.2.2.3, in the first paragraph, third sentence,

“However, the improved preamble detection algorithm is quite susceptible to finding false preambles made from overlapping Mode A/C fruit replies.”

I propose rewording this as follows.

“However, the improved preamble detection algorithm is quite susceptible to false preamble detections caused by heavy interference.”

(6) Valid pulse positions. In I.4.1.2.2.3, in the third paragraph, the text used the term “valid pulse positions”. This is not clear to me, because whenever a 1 is preceded by a 0, the 1-pulse will be a continuation of the 0-pulse, and therefore will not have a leading edge. I will work with John Van Dongen to develop better wording for this.